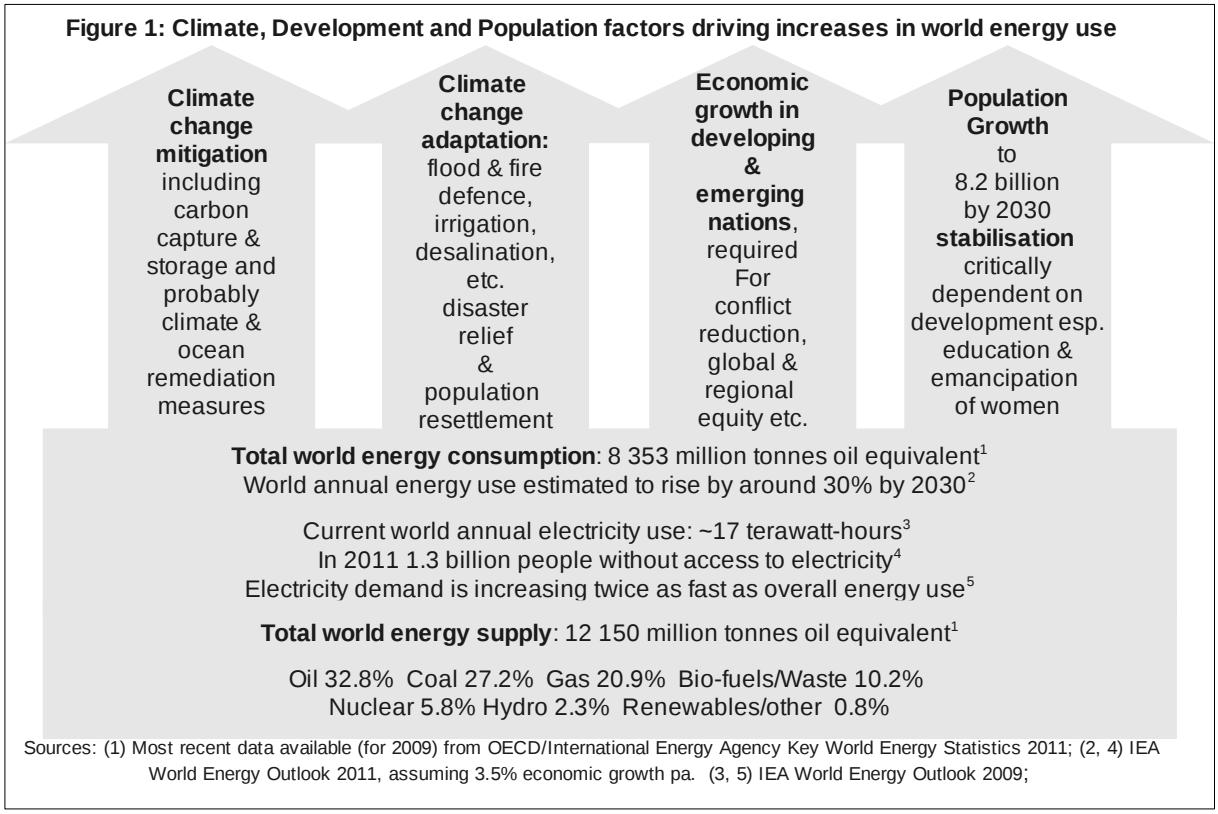
NUCLEAR ENERGY: ONE STRAND OF HOPE FOR ENVIRONMENTAL AND SOCIAL JUSTICE ON A CROWDED PLANET?

