Changes in business and the environment: metaphors, partnerships, tools

Background paper for ECO 99, 6-9 June, Paris

by

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Introduction

Taking the environment into account modifies all aspects of human activity, including industrial and commercial practices, from the conception of products and factories, to the growth strategies of major industry, to financial and other relationships between customers and suppliers. The environment is now a strategic concern for many businesses.

The environment has therefore become a component of competitiveness for some businesses and nations. It is becoming a feature of modern industrialisation, but political leadership is often lagging behind the cutting edge of business.

Certain business initiatives appear to be outpacing both political decision-making and administrative directives. Yet, if environmentally focused developments by business are not recognised, and communicated to politicians, it becomes more difficult for governments to set higher global objectives within a new socio-economic framework that supports – rather than hinders – 'sustainable development', i.e. 'meeting the needs of today without compromising the ability of future generations to meet their needs'.

It is therefore important to illustrate, in accessible way, how some business leaders and politicians the world over are incorporating environmental concerns into their businesses and the economy. At the same time as we have strong, forward-thinking examples from various business leaders, it is important to encourage political leaders to be equally courageous and to join the efforts of innovators, businesses and communities in creating more welfare from less use of nature.

However, although business examples are beginning to change the global environment they are not changing the basic rules of economics, trade and growth which underlie the globalisation of the marketplace. But such problems as climate change and biodiversity losses cannot be solved without a global change towards sustainable development, an issue that can seem too large, too abstract, too scary to deal with. So useful ways to get from where we are to where we want to be – metaphors for change – may help. And once the scale and direction of change is perceived, then getting there will require new partnerships and tools.

These papers from the ECO 97 Conference illustrate some of the 'change agents' needed to help us achieve sustainable development: metaphors, partnerships and tools for change. They provide, along with an introductory essay from the European Environment Agency ('Meeting needs, consuming resources'), useful background information for the ECO 99 Conference. Proceedings from both Conferences will be published as a book later in the year. Constructive comments on the structure and contents of the proposed book, provisionally entitled 'Business and the Environment: from the Margins to the Mainstream?', are welcome.

Part 1. Metaphors for change

Metaphors for change can deliver to the public and to decision-makers new perceptions ('structured knowledge') that can help interpret the past and the present, and help us forge the future. The wider the gap between the 'now' and the 'necessary', the stronger the bridging perceptions have to be in order to break through barriers of fear and conservatism.

Environmental questions have been dealt with metaphorically up to now either by catastrophism or manicheism (zero growth; Malthusianism; Deep Ecology; 'man is the enemy'; etc.). These metaphors have had limited impact because they have failed to connect with the mainstream of political and business ideas.

Other constructive concepts are:

* **'sustainable development'** (from the Bruntland report, 1987) which is not specific enough to divert new actions;
* the **'polluter pays principle'** which has launched new thinking and regulations;
* the **'precautionary principle'**, which is not well understood, or clearly defined, and which has generally not led to positive environmental action early enough.

There are other concepts which have the potential to be effective. An example of such a metaphor is: **'put the eco into eco-nomics'**, which involves integrating environmental or ecological concerns into the economy and business. This requires a radically different approach to how we consume resources in order to meet our needs, and the opening chapter in this collection of papers, extracted from the European Environment Agency's forthcoming book, *Environment in the European Union at the turn of the century*[1], provides the background for the ideas of eco-efficiency, industrial ecology, 'products to services', sectoral integration, zero emissions and environmental diplomacy, which are described in the following papers from ECO 97.

'Eco-Efficiency'

'Meeting needs, consuming resources' written by **David Gee**, European Environment Agency, is the opening chapter in the EEA's report, *Environment in the European Union at the turn of the century*, to be published 24 June, 1999.

[1] To be published in France, the UK and other EU countries on 24 June 1999. Details from the European Environment Agency, Kongens Nytorv 6, DK-1050 Copenhagen K. Tel: +45 33 36 71 00, fax +45 33 36 71 99, e-mail eea@eu.int

2.1. Meeting needs, consuming resources

1. Economic activity and the environment: links and limits.

It has been estimated that it took the whole of human history to grow to the EUR 60 billion scale of the world economy of 1900 (Speth, 1989). The world economy now grows by this amount about every two years (Goodland, 1991), and is currently at EUR 39 trillion (1998).

It is the speed and scale of this economic development which presents a threat to the integrity of the environmental support system that underpins economic activity (Box 2.1.1), and it is this which has changed most significantly over the last few decades.

Ecological services, unlike man-made technologies, are largely free, but their value can depreciate, and may disappear with over-use, as in the case of energy and materials taken from the environment, converted into useful products, then returned to the environment as waste and emissions. Such 'economic metabolism', if it exceeds the resilience of the environment, could cause shortages of both resources and ecological services.

However, managing the exploitation of the *sources* of energy and materials from nature, such as metals, minerals and forests, is much easier than managing the ecological *services* of nature, such as climate regulation, nutrient recycling, waste assimilation, and radiation protection from the ozone layer.

Shortages of materials can be overcome by improvements in efficiency, or via alternative products, such as plastics from biomass waste. Furthermore, the deposits of metals and fossil fuels are usually owned by someone, so that control over their use, via price and other means, is possible. Scarcity, and its associated price rises, stimulates invention, and man-made capital can sometimes replace natural materials from nature.

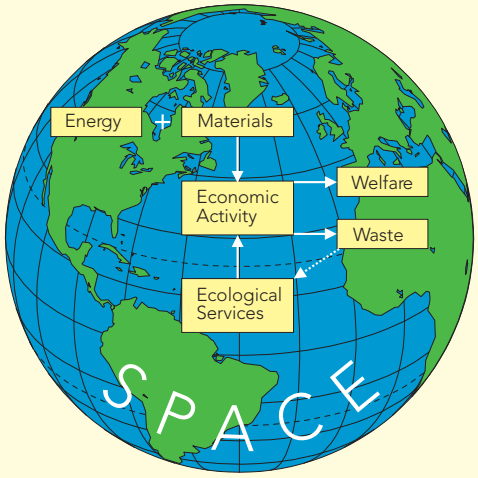
Ecological services are more difficult to deal with. It is not possible to replace the ozone layer (see Chapter 3.2) or the climate regulatory systems with man-made capital, and their efficient functioning can fail once thresholds of 'load' are passed. Such ecological services are not owned by anyone, nor do

Box 2.1.1. Economies depend on the environment

The planet is an integrated system of energy and material flows which involves the circulation of carbon, chlorine, nitrogen, sulphur, water and other key elements between the environmental compartments of air, water, soil and vegetation. The sun is the initial driving force behind such activity. This environmental system not only sustains individual life via air, food and drink but also enables us to collectively organise food, clothing and shelter in an economic sub-system through the provision of:

-Sources of energy and materials
-Sinks for waste and pollution
-Services such as water flow regulation; and
-Space for people, nature and aesthetics.

Economies and the environment: key links Figure 2.1.1



Economic Activity depends on:
'Sources' of Energy and Materials
'Sinks' for Waste
'Services' such as Water Flow Regulation
'Space' for People, Nature & Aesthetics

Source: EEA

These four basic 'life support' functions of the environment are essential to any economy, but whilst the products of nature such as food and drinking water are vital, the more hidden, but essential, ecological services are often ignored, or under-valued. For example, rivers and wetlands not only provide fish, water and facilities for recreation but scientific advances show that their servicing functions include holding and circulating water, producing oxygen, storing carbon dioxide, helping to regulate climate, and filtering pollution.

they usually have prices, so preserving them via market mechanisms is not so easy.

It is therefore concern about the current systems of economic activity overwhelming the *sinks* and destroying the *services* from the environment, rather than possible shortages of energy or materials, that have moved scientists, politicians and others to suggest that radical change in the way that we meet our needs is required (Box 2.1.2).

2. Natural and man-made resources: substitutes or complements?

Both the rate at which natural resources can be safely exploited, and the particular use of the resulting income stream for re-investment in replacement stocks, depends on whether it is possible to replace the functions of natural capital with those from man-made capital. If such substitution is possible, 'sustainability' can be achieved by leaving a constant stock of some combination of man-made and natural capital for future generations – this is the 'weak sustainability' view (Peskin, 1991). If substitution is not possible, as is the case with such ecological services as radiation protection from the ozone layer, or climate regulation, then natural capital must be preserved- the 'strong sustainability view' (Opschoor, 1992).

