A short critique of the Stern Review

Ted Trainer (University of New South Wales, Australia)

The application of economic modelling has led the Stern Review (2006) and the Intergovernmental Panel on Climate Change (IPCC) Working Group 3 (Barker, et al., 2007) to assert that the greenhouse problem can be solved at a negligible cost. These conclusions have been taken as gospel throughout the world and are now the basic assumptions underlying the policy and action of virtually all governments and official agencies, and the understanding of the situation held by the general public.

I have detailed the argument that both these conclusions are incorrect; i.e., that the greenhouse problem cannot be solved at any cost in a society that is committed to high material "living standards" and economic growth. (Trainer, 2007a.) It should be stressed that this is a critique of arguments to do with the possibilities and costs of mitigation and not of the climate analysis given by Stern or the IPCC, both of which are accepted as valid and important.

A brief summary of the faults in Stern's Review.

The carbon dioxide emission target Stern adopts (the amount which will stabilise atmospheric carbon dioxide at 550 ppm) is far from sufficiently low. Many now say that to prevent a global temperature rise of more than 2 degrees C the limit must be 450 or even 400 ppm. (Baer and Mastrandrea, 2006.)

Stern does not provide for a world of 9 billion people, which we will have soon after 2050. If his energy provision target was to supply 9 billion people with the energy per capita we in Australia will probably consume by 2050 then the target would be 5 times as great as Stern takes. (If such an equitable goal is not taken then he should deal with the problems of justice, resource inequality, envy, insecurity and global conflict that will result.)

Stern deals only with *the steps that must be taken by 2050 to be on track to stabilise at 550 ppm at a much later point in time*. Those steps would only be the beginning and much bigger steps would have to be taken after 2050 to achieve that goal, let alone the more appropriate goal. Stern's steps, if they could be achieved, would only cut global emissions by some 30% by 2050, yet his own fine print acknowledges that they must eventually be cut by more than 70% even to achieve the 550 ppm target. The IPCC's Fourth Assessment Report shows that the 400 ppm target would require emissions to be cut to 5 - 15 GT (*See Glossary of Technical Abbreviations at end of the paper*) by 2050 and to more or less zero by 2100 (taking the mid range of estimates).

These three highly challengeable problem-defining moves have allowed Stern to focus on a task that is far easier than the one that should have been taken, perhaps by a multiple of 15.

However, by far the main fault in the Review is in the assumption that the use of "bottom up" and "top down" economic modelling of the costs of carbon abatement is appropriate and sufficient. "Bottom up" modelling focuses on a particular action or technology which could eliminate the emission of one tonne of carbon at a cost of X dollars, stipulates that it will be applied on the sale required to eliminate Q tonnes of carbon, and concludes that this can be done at a cost of QX dollars. Usually this approach is applied to several alternative technologies, such as wind, sun, biomass, and the associated aggregate dollar cost is tallied to arrive at a net total achieved at the resulting aggregate cost. “Top down” modelling focuses on the overall, e.g., GDP, effects that would result if particular steps, such as carbon taxes or caps were applied across the whole economy.

These approaches are appropriate for many problems but they involve the crucial assumption that there is no problem of “scale-ability”. There are in fact a number of important technical and non-economic reasons why the carbon abatement steps Stern and the IPCC recognise as possible and cost-effective here and now on a small scale will become technically impossible or too expensive as scale increases. The following reference to the limits of renewable energy technology are drawn from the extended discussion in Trainer, 2007b.

- Stern’s assumed wind contribution corresponds to 62 EJ, some113% of the present world electrical generation. To deliver this would require mills with a peak capacity of 270 EJ. This is around 180 times the present world installed wind capacity. Where is all this capacity to be located? It is highly unlikely that sufficient sites to locate more than a small fraction of it could be found within thousands of kilometres of demand centres. Some large European regions might not be far from their limits already. The IPCC estimates off-shore sites as somewhat larger than on-shore potential, but not markedly so. In addition, very large scale deployment would lower the present .23 capacity factor because decreasingly suitable sites would have to be adopted.

- Stern’s assumed nuclear capacity, 116 EJ or 12 times present installed capacity, would use up all estimated recoverable Uranium in less than 20 years. (Leeuwin and Smith, 2003, Zittel, 2006.)

- The coal capture and storage (i.e., geo-sequestration) capacity assumed by Stern, 7.7 GT/y of CO_2 p.a., approximately corresponds to half the weight of the present global coal production. Only 80 – 90% of CO_2 can be captured (and only from stationary sources). According to the IPCC by 2100 emissions probably have to be completely eliminated, so geo-sequestration might not be viable at all then.

- The quantity of biomass energy Stern assumes, 110 EJ, could be feasible as it corresponds to 870 million ha harvested at 7 t/ha. However this amount of primary energy would only provide 9 billion people with 12 GJ per person. If converted to ethanol this would provide around 4 GJ of liquid fuel, some 7% of the present Australian per capita consumption of transport fuel. Stern does not explain how transport could be fuelled. For 9 billion people to use the present Australian per capita amount of transport energy (60 GJ), 540 EJ would have to be provided, so 430 EJ would have to come from other than biomass sources.

- If this energy for transport is to come from hydrogen then very high losses and inefficiencies would have to be accepted due to the difficult nature of the hydrogen atom, multiplying capacities and costs greatly. Bossel explains that to deliver one unit of energy from windmill to wheels via hydrogen would require wind generation of 4 units of electrical energy. Therefore 1320 EJ of electricity would have to be generated for transport. This would be 25 times the quantity of wind capacity Stern assumes. If it were to be derived from nuclear sources then 144 times the present nuclear reactor capacity would be required, again running into the above Uranium limit. According to Bossel electric vehicles would halve the losses involved with hydrogen-fuelled vehicles, but Australian transport takes 1.7 times as much energy as electricity supply, so to electrify this sector and meet normal electricity demand would require generation of about 4.5 times as much electricity as is generated now. Stern does not discuss these problems.

