Professor Steve Rayner, Director, Institute for Science, Innovation and Society, comments on themes from the distinguished lecture by Professor Amartya Sen. The lecture, on Wednesday 11 July, marked the launch of the Oxford Martin Programme on Resource Stewardship

ENERGY, EXTERNALITIES AND RISK

Professor Steve Rayner writes; "I would like to take a few minutes to take up a couple of themes that I picked up from Professor Sen's talk. One is to emphasise the importance of moving away from benefit-cost analyses of individual technologies towards recognizing the need for risk-risk trade-offs in systems – in this case, trading off nuclear and climate risks in the world energy system. The second is to take up the theme of externalities and to suggest that we recognize that there can be positive externalities from economic activity and that taking advantage of these in energy innovation may be our best chance of coming to grips with climate mitigation.

On the first theme, whatever the flaws in our current scientific understanding of climate science specifics – and there are many – the underlying physics clearly tells us that humanity is facing a significant carbon emissions constraint.

Over the course of this century, that constraint may be as much as three times larger than the highest IPCC scenarios suggest, as all of those scenarios assume historically optimistic rates of decline in energy and carbon intensity per unit of global GDP, whereas this 100 year trend has in the past half decade gone into reverse – largely due to the spectacular growth of China and India.

At the same time, it is clear that the world needs more energy, not less. Not only to fuel the growth of the emerging giant economies, but to provide access to safe and reliable electrical energy to the 1.5 billion people who currently lack it – a situation that should be an affront to civilized society.

My colleagues at McGill University, Isobel Galiana and Chris Green, estimate that to provide universal energy access, while simultaneously putting the world on a carbon stabilization pathway over the next 40 years, would require an increase from 2.5 to 15 TW of non-carbon based energy. (Assuming a modest growth in demand of just 2% per annum.)

That is a tall order, not least because almost all of the existing 2.5 TW comes from nuclear and hydro. And because much hydro potential is already exploited, new hydro is likely to require displacement of populations on the scale of the 1.5 million people moved to make way for the Three Gorges Dam.

Existing renewables, particularly solar and wind have improved in both technical and economic terms over the past decade – thanks mostly to the Chinese – but they are still far from being competitive with fossil fuels. As intermittent sources, they also suffer from the absence of satisfactory ways of storing large quantities of electricity in the grid, which surely is a necessary capacity given that 50% of the world's population already live in cities – a number projected to be over 70% by mid-century.

Clearly the twin imperatives of atmospheric carbon stabilization and expanding energy supply on this scale need to be reconciled, which requires a massive programme of energy modernization including Research, Development, Demonstration and Deployment for carbon-free energy technology.

In 2007, LSE colleague Gwynn Prins & I suggested in *Nature* that this merited investment of about US$80bn/year. Subsequently the IEA has suggested a figure of US$48bn/year between now and 2030. (To put these figures into perspective Iran currently subsidises fossil fuel consumption to the tune of US$80bn/year and the world subsidies amount to over US$400bn).

Putting the UK on track to meet the target of 60% emissions reductions by 2030 with existing technology would require the construction of 15 new nukes by 2015. This is clearly not going to happen!

This brings me to positive externalities. The 2010 Hartwell Paper, of which I was a co-author, suggests that reconciling growing energy demand and the carbon constraint can best be achieved by reversing the logic and language of externalities as discussed by Prof Sen. The climate rhetoric of doom and gloom is proving not to be an effective motivator of public policy as opinion polls reveal growing catastrophe fatigue among politicians and publics. The benefits of conventional climate policy are too long deferred to be an effective motivator, especially in times of elevated economic anxiety.

Public and private investment in energy modernization would be a source of immediate benefit and suggests taking the climate benefits as a positive externality, whereas the conventional approach might see energy-for-all as merely a secondary benefit of policies aimed specifically at climate change.

What might be the role of nuclear energy in seeking positive externalities for climate?

If large amounts of nuclear capacity could be rapidly brought on line in time to affect atmospheric carbon concentrations by mid century then, at the very least it might be a bridging technology to a renewables future and, in the absence major cost overruns and accidents, it could possibly establish itself as a major energy source for the foreseeable future.

However, to do this, nuclear must overcome at least three limitations:

- concerns about costs
- availability of a nuclear skilled workforce
- public acceptability.

While there is on-going dispute, referred to by Prof Sen, about the true costs per kilowatt hour delivered by new nuclear technology, it seems likely that it will remain at the high end of available options in liberalized energy markets, especially with the prospect of plentiful cheap shale gas as the future benchmark.

Skilling up a nuclear workforce is not an overnight prospect. It is unlikely that we could develop the extensive human resources necessary for nuclear to make a major dent in atmospheric carbon concentration by mid century.

As for public acceptability, despite the good safety record of the European and US industries post TMI, there remains a strong legacy of public anxiety hanging over from the first generation of civilian nuclear power with its attendant concerns about waste and proliferation.

Hence I tend to agree with Oliver Moreton of the Economist that while nuclear will not disappear from the scene it is likely to continue to be a relatively minor element in the world energy mix.

All of which suggests that we will have to rely heavily on adaptation which is increasingly looking like the best option for saving lives and property over the course of this century. And, today's discussion is typical of the climate policy discourse in that it has all but ignored adaptation to existing climate variability, - think New Orleans and Hurricane Katrina - which will again provide positive externalities in better equipping us to deal with what have long been inevitable climate change impacts.