There may be cases where losses of small amounts of natural capital, such as wetlands or forests, could in theory be 'compensated' with the creation of similar resources, but despite many attempts, particularly in the USA, there have been few examples of the successful recreation of complex ecosystems such as wetlands (NRC, 1992).

There are clearly economic as well as physical limits to the replacement of free ecological services by engineered systems powered by fossil fuels. For example:

- replacing the functions of a forest requires replacements for wood products and the construction of erosion control works, air pollution control technology, water purification plants, flood control works, air conditioning plants and recreational facilities, all of which make large demands on taxes, as well as the consumption of other natural resources, with the loss of their ecological functions, such as soil (see Chapter 3.6);
- the functions of soil include food and timber production; storing twice as much carbon as the atmosphere; and

Box 2.1.2. Living beyond our means?

'The future of our planet is in the balance…The present pattern of human activity, accentuated by population growth, should make even the most optimistic about future scientific progress pause and reconsider the wisdom of ignoring these threats to our planet. Unrestrained resource consumption for energy production and other uses, especially if the developing world strives to achieve living standards based on the same level of consumption as the developed, could lead to catastrophic outcomes for the global environment.' (Royal Society/National Academy of Sciences, 1992).

Two crises are nudging humanity towards the 'outer limits' of what earth can stand.

First are the pollution and waste that exceed the planet's sink capacities to absorb and convert them. Use of fossil fuels is emitting gases that change the ecosystem – annual carbon dioxide (CO_2) emissions have quadrupled over the past 50 years. Global warming is a serious problem, threatening to play havoc with harvests, permanently flood large areas, increase the frequency of storms and droughts, accelerate the extinction of some species, spread infectious diseases – and possibly cause sudden and savage flips in the world's climates. And although material resources may not be running out, waste is mounting, both toxic and non-toxic. In industrial countries, per capita waste generation has increased almost threefold in the past 20 years.

Second is the growing deterioration of renewable resources – water, soil, forests, fish, biodiversity:

- twenty countries already suffer from water stress, having less than 1 000 cubic metres per capita a year, and water's global availability has dropped from 17 000 cubic metres per capita in 1950 to 7 000 today;

- a sixth of the world's land area – nearly 2 billion hectares – is now degraded as a result of over-grazing and poor farming practices;

- the world's forests – which bind soil and prevent erosion, regulate water supplies and help govern the climate – are shrinking. Since 1970, the wooded area per 1 000 inhabitants has fallen from 11.4 square kilometres to 7.3;

- fish stocks are declining, with about a quarter currently depleted or in danger of depletion and another 44% being fished at their biological limit.

Source: United Nations Development Programme (UNDP), 1998

providing home to the micro-organisms which are responsible for the creation of the oxygen-rich biosphere that permits life, as well as contributing to the maintenance of soil quality, the recycling of nutrients, and the breakdown of pollution (European Commission, 1997);

- it may be possible to replace, or even lose some of the millions of species in the world without too much cost, but it is very difficult to guess which species may have 'keystone ' functions that may be highly critical for ecosystem functioning, particularly under changing environmental conditions which are themselves difficult to predict (Frost *et al*, 1995). Genetic variability is therefore an insurance against the unforeseen (European Commission,1998a). A rich array of plant species, for example, ensures that when drought or other environmental stress causes some species loss, other species, with different tolerances, can compensate. Given the lack of knowledge about how ecosystems function, the present level of biodiversity may be the best proxy that scientists have for a 'safe' level of biodiversity (Baskin, 1997).

Research funded by European Commission (DG XI) is underway into the identification of critical natural capital and its management (Ekins, 1998). Adequate supplies of natural capital are also needed to maintain the value of man-made capital, e.g. saw mills without logs, or fishing boats without fish rapidly lose their value.

3. Resources: stocks, flows, accounts and impacts

Before the beginning of the Industrial Revolution, around 1750, economic activity was mainly powered by the use of flows of energy from the renewable resources of sun, wind, wood and water. After the invention of the steam engine, energy supplies moved to the exploitation of non-renewable stocks of fossil fuels, such as coal, then later oil and gas (Table 2.1.1).

For non-energy products too, there has been a similar shift towards using stocks of non-renewable resources, such as metals and minerals, rather than the flows of renewable resources, such as biomass. Non-renewable resources now account for about 70-75% of total material flows in industrialised countries compared to about 50% at the beginning of this century (Jackson, 1996; Schuster, 1997).

Main environmental re-sources: stocks and flows Table 2.1.1.

Stocks ('Non-Renewable')	Flows ('Renewable')
Fossil fuels	*Permanently renewable:*
- recyclable - oil for plastics	Sunlight
- non-recyclable - oil for fuel	Winds
Metals	Tides
Minerals	*Conditionally renewable*
Land	Inland Water
Sea	Air
Space	Soil
	Biodiversity
	Biomass.

Source: EEA, adapted from RMNO, 1994

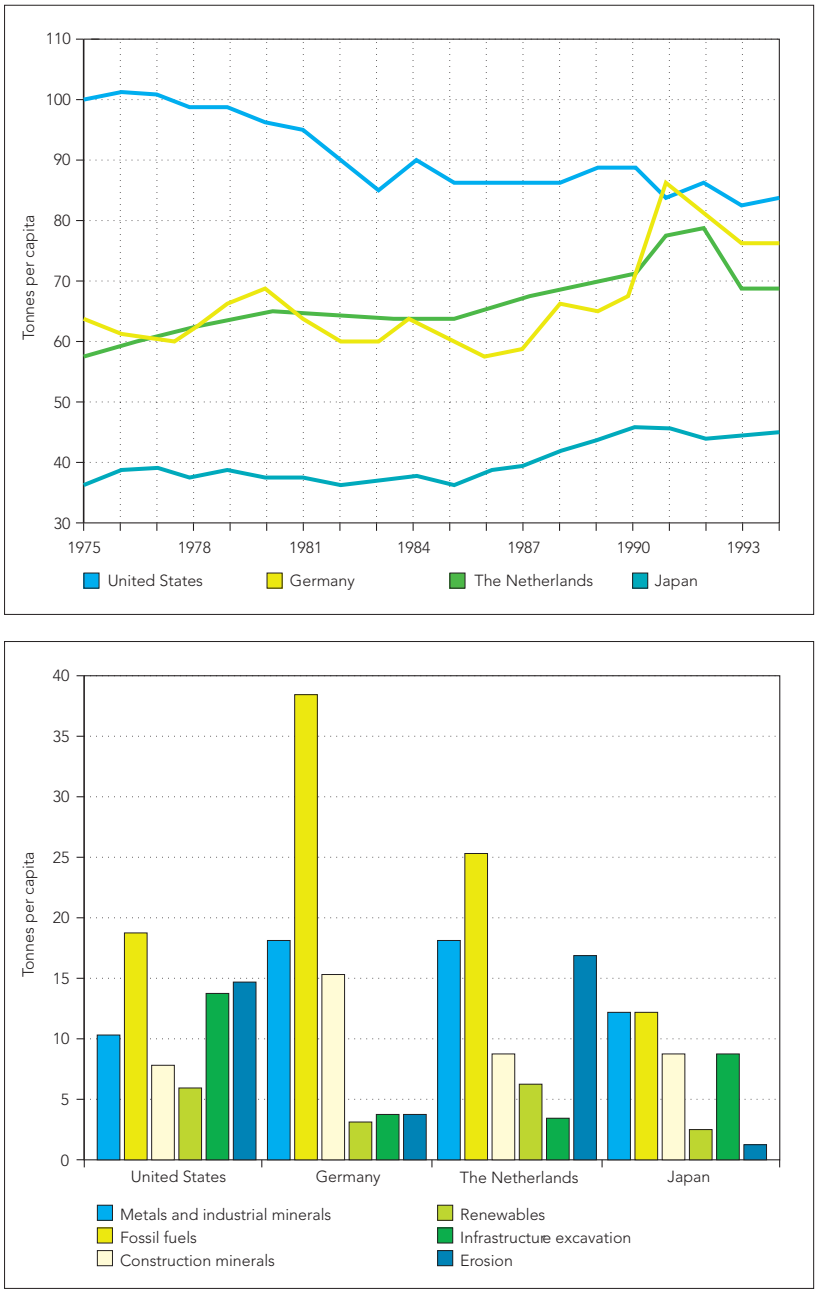
Data on total material flows in the EU is lacking, but indicative figures are available for Germany and The Netherlands, and on a comparable basis for the USA and Japan (Figure 2.1.2).

