



# Factor four: Doubling wealth, halving resource use

Review by Phillip Crowson

Ernst Von Weizsacker, Amory B. Lovins and L. Hunter Lovins, *Factor four: Doubling wealth, halving resource use*, Earthscan Publications Ltd, London 1998, 322 pages, paperback

Enthusiastically evangelical in tone, this tract for our times is of curiously uneven quality, perhaps reflecting its triple authorship. Its basic message, set out in its Introduction, is 'that resource productivity can – and should – grow fourfold. The amount of wealth extracted from one unit of natural resources can quadruple'.

Not only can it quadruple, but it is imperative that it does so if the world is not to run into unprecedented troubles and disasters caused by mounting scarcity of resources and by the acute pressures of material development on the global environment. In essence this book takes over, a generation later, from the Club of Rome's *Limits to Growth* of the early 1970s. It is, however, more than just a polemic against the excesses of modern industrial civilisation.

It recognises the strength of all the wants and needs that govern economic activity, and suggests ways in which market systems can be harnessed to meet the authors' objectives. That the paramount importance of those objectives, and the basic assumptions that underlie them, are by no means universally accepted does not undermine the validity and relevance of many of the book's insights and prescriptions.

Neither do the many sweeping generalisations such as 'in the past, progress was the increase in labour productivity', nor the often cavalier treatment of facts. Although they stress the effectiveness of properly harnessed and applied economic concepts, and especially of the price mechanism, the authors ridicule some branches of conventional economic teaching, as they perceive it.

To the extent that much of modern economics has become overly theoretical, or pre-occupied with modelling the measurable or quantifiable, even to the exclusion of common sense, they may be entitled to their fun. That their perceptions are sometimes partial, and a travesty of many strands of economic thought, does, however, rather detract from the seriousness of their message.

Economists have always recognised that non-material wealth is important, and that their 'science' studies only a part of the human condition. The argument is well set out, for example, in the initial chapters of Alfred Marshall's *Principles of Economics*, one of the landmarks of economics that was first published nearly a century ago.

The underlying premise of the book is that society has hitherto devoted its efforts almost exclusively to raising the productivity of labour, which has involved the use of more natural resources, to the point that the earth's absorptive capacity is being rapidly exhausted.

We are already bumping against resource constraints, that will become increasingly severe and restricting in the coming decades. Yet those constraints

can be surmounted by eliminating waste and raising efficiency. Modern industrial processes and methods of consumption are inherently wasteful, and needlessly profligate in their use of all resources, but above all of the global commons of water and the atmosphere.

Against that background the first part of the book contains fifty case studies, or examples, of ways in which resource productivity can be dramatically increased, often at little or no extra cost over existing technology, and in some instances with a net saving. The time scale for the potential savings varies considerably from nearly instantaneous to several decades. Twenty examples are of methods of revolutionising the productivity of energy, twenty of materials, and the remaining ten of transport.

The authors emphasise that goods are seldom demanded for their own sake but for the services and welfare they provide. Consumers are more interested in securing comfortable temperatures and adequate light, for example, than in the precise ways in which those wants are met. Tradition plays a large part in determining the present means of satisfying those wants.

The examples range from the substantial to the insignificant. It is sometimes overlooked that individuals have a wide range of competing objectives, and that the minimisation of resource usage has to take its place in that hierarchy. One of the more trivial suggestions is that German consumers should be weaned off imported orange juice to domestically produced blackcurrant juice as an alternative source of vitamin C drinks. The two are by no means close substitutes.

Even ignoring the more simplistic suggestions, there clearly is scope for substantial improvements in materials productivity, and not just at the frontier of production possibilities on which some of the example lie. Society, however, like consumers, does have competing objectives, many of which are non-material. Satisfaction of some will probably in

volve a greater usage of materials than a single-minded pursuit of materials productivity.

The costs of the various factors of production, including all natural resources and the environment, are not uniform throughout any country, let alone in the world as a whole. It takes time for innovations to be widely diffused, no matter how revolutionary and cost-reducing they might be.

