

# The business of sustainability

## Factor Four: Doubling Wealth, Halving Resource Use

by Ernst von Weizsäcker, Amory B. Lovins and L. Hunter Lovins  
*Earthscan: 1997. Pp. 332. £15.99*

## Charging Ahead: The Business of Renewable Energy and What It Means for America

by John J. Berger  
*Holt: 1997. Pp. 399. \$30*

**Robert Day**

It would be easy for a business person or policy-maker to begin reading *Factor Four*, put it down halfway through and decide: "Yes, we're on the right track". What company is not constantly looking for greater efficiency? Which government is not encouraging its private sector to become more efficient? Achieving sustainable development solely through dramatic efficiency improvements appears at first glance to be the message of this book.

This impression, however, would be wrong. As the reader delves deeper into the text, perceptive and exciting ideas emerge for transforming our entire economic system towards sustainability. *Factor Four* provides a snapshot of the current state of the 'eco-efficiency revolution' but also demonstrates the limits we can achieve without making more radical changes to unleash the potential of the private sector.

At the beginning of the book, 50 examples of resource and energy efficiency drive home the point that there are many highly profitable opportunities for businesses, opportunities that actually build on each other. This is one of the more interesting ideas in the book — that instead of diminishing returns from eco-efficiency improvements, even greater opportunities are opened up for major process changes. A considerable improvement is usually found when the company realizes that it is providing a service and not a product. Utilities, for instance, are not selling electricity: they are keeping milk cold and houses warm. Is it necessary to pollute in order to do that?

Although the authors make it clear that they feel market failure is the rule and not the exception, they suggest policy changes and investment schemes that align market incentives with the needs of environmental protection, including 'polluter-pays' taxes, emissions trading and general regulatory reform. The authors conclude with a plea for greater investment by society in intangibles: "Markets were never meant to achieve community or integrity, beauty or justice, sustainability or sacredness", they write, "and they don't. If markets do something good for whales or wildness, for God or Gaia or

grandchildren, that is purely coincidental."

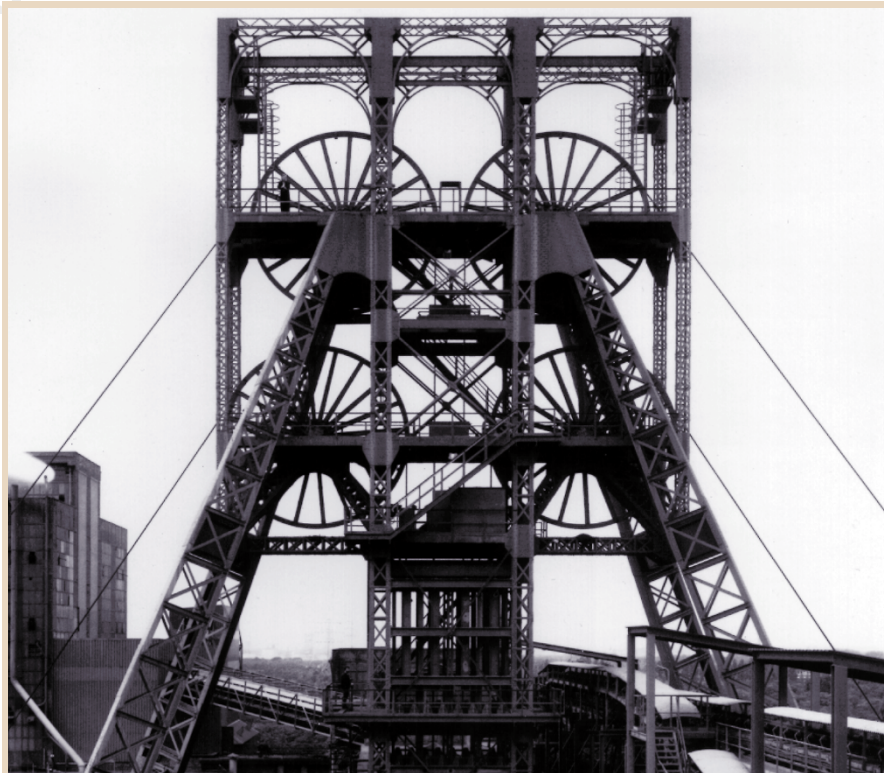
Such ideas are important because the authors explicitly acknowledge the need for business to make a profit. Parts of the book, however, are a little confusing. Much of the policy discussion, for instance, focuses on the experiences of utilities with energy savings (or 'negawatts') markets, regulators and deregulation. The lessons drawn are interesting and useful, but readers unfamiliar with the peculiarities of utility regulation in the United States may find more use in such exciting ideas such as the 'golden carrot' awards — monetary awards given to the first company that not only invents a super-efficient household appliance but also successfully brings it to the marketplace. Through such stories, the reader can quickly see how small, inexpensive incentives can 'jujitsu flip' market forces to drive eco-efficiency.