- Stern makes no reference to the major problem facing renewables, which is to do with integrating highly intermittent sources into supply systems. It is a mistake to assume that to build X GW of wind capacity and Y GW of solar capacity provides us with the capacity to generate X plus Y GW, because there will be times when this would give us no capacity to generate any energy, such as on calm nights. It is in other words a mistake to regard renewable capacities as additive. They are best thought of as *alternatives* that can at times be substituted for fossil fuel plant. One consequence is that if a large amount of renewable capacity is built it will not be possible to retire much conventional plant, because there will be times when the renewable plant will be making little or no contribution. Thus much of the time large amounts of a number of expensive alternative capacities will sit idle while one or two meet demand.

- Possibly more important is the problem of "ramping" fossil or nuclear plant up or down quickly to follow fluctuations in supply from the variable renewables. It can take many hours to bring these thermal units up to full generating capacity. This is not a significant problem when renewable sources constitute a small proportion of total generating capacity. (Gas-fired generating plant can be ramped up more quickly but gas is about as limited as oil, and it produces CO2, so should not be assumed in a discussion of a sustainable or renewable energy future.) The ramping up problem does not affect hydro generators, but these provide only around 15% of world electricity and thus could not carry the bulk of demand on their own at times when combined renewable input is low.

These have been reasons why renewable and other non-fossil technologies that are feasible on a small scale either would be extremely difficult and costly to implement on a very large scale, or could not be implemented at all. Although Stern and the IPCC occasionally identify some of these problems in the briefest of terms they do not deal with any of them, and do not take into their energy accounting any provision for difficulties or limits.

There have been hundreds of studies based on top-down and bottom up modeling of the costs of carbon abatement. I have scanned many of these and have found within them no discussion of any possible technical limits to the scale-ability of renewables, CCS or nuclear energy.

If the case outlined above is valid, it would seem that the topic of carbon mitigation provides critics of conventional economics with one of the most impressive illustrations of how its narrowness can lead to a totally mistaken understanding of a field and to catastrophically inappropriate policy choices.

What then is the answer?

If the question is "How can we provide the energy to run a society committed to affluent living standards and economic growth?" then the answer is that we cannot. A number of distinct lines of argument show clearly that the lifestyles and per capita resource and ecological impacts of the rich countries are far beyond sustainable limits. For instance the Australian footprint of approximately 7 ha of productive land per capita is about 6 times the global average, and by the time we have 9 billion people on earth the multiple will be about 10. Even if none of these alarming sustainability problems confronted us, rich world living standards would not be possible without the grotesquely unjust global economy which delivers most of the world's resource wealth to the enrichment of our corporations and supermarket shelves. The problems consumer society is running into are due to massive faults deep within the foundations of this society, most obviously to do with an economy driven by market forces, profit and growth, and a culture obsessed with material wealth. It is not just that consumer-capitalist society is unsustainable and unjust -- *it can not be made* sustainable or just.

A sustainable and just society cannot have anywhere near the per capita rates of resource consumption typical of rich countries today. "The Simpler Way" is the label that seems to me to most appropriately stand for the only way out of the global predicament the commitment to affluence and growth have got us into. Its key principles have to be, non-affluent lifestyles, mostly small and highly self-sufficient local economies (peak oil will soon eliminate globalization), enormous cultural change, away from the competitive, individualistic pursuit of wealth. The case for all this is spelled out in detail at The Simpler Way website below.

Glossary of Technical Abbreviations

IPCC International Panel on Climate Change.
EJ Exajoule, unit of energy equal to a billion billion joules.
GT Gigatonne, one billion tonnes
O2 Carbon dioxide.
Ha Hectare
GJ Gigajoule, one billion joules.
GW Giga-watt, one billion watts.
CCS Carbonb capture and storage.

References

Barker, T., et al., (2007), Working group 111 Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report, Climate Change 2007: Mitigation of Climate Change, *Summary for Policy Makers.*

Baer, P, and M. Mastrandrea, (2006), *High Stakes; Designing Emissions Pathways to Reduce the Risk of Dangerous Climate Change,* Institute of Public Policy Research, Nov. www.ippr.olrg. See *Rising Tide Australia*; 2007. http://risingtide.org.au/cleancoal

Bossel, U., Eliasson, B., and Taylor, G., (2003), *The Future of the Hydrogen Economy; Bright or Bleak*, http://www.oilcrash.com/articles/h2_eco.htm

Leeuwin, J. W., and Smith, P., (2003), "Can nuclear power provide energy for the future; would it solve the CO2 emission problem?" www.oprit.rug.nl/deenen/, (and in more detail at www.oprit.rug.nl/deenen/Technical.html

Stern, N., 2006, *Review on the Economics of Climate Change*, H.M. Treasury, UK, October, . http://www.sternreview.org.uk

Trainer, F. E. (T.), (2005), The Simpler Way website, http://ssis.arts.unsw.edu.au/tsw/

Trainer, F. E. (T.), (2007a), The Stern Review; A critical examination of its mitigation optimism", http://ssis.arts.unsw.edu.au/tsw/SternReview.htm.

Trainer, F. E. (T.), (2007b), *Renewable Energy Cannot Sustain A Consumer Society*, Dordrecht, Springer.

Zittel, W, et al., (2006), *Uranium resources and nuclear energy*, Energy Watch Group, Dec.

SUGGESTED CITATION:
Ted Trainer, "A short critique of the Stern Review", *real-world economics review*, issue no. 45, 15 March 2008, pp. 54-58, http://www.paecon.net/PAEReview/issue45/Trainer45.pdf