Stress is laid on the switch towards the consumption of services in the more mature industrial countries. That is an undeniable trend, and one set to continue, but it should not be assumed that the provision of services requires no materials. It often involves heavy capital investment in buildings, infrastructure, and equipment.

Contrary to the authors' implicit assumptions, there have been steady increases in materials productivity for very many years. The television sets, domestic appliances, and motor cars of today, for example, are substantially lighter and less materials-intensive than those of twenty, let alone fifty years ago.

The changing ways in which society meets specific needs also raise materials productivity. For example, mobile telephone networks, that are widespread in countries like Malaysia, do not need the fixed cable systems that characterize the telephone systems of Western Europe. One measure of the improving trend in materials productivity, on a global basis, is the recorded consumption of metals per unit of real gross product. That is effectively the reciprocal of the intensity of materials usage, which is the measure more commonly examined in the metals industry.

In passing, the metals industry's concentration on the intensity of use does partially support the authors' argument that attention is too heavily focused on the consumption of materials and too little on their productivity. Be that as it may, the global productivity of crude steel rose at an annual average rate of

about 2.5 per cent per annum over the twenty years to 1990, looking solely at the volume consumed relative to global gross product, measured not at official exchange rates, but at more realistic purchasing power parities. The productivity of non-ferrous metals, taken collectively, increased by around 1.7 per cent per annum over the same period.

Neither measure allows for the substantial changes in quality that occurred over the period, that further raised their productivity, nor at the considerable increases in the productivity of their production processes. These global shifts embrace countries whose consumption of materials has risen much less rapidly than their gross product as well as those at earlier stages of industrialisation, whose materials consumption is rising faster than their gross product. That materials productivity has been rising at reasonable rates for many years, does not undermine the authors' arguments, but it does place them in context. They are by no means as revolutionary as is claimed.

Undoubtedly, the pace of change could be accelerated by a greater, and more consistent reliance on market-based systems, and more particularly on the price mechanism. This is the essential message of the book's second part. Even modest shifts in relative prices can have substantial effects, let alone large and sustained changes. Unfortunately, market prices do not always reflect full costs, and particularly the external costs of pollution and environmental degradation of all forms. Markets are never completely free and unfettered, but they always operate within constraints and guidelines.

The authors argue convincingly that some of the guidelines need changing in order to re-direct society's priorities, and internalise such external costs. Above all, the price system should be modified to encourage the satisfaction of people's basic final objectives, rather than specific means of meeting those objectives through the consumption of goods and services. Where the market gives false,

or misleading, price signals, it can be reinforced by appropriate tax systems. Taxes designed to internalise external costs need not raise the net burden of taxation, but merely redistribute it.

The authors sometimes take their argument about finding alternative, less materials-intensive, ways of satisfying basic wants to utopian extremes, for example in their comments about defence spending (p. 176). Some of their proposals overlook the diversity of human motivation, and the present wide disparities between living standards in different parts of the world.

Notwithstanding the emphasis on the power of economic instruments, some of the economic discussion is superficial, as in the discussion of trade in chapter 13. It is also rather dirigiste in tone when it comes to the introduction of the favoured instruments. Different countries will always have different objectives, and employ different means of achieving those objectives. The imposition of tax and price systems that are designed to achieve specific objectives on countries with different value systems and objectives is a form of imperialism.

The authors' answer to that charge lies in the third part of the book, which sets out their justification for seeking the changes they have outlined in the earlier chapters. They argue that 'humanity is on a collision course with natural boundaries. If we fail to change course soon enough and the collision occurs, nature will survive the event somehow. Humanity will not'.