Although the book asserts that business can use the eco-efficiency idea to achieve deeper social and environmental goals, its roadmap for doing so is somewhat vague. We cannot back our way into a sustainable future by simply doing what we do more efficiently. For example, the authors point out that while CAFE (fuel efficiency) standards for vehicles have lowered fuel use per mile in

the United States, Americans now drive more miles per person. We cannot achieve sustainable development without real change in our economic patterns, not just process improvements.

One way to think about the difference between eco-efficiency and sustainable development is in the context of public goods. Public goods such as infrastructure, clean air and water, social culture and security are used productively by all businesses, big or small. Eco-efficiency is all about minimizing our negative impact on the sources of these public goods: the environment, society and people. Sustainable development, on the other hand, requires us to contribute to these public goods. To achieve sustainable development, we must create systems that allow businesses to profit from the production of public goods.

This is not as impossible as it seems. Occasionally, the collective action of the market itself may be enough to provide sufficient incentives. There are opportunities right now for businesses that look hard enough. For instance, telecommunications companies may find it advantageous to build a public wireless communications network — because it will mean that more people use their product — even though they are pro-



## On the shoulders of giants

Bernd and Hilla Becher see themselves as 'industrial archaeologists', capturing on film the "delicate giants" that stand over the shaft

entrances to mines in Europe and North America. This picture is one of 180 in their album *Mineheads* (MIT Press, \$75, £49.95).

viding infrastructure that could also be used by their competitors' products. Government, as the custodian of public goods, can also help. Its laws and regulations must be designed to reward businesses for providing public goods. In effect, government is 'outsourcing' its job through incentive-based regulation. To their credit, the authors of *Factor Four* take on these and other difficult issues, and they recognize the need for greater change beyond 'eco-efficiency'.

*Charging Ahead* gives a good example of this principle. This book is a definitive description of the US renewable energy industry and an argument for regulatory change to support it. The author has apparently talked to almost everyone involved in the industry, and he includes many fascinating case studies. Although the book is focused on industry in the United States, its value extends beyond that country. The book gives an overview of the industry and the technologies involved. Although it is a snapshot of what was state-of-the-art in 1996, it is comprehensive and clearly written. Even readers with little or no previous knowledge of the subject will be able to follow the author. The case studies themselves — with their personal stories of struggle and triumph — yield valuable and basic lessons on entrepreneurship that could be useful in a business-school classroom. Finally, the book provides resources for researchers, including a directory of organizations active in the field.

Businesses today that strive for eco-efficiency often face a trade-off between materials and energy efficiency. For instance, they can use processes that require fewer raw material inputs but are more energy-intensive. This results in more greenhouse-gas emissions and other pollution. Many of the examples given in *Factor Four* demonstrate this trade-off, a large obstacle to achieving sustainable development through improvements in efficiency.

The root of the problem is that we obtain most of our energy from physical materials such as fossil fuels. The result is that these efficiency improvements simply trade one form of material for another. What if there were a source of energy that did not require pollution or massive materials use? Then we could have energy-intensive industrial processes with no environmental trade-off for high material efficiency. Then both business and society could meet their needs.