A Schumacher Institute Challenge Paper

Steven Robert Harris

The Challenge: On an increasingly crowded and polluted planet, dealing with the multiple impacts of anthropogenic global warming *and* continuing to work to improve global equity will require sufficient baseline energy supply to enable further advances in education, healthcare and human rights around the world while rapidly achieving large reductions in fossil-fuel combustion. Current evidence suggests that in the short to medium term (10-100 years) the very large gap between growing global energy demand and renewable energy supply is unlikely to be bridged by energy efficiency measures. With over 1.3 billion people still without access to electricity, significant *reductions* in global energy demand also appear very unlikely, particularly given the increasing need for large-scale, energy-intensive climate change mitigation, adaptation and remediation measures as global warming gathers pace. Among the many scenarios for replacing a significant proportion of world fossil-fuel use, only those which accompany a rapid expansion of renewables with steady increases in clean electricity generation through nuclear fission currently appear technically credible and economically feasible. Given the huge costs and likely catastrophic impacts of continued fossil-fuel combustion, continuing blanket opposition to nuclear energy technologies by sustainability activists may no longer be defensible on environmental, social or economic grounds.

Figure 1: Climate, Development and Population factors driving increases in world energy use



Sources: (1) Most recent data available (for 2009) from OECD/International Energy Agency Key World Energy Statistics 2011; (2, 4) IEA World Energy Outlook 2011, assuming 3.5% economic growth pa. (3, 5) IEA World Energy Outlook 2009;

1. Energy, social and environmental issues are inextricably linked

In the 21st Century the principal challenges faced by humanity involve averting catastrophic global warming; preserving, protecting and restoring the Earth's ecosystems; and stabilising global population growth – all whilst striving to achieve and maintaining globally equitable levels of sustainable human development. None of these issues can be tackled in isolation, and each demands an unprecedented expenditure of intellectual, cultural, physical and spiritual resources. In the short-

to medium term (10-100 years) the effort to meet these very serious challenges is also highly likely to contribute toward growth in global energy demand, as illustrated by Figure 1 and summarised below:

- Given that at least a 2° Celsius rise in average global atmospheric temperatures appears to be already locked-in by historic and currently increasing levels of greenhouse gas emissions, large-scale climate change adaptation and climate and ocean remediation (geoengineering) measures seem inevitable, and will likely be extremely costly, in both energetic and economic terms;
- Many countries of the world still require considerable development to achieve acceptable levels of security, liberty, education and opportunity for their citizens; given the drives and aspirations evident globally, many nations are likely to pursue development trajectories that involve energy and resource use at least equal to that of the currently highly developed nations. This has very serious implications for climate change and ecosystems degradation if the bulk of the energy required continues to be derived from fossil fuels.[1]
- Global population stabilisation and the socially and environmentally desirable goal of gradual and consensual population reduction appear to be critically dependent on the education and emancipation of women in developing nations. This in turn requires a sufficient level of development and the provision of basic human rights – access to fresh water, food security, conflict resolution and adequate healthcare.[2] The evident relationships between access to adequate and secure of baseline energy supplies (particularly electricity), moderately high levels of development and declining fertility suggests that avoiding the inverse – rising fertility in response to economic decline, increasing insecurity and ecosystem degradation – may prove difficult to achieve under low-energy scenarios.

Establishing the conditions for further human development on a climate- and population-stabilised planet is therefore likely to require an energy expenditure at least equal to, if not surpassing, current levels. It is absolutely imperative that the continued expansion of global energy generation is not accompanied by further increases in greenhouse gas emissions; for humanity to thrive, the world must radically and rapidly shift toward the use of clean energy.

2. Renewable energy plus energy efficiency may not be sufficient to meet demand

Although their contribution to world energy supply is rapidly increasing, renewable energy technologies (solar, wind and tide) currently provide little more than 1% of global energy supply (see Fig 1). Unfortunately, the barriers to the rapid upscaling of these truly clean and renewable energy technologies are not only technical (geography, efficiency etc.) but also include resource, land-use and social issues. In some locations the area required for adequately-scaled renewable installations and their supporting infrastructure[3] may adversely impact on already established land uses such as food production. In some developed countries, the roll-out of renewables is also being challenged on aesthetic, cultural, economic and conservation grounds.[4]

Despite many claims to the contrary, the large gap between actual (and near-term potential) supply from renewables and energy demand is also unlikely to be easily filled by savings made through

1 See United Nations Development Programme (2011). Human Development Report 2011; Sustainability and Equity: A Better Future for All. New York: Palgrave Macmillan. ISBN: 9780230363311

2 Based on the projections and assumptions in the UN Population Division (2010) World Population Prospects, 2010 Revision. Geneva: The United Nations. See http://esa.un.org/unpd/wpp/index.htm

3 See David J.C. MacKay (2008). Sustainable Energy – without the hot air. Cambridge: UIT. ISBN 978-0-9544529-3-3 for some realistic and sobering estimates of the scale of renewable installations required to power the UK, Europe, US and the world as a whole.

4 Across Europe there have been widespread protests against both on- and off-shore wind turbines. For example in Wales, UK during 2011 large popular protests against rural wind farms and their associated electricity transmission grid infrastructure resulted in policy changes by both local and national government.

increasing the energy efficiency of devices or processes. This is because many estimates of the impact of efficiency savings fail to take account of the presence of 'rebound effects'. These increasingly well-documented effects tend to undermine the impact of efficiency gains by around 15 to over 100% depending on scale, sector and context. Studies show that efficiency savings made in one aspect of an individual, company or sector's activities often in time actually lead to increased energy use overall, as their activities expand to make use of the resources released.[5]

Economics is another confounding factor. History seems to suggest that established primary energy sources (e.g. wood) only tend to lose their market dominance when higher-yielding sources (e.g. coal) and the technology to utilise them (e.g. steam engines) become cheap and widely available. Currently, globalised market forces appear to continue to favour expensive fossil-fuels (even when obtained through expensive extraction techniques such as deep-sea oil drilling and gas shale 'fracking') over renewables, while state subsidies for renewables are increasingly threatened by recession-driven cutbacks. There are strong arguments that decarbonisation of the global economy could be radically accelerated by introducing effective carbon taxation, but as yet few such systems are in place and the implementation of an international framework seems some way off.

3. Nuclear energy is much safer and cleaner than fossil-fuel combustion

Nuclear fission currently provides around 6% of world energy supply; its advocates claim that nuclear science and technology are sufficiently well-established to allow its rapid, safe and sustainable expansion. China and India currently lead the world in pursuing large-scale nuclear new-build programmes. The weight of scientific evidence suggests that in terms of workforce and public safety, greenhouse gas emissions *and* radioactive pollution nuclear power is very much less dangerous than fossil-fuel combustion.[6] Among the developed nations countries with well-established nuclear programmes, such as France and Norway, are distinguished by their comparatively low levels of carbon emissions. By way of contrast, Germany's forthcoming phase-out of its nuclear reactors – which currently provide 23% of its electricity - will result in an increased output of around 300 million metric tons of carbon dioxide over the next ten years.[7]

No energy generation technology is without some costs and risks. Although nuclear clearly presents some real grounds for concern, particularly around the handling and long-term storage of nuclear waste, the risks are small in comparison to the harm done to the climate by burning coal, a truly dirty and damaging fuel. Historically, the dangers of civil nuclear power have often been greatly exaggerated by anti-nuclear campaigners. The disproportionate public fear of nuclear technologies has also been encouraged by the links with nuclear weapons production - undeniably an important driver of civil nuclear power development in the post-WW2 period - and by the corruption, secrecy, and misinformation endemic to the military-industrial complex. However, the new generation of advanced reactor designs appears to more than meet most of the objections legitimately raised by those fearful of safety, radioactive pollution, and resource depletion. A number of analyses also suggest that nuclear can be cost-effective, even with decommissioning and waste storage costs fully factored-in, and that over its full life-cycle the carbon footprint of nuclear is comparable to that of solar electric.[8] Nuclear power stations do not require the large areas of land demanded by

5 For example, households may spend savings made on their electricity bill due to installing energy-efficient light bulbs on a new TV or foreign holiday. See Maxwell, D., Owen, P., McAndrew. L, Muehmel, K., Neubauer, A. (2011). Addressing the Rebound Effect, a report for the European Commission DG Environment. Brussels: EC DG ENV, 26 April 2011; and Jenkins, J, Nordhaus, T & Shellenberger, M (2011) Energy Emergence: Rebound and Backfire as Emergent Phenomena. Oakland, CA: The Breakthrough Institute.

