

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

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I offer this commentary to highlight what I think is the most important contribution of this paper. The authors make use of the fact that the global economy, like any other system composed of atoms and information, operates according to physical principles, specifically the conservation of energy and its dissipation in production of work. They show how consideration of those principles, which stand independently of economic relations such as demand versus supply, provides insight into the dynamics of the global economy. This kind of “toy” model, common in physics, is often belittled by practitioners of other disciplines as being too aggregate in nature because it doesn’t directly address the behavior of many of the intrinsic variables that form the bread and butter of their field. But where those variables are subject to broad physical constraints, a

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simple, “toy”, holistic model can sometimes yield results that would be hard to discern otherwise. In their GAP model the authors distill the global economy into a giant effective feedback loop of primary energy production transformed via dissipative processes into work, which is variously apportioned to system maintenance, growth, including development of new efficiencies, and to further energy extraction from primary sources. To my mind, a central contribution of the paper is their conclusion, as in lines 465-470 and the conclusion of the abstract, that this feedback mechanism is essentially autonomous, e.g., “. . .the underlying calculus of the economy may well be underpinned by thermodynamic constraints and hence prove difficult to shape. . .”, and “. . .this paper supports a conclusion that future enhancements in energy efficiency intended for emissions reduction are at significant risk of being co-opted to support GWP growth.” Although not stating explicitly that humans have been demoted from their often self-assumed position as creators of the modern world and directors of its affairs, these are still controversial claims that can generate strong pushback in view of the assumption by many that solving global problems like climate and environmental degradation lies within the capability of humankind. The main point for the present paper, in my view, is that if an analysis of system dynamics based on physical principles points to a contrary conclusion regarding the role of humans in the global economy than might have been expected a priori, then, in the absence of concrete dynamical objections, such a result should be welcomed as a contribution to an ongoing discussion of this question in the broader community of dynamicists and other scientists. In any case, the questions raised in the present paper about the role of humans in complex systems of which they are a part are of much broader and deeper import than the particular subject matter under review.

Some minor comments that would help the reader navigate the paper are as follows:

First para: should contain a definition of aggregate energy efficiency AEE.

Line 56: Need a clear statement of what is meant by “useful” work or (line 61) “activities judged to be useful”.

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Line 66: “The relationship is not causal, but rather summarizes. . .” Might also be useful to explain that the fundamental reason it is not causal is because $GWP \sim AEE * PEU$ is part of a feedback loop not a oneway street.

Lines 79,82: provide clear definition of what is meant by “productive”.

Lines 96-97: not sure what “standard growth accounting” entails.

Fig 1: describe what Shared Socioeconomic Pathway is, and how does SSP differ from IAM.

Line 443: “. . .high growth rates in AEE simply act to accelerate the system. . .” Might a reference to Jevons (1865) be appropriate here or elsewhere in paper?

Lines 465-470: It might be useful to make these remarks more explicit in what they say about the human capability to get their hands around the global economy.

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