*Charging Ahead* declares that one such source of energy is the Sun. Unfortunately, official and unofficial government subsidies for fossil fuels and nuclear power make it appear that photovoltaics, biomass, wind turbines and other renewable energies derived from the Sun are not as economically attractive. But the fact is that the true cost to society of a gallon of gas is much more than what we pay at the pump. Nevertheless, the

author argues that technology is reaching a level where these energy alternatives will soon be inexpensive enough to begin taking over the market. He suggests that the United States should not only eliminate the subsidies given to fossil and nuclear fuels but that it should also begin investing in domestic research in renewables. Otherwise the United States will fall behind in the coming energy revolution. Specific policy recommendations are given.

*Charging Ahead* provides good examples of profiting through sustainable development. The author argues that the United States can contribute to human development and also gain economically by encouraging business to sell renewable energy technology to the developing world. He describes several businesses that are already doing this on a small scale.

When read together with *Factor Four*, the message of a radical, profitable and sustainable change comes through loud and clear. Both books provide a challenge to industry and policy-makers to look for the business opportunities in sustainable development. □

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## Emergent learning

### Connected Knowledge: Science, Philosophy, and Education

by Alan Cromer

Oxford University Press: 1997. Pp. 221. \$25, £19.99

**Eugenie C. Scott**

Alan Cromer is a man with a mission. A self-described "optimistic know-it-all", he wants US science education to shape up and abandon constructivism and other trends that he feels are not only failing to educate young Americans but are also mis-educating them. As in his earlier book, *Uncommon Sense* (Oxford University Press, 1993), he presents science as a non-intuitive way of knowing about phenomena whose causes are not obvious. To learn how the world works requires systematic introduction of principles that build upon one another. Scientific understanding is based on feedback between theory and experience, spiralling up to a more complete understanding of nature. He blends this philosophy of science with the teaching of science, taking us through quantum physics, the nature of the social sciences, his personal theory of human social organization, a history of education, some idiosyncratic views of learning theory, an even more idiosyncratic commentary on genetics, race, class and IQ, and finally his recommendations for reorganizing US science education.

There is no doubting Cromer's passion

and dedication. He has spent several years with Project SEED, an innovative teacher-training programme, as well as developing programmes for teaching basic scientific literacy to prison inmates. He has thought carefully about what high-school graduates should know and about how to design a curriculum to achieve these objectives. His advice flies in the face of some cherished values in US education — which alone recommends the book.

Constructivism, promoted in all reform guidelines on US science education, comes in for a sound thrashing. In constructivist learning, students 'construct' knowledge of science by 'discovering' principles, especially 'learning by exploring'. This is thought to result in deeper and more complete understanding. Critical thinking is taught through 'open-ended problems' with either no clear answer or many possible answers.

Wrong reasoning, says Cromer. To learn even the simplest scientific principles (he takes most of his examples from physics) requires the direction of a teacher. "In mucking about randomly, a student learns as little as a mouse does while meandering about the maze on its first trial. Only when the student reaches a goal, such as getting an experiment to agree with an equation, does the whole enterprise begin to make any sense... An experienced science teacher knows that some detours are so wasteful of time and energy that students should be warned against them, whereas other byways might be left for the students to explore... it may seem far-fetched to compare a student doing a physics experiment with a mouse running through a maze, but only to someone who has never taken a physics laboratory course."

But the term 'constructivism' hides much variation, and I have seen some classroom teachers leading students to understanding in precisely the way Cromer recommends — and calling it constructivism. Some constructivist approaches cheerfully if mindlessly exhort the teacher to "accept all answers" instead of reminding them that the point of the exercise is to help the student to understand some principle or other. But some uses of constructivism, such as in pre-assessing a student's understanding (or misunderstanding) of a topic, are certainly worthwhile. There is a place for letting students explore, as Cromer would agree. But for a student to understand either basic principles of science or how science works, the guidance of a teacher is necessary because "without knowledgeable guidance from their teacher, students are truly like mice in a maze. Each will arrive at his own version of the goal with his own set of errors and misconceptions." What is dismal about US education is that most teachers do not understand enough about basic science to be able to supervise such explorations properly, whether called constructivist or something else.