Drawing on earlier reports of the Club of Rome, and the Worldwatch Institute, the authors argue that their proposed Factor Four efficiency revolution is the 'most powerful strategy for closing those abyssal gaps that are opening before us'. They link their diagnosis of the earth's ills to the themes of the 1992 Earth Summit in Rio de Janeiro 'of sustainable development in general, climate, and biodiversity'. These final chapters are the most polemical, and in many ways weak



## Books received

edited by Robert Lilljequist

Mike Hinchy et al., *International Trading in Greenhouse Gas Emissions – Some Fundamental Principles*, Research Report 98.3, ABARE, 1998, GPO Box 1563, Canberra 2601, Australia. Fax: +61-2-62722001, Internet: [www.abare.gov.au](http://www.abare.gov.au), ISBN 0 642 26625 5, 1 050 p.

This report provides a discussion of the many issues which need to be considered in establishing a scheme for greenhouse gas emissions trading, with an emphasis on international trading. The more specific findings of the report include: (1) Any restrictions placed on trading will significantly increase the costs incurred by countries, even the developing countries that do not have to meet targets; (2) Unrestricted emissions trading will increase the world volume of production and international trade relative to a situation where emissions trading is restricted; (3) Restrictions on emissions trading will reduce the gains from international specialisation in production, and (4) The financial instruments used in emissions trading and derivatives based on them could play an important role in spreading the risks of activities associated with reducing emissions.

Jane Harris et al., *Energy Efficiency Investment in Australia*, Research Report 98.2, ABARE, GPO Box 1563, Canberra 2601, Australia, Fax: +61-2-62722001, Internet: [www.abare.gov.au](http://www.abare.gov.au), ISBN 0 642 26624 7, 71 p.

This report provides an insight into the behaviour of firms when they make energy related investments. The results are based on an enterprise energy audit program run between 1991 and 1997.

est parts of the book. This is where assertion sometimes takes precedence over facts.

Thus the unsubstantiated statement on page 240 that 'tropical forests may suffer more from mining (including access roads) than logging for lumber' appears merely absurd in a year that has seen the destruction of over 20 000 square miles of forests in Indonesia alone through fires that are directly related to logging. Certainly mining may cause local, if often temporary disturbance, but the comments about mining in chapter 9 are facile in the extreme. Different materials bring different benefits and costs that cannot be completely subsumed in comparisons of material flows shown solely in tonnages.

Different environments have completely different absorptive capacities for individual elements. It is at least questionable whether the removal of waste and overburden from a mine in a Chilean desert has as great an environmental impact as the ploughing up of an equivalent amount of marginal land for agriculture in a temperate country. It is not so much the volume of each product's 'ecological rucksack' that matters but the quality and composition of its contents, and the net rather than gross claims that it makes on all resources.

Of course all resources are ultimately finite, but it is invalid to stress the benefits of an efficiency revolution on the one hand while seemingly dismissing the impact of technology in pushing out the frontiers of usable resources on the other. They are different sides of the same coin. Certainly many of the suggested technologies of twenty years ago have not lasted the distance, particularly in the energy field.

One strong reason has been that energy prices did not move as many expected but fell back in real terms, thereby undermining the new technologies. That does not mean that they will never be introduced, but that their time has not yet come. It may never, but they do form part

of the portfolio of potential solutions to any future shortages. In summary, this book is, like the proverbial curate's egg, is good in parts. It contains many useful insights, but they are not quite as revolutionary as the authors claim.

Their proposals for the much wider and more intensive use of price-based incentives to achieve environmental objectives provide a reasonable agenda for governments, provided they are set within a wider context than the single-minded pursuit of resource efficiency. It is possible to accept the validity of the prescription without fully agreeing with the diagnosis. ■

ABARE UPDATE, ABARE, GPO Box 1563, Canberra 2601, Australia, Fax: +61-2-62722001, Internet: www.abare.gov.au, ISBN 0 642 26625 5, 24 p.

This magazine is published twice a year and aims to provide clients with valuable information and commodity forecasting. The latest issue features "Earning Money Off the Farm", "Grain Growers Outperform Other Agricultural Industries", "Greenhouse Gas Emissions Trading", "Gold – What Lies at the End of the Rainbow", "Markal Energy Modelers in Demand", and "Water Reform in the Murrey-Darling Basin".