Germany, the Netherlands and the USA consume about 80 tons of materials per person per year (excluding air and water), with Japan consuming about half that. These total material requirements of current economic activity have been relatively stable over the last 20 years, despite efficiency improvements. They consist mainly of fossil fuels, mining and construction materials. Between a quarter and a half of these material flows include over-burden from mining, waste from logging etc. That do not enter normal accounting systems and which are therefore 'hidden' from the market. They are also hidden from the direct experience of the consumers, in that large amounts of materials are imported. Between one and two-thirds of these material flows are imported into Germany and the Netherlands respectively, representing part of the 'ecological footprint' of their economic activity on the rest of the world.

Stocks of non-renewable resources such as fossil fuels and metals are by definition finite but from a human perspective the stock is dynamic because the boundaries between the categories of resources that are 'known' and exploited move under changing market, technological and geological conditions (Figure 2.1.3).

How much of the stocks of such resources are used depends on whether the resource can be recycled (as with metals; and fossil fuels used as materials), or not (as with fossil

Figure 2.1.2 **Total material requirements: annual flows and main constituents**



Source: Adriaanse et al., 1997

fuels used as energy). Exploitation of resources also depends on the environmental impact of their use with available supplies sometimes being unused where environmental impacts would be unacceptably high, as with some mineral deposits.

The rate of exploitation of renewable resources must not exceed their rate of renewal if the stock is not to decline, but this principle is often ignored (Box 2.1.3).

3.1. Accounting for nature.

The market currently uses price and accounting signals which encourage the overuse of the environment. Firstly, current methods of accounting for the use of national resources via production, consumption and investment, and the associated indicator, the GNP, overestimate real growth of income because they fail to properly account for both the depletion of natural capital and for damage from pollution and associated 'defensive ' expenditures, such as the health service costs of air pollution, or the clean up of chemical spills. The consumption of natural capital is treated as income, which economists (Hicks, 1946; Repetto *et al.*, 1989) and business leaders agree is unsound. Both ecological damage to other countries (see Chapter 3.4), and the loss of global welfare from the destruction of tropical rain forests and other critical natural capital (see Chapter 3.11) need to be properly accounted for if optimal global well-being is to be achieved. However, accounting for the hidden subsidies from natural capital is not easy, particularly when the value of, say, biological diversity is more than the sum of its parts (Box 2.1.4).

In order to measure progress more accurately, several proposals to environmentally

Box 2.1.3. Fisheries: living off the capital or the interest of nature?

One way to picture the use of renewable resources is to imagine a fish biomass as being like money in a bank savings account. The money might earn 5% interest a year. If at the end of each year, 5% of the initial account were consumed, the balance of money in the account would remain the same. If more than 5% were consumed, the account would get progressively smaller and if less than 5% were consumed, the account would get bigger. Clearly, the account remains the same size only if the removal rate equals the interest rate.

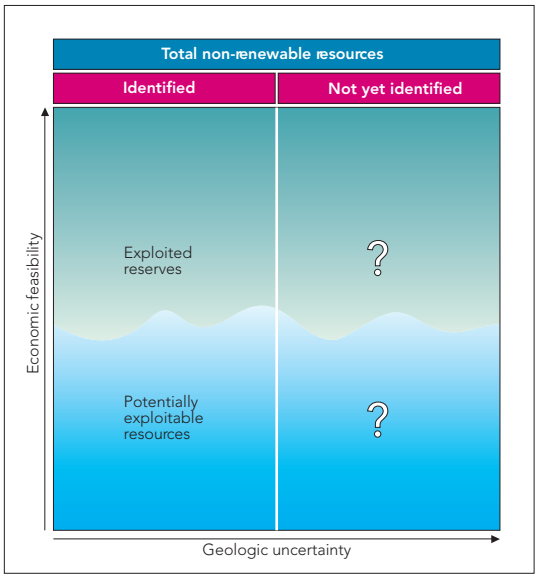
This is approximately what happens with fish populations when they are harvested. In fisheries, as in banking, it is important to distinguish between capital and interest. It is always possible to fish harder to get a higher harvest rate. However, this leads to diminished capital and hence potentially to reduced future income. Many of the world's fish stocks are being over-fished; e.g. the seven countries of the North Atlantic Salmon Conservation organisation agreed in June 1998 to a moratorium on commercial salmon fishing (EEA, 1998a).

'The bottom line is that the human species is living more off the planet's capital and less off the interest … this is bad business … many of our attempts to make progress are simply unsustainable….fundamental change is needed.' (Schmidtheiney/BCSD, 1992).

Box 2.1.4.

'How should the American oyster population of the Chesapeake Bay be valued? Is its value what it brings to market as seafood annually? Or is it the value from the current population filtering a volume of water equal to the entire bay once a year? Or is it the value before pollution and degradation, when it filtered that same enormous volume once a week? Our economies are riddled with such beneficial subsidies from nature, for which there is no current accounting. Similarly, our economies are riddled with subsidies and incentives that lead to environmental degradation.' (Lovejoy, 1995).

Stocks of non-renewable resources are not static Figure 2.1.3



Source: EEA

adjust national accounts and associated indicators have been made, such as the Index of Sustainable Economic Welfare (Jackson *et al.*, 1997; Box 2.1.5), and the 'genuine savings' indicator, but much further work is needed before environmentally-adjusted accounts and indicators are agreed and used. (Bouwer and Leipert, 1998)

Secondly, market prices do not include the full costs of environmental damage which, for transport for example, have been estimated at 4% of the EU's GNP in accidents, congestion and pollution costs. Environmental costs need to be 'internalised' into market prices, via taxes, etc. if overall welfare is to be optimised (European Commission, 1998) (see Chapter 4.1).

3.2. Impacts of human activity

In pre-industrial economic activity, the flows of carbon between the different compartments of the environment were in balance, but once the burning of fossil fuels began, the previously 'locked in' carbon was released (Figure 2.1.5).

In a relatively short space of time, this accumulated as carbon dioxide in the atmosphere, where it and other greenhouse gases contribute to global warming (see Chapter 3.1). There have been large variations in levels of greenhouse gases such as carbon dioxide and methane before now. Some of them have led to rapid changes in global temperature, such as an increase of about 7°C in the Arctic during a 50-year period some 10 700 years ago, according to

Box 2.1.5. Measuring real progress?

The Index of Sustainable Economic Welfare (ISEW) was originally pioneered for the United States (Daly and Cobb, 1989) and further developed in the UK (Jackson *et al.*, 1997). It starts with the GNP and then adjusts this figure for inequalities in the distribution of incomes using non-monetarised contributions to welfare from services provided by household labour; certain defensive expenditures against pollution; changes in the capital base, e.g. the human capital stock; and the loss of future ecological services as a result of the depletion of natural resources, the loss of habitats and the accumulation of environmental pollution.

ISEWs have been computed for the UK, Sweden and Germany, as well as the USA. They all show a similar pattern, i.e. a lower growth rate than GDP up to about the mid 1970s, then a decline, resulting in a measure of welfare in 1996 that is little higher than that in the 1950s.

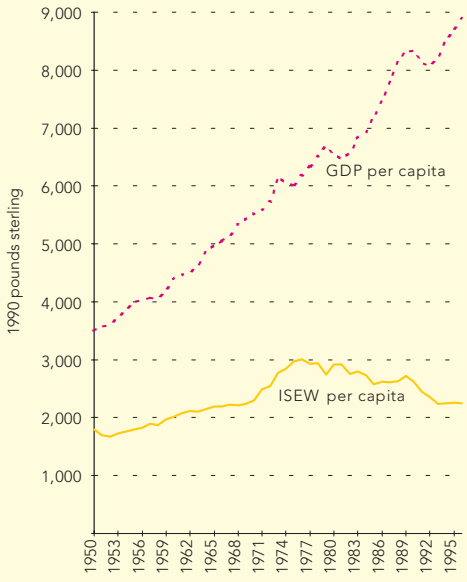
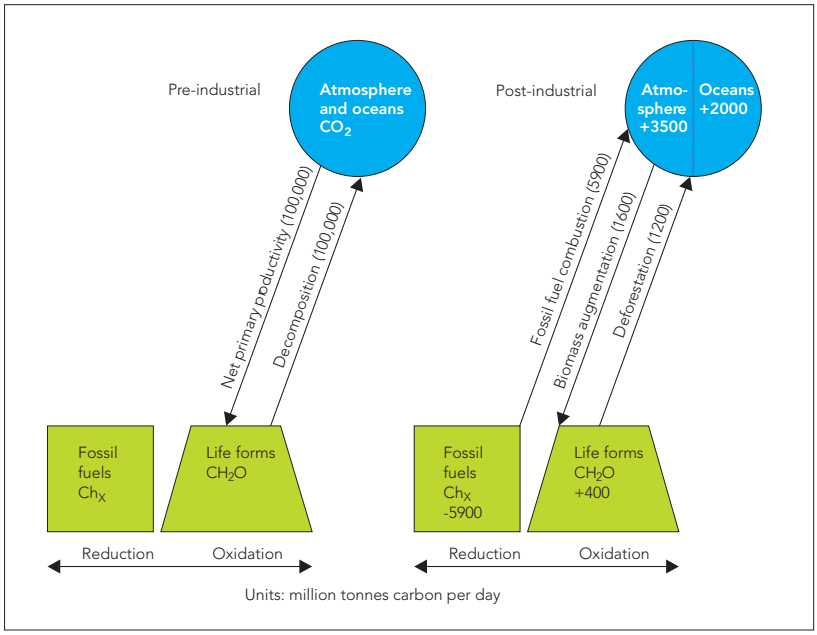


