# CliSciPol

### **Climate Science and Policy for Nonscientists**

#### One Picture is Worth a Thousand Words.



This scene recurred all over Spain and Portugal. The coverage in the US media was minimal. The blackout could not be blamed on climate change. Rather the problem can be blamed on the instability of electric grids that rely heavily on solar and wind. At the time of the blackout the Iberian grid was getting over 60% of its electricity from those sources. Power was quickly restored in France, but many parts of Spain and Portugal were without electricity for days. Once a grid goes down, it can take significant time to restore operations.

## The Grid Is Our Biggest, Most Important, & Most Complex Energy Network.



500 kV switchyard, Grand Coulee Dam

#### THE IBERIAN BLACKOUT

On Monday, April 28, just after noon all of Spain, Portugal, and parts of Southern France suffered a massive blackout, affecting over 55 million people. Trains, subways, and elevators lost power. Over 35,000 people were rescued from railways and underground tunnels. Traffic lights went off. Air traffic control was scrambled. Gas stations could not pump gas. Stores could neither operate their cash registers nor accept credit cards. Some people died in their homes when medical devices stopped working. This has been described as probably the largest blackout in European history.



Electric grids are miracles of modern engineering. Operating a grid is analogous to walking on a high wire. Supply/demand, voltage, and AC frequency each have to be kept within very narrow limits, or the grid shuts down. The problem of wind/solar intermittency is relatively well known. There is no solar electricity when the sun is down or covered by clouds. There is no wind power when the wind does not blow. But the problem of AC frequency control is not well known. Grids use alternating current. The US standard is 60 Hz, and in Europe it is 50 Hz. Very small deviations in frequency can destroy the equipment that makes up a grid, so there are circuit-breakers set up to shut the grid down automatically when such frequency deviations occur. Shut-down can be triggered by deviations as small as +/-0.2 Hz. In Europe this means when the frequency is greater than 50.2 or less than 49.8 Hz.





It is still unclear what initially started the problem, but it appears that there were "large unexpected frequency anomalies" that triggered automatic grid shutdown. In a system as complex as a modern electrical grid such anomalies occur frequently, as shown by this record of such anomalies in the US. But the key point is that with coal, oil, gas, or nuclear power the system has a built-in capacity to stabilize itself and avoid shutdown. This capacity does not exist with wind and solar. At the time of the blackout the Iberian grid was operating with between 64% and 78% wind and solar power, and so it lacked the ability to stabilize itself.

#### **CONCLUSION**

For grids to be reliable they have to be able to deal with the frequency anomalies that inevitably occur. Wind and solar not only bring instability to a grid, but also they lack the ability to stabilize the grid when anomalies occur. One expert concludes that 40% is the "practical upper limit," given present technology, for the use of wind and solar on a grid. Back in September 2016 there was a massive blackout in South Australia that is attributed to this lack of the ability of wind and solar to stabilize the grid. Since at least 2017 experts, including grid operators, have publicly warned about this problem. Michael Shellenberger has now commented that this Iberian blackout was "the predictable result of ignoring clear, repeated warnings about how fragile the modern grid is becoming."

#### **CLIMATE MODELS**

A part of the DOGE cuts being implemented by President Trump is the reduction of federal funds to be used for climate models. NASA will focus on space and not maintain a model. NOAA will focus on weather and not maintain a model. Climate models are run on supercomputers and are expensive. There are more than 40 climate models world wide and 13 of the leading models are located in the US. How many models are needed? Are these models at all accurate?

There are two basic ways to predict future temperatures - using trend lines and using climate models. World temperatures have been rising slowly and steadily, so the trend line shows an increase of about 1 C by 2100. This image was created around 2007 when the IPCC's Fourth Assessment Report was issued. Using the models, the IPCC in AR4 predicted an increase of about 3 C by 2100, as shown. The period 2005-2010 was roughly the high point in belief in the accuracy of the models.



Supporters of the climate models were embarrassed not only by how much the model predictions exceeded actual measured temperatures, but also by the lack of agreement among all the models. Model results were widely scattered with no evidence of convergence toward a number that could be considered correct. As a result the IPCC in AR5 (2013) made no prediction as to future temperature rise.

FAQ 7.3: Equilibrium climate sensitivity and future warming Equilibrium climate sensitivity measures how climate models respond to a doubling of carbon dioxide in the atmosphere Climate sensitivity of models Future projection Climate models from the new generation (=) are on average more sensitive to carbon diox than those of the last generation (=) More sensitive But projections in models do not solely rely on models Equilibrium Climate Sensitivity (°C) 100 PCC best estimate PCC be CMIP5 CMIP6 AR6 CMIP5 CMIP6 AR6



1800 1820 1840 1860 1880 1900 1920 1940 1960 1980 2000 2020 2040 2060 2080 2100

In 2002 world temperatures stopped rising, and what became known as "The Pause" continued until 2015. As the pause continued beyond 2007, it became increasingly obvious that the climate models that calculated large temperature increases were seriously wrong.



