

pose an upper bound on aggregate economic output. Central to this analysis is that solar radiation is the singular energy source entering the total system. Materially it is a closed system with steady-state mass cycling. This provides for a well-defined feedback process across the boundary that demarcates the economic and ecological systems. This analysis and resulting simulations focus upon physical quantities, not upon the monetary value of output. If monetarists are correct in their assertion that money is indeed “neutral,” this simplification will not prove to be an analytical shortcoming. The results derived from this framework are consistent with many derived by neoclassical analysis of nonrenewable resource extraction: there is an inverse relationship between the discount rate and time paths for extraction, as well as for intertemporal welfare. More interesting is the expanded model. Here, welfare is derived not only from production (based upon renewable and a nonrenewable resource), but from leisure time and nature, the latter consisting as both a source of inputs and natural services and aesthetics, both being dependent upon the integrity of the ecological system. Material cycles and energy flows are incorporated using a limited, yet complex, set of feedback processes. Time paths for resource extraction, manufacturing and agriculture are then derived and simulated when the above ecological and thermodynamic constraints are imposed.

*Integrating Economics, Ecology and Thermodynamics* successfully presents a theoretical framework that integrates the core concepts from each of the three respective disciplines contained in the title. Ruth’s

careful attention to explicitly note the role of assumptions in shaping the form and conclusions of analysis, the systematic presentation of core concepts to present a unified language for discourse, and his review, and integration, of a multitude of important lines of previous analytical contributions from ecological economics proved to be both insightful and stimulating. In this vein there are numerous topics I found of great interest: the complementary role of an energy theory of value for complete system’s valuation, the relationship between discount rates derived from human and ecological systems, the potential applicability of  $r$  and  $K$  strategies for adaptation in economic analysis, his treatment of energy and material flows within the context of diversity and stability, etc. Unfortunately, the spatial constraints of a book review make it impossible to enumerate upon them. If there is any shortcoming to this book, it is that specific policy prescriptions are not forthcoming. But then, that was not the author’s objective. His was to systematically integrate core concepts into a dynamic framework capable of yielding quantifiable results. This he did most successfully and, in so doing, marks another important step forward in establishing the ground work for the science of sustainability in what may prove to be a milestone in ecological economics as a science.

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## The Ecology of Commerce

*The Ecology of Commerce: A Declaration of Sustainability.* Paul Hawken. Harper Business, New York, 1993, 250 pp., ISBN 0-88730-655-1.

If you’re looking for a book to convince your friends (especially those in the business community) that there really is something to this idea of sustainability, then this is definitely the book. Paul Hawken has managed to put the major tenants of ecological economics into such a compelling, and accessible form that it can be

read and appreciated by a very broad audience, from the lay public to undergraduate and graduate students. Readers of *Ecological Economics* won’t find any radically new ideas in the book, but its power and its purpose lie in its ability to get the message out well beyond the academy.

It begins by setting up the problem of sustainability as a positive opportunity for business – not business as usual, but a much broader definition of business and commerce in the service of humankind. Hawken does not fall into the popular trap of thinking that a little tinkering at the edges of the business community is all that is needed. If we can just convince them to do more recycling and green marketing and find all those “win-win” opportunities, the story goes, then things will be

all right. He goes to the heart of the issue and states that: “The critical myth is the assumption that we can “clean up” our environment. In other words, we can admit that industry was a little sloppy in the past, while being assured that it can do better in the future. With spit, polish, technology, and enough landfills, we can stop releasing pollutants into the environment. This strategy is often dubbed ‘end-of-pipe’ clean-up.” But ultimately this can’t work, according to Hawken, because: “The biosphere represents our source of wealth. It is the capital which we draw down to support our lives. Whenever we pollute or degrade that system with toxins or waste, we are destroying our natural capital and reducing our ability to sustain our civilization. It is that simple.” And Hawken is savvy enough to know that business will not make such a radical change of course and mindset unless the basic rules of the game are changed. After documenting the many problems of current corporate business structure, and the ecological dangers of *not* changing, the last part of the book is devoted to laying out how the rules need to change and how we might go about changing them. He first develops a list of principles for sustainable small businesses and works through their implications. The list includes:

“Replace nationally and internationally produced items with products created locally and regionally.

Take responsibility for the effects they have on the natural world.

Do not require exotic sources of capital in order to develop and grow.

Engage in production processes that are human, worthy, dignified, and intrinsically satisfying.

Create objects of durability and long-term utility whose ultimate use or disposition will not be harmful to future generations.

Change consumers to customers through education.”

But ultimately, in order to allow these things to happen, the market must be changed to give the right signals to business. “Businesses should literally compete to become more ecological, not only on moral or ethical grounds or because it is “the right thing to do,” but because such behavior squarely aligns with their bottom line.” How to do this? Hawken advocates a mixture of green fees and the creation of public “utilities” similar to current power utilities to handle a range of other public goods. In his words:

“The whole key to redesigning the economy is to shift incrementally most if not all of the taxes

presently derived from “goods” to “bads,” from income and payroll taxes to taxes on pollution, environmental degradation, and nonrenewable energy consumption. Because green taxes are incorporated into the price of a company or customer pays for a resource, product, or service, they create powerful incentives to revise and constantly improve methods of production, distribution, and consumption, as well as a means to reconsider our wants and needs. The purpose of a green tax is to give people and companies positive incentives to avoid them.”

He suggests implementing the green taxes over a 20-year period to allow adequate time for adjustment and planning. These ideas are coming out of many circles these days (Costanza and Daly, 1992; Passell, 1992; Repetto et al., 1992; von Weizsäcker and Jesinghaus, 1992; Costanza, 1994), and what I find significant and exciting is the growing consensus around the critical need to do something like this. Ecological tax reform is gaining momentum both in the US and, with even more speed, in Europe. Hawken’s book goes a long way toward helping to further develop that consensus by clearly laying out both its necessity and its positive implications for business and society. It can be a tremendous opportunity for business, if we can get past the short-term special interest objections that stand in the way of any change. And the only way to get past these objections is to clearly show that the proposed changes are in the long-term best interest of both business and the society it serves, and to make business a key part of the dialogue and the solution, not just the nexus of the problem. Until we can fully motivate business with appropriate market forces that include all the currently “external” ecological and social costs, we stand little chance of achieving sustainability. Only after we succeed in presenting business with the right incentives, can they, and all of us, begin to reap the benefits of what a “free” market can do. A proper institutional framework is needed. As Hawken paraphrases G.K. Chesterton: “there is nothing wrong with a free market, it is just that no one has tried it out yet.” Getting the prices right won’t solve all our problems or guarantee sustainability, but *failure* to get the prices at least approximately right will prevent us from doing anything but continuing on our current unsustainable path. With the help of books like *The Ecology of Commerce*, we may be able to build the broad consensus necessary to overcome the short-term special inter-

ests and implement a broad ecological tax reform that can stimulate the development of more effective markets to begin to work in the service of sustainability.

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