Figure 2.1.4
Development of ISEW and GDP in UK 1950-1996

Source: Jackson *et al.*, 1997

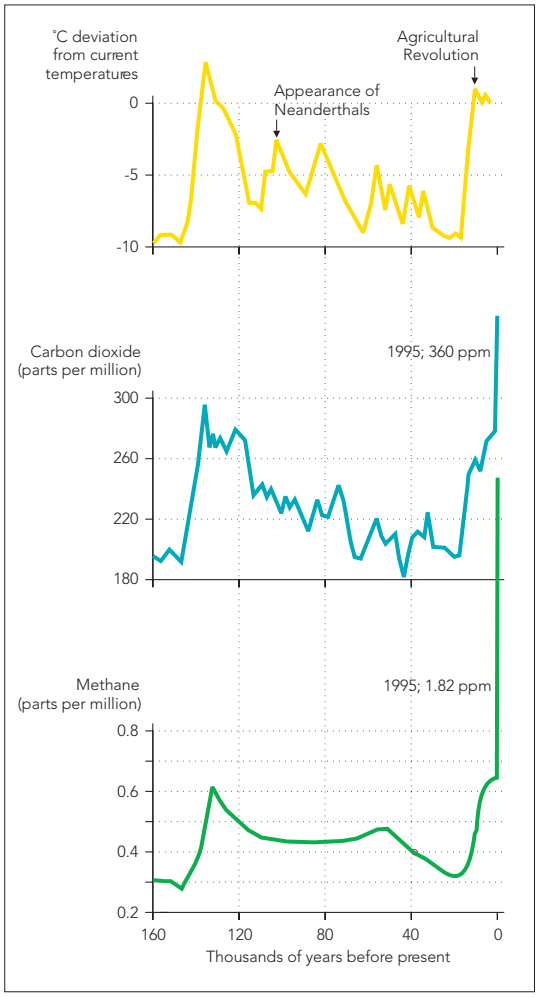
Figure 2.1.5 **Pre- and post-industrial carbon flows**



Source: Ayres, 1994

Figure 2.1.6 **Variations in some greenhouse gas concentrations and global temperature**

Source: Houghton, 1994 (updated with 1995-figures)



ice core evidence (Houghton, 1994). However, whilst it took nature about one million years to lay down the fossil fuels, their exploitation over the last 250 years has led to relatively rapid rises in carbon dioxide and methane concentrations in the atmosphere (Figure 2.1.6).

A similar change has occurred with the nitrogen cycle, with human additions of 150 million metric tons of nitrogen a year (90 from fertiliser, 40 from leguminous crops and 20 from fossil fuel combustion), providing an approximate doubling of the pre-industrial rate of nitrogen fixation (Ayres *et al.*, 1994). The speed of increase is again significant. Half of the one billion extra tons of global nitrogen added to nature from fertilisers during the period 1920-1985 accumulated during the period 1975-85 (Smil, 1991). While a more fertile world can have some benefits, the rate of increase of additional nitrogen from human activity seems to be too high for benign assimilation, leading to eutrophication, and contributing to acidification and photochemical smog. However, whilst the carbon cycle has received much attention from businesses and politicians, leading to energy efficiency gains etc., relatively little attention has so far been paid to the disturbances of the nitrogen cycle caused by fertilisers and fossil fuels.

Other human disturbances to the 'grand cycles' of nature, such as the sulphur and chlorine cycles, have led to problems of acidification and ozone layer damage (see Chapters 3.2 and 3.4). Although the human additions to natural stocks and flows can often be very small, they can be large enough to disturb the system. For example, the human-induced addition to the flow of fixed 'new' nitrogen every year is only about 1 part in 30 million of the stock of nitrogen in the atmosphere – but as nearly all of the atmosphere stock is bio-unavailable, all life depends on this trickle of fixed nitrogen, and doubling its flow may have significant impacts (Ayres, 1994).

Clearly, the use of resources to meet human needs requires a radical change in the efficiency with which they are exploited.

4. Eco-efficiency: getting more from less

Meeting needs with less use of natural and man-made resources but with more use of people has become an environmental and economic imperative (Box 2.1.6). 'Eco-

Box 2.1.6. 'Less nature, more people?'

'The serious economic and social problems the Community currently faces are the result of some fundamental inefficiencies: an 'under-use' of the quality and quantity of the labour force, combined with an 'over-use' of natural and environmental resources... The basic challenge of a new economic development model is to reverse the present negative relationship between environmental conditions and the quality of life in general, on the one hand, and economic prosperity, on the other hand.'

Source: European Commission, 1993

efficiency' aims at de-coupling resource use and pollutant release from economic activity and is becoming an object of environmental policy (OECD,1998; EEA, 1998b).

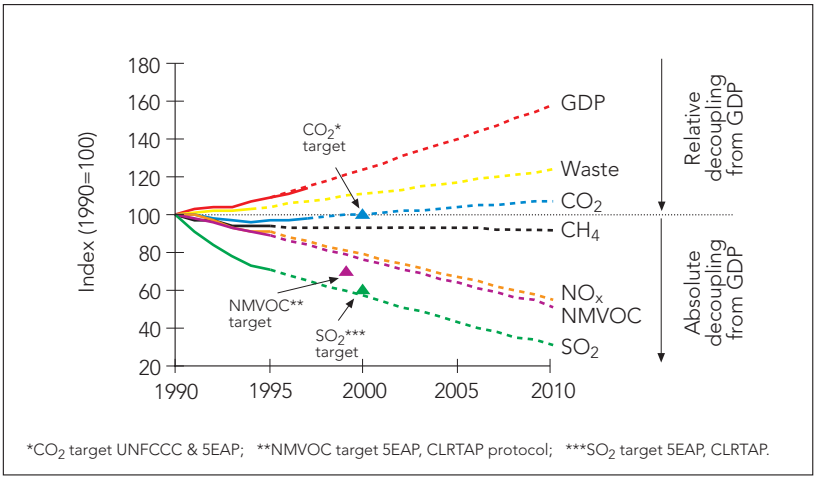
The Agenda 21 up-date (UN, 1997), in its paragraph on integration, notes the need to improve the efficiency of resource use; to consider a ten-fold improvement in resource productivity in industrialised countries; and, to promote measures favouring eco-efficiency. This will require breaking the links between use of nature, as measured by environmental indicators, and economic development, as measured by output indicators, such as GDP, or passenger-kilometres in transport for example. Both 'use of nature' and 'welfare' indicators need improving in order to better reflect reality and human needs, but some current trends in eco-efficiency can be gauged from using existing information.

Improved eco-efficiency is not a sufficient condition for sustainable development, as absolute reductions in the use of nature, and associated environmental pressures, may be necessary to get within the earth's (and human) carrying capacities, so that both relative and absolute de-linking between the use of nature and economic growth will be necessary.

