

Interactive comment on “Energetic regimes of the global economy – past, present and future” by Andrew Jarvis and Carey King

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Rosen - Unfortunately, the first review comment was far too polite.

Response - In a Discussion forum such as this, being polite is a useful trait if the aim is to foster mutual understanding and advance learning.

Rosen - I have been doing energy research for over 40 years and this paper makes absolutely no sense to me.

Response - What we read doesn't have to chime with our long-held world view. If it did, there would be no progress. We appreciate the metabolic, thermodynamic and network concepts used to explain the observed global scaling relationship between energy consumption and GDP are not commonplace in “energy research” or economics, although

this journal has published articles in this space (e.g. Garrett 2015; Jarvis et al 2015). We believe it is important to challenge this orthodoxy, not only because of the important insights metabolic, thermodynamic and network concepts offer, but also because, through ignoring the physical constraints under which the global energy/economy system evolves, the the IPCC scenarios are, in all likelihood, not reasonably bounded. As such, we believe the paper offers controversial, but important new insights on past, present and future patterns of energy and economic development at the global scale.

Rosen - First of all the methodology is not clear, and even if it were it is at far too aggregate a level to be meaningful given the kinds of issues that the authors seem to want to address, as far as I can tell.

Response - Either Rosen doesn't understand the methodology, or he does and believes it to be "far too aggregate". Given the methodology is simply to plot two projections of the observed values of Gross World Product (GWP) and Primary Energy Use (PEU) 1950 - 2018, one in loglog space, the other in growth rate space, we would have to assume it is the aggregation issue that is causing him most concern/offence. Because he doesn't articulate what that concern is specifically, we are unable to address his concern directly beyond saying the following. It is only at the global scale that the network effects are fully accommodated. At all scales below this, analysis is invariably distorted by the wider network effects. In short, the connectivity within the global economy is such that it behaves as a global system and should be analysed and understood as such. We do not think that is contentious and, as R1 indicates, although most research in the energy-economy space has elected to focus on ever finer grained data as it becomes available, there remains critically important unanswered questions over global scale behaviours. As stated by Meadows et al, (1972), "Questions of detail, of individual nations, and of short-term pressures can be asked much more sensibly when the overall limits and behaviour modes are understood." We believe this still holds.

Rosen - Secondly, the paper is terribly written, which is part of the reason why it seems to make little or no sense. Surely, this paper should not be published. It is not even

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close to being a professional paper.

Response - No doubt the text could be improved and suggestions in that direction are invited. But either Rosen understands what we have done and hence should say specifically what is wrong with it, or he doesn't because it is badly written and hence he cannot comment. He can't have it both ways. Because he does not suggest areas for clarification, or ask questions of clarification, it would appear to us that it is the content of the paper that has offended him most, suggesting that the arguments could be accessed to some extent.

We are intrigued by the apparent level of offence our paper has caused Rosen. In reading some of his writings on energy systems we observe he adopts a strongly normative position, assuming high levels of agency for human actors. The paper under review infers the opposite, that the economy evolves along similar lines to organisms or ecosystems. This suggesting to us at least two possible rationales: (1) humans have similar levels of agency to individual cells, organs, and eusocial insect species (e.g., ants), or (2) humans have less agency than normally assumed in that our collective, 'socially-acceptable' practices are acquired under, and constrained by, unconscious physical imperatives that, in aggregate, seek growth in ways that maximize power flow, in the same way it appears to in other biological species and their collective ecosystems. We think the 1st explanation is unlikely, and we present the 2nd explanation in this paper. This difference in perspective on human agency is likely a fruitful area to explore in this Discussion, which we invite. One of our core research goals is to better understand the possibilities and constraints for human agency to shape the evolution of the global economy.

Garrett TJ (2015). Long-run evolution of the global economy – Part 2: Hindcasts of innovation and growth. *Earth Syst. Dynam.*, 6, 673–688.

Jarvis AJ, Jarvis SJ, Hewitt CN (2015). Resource acquisition, distribution and end-use efficiencies and the growth of industrial society. *Earth System Dynamics*, Vol. 6,

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689-702.

Meadows et al., (1972), Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind. P.96

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