

## Book Review

*The Second Law of Economics:  
Energy, Entropy, and the Origins of Wealth*  
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By Reiner Kümmel

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*The Second Law of Economics* is a book written by an author with a mission. Although the title lets the reader expect still another application of thermodynamic principles in economics, this is far from the case. The author is not the usual unbiased scientific writer; he is selling the green revolution, convinced that the disaster of global warming is caused by human greed, and that we are all ethically obliged to forsake our current lifestyle in order to save the globe. As such it is a well-written, encouraging book which skillfully uses thermodynamic notions and results to argue the point – but for the sake of honesty a more appropriate title would have been something like *The Second Law of Economics in the Service of a Greener Future*.

The book is divided into two main parts focusing, respectively, on thermodynamics and economics, wrapped between a prologue and an epilogue. The style of writing seems to be aimed at a general audience with little scientific training. Concepts and arguments are explained in general words with almost all equations and exact statements relegated to appendices. Unproductively, there is an abundance of excuses for thermodynamics being so complicated and incomprehensible, in particular entropy. In my eyes this is quite unnecessary. Entropy is nothing but counting the number of energetically equivalent states, and it does not take much schooling to understand counting. Similar excuses are not found in the economics section, although those concepts are less rigorously founded in the real world than is thermodynamic theory.

The prologue, called “Time Travel with Abel,” is a cute way of taking the reader all the way from the Big Bang to the present while focusing on the energy available for the important processes in each epoch, in the latter stages the energy available for human activities. All this is told through the imaginary all-knowing tour guide Abel. This is an amusing way of looking

at the evolution of human society and actually quite thought provoking as the energy consumption per capita continues to grow. However, as long as the total human energy consumption does not approach the influx from the sun, we are not in serious trouble since all the incoming energy which we do not make use of will just be turned into heat and reradiated into space. The overall entropy production with or without man will be the same, just distributed differently.

The energy part presents the thermodynamic quantities of energy, entropy, and free energy (exergy) in a fairly traditional way, garnished with a number of moral/political comments on waste and on nuclear energy. The laudation of the IPCC reports is beyond science. While it is important to stress that there is no such thing as a free lunch, the sections on how much waste is caused by haste could have been more precise and up to date with recent results in irreversible thermodynamics and finite-time thermodynamics in particular. The arrow of time, another important issue in thermodynamics, is nicely handled, although a few pointers to Landsberg's contributions would have been in place. The section on heat equivalents of wastes (HEONS) is a funny way of mixing apples and pears, not to say carrots and rocks. It becomes particularly absurd when radioactive waste is being converted into a heat equivalent.

The economics part is presented quite differently. Here the main flow of the text contains some pretty complicated equations and an abundance of statistical data for the economies of, in particular, Germany, Japan, and the United States. On this background many pages are spent arguing for a much higher functional price of energy and correspondingly smaller one of labor, leading to the political message that we should save considerably more on energy while using more labor. This being said, the introduction of thermodynamic arguments, not least those connected with entropy and the second law of thermodynamics, into economics is well argued and leads to some strong statements. A new parameter is introduced into the economic theory, that of creativity. Abstractly, it makes a lot of sense that the creativity of a population is equally as important as its labor force, if not more important, but I find it exceedingly difficult to quantify creativity on an equal footing with capital, labor, and energy. The attempt made in the book falls dismally short of being quantitative and realistic. For starters, what is the unit of creativity?

The epilogue has two sections: "Ethics" and "Reason." This brings us directly back to the non-scientific mission of the book, encouraging the world to become responsible, not passing debt, pollution, or depleted resources on to our children and their children. This is further argued with

references to the financial crisis emanating from the United States a couple of years ago, the Cold War, and the risk of future wars due to changing environmental conditions and population evolution. Amen.

In spite of my fairly critical comments above, *The Second Law of Economics* is definitely worth reading – I read it cover to cover on a long flight – if not for its scientific content then for its many unconventional perspectives and its dedication to its mission. I would probably have been more sympathetic in my comments if the title had been more honest and not pretended to be rigorous science.

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