

vitriolic defence of WS when the more measured views of other contributors would have served better.

Neumayer's optimism over resource substitution possibilities depends to a large extent on a continued and increasing supply of cheap energy, an assumption being challenged by Colin Campbell and others who believe that we have reached the end of cheap oil from conventional sources. Likewise, according to USDA data, the world supply of grain per capita has declined since 1984 and yet Neumayer believes that "nature as such does not seem to impose limits on increasing food production to feed many more people."

Neumayer correctly reports that Jevons warned that nineteenth century Britain was running out of supplies of cheap coal threatening the competitiveness of British industry. In saying so, history proved Jevons right not wrong as Neumayer and others like to claim. Britain did lose its economic supremacy to the USA and the discovery of oil in the USA, of which Jevons was aware, was a key factor. Likewise, Neumayer repeats misrepresentations of Meadows et al. in *The Limits to Growth* especially in regards to prices. It's true they did not model prices explicitly but they did analyse increases in the efficiency of resource use, technological progress in pollution abatement, increases in food productivity and the discovery of new resources, all of which are types of price-induced responses that critics of their work insist they neglected altogether.

Whether or not nature or the environment can be adequately described as capital is not taken up by Neumayer. He simply assumes that they can. Yet the concept of capital as developed in economics brings with it a perspective and a set of problems that may not suit nature and the environment very well. For example, nature as a complex system, with non-linearities, feedbacks, thresholds, irreversibilities and so on is not well-described by a concept designed to represent buildings and equipment that can be increased or decreased at will. Another problem is the aggregation of man-made capital using prices and present values which has been the subject of much controversy. Neumayer fails to mention this problem yet it has implications for aggregating natural capital especially in the absence of market prices.

Perhaps because he accepts the description of nature as capital, Neumayer says that estimates of total value are unhelpful for decision making because

"such decisions are always about marginal values, not total values". He has a point of course, except where decisions about the environment are about tipping points, system flips, and discontinuities. In these cases, marginal values are not defined and we need something more.

This leads me to my last point. Neumayer has addressed the WS versus SS debate from the standpoint of a neo-classical economist. He comes at the debate from the inside out, rather than the outside in so to speak. He starts from the economy and works out to the environment rather than the other way around. So while he mentions the laws of thermodynamics he gets them confused. He is on surer footing when he develops his dynamic optimisation model to examine 'Genuine Savings'. He uses this model to generate results that he describes repeatedly as 'theoretically correct'. This may be true if the theory in question concerns neo-classical utility maximization over time. The more important question is whether this particular theory is correct for understanding sustainable development and clearly, that is matter of further debate.

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Vaclav Smil, 2003. *Energy at the Crossroads: Global Perspectives and Uncertainties*, MIT Press, ISBN: 0262194929, 448 pp.

Vaclav Smil has authored many excellent books in the area of energy and agriculture. In his latest book "Energy at the Crossroads" Smil considers the interaction between our modern world's unceasing demand for energy and the environment. After a century of economic growth, innovation, and expanded consumption of energy, the world faces a number of critical challenges in the form of inequitable energy consumption patterns, potential resource constraints, and environmental impacts of our massive consumption of energy. Smil argues that the dependence on fossil fuels must be reduced not because of

any imminent resource shortages (the stone age did not come to an end because of a lack of rock) but especially because of environmental problems. Smil sees the problem of climate change as the most pressing of all environmental problems currently faced by the energy system. While Smil also discusses the security issues surrounding especially the supply of oil, climate change takes center stage as the key challenge for our energy system.

The book starts with a 30,000 feet level overview of the trends in energy production, discussing energy prices, the real cost of energy, and links to the economy, quality of life, and the environment. This is followed by a chapter discussing the problems with many forecasts and forecasting methods used, arguing for the use of normative scenarios (i.e. focus on what should happen, instead of extending current trends into the future). He then further discusses the main energy carriers (e.g. the various fossil fuels, nuclear, hydro-power and renewables), to end with a plea for large improvements in energy efficiency as well as changes in consumption patterns to reduce the negative environmental impact of energy use of our society.

Although, the book is “sprinkled” with details, the book stays at this elevated level to provide a general overview of issues surrounding energy supply. While interesting, the (sometimes anecdotal) details take away from the central storyline. Also, many of the references used are relatively old. While trying to discuss the drivers for energy use, the book is generally a discussion of the many uncertainties. This begs the question what the main goal of the book is and what the intended audience is.

If the book is indeed a plea for improved energy-efficiency and changes in consumption patterns, why is more than half of the book spent on a very traditional discussion of the supply side of the problem, instead of focusing on the potential solutions and barriers? I fully agree with Smil that we need to start reducing the demand to enable more cost-effective solutions on the supply side and to avert misguided policies aimed solely at increasing the short-term supply of energy sources. However, the book remains weak in developing this scenario, especially considering the focus of Chapter 3 on normative scenarios.

In order to get to a better basis for the concluding chapter, there is a need for an improved analysis of the forces driving the growth in energy use. This

discussion is currently weak in the book. For example, the discussion on indicators for energy efficiency is out of date (Chapter 2) and a lot of interesting work to understand energy use patterns at the sector level has been published since. Such a discussion would enable improved understanding of the differences in energy use patterns and opportunities to reduce energy use, and would also have provided a much stronger foundation for his plea in the final chapter of the book.

Despite his plea for normative scenarios, Smil keeps criticizing the scenarios of Amory Lovins and others. While Lovins may be accused of being optimistic on the adoption of innovative technologies by society, his scenarios have a clear normative character, and should not be seen as a forecast as Smil seems to suggest. Given the focus of Chapter 3 and its goal of underlining the need for well-grounded analysis as the basis for the further development of the energy system, it is especially strange that the publisher uses on the back cover a quote to market the book by the author of a remarkably tainted analysis. I am sure that the author cannot be blamed for the action of the publisher.

In short, “Energy at the Crossroads” is rightfully a plea for critical analysis of our energy use patterns, especially given the challenges that we are facing. The book gives a good high level overview of the trends and future of the different energy sources. Unfortunately, the book could have done a better job at analyzing those energy demand patterns and providing the reader with information on potentially successful ways to reduce our dependence on fossil fuels. Having said this, the book will be helpful for students to get an introduction into the many-faceted field of energy, and will help them to find critical areas for future research. Which is an important compliment to a book that will never be complete or finished.

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