6 For an overview of the scientific evidence on radiation hazards see Allison, W. (2008). Radiation and Reason: The Impact of Science on a Culture of Fear. York: York Publishing Services. ISBN: 0956275613.

7 Strathern, David (2011) The carbon cost of Germany's nuclear 'Nein danke!'. *New Scientist* 2823*:* 2 August 2011.

8 See for example Fthenakis, V., M and Kim, H. C. (2006). Greenhouse-gas Emissions from Solar Electric and Nuclear Power: A Life-cycle Study . Energy Policy Volume 35, Issue 4, April 2007, Pages 2549–2557.

comparable (in terms of energy output) solar and wind installations, and are orders of magnitude more efficient in converting financial and resource inputs into electricity. On the hundred-year time scale relevant to averting extreme climate change Uranium is a relatively plentiful resource; Thorium – a fuel whose fission produces far less waste and is not easily weaponised - even more so. Current reactors are using materials from decommissioned nuclear warheads as fuel (a desirable activity in itself); next-generation Fast Reactors will efficiently burn existing nuclear waste stockpiles. This means there are no practical long-term resource limits to nuclear generation; the science and technology are already in our grasp. In the West, the main barriers to expanding nuclear energy production are raising sufficient economic investment and gaining public acceptance.

4. Implications for the Environmental and Sustainable Development movements

Development requires energy; no known energy production process is without some risk and environmental impact. Sustainable development requires clean energy. A considerable amount of evidence suggests that nuclear fission is among the best clean energy options currently available. While renewable energy technologies have an important role to play, they cannot in themselves offer a route to the very large and immediate reductions in fossil-fuel combustion required to avoid further accelerating global warming; neither can energy efficiency measures. Similarly, behaviour-change seems unlikely to deliver the decarbonisation needed on the timescale demanded. Despite heartening developments such as the growth of 'green' awareness and consumerism in Western Europe we not as yet seen any significant reductions in global energy and resource consumption and their associated pollution. In fact 2010 saw the highest levels of GHG emissions ever recorded in human history.[9] Those voices calling for widespread political change and the replacement of growth-oriented, globalised market capitalism as a precursor to the development of a socially and environmentally just global society have not, as yet, found wide acceptance and seem some way from making any significant impact on behaviour. As the recent economic upheavals demonstrate, a collapse of the globalised market economy, although possibly good for GHG reductions, would also likely result in increases in conflict, poverty and disenfranchisement, an abandonment of environmental regulation and protection (particularly on the global scale), and the destruction of many countries' ability to implement climate change adaptation measures and disaster relief. In the longer term it could also have an impact on population growth, as families respond to increased insecurity by having more children.

These considerations suggest that, recognising the looming climate and population bottlenecks, there may be little practical alternative to using nuclear technology to 'buy time' to continue the longer-term project of developing an environmentally- and socially-just global civilisation. It follows that organisations and individuals committed to sustainable human development should now consider embracing nuclear power as part of the clean energy mix - or at the very least abstaining from actively opposing it. Such a change in attitude would not and should not mean abandoning efforts to lower energy demand, make polluters pay the true price of their emissions through carbon taxes, and develop and deploy effective and appropriately-scaled renewable energy technologies wherever possible. Rather, it might signal the emergence within the sustainable development movement of a more rational, balanced and evidence-based approach to energy issues.

Steve Harris is a Research Fellow at the Schumacher Institute for Sustainable Systems, Bristol, where he investigates the social, technical and economic challenges of climate change and the transition to post-carbon living, with a particular focus on developments in post-devolution Wales.

---

9 Peters,G. P., Marland, G.,Le Quéré, C., Boden, T., Canadel, J. G. & Raupach, M. R. (2011). Rapid growth in CO2 emissions after the 2008–2009 global financial crisis. *Nature Climate Change*, 04 December 2011.