By 2021 the models were even worse. They calculated even higher temperatures and had even a wider range of disagreement among themselves, as shown. [AR6 p.1025 (2021] Meanwhile measured temperatures have continued their slow, steady rise of around 1 C per century, which is generally viewed as a mild rate of increase. Some scientists argue that such a rate of increase is net beneficial. The idea of a climate "crisis" or of an "existential threat" is based on the climate models that have demonstrated their inaccuracy, and that do not agree with each other.



#### **HOLOCENE TEMPERATURES**

The world is presently in the geological period named the Holocene Interglacial, which began with a period of rapid warming about 11,000 years ago. Many scientists believe (as shown) that the world was warmer than today for most of this period, which suggests that natural variability could be causing the present warming. Also for the most recent 7,000 years this graph shows temperatures declining while CO2 levels were rising. Both of these points indicate that the modern CO2 Control Knob Theory of climate change is wrong. So supporters of that theory deny the high temperatures shown in this graph. But in recent years there have been a series of published, peer-reviewed papers confirming these temperatures. A recent paper, published in April 2025, concluded that Central Africa was at least 2.5 C warmer than today 7,000 years ago.



GE Hitachi Nuclear Energy's BWRX-300 SMR could debut in Canada by 2029. GE VERNOVA

#### **SMALL MODULAR REACTORS**

In Canada this year GE Hitachi plans to start construction on its BWRX-300 SMR. Commercial operation is targeted for 2029. This is the closest thing to a "live" SMR project in North America. It is a Gen III+ reactor, which includes significant improvements over prior reactors, including passive safety features and improved fuel management.

# Fig. 2: Evolution of annual and seasonal average precipitation anomalies over the Mediterranean region.



#### PRECIPITATION

The IPCC predicts, in general, based on various models, that annual mean and global mean precipitation will very likely increase by 1-3% per degree C of global warming." [AR6 p.615 (2021)]. If this proves true, it may well prove to be a beneficial result of climate change. But, as with the temperature models, the precipitation models have not demonstrated their reliability. Actual data tends to show less change than is predicted by the models, but with substantial variability from year to year. An example is the data above, from a recently published paper, for precipitation in the Mediterranean region 1871-2020.

### Indoor Air Pollution From Cooking With Biomass Kills More People Than AIDS/HIV, Cholera, Malaria, & Tuberculosis <u>Combined!</u>



### **DISASTER LOSSES**

Adjusted disaster losses as a percentage of GDP for 2024 are now available. Losses have to be adjusted, because the number of exposed buildings and the value of exposed property increases. For example, a Cat.3 hurricane hitting Florida today will cause much more damage than the same storm hitting Florida 20 years ago. The data since 1990 shows a clear downward trend but significant interannual variability.

#### **INDOOR AIR POLLUTION DEATHS**

In 2024 WHO estimated that two billion people (mostly in Africa and Asia) still cooked their food and heated their homes by burning dung, wood, or other biomass. This creates serious indoor air pollution that kills an estimated 3.2 million people per year. If coal-fired electricity was provided to these people, there would be a net reduction in CO2 emissions, in total air pollution (indoor + outdoor) and in deaths caused by air pollution.



Forecast Parameters	CSU Forecast for 2025*	Average for 1991-2020
Named Storms	17	14.4
Named Storm Days	85	69.4
Hurricanes	9	7.2
Hurricane Days	35	27.0
Major Hurricanes	4	3.2
Major Hurricane Days	9	7.4
Accumulated Cyclone Energy (ACE)+	155	123

#### **HURRICANES**

This is the time of year that scientists issue their predictions for the hurricanes in the Atlantic Basin for the upcoming June-November season. Above is the prediction by the hurricane group at Colorado State University. The prediction is for a more-active than average season. But then CSU notes that there "remains considerable uncertainty" as to the phase of the El Nino Southern Oscillation, which affects Atlantic hurricane activity. And CSU adds, "Predicting ENSO requires models to use non-linear equations, multiple times, in models, which guarantees *chaotic* results." (italic added) Scientists classify earth's climate as a "coupled, non-linear, *chaotic* system." "Chaotic" means random or unpredictable, which is the reason meteorologists can not accurately predict the weather more than a week or two in advance. So don't complain to CSU if its prediction turns out to be wrong.



All citations are to the Intergovernmental Panel on Climate Change's publication, Climate Change 2021 The Physical Science Basis.

