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Can nuclear energy reduce CO2 emissions?

Mark Diesendorf

With Bob Carr and Peter Garrett calling for a debate on nuclear energy, it is timely to examine whether nuclear energy can really reduce carbon dioxide emissions in the long term.

Nuclear power stations themselves do not emit CO2. But the nuclear fuel cycle is a complex process with many steps, some of which are large users of fossil fuels. The corresponding CO2 emissions have been calculated by several authors who are independent of the nuclear industry, most recently by Jan Willem Storm Van Leeuwin, a senior consultant in energy systems, together with Philip Smith, a nuclear physicist (see http://www.oprit.rug.nl/deenen/.)

As we might expect, they find that the energy inputs, especially to mining, milling and enrichment, depend sensitively on the grade of uranium used. For high-grade ores (i.e. those with at least 0.2% uranium oxide) the energy inputs are indeed much less than the electricity generated. But, the quantity of known uranium reserves with ore grades richer than this level is so small, that it would only last for a few decades at the current usage rate.

For the more common low-grade ores (i.e. 10-20 times less concentrated than the high-grade ores), Van Leeuwin and Smith find that the total fossil energy consumption in uranium mining, milling, enrichment and power station construction becomes so large that nuclear power emits more CO2 than an equivalent gas-fired power station.

The World Nuclear Association has produced an anonymous "reply" to Van Leeuwin and Smith. But this fails to rebut their calculations, rather obscuring them with irrelevancies, e.g. by citing a report by the Swedish electricity utility, Vattenfall, that does not address the issues either.

A possible but questionable "solution" to the shortage of high-grade uranium would be to switch to fast breeder reactors. These "breed" so much plutonium that in theory they can multiply the original uranium fuel by 60. Large-scale chemical reprocessing of highly radioactive waste would be necessary to extract the plutonium, and this has its own hazards and costs.

In the USA all three non-military reprocessing plants have been shut down. Of the two remaining large-scale reprocessing plants in the world, only one (in France) is still operating. The other, Sellafield in the UK, has just been shut down, possibly permanently, because it has been discovered that 83,000 litres of highly radioactive liquid leaked unnoticed from it for up 9 months.

Fast breeder reactors use liquid sodium as a coolant and so are even more dangerous than ordinary nuclear reactors. So far, fast breeders have all been technical and economic failures. The largest was the French 1200 MW Superphénix, which operated only intermittently and very

rarely at full power, experiencing leaks from its cooling system and several accidents. It was shut down at the end of 1998 after costing an estimated total of about A$15 billion. This does not appear to be a fruitful pathway for nuclear energy.

So, on the basis of existing nuclear technology and the small reserves of high-grade uranium, the potential contribution of nuclear energy to the reduction of CO2 emissions is quite limited. The only long-term solution to the enhanced greenhouse effect, based on existing technologies, is a mix of efficient energy use, wind power and bioenergy from crop residues.

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