December 1st, 2023

COP 28: Let's Talk Numbers

The Equivalent of Some 25 Years of CO_2 Emissions Avoided in France Thanks to Its Opting for Nuclear Power

An urgent task for COP 28 is to identify every possible means of reducing greenhouse gas emissions. Here we can learn from the real-life experience of over 40 years' operation of France's nuclear power plants.

For more than three decades, these have generated 70 to 75% of the country's electricity, thus avoiding a considerable amount of CO_2 emissions, an amount that can be evaluated.

Without nuclear power, these 70 to 75% of electricity would have been generated from fossil fuels - coal, heavy fuel oil or natural gas. Like nuclear power, these sources are dispatchable, i.e. they can be adjusted in real-time to demand. A fundamental difference, however, is that nuclear power emits very little CO_2 (4 g per kWh of electricity generated in France), whereas fossil fuels emit considerably more: 986 g for coal, 777 g for fuel oil and 429 g for gas, according to RTE's eco2mix website.

* Since its introduction in 1977, France's nuclear power fleet has produced over fourteen thousand billion kWh (14,000 TWh);

* To estimate the amounts of CO_2 that a fossil-fired fleet would have emitted to produce the same amount of electricity, it is necessary at this stage to make assumptions, as realistic as possible, concerning the fossil fuel mix (how much coal, heavy fuel oil, natural gas) that could have been used. Several items must be considered:

  - Historically, the cheapest fuel has been coal - imported, of course, but abundant worldwide. It is therefore reasonable to assume that it would have been dominant in the fuel mix;

  - Heavy fuel oil, the least noble and least valorized by-product of oil, saw its price rise sharply following the oil shocks of 1973 and 1979. It would nevertheless have continued to be used insofar as some power plants had already been built for this fuel and possibly more would be built, but its role would have remained less prominent than that of coal;

  - Natural gas, long considered too noble an energy source to be used for power generation, began to make inroads in this area only with the development of highly efficient power generation facilities (combined cycle) in the late 1990s. Natural gas use increased as of the 2000s, driven by climate concerns: gas emits less than half as much CO_2 as coal. However, its use would probably have remained limited because of its price.

Several mix assumptions can be made. Here, we'll take the example of a mix that is not among the most carbon-intensive, with 40% coal, 30% fuel oil and 30% gas. On average, such a mix emits around 750g more CO_2 than nuclear power per kWh of electricity generated.

We can now estimate the total CO_2 emissions avoided since the introduction of nuclear power: with its 750g of CO_2 per kWh over and above those of nuclear power, this mix would have emitted around 10,700 million metric tons of CO_2 more than nuclear power did to generate the 14,000 billion kWh of electricity. This enormous quantity represents 26.5 times France's total 2022 emissions!

A good round number approximation that is easy to remember: France's nuclear power option has allowed the country to avoid considerable CO_2 emissions, corresponding to roughly 25 years' worth of the country's current annual emissions. This is a major contribution to the fight against global warming.