Polish Academy of Sciences, Mineral and Energy Economy Research Centre, *Minerals Yearbook of Poland 1996*, Department of Mineral and Energy Policy, Krakow, 1998, Edited by Andrzej Bolewski et al., Polish Academy of Science, 7 Wybickiego St., Krakow 65, PO Box 49, Poland. Tel/fax: +48-12-6322068, E-mail: lewicka@min-pan.krakow.pl. ISBN 83-907306-0-X, 538 p.

This second English edition of the *Minerals Yearbook of Poland* contains economic data on 113 mineral commodities in Poland for the period 1992–1996, and makes a contribution to the ongoing process of Poland's integration with the European Union. The data on production, value of trade and domestic consumption of mineral commodities are drawn from the Central Statistic Office and from domestic producers and users. Addresses of companies active in each branch are also provided. Growth predictions to the year 2 000 are presented.

Bertil Odén, *Södra Afrikas Ekonomi. Regionalisering och Polarisering (The Economy of Southern Africa. Regionalisation and Polarisation)*. A book in Swedish from the Nordic Africa Institute, PO Box 1703, SE-751 47, Uppsala, Sweden, Fax: +46-18-695629, E-mail: nai@uu.se. 48 p.

Gordon, Jeffery, *A World of Metals: Finding, Making and Using Metals*, International Council on Metals and the Environment (ICME), 294 Albert Street, Suite 506, Ottawa, Ontario, Canada K1P 6E6, Fax: +1-613-2352865, E-mail: info@icme.com, ISBN 1-895720-26-5, 41 p.

ICME is a non-governmental organisation that promotes the development and implementation of sound environmental and health policies and practices in the production, use, recycling and disposal of non-ferrous and precious metals. This book presents an overview of the many activities involved in finding, making and using metals. It is aimed essentially at non-technical readers and outlines the role of metals throughout history as well as in the global society of today and the future.

Ministry of Environment of the Czech Republic, *Mineral Commodity Summaries of the Czech Republic*, June 1997, Department of Mineral Resources, Geofond of the Czech Republic, Kostelni 26, 170 00 Praha, Czech Republic, ISBN 80-7212-007-7, 166 p.

This handbook, published for the first time, is intended to provide assist professionals and business executives in developing small and medium size enterprises in mineral exploration and mining. The book includes basic data extracted from the register of reserves of mineral deposits. Each mineral is presented in individual chapters containing information about resources, registered deposits, basic statistical data, tariff structure, and mining companies in the Czech Republic.

Juan Aste Daffós, *Transnacionalización de la Minería Peruana – Problemas y Posibilidades Hacia el Siglo XXI*, Friedrich Ebert Stiftung, Apartado 18-0955, Lima 18, Peru, E-mail: postmaster@fes.org.pe, ISBN 9972-43-014-6, 175 p.

This book explains the restrictions and the danger of a mining boom through un-

limited trans-national inversions. The author suggests an alternative, that on the same time incorporates the presence and actions of international mining companies interrelated with a regional and national development.

The Jamaica Bauxite Institute, *The JBI Journal*, Vol. 13, 1998, JBI, Hope Gardens, PO Box 355, Kingston 6, Jamaica, Fax: 876-927-1159, Email: genjb@cwjamaica.com. Subscribing price: USD 12.50, ISSN 0254-5241, 32 p.

The *JBI Journal* contains original socio-economic, legal and technical articles highlighting development issues as they affect the Third World, with special reference to aluminium without excluding other mineral commodities.

World Resources Institute, *1998-99 World Resources – A Guide to the Global Environment, Part I: Environmental Change and Human Health, Part II: Global Environmental Trends*, WRI, 1709 New York Avenue, NW Washington, D.C. 20006, ISBN 0-19-521408-0, 369 p.