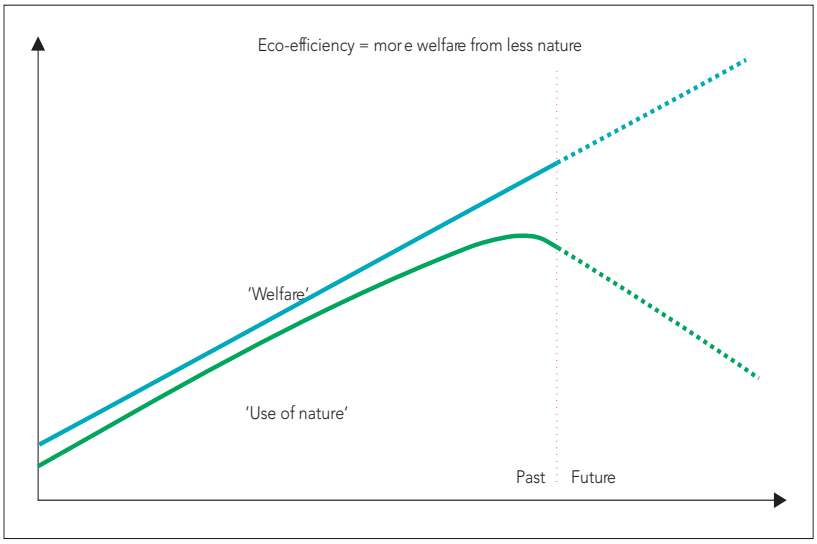
Figure 2.1.7 summarises progress with the de-linking of some environmental indicators from economic growth in the EU in the first half of the 1990s, with outlooks to 2010.

The case of Austria, which was the first country to adopt the Factor 10 target in its national environmental plan, illustrates the difference between relative eco-efficiency gains and the continued rise in the absolute use of resources from economic growth (Figure 2.1.8).

Relative and absolute de-linking: current developments and future directions — Figure 2.1.7



*CO_2 target UNFCCC & 5EAP; **NMVOC target 5EAP, CLRTAP protocol; ***SO_2 target 5EAP, CLRTAP.



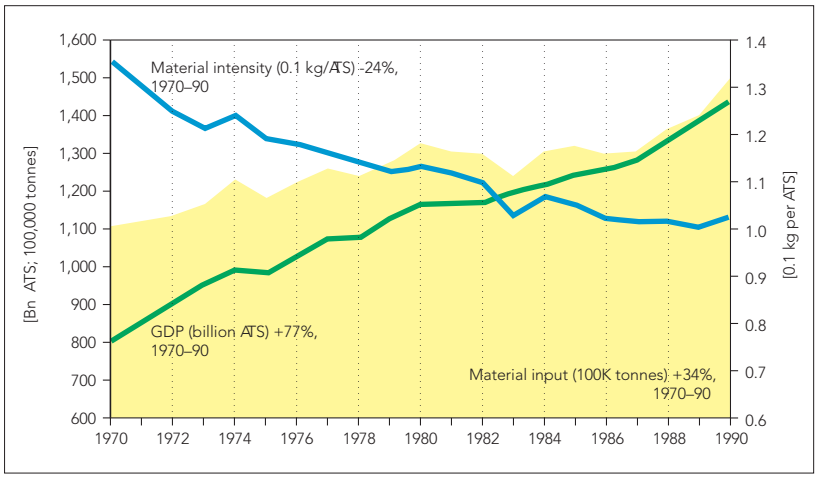
Source: EEA

There are two broad ways to enhance eco-efficiency:

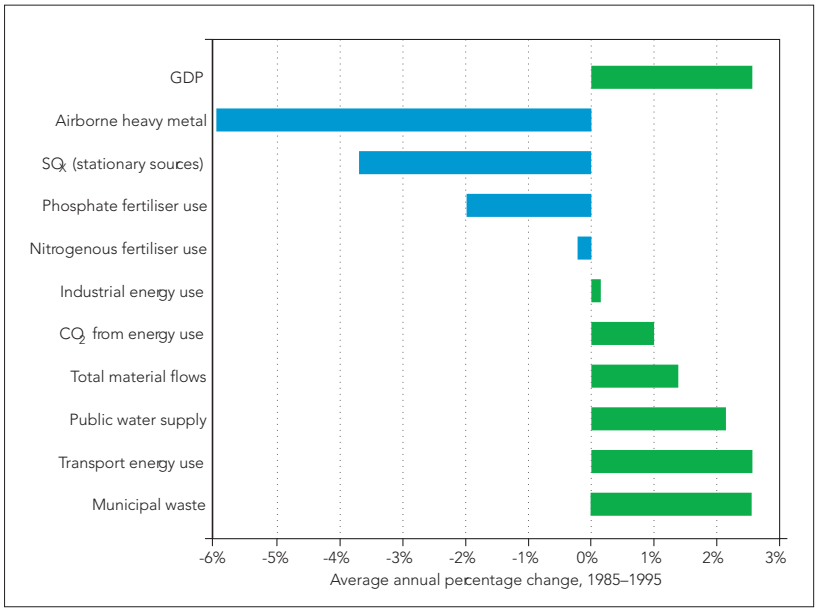
- via the more elegant and equitable use of resources, through innovation in the use of resources and labour; and
- via a focus on meeting human needs more from labour-intensive services than from capital-intensive products.

There is considerable potential for initiatives by firms and communities to improve eco-efficiency using current technologies. For example, manufacturers have found profitable ways to reduce their use of materials, energy and water per unit of production by 10-40% (OECD, 1998) and initiatives in the services sector, local governments and households achieve similar savings. Firms have also demonstrated technologies that cut the use or emission of toxic substances by 90% or more, although these technologies are not always put into place (OECD, 1998; Weizsäcker *et al.*,

Figure 2.1.8 **Eco-efficiency and material flows in Austria**



Source: Schuster,1997



Source: OECD, 1998

1997). A few firms have taken initiatives to reduce environmental impacts during and after the use of products, for example by recovering used equipment and re-using durable components (see Chapter 3.7). Initiatives that address impacts over the full life-cycle offer the greatest potential for reducing pollution and resource use economy-wide, but few firms have developed comprehensive strategies for achieving this. Business organisations such as the World Business Council for Sustainable Development (WBCSD) are encouraging reductions in the intensity of energy and materials use via the promotion of eco-efficiency (Box 2.1.7). 'Demand-side management' in the energy, water, transport and parts of the chemicals sector is beginning to shift the focus from consuming products to using services, with associated eco-efficiency and employment gains.

Industrial ecology has been slowly emerging as an approach to eco-efficiency and sustainability since the early 1970s (Erkman, 1997). It includes the promotion of regional recycling networks (or industrial ecosystems) such as the Industrial Symbiosis networks in Kalundborg, Denmark, parts of the Ruhr, Germany, and Styria, Austria, which already involve using the outputs of substantial quantities of waste from some companies as inputs for other companies. For example, of the estimated 3.8m tonnes of non-construction waste generated each year in Styria, about 1.5m is now used as production inputs to iron manufacturing, construction materials, paper and cement plants within the recycling network (Schwarz and Steininger, 1997).

Eco-industrial parks (Lowe, 1997) are being developed, mainly in the USA and Japan, where the principles of industrial symbiosis and 'zero emissions' (Pauli, 1997) are being designed into the development plans of the parks. Although there are thermo-dynamic, energy and economic limits to recycling, the current high ratio of wastes to useful products indicates that there is considerable scope for the more efficient use of resources.

The search for innovative chemical processes which facilitate less toxic and resource-intensive chemical production (Box 2.1.8) is being stimulated by 'Green chemistry' networks in Germany, Italy, the UK, Japan, and the USA (Anastas and Breen, 1997; Tundo and Breen, 1999; Royal Society of Chemistry, 1999). As the US Academy of Engineering has pointed out, 'design should not merely meet environmental regulations: environmental elegance should be part of the culture of engineering education.' (Jackson, 1996). Those companies and countries that first succeed in emulating nature's elegance in resource use will provide a great service to the environment and human society (EEA/UNEP, 1998).

In general, the focus on eco-efficiency will lead to the development of circular, rather than linear economies, where wastes become inputs rather than outputs.

The OECD has identified several ways in which governments could encourage eco-efficiency initiatives by firms and communities, such as: tax and subsidy reform; regulations; promoting 'extended producer responsibility'; and supporting the development of standard monitoring and reporting procedures.

