What Policies, Corporate Strategies and Changes in Awareness are needed to Combat Climate Change?

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The IPCC has determined that in order to keep global warming below 2°C, emissions of greenhouse gases must be decreased by 50% by 2050, relative to the levels observed in 1990. In order to reach this target, developed countries may need to be more stringent in reducing emissions, while countries responsible for large emissions (developing countries such as China, Brazil and India) should be aiming to limit their emission growth.

However, little seems to be changing, rather than decreasing, carbon emissions rose by 1.6% in 2017 and are expected to continue to rise in 2018 and 2019[1]. Some countries, including the UK, have been able to reduce emissions over the last decade without an effect on Gross Domestic Product, but others that pride themselves on being "climate aware", such as Germany, have not been able to sustain initial reductions in carbon dioxide emissions.

There has been a decrease in the global use of coal, but a rise in the use of oil and gas. Although Germany has invested heavily in the use of solar and wind, its emissions have not declined, as its determination to phase out nuclear power as baseload has resulted it its replacement with carbon producing oil and gas. Indeed, the German energy policy for transition to renewables (the Energiewende) has come under attack in the popular German media for failing to produce the decrease in emissions predicted[2]. In 2017, 65% of electricity was generated from the burning of fossil fuels. Despite the strong support for, and growth in, intermittent renewable electricity sources in recent years, the fossil fuel contribution to power generation has remained virtually unchanged in the last 10 years or so (66.5% in 2005).

It therefore seems that while the evidence based scientific arguments for climate change grow stronger, our resolution to deal with the situation seems to be losing ground. What then needs to change in order for societies to achieve their climate goals? We already have the evidence from Germany that switching to renewables at the expense of nuclear does not result in reduction of CO_2 emissions, so it would seem that inclusion of nuclear power in the energy mix is a pre-requisite.

It has been estimated that nuclear energy must account for 25% of energy generation by 2050. Around 10% of the world's electricity is generated by about 450 nuclear power reactors. About 50 more reactors are under construction, equivalent to about 15% of existing capacity. However, the

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nuclear fleet in many countries is currently coming to the end of its useful life, and therefore nuclear new build needs to be accelerated in order to meet the 25% target. In the decarbonisation scenario envisioned by the OECD's International Energy Association (IEA)[3], electricity generation from nuclear increases by almost 90% by 2040 to 4960 TWh, and capacity grows to 678 GWe. The World Nuclear Association puts forward an even more ambitious scenario than the IEA – the Harmony programme proposes the addition of 1000 GWe of new nuclear capacity by 2050, to provide 25% of electricity then (about 10,000 TWh) from 1250 GWe of capacity (after allowing for 150 GWe retirements)[4].

This latter scenario may sound overly ambitious, but the growth that it is required (25 GWe per year from 2021, escalating to 33 GWe per year) is not that much greater than the growth observed in the 1980s, when nuclear power production increased by 201GWe. However, whilst such a growth may be technically possible, there are certain obstacles in the way. These include public acceptance of the technology, and methods of financing the building of new nuclear plants.

Public acceptance of the technology is influenced by two main concerns – cost and health risks. Both of these have been subject to a large amount of misinformation in social and conventional media. Nuclear power plants take a long time to build and therefore their costs prior to operating are high, but once operational, they are relatively cheap to run and operate over a long period of time. Nuclear operators are also required to factor in the costs of decommissioning at the end of a plants' useful life. Other methods of electricity generation are not required to include clean-up costs and disposal of hazardous waste in the same manner. The levelized cost of electricity (LCOE)[5] is a method of comparing forms of electricity generation by using the average revenue per unit of electricity generated that would be required to recover the costs of building and operating a generating plant during an assumed financial life and duty cycle. LCOE suggests that nuclear may well be a cheaper form of electricity generation than renewables, particularly when the need for battery storage costs are included to mitigate for variability in supply from solar and wind. There is also evidence that building multiple plants of the same design brings down build costs, and improves the efficiency of the build process, reducing future costs of new nuclear considerably. While nuclear engineers revel in building shiny new designs, perhaps for the sake of climate change we should concentrate at the present time on building a standardised design of reactor to speed up new nuclear power generation, before it is too late and the climate spirals out of control.

Explanation of the relative costs of electricity generation to the public is difficult as it is complicated. There is also little discussion of the comparative land use per terawatt hour of different generating methods – it is estimated that wind and solar take up substantially more land than nuclear to produce the same amount of electricity. This may not be important in countries with suitable land in abundance (Australia, the US) but for island nations such as Japan and the UK, only relatively small areas of land are usable without considerable detriment to the countryside.

The other area that provokes public concern is the health consequences of exposure to radiation. In contrast to most of the public's perception, nuclear is the safest way to generate electricity[6]. The health effects of nuclear power plant accidents are vastly over- estimated in both social and mainstream media, and although many scientists seek to rebalance these views, conspiracy theories and horror stories seem to be accepted more readily by the population than scientific truth. The scientific evidenced based facts on health risks are simply too boring to provoke public and media interest alike.

So what corporate strategies and changes in awareness need to change? Firstly, governments need to get behind nuclear, devise better ways for financing nuclear new build, and encourage building of multiple plants of the same design. Small modular reactors may be considered for the future, but for the present, new build should concentrate on tried and tested designs. Secondly, public communication needs to improve on many fronts, but particularly around costs of energy production and health risks. Scientists may need to consider working with those with better public communication skills and social media presence to get these messages across. This, while challenging and very time consuming, is rewarding and will reach audiences that do not usually engage with science. It would be nice to think that better education in science at school would help facilitate this, but time is running out and changing school curricula is unlikely to result in major changes in public opinion for decades.

By rejecting nuclear power as a source of low-carbon energy, because of our lack of perspective on its real risk and expense, we expose ourselves to the much greater risks (both in terms of health and the global economy) posed by climate change. The inability to mitigate climate change is a risk not just to our species, but to all species on this planet.

We need to get over our fear of nuclear and embrace a technology that offers a stable power source for all, and a solution to climate change – before it is too late!

〈References〉

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Gerry Thomas is Professor of Molecular Pathology at Imperial College London and the Director of the Chernobyl Tissue Bank (CTB). The CTB was established in 1998 to facilitate research, in cooperation with Belarussian, Ukrainian and Russian scientists, into the biological mechanism that are involved in development of thyroid cancer following a nuclear power plant accident. Since the Fukushima accident in 2011, she has been engaged in public communication of the real health risks of energy production, including exposure to low doses of radiation from nuclear accidents.