This publication notes that despite vast improvements in health globally over the past several decades, environmental factors remain a major cause of sickness and death in many regions of the world. In the poorest regions, one in five children do not live to see their fifth birthday, largely because of environmentally related diseases. Although there has been progress recently in tackling air and water pollution problems in some countries, many negative trends, such as the loss of tropical forests and the build-up of greenhouse gases in the atmosphere, continue unabated. Consumption of natural resources by modern industrial economics remains very high, in the range of 45 to 85 metric tons per person annually. Global energy use has increased nearly 70 percent since 1971 and is projected to increase at more than 2 percent annually for the next 15 years. Global water consumption is rising quickly, and water

availability is likely to become one of the most pressing resources issue of the 21st century.

African Development Bank, *Annual Report 1996*, ADB, 01 B.P. 1387 Abidjan 01, Côte D'Ivoire, Fax: +225-204444, 232 p.

The African Development Bank is a regional multilateral development bank, engaged in promoting the economic development and social progress of its regional member countries in Africa. The Bank started functioning in 1966 with its headquarter in Abidjan. Its shareholders are the 53 countries in Africa as well as 24 countries in the Americas, Europe, and Asia.

Björn Andersson, *On Material Constraints for New Energy Technologies*, Department of Physical Resource Theory, Chalmers University of Technology and Gothenburg University, Sweden, SE-412 96 Gothenburg, Sweden, Fax: +46-31-7723150, E-mail: frba@fy.chalmers.se.

Harnessing solar energy by using photovoltaic cells has the potential to become a major CO<sub>2</sub>-free energy source. The use of solar cells based on Cd, Ga, Ge, In, Ru, Se and Te as a major energy supply technology has severe resource constraints. For some of these metals, there is a risk of enhanced, environmentally deleterious concentrations in the ecosystem due to leakage from manufacturing, use of waste handling.

The Lennart Lundberg International Symposium, edited by Marian Radetzki, *Global Power Generation in the 21st Century: The Critical Choices*, Reprint from *The Energy Journal*, Vol. 19, No. 2, 1998, SNS Energy, Box 5629, SE-114 86 Stockholm, Sweden, Fax: +46-8-205041, 134 p.

This publication is a collection of five major papers, plus discussant comments and a couple of shorter notes, all taking a broader look at issues in the power gener-

ation sector world-wide. In particular they discuss the adjustments and changes of the sector in coming years. The main contributions include "The Role of Electricity in Industrial Development", "Electricity Sectors in Transition", "Technological Options for Power Generation". "The Environmental Challenges of Power Generation".

Yves, Tardy, *Petrology of Laterites and Tropical Soils*, A.A. Balkema, PO Box 1675, 3000 BR Rotterdam, The Netherlands, Fax: +31-10-4135947, E-mail: info@ashgate.com, ISBN 90 5410 678 6, 40 p.

Laterites constitute the thick weathering mantle that covers the bedrock of old continents in the inter-tropical domain. Lateritic soils in Africa, South America, Asia and Australia represent one third of the continental land mass and sustain a large part of the forest reserves of the world.

International Monetary Fund, *World Economic Outlook May 1998. A Survey by the Staff of the International Monetary Fund*, IMF, Publication Services, 700 19th Street, N.W. Washington, D.C. 20431, USA, Fax: +1-202-6237201, E-mail: publications@imf.org, ISBN 1-55775-740-2. 227 p.

The projections and analysis contained in the World Economic Outlook are an integral element of the IMF's ongoing surveillance of economic developments and policies in its member countries and of the global economic system.

Marilyn Carr et al., *Environmental Protection and Its Employment Effects on Miners in Small and Artisanal Mines in Zimbabwe*, Sectoral Activities Programme, International Labour Office Geneva, CH-1211 Geneva 22, Switzerland, ISBN 92-2-110969-0, 24 p.

There is enormous potential for absorbing greater numbers of people in productive employment in the mining sector in

Zimbabwe. Indications suggest that this can be done in an environmentally friendly way. The measures needed to bring this about fall into four broad categories: policy and legislation, institutions, support programmes, and research. Small miners need more credit, more information, better training and more appropriate technology if they are to start and operate profitable businesses, employing more workers at higher wages. Government agencies, as well as NGOs, should consider how to accomplish this as existing support programmes are inadequate. ■