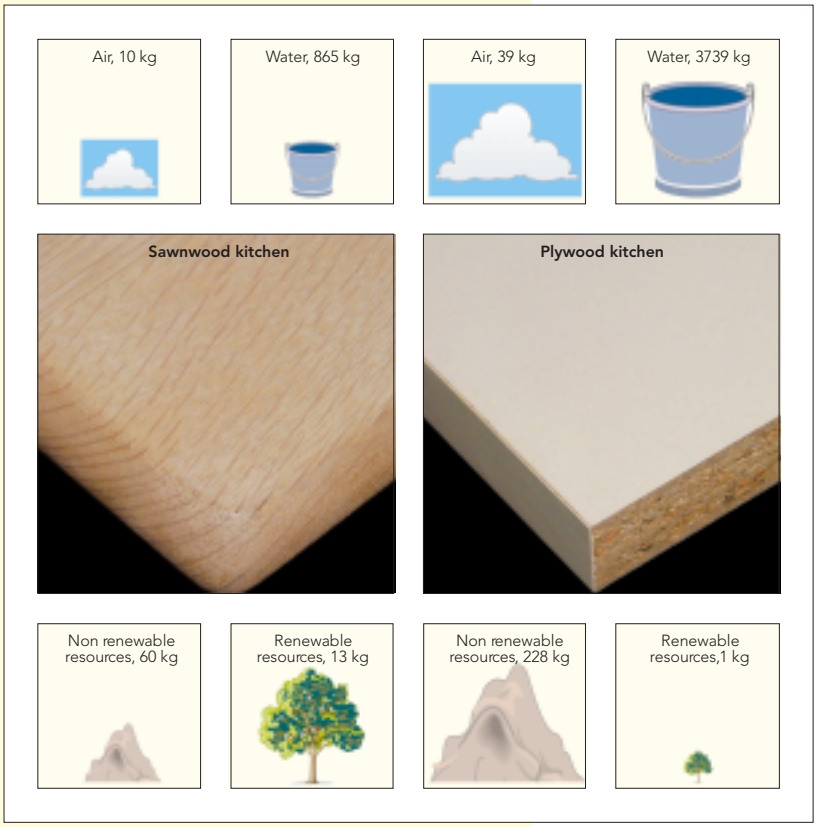
Box 2.1.7. Eco-efficiency criteria of the World Business Council for Sustainable Development

1. minimise the material intensity of goods and services;
2. minimise the energy intensity of goods and services;
3. minimise toxic dispersion;
4. enhance material recyclability;
5. maximise the use of renewable resources;
6. extend product durability;
7. increase the service intensity of goods and services.

Source: WBCSD/EPE, 1999

The materials intensity of two different types of kitchen illustrate the application of some of these criteria (Figure 2.1.9)

Materials intensities: kitchens example Figure 2.1.9



Source: Liedtke et al., 1994

5. Equity and sustainable development

'It took Britain half the resources of the planet to achieve its prosperity: how many planets will a country like India require?' (Mahatma Gandhi, when asked if, after independence, India would attain British standards of living).

It has long been recognised that the rest of the world could not achieve northern standards of living by using the same resource consuming methods. 'It will be impossible for the habits of comfort prevailing in western Europe to spread themselves over the whole world and maintain themselves for many hundred years.' (Marshall, 1920). The present global shares of resources are very unequal (Box 2.1.9) and have become more so in the last 40 years (UNDP, 1998).

Both poverty and affluence can destroy resources and damage ecological functions, but whereas both cause local and regional damage, only affluence causes widespread global damage. 'Sustainable Development'

Box 2.1.8. Green chemistry: key objectives

- Clean synthesis (e.g. new routes to important chemical intermediates including heterocycles).
- Enhanced atom utilisation (e.g. more efficient methods of bromination).
- Replacement of stoichiometric reagents (e.g. catalytic oxidations using air as the only consumable source of oxygen).
- New solvents and reaction media (e.g. use of supercritical fluids and reactions in ionic liquids).
- Water-based processes and products (e.g. organic reactions in high-temperature water).
- Replacements for hazardous reagents (e.g. the use of solid acids as replacements for traditional corrosive acids).
- Intensive processing (e.g. the use of spinning disc reactors).
- Novel separation technologies (e.g. the use of novel biphasic systems such as those involving a fluorous phase);
- Alternative feedstocks (e.g. the use of plant-derived products as raw materials for the chemical industry).
- New safer chemicals and materials (e.g. new natural product-derived pesticides).
- Waste minimisation and reduction (e.g. applying the principles of atom utilisation and the use of selective catalysts).

Source: 'Green Chemistry', Vol. 1, No. 1, Feb. 1999, University of York

Box 2.1.9 Global inequity

- Developed economies with only 20% of the world's population, consume 80% of its resources whilst sharing less of the world's increasing wealth with the 80% of the population in less 'developed' countries than 30 years ago; despite consuming large proportions of resources from developing countries, such as:

  - 45% of all meat and fish; the poorest 20% of the world's population consume 5%;

  - 58% of total energy, the poorest 20% of the world's population consume less than 4%.

- Consumption per capita has increased steadily in industrial countries (about 2.3% annually) over the past 25 years. The average African household today consumes 20% less than it did 25 years ago. The poorest 20% of the world's people and more have been left out of the consumption explosion.

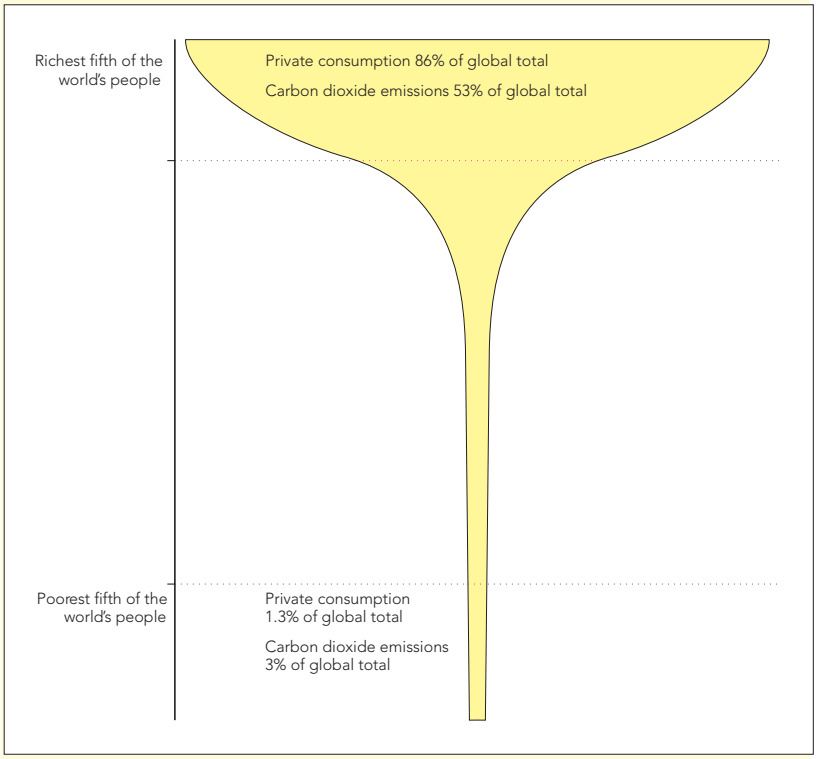
- Deforestation is concentrated in developing countries. Over the last two decades, Latin America and the Caribbean have lost 7 million hectares of tropical forest; Asia and Sub-Saharan Africa 4 million hectares each. Most of it has taken place to meet the demand for wood and paper, which has doubled and quintupled respectively since 1950. But over half the wood and nearly three-quarters of the paper is used in industrial countries.

Source: UNDP, 1998

The combined wealth of the world's richest 225 people is $1 trillion, whilst the combined annual income of the world's poorest 2.5 billion people is also $1 trillion (Worldwatch Institute, 1999).

Current global shares of consumption and carbon dioxide are shown in figure 2.1.10.

Figure 2.1.10 **Fair global shares?**



Source: EEA, based on UNEP, 1992 and 1998

therefore embraces equity and social considerations as well as economic and environmental issues.Trade issues are also important. For example, improving the overall efficiency of resource use by internalising full environmental costs into market prices can penalise the 'pioneer' countries who adopt full cost pricing first, if 'free trade' prevails. International agreements are therefore being proposed to help achieve optimal global welfare (Box 2.1.10).

Achieving well-being depends on achieving the optimal balance between the three pillars of sustainability, the economic, the social and the environmental (Box 2.1.10; Figure 2.1.11).

6. Monitoring progress towards more welfare from less nature

Monitoring progress in using less nature to meet human needs requires measures of accounting and reporting that relate *welfare* to the *use of nature*. In practice, this involves measuring the eco-intensity of production and consumption via efficiency indicators, which are one of four main types of indicators (EEA, 1999). New reporting systems, such as the Transport and Environment Reporting Mechanism (TERM) currently being developed at EU level, are trying to use a wider range of indicators to capture both eco-intensity ratios, such as energy use and pollutants per billion kilometres of output, and performance against target values, such as air quality standards.

Many firms have also developed indicators and targets for reducing their intensity of material use, energy consumption and toxic emissions per unit of production (Box 2.1.11). They monitor progress towards these targets and release the results in their annual environmental reports. Few have yet developed quantitative indicators or targets for concepts such as 'service intensity' (i.e. the quality of the service they provide to their customers), or for reducing impacts over the life-cycle of their products and services.

At the level of the economy there is a need to focus on key indicators for resource use and associated impacts: nine have been proposed by the EEA (Box 2.1.12) and similar ones are being developed by countries such as Germany, Sweden, the Netherlands and the UK. They will be further developed and described in the regular indicator reports from the EEA, Eurostat,

the European Commission and Member States expected in 1999. In some cases, they will be linked to targets for the use of nature which are either linked to output, such as the 'Factor 4' eco-efficiency target, which assumes a doubling of welfare from a halving of resource use (Weizsäcker *et al.*, 1997), or the target of 'Factor 10', which aims at the absolute reduction of the global use of nature, 'over one generation' by one half, and its more equitable distribution across the world. This will involve a ten-fold reduction in absolute resource use in industrialised countries (Carnoules Declaration of the Factor 10 Club, 1997).

Some Member States have referred to overall resource-use targets, such as Germany ('Increasing raw materials productivity 2.5-fold by 2020 compared to 1990') and Austria and Sweden (Factor 10), but there is as yet little development of such targets at economic sector level (EEA, in press).

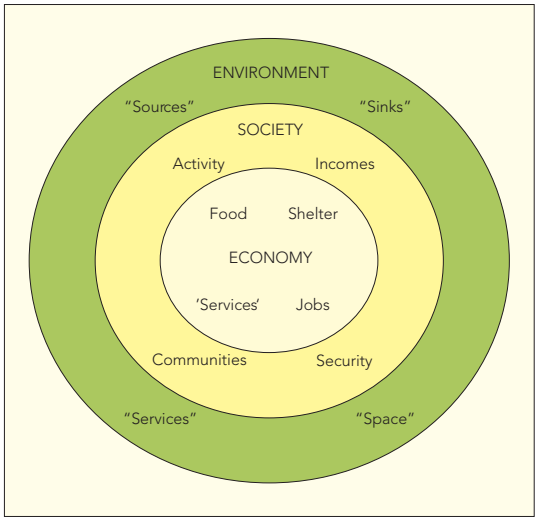
Progress towards less use of nature will require greater integration of economic and environmental activity in sectors, such as through the internalisation of external environmental costs into market prices (see Chapters 2.2 and 4.1).

Box 2.1.10. International commodity related environmental agreements?

The 'internalisation' of environmental costs into market prices can help improve economic efficiency and welfare, but this approach is not usually available to developing countries, who are usually 'price takers', with no influence on world prices for their products. Where natural capital in developing countries provides global ecological services (e.g. tropical rain forests), or when full cost pricing for traded commodities is the objective, then International Commodity Related Environmental Agreements (ICREA) have been proposed. These involve import taxes in developed countries which provide earmarked funds for developing countries to use on environmental projects. Such taxes on 'northern' consumption represent full cost pricing payments for the externalities of ecological damage and services. As the trend in commodity prices has been in favour of 'northern' consumers since 1970 (whilst interest on Third World debt payments has also risen), such moves towards 'fair and efficient pricing' of commodities could contribute to sustainability at global level.

Source: Kox and Linnemann, 1994

The three pillars of sustainability: Economy, society and environment Figure 2.1.11



Source: EEA

Box 2.1.11. Corporate reporting on eco-efficiency

The WBCSD's working group 'eco-efficiency metrics & reporting' recommends using the following ratio as a general equation to measure and report eco-efficiency:

- eco-efficiency = unit of value provided per unit of environmental burden

The following cross-comparable indicators have been considered by the WBCSD working group:

Environmental Indicators	**Value Indicators**
- Total Amount of Energy Use	- Mass or Number of Product
- Total Amount of Materials Use	- Number of Employees
- Greenhouse Gas Emissions	- Sales/Turnover
- Ozone Depleting Substances Emissions	- Gross Margin
- SO_2 and NO_x Emissions	- Value Added

Source: WBCSD: Executive Brief, January 1999

Box 2.1.12. Nine possible key indicators for resource use and associated impacts

Inputs (resource use):	*Outputs (impacts/ pollution)*
- material input	- emission of greenhouse gases
- energy use	- emission of acidifying substances
- land-use	- emission of ozone-depleting substances
- water consumption	- generation of (hazardous) waste
	- hazardous chemicals

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The following excerpts from a talk by **David Buzzelli**, who was co-chair of the US Residential Advisory Committee on Sustainable Development and the Dow Chemical Company's Vice President for Environment, Health & Safety at the time of ECO 97, illustrate the idea of eco-efficiency in industry. For many people, the name Dow remains forever attached to the napalm the company manufactured during the Vietnam war. Yet today, Dow is a diversified chemical group that has, next to its bank of chemists, a large environmental division, which looks at environmental questions from all angles. In the following paper, David Buzzelli moves from the principles developed by the Business Council for Sustainable Development to concrete implementation in a major chemical company.

The challenge of eco-efficiency

by David Buzzelli

The Chemical Industry and the Environment: A fundamental change has taken place in the chemical industry's attitude towards the environment over the last 35 years. From managing single products and plants, the industry has moved to managing complete product life cycles.

In 1989, Dow's Annual Report included for the first time a special shareholder's report on the environment. The following statement which appeared on the cover illustrates how environmental policy was evolving towards greater integration with business performance:

> *One issue, more than any other, will affect Dow's prospects in the 1990s and beyond. That issue is the environment.*

Fundamental change in society and human needs, coupled with a significant increase in global population, will alter existing consumption patterns.

The sustainable corporation must transform materials and provide services which people value for the contribution to the quality of life and the protection of the environment. This means that the goods and services provided can be consumed by an increasingly large segment of the population to respond to population growth and the need for more equity. This consumption growth should not threaten the ecological security.

Production, supply and disposal systems must be designed and operated in a way which reconstitutes and maintains the environmental quality. This requires cleaner technologies and developments like alternative non-fossil energy and raw material sources and integrated processes or closed material loops.

Eco-efficiency is broadly defined as the production, delivery, and use of competitively priced goods and services, coupled with the achievement of environmental and social goals. The Business Council for Sustainable Development (BCSD), in its 1992 publication, *Changing Course,* proposed the following definition for eco-efficiency:

Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing ecological impacts and resource intensity, through the life cycle, to a level at least equal with the Earth's estimated carrying capacity.

1. An eco-efficient product is durable, repairable, and reusable, and therefore more attractive to consumers.
2. An eco-efficient business takes account of its environmental responsibilities when designing technologies, processes and products. In doing so, it finds opportunities for efficiency gains and other overhead savings.

3. Eco-efficiency is not an absolute. The notion will evolve as a function of innovation, customer values and economical policy instruments. It represents the direction of an effort.
4. At Dow we have developed a six-dimension model we call the Eco-Innovation Compass. This Compass helps us to evaluate existing products and guide us in the development of new or improved ones. It can play a role in helping us incorporate the concept of eco-efficiency into our business strategies by providing insight into how we can make environmentally improved products that are also commercially viable.

Before evaluating any product, a company must first change its perspective and look beyond the end-use product. One must consider the total design-make-supply-use system and the total life cycle of the product from initial raw materials to final waste products after use. Eco-efficiency must be evaluated and improved in this context of the life cycle of a total system. This implies that one must look at the function fulfilled by the product rather than the product itself.

The Eco-Innovation Compass compels us to scrutinise six dimensions of the total system:

1. Mass: The total of raw materials, fuels and utilities consumed in the system during the life cycle to deliver the desired function. The opportunity is to significantly reduce the mass burdens and de-materialise the way the system provides quality of life and benefits to the market chain
2. Energy: The opportunity is to spot the parts of the system and the life cycle which have the highest energy intensity and redesign the product or its use to provide significant energy savings.
3. Environmental Quality and Human Health: Reduce and control the dispersion of elements that have negative environmental or health impacts when they reach, or accumulate to, a level beyond a critical dose for the environment or humans.
4. Material utilisation: Designing for recyclability is important; recycling effectively and efficiently is even more important. Another opportunity is to design the system as part of a larger natural cycle. Materials are borrowed and returned to nature without negatively affecting the balance of the cycle.
5. Renewable materials: In some cases, these materials have advantages over reactive chemistry from a total cradle-to-grave perspective.
6. Durability and functionality: Extending the durability and service part of a system, especially in the usage phase, can improve eco-efficiency. Improving the functionality of products also increases their eco-efficiency (e.g. Swiss army knife).

Getting eco-efficient is a matter of re-designing a system in every possible respect. One must consider reductions in mass and energy utilisation, fewer toxic chemicals, improvements in recycling or in the use of renewable resources, and innovation in service life and functionality. The six dimensions are not independent. They overlap and inter-relate significantly.

And it works ... Here are some examples:

1. Dow developed ‘closed-loop’ systems for collecting, recycling and ultimately reselling chlorinated solvents used in the dry cleaning and metal cleaning industries throughout most European countries. Closing the loop on products reduces the net environmental impact of our products and processes, while satisfying the needs of a growing market. The program was pioneered by Dow affiliate Safechem Umwelt GmbH in Germany, Austria and Switzerland. (This is a ‘product-to-services’ shift: see the Manzini paper below.)
2. DowElanco developed a new technology to control termites (Sentricon Colony Elimination System) which is more effective, less toxic, less odorous and requires substantially fewer material inputs than most other methods.

3. Due to increasing public concern about toxic materials in televisions, Sony Europe developed the 'Green TV' which is lighter, less energy intensive and creates less health and environmental risk than previous models. It also has better picture quality and is cheaper to produce than its predecessor.
4. Dow developed a nanofiltration membrane, FILMTEC NF200B, for surface water potabiliation for SEDIF (Syndical d'Eau de l'Ile de France) that removes organic components below the legal limits and limits all possible food sources for bacteria while improving the overall quality of the drinking water.

All these examples show us that the name of the game is significant change, not incremental change.

* * *

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'Industrial ecology'

Continuing with the idea of **'putting the eco in eco-omics'**, **Brad Allenby**, Vice President of AT&T spoke on industrial ecology at ECO 97, which is about putting the 'eco' into industry. A father of the industrial ecology field, Dr Allenby is now again at AT&T after a stint as Director, Energy and Environmental Systems, Lawrence Livermore National Laboratory, USA, where he was in charge of a $250 million research program. The interest of large government and industrial organisations in industrial ecology is clearly high. Is industrial ecology thus becoming a new science? Regardless of what it is called, according to Allenby, it is apparent that substantial fundamental research is required if sustainability and sustainable development are to become more than slogans. Few people, however, even recognise the profound depths of our ignorance, much less understand the need for an integrated, international Research and Development program.

Is industrial ecology a new science?

by Brad Allenby, AT&T

1. It is important to realise the fundamental nature of the shift of environmental issues from overhead to strategic for consumers, producers and society, which is the essence of sustainability. As professionals, as industry, as society, we have yet to recognise the challenge posed by this shift, or how profound our ignorance really is. It is not an insult to current research efforts in such areas as Design for Environment (DFE) or Life Cycle Assessment (LCA) to say that we know almost nothing yet about sustainability. The research necessary to support such change has really not yet begun in earnest. Two examples might be useful to illustrate this point.
    a) There is much discussion about 'sustainable communities' and 'sustainable companies'. If, as is likely, sustainability is an emergent characteristic of a properly self-organised complex system – that is, the global economic structure - these terms are oxymoronic: sustainability is a property of the whole, and not of the parts. The terms are useful in that they indicate a generic goodwill towards the environment. To a scientist, however, they beg the question. One must begin by asking: what is the physical and energetic basis of the community or firm in question? What stocks and flows of materials support the community? What is the linkage between these processes and supporting natural systems? What are the environmental impacts embedded in products and materials imported into the communities, which have the effect of exporting the community's impact around the world? How do different communities compare along these dimensions? Although some sporadic, high-level work has been done on these issues, the real task has yet to be begun.
    b) If a manufacturer were to ask a designer to design a 'green telephone', she would of course say yes, as few are actively against the environment. Her first question, however, would be what are the preferred materials for the various applications? Such data do not now exist. If one cannot answer even such a simple, reasonable question, how far are we then from understanding sustainability?
2. In considering these issues, it is important to first construct an intellectual framework, which supports a reasoned, rational approach. As materials choice, use, and management over the lifecycle are obviously important aspects of improving the environmental efficiency of

economic activity, their relationship to levels of the intellectual framework are used as illustrations. It is important to note that our ability to understand what 'sustainable material use' might be is virtually non-existent, but we can certainly make progress at the DFE/LCA level in improving the environmental efficiency of current practices and technologies. Fundamental research is not, in other words, a substitute for incremental progress – or a reason to avoid making today the improvements that are possible. Research at all levels of the system can, and should, proceed simultaneously.

3. In brief, it is obviously difficult to sketch out an entire research agenda. Many obstacles to progress in such research exist, including the fact that reductionist scientific approaches, which is the standard in Western countries, are of little value when the perturbations are profoundly system. Some progress in defining the needs is, however, being made. In fact, there is a group of industrial ecology experts in the United States, known as the Vishnus, that have been working on just such an agenda under the sponsorship of Lawrence Livermore National Laboratory. This must be regarded as preliminary work, however, and of course it does not begin the research actually required.

4. Two points bear emphasising. First, our ignorance in this area is profound and vast; most people, even researchers, are unaware of the extent to which our technologies, our science, our cultures must change if we are to approach sustainability. Second, whether it is called industrial ecology or something else, a massive scientific and technological research and development effort will be required to support such an evolution. Such an understanding will not be sufficient in itself to achieve a sustainable state, but it is an absolute prerequisite to it.

* * *

Reference

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'From products to services'

Another metaphor for change is **the move from products to services,** where the challenge is to disconnect economic growth from increased consumption of natural resources, by focussing on providing the service functions of products rather than on selling the products themselves.

Following are excerpts from an ECO 97 talk by **Ezio Manzini** (Politecnico de Milano) on strategic design for a new product-service mix – with examples from businesses such as Rank-Xerox, Ciba Geigy, Dow, and Black & Decker. Environmental design, according to Ezio Manzini, is not just drawing the skeleton and outline of a product. Rather, it involves understanding the function of a product or service and then re-inventing it with new rules, all of which require changes in the business-as-usual attitude. It is on this product:service cusp where much new action on sustainable development is taking place. For the industrial designer, environmental questions take their place alongside economic and aesthetic demands.

Leapfrog: short-term strategies for sustainability

by Ezio Manzini

Sustainability, in its strongest sense, implies such a deep transformation of production and consumption activities as to represent a 'systemic discontinuity': a change that requires much more than the incremental innovation of technologies in use, or redesigning what exists. Sustainability is more than a partial modification of the existing non-sustainable ways in which industrial societies produce and consume.

Therefore, achieving sustainability has to be considered a 'transition': the transition towards a new system of production and consumption requiring a new economy and a new culture.

From this perspective, the short-term strategies for sustainability means a set of initiatives whose goal is to favour transition as well as to make it take place in the most acceptable way for society, that is to say assuming both production continuity and social democracy.

Short-term strategies for sustainability

An environmental and industrial policy which leads to an increase by one point in the efficiency of existing car engines may be very significant in terms of immediate quantitative results, and therefore a very positive environmental policy. Nonetheless, it cannot be considered a strategy for sustainability. On the quantitative side, the increased environmental performance of existing engines, even if driven to its utmost possibility, does not get to the roots of the environmental and social problem of mobility. On the cultural side, to promote better efficiency of engines doesn't change the user's attitude towards mobility, nor the corporate culture of the manufacturer. For car industries, improving the efficiency of engines is the most normal and institutional activity that their research centres can do. Thus this policy, being entirely in keeping with traditional behaviours and business-as-usual routines, doesn't represent any discontinuity towards sustainability.

Let's now consider a policy which seeks to increase some form of sharing in car utilisation: from the idea of 'rent-a-citycar', to that of the collective taxi, right up to the promotion of car sharing

or car pooling systems. Even if the overall quantitative results attainable by following this road would be almost negligible, a policy working in this direction is absolutely in line with the prospect of sustainability, and is to be seen as a short-term strategy to sustainability. Indeed, whilst for the time being involving only a minority of users, the shared use of cars presents a relevant point of cultural and behavioural discontinuity. Offering a relation with cars different from the one that has ruled to date is a potential contribution to defining a new idea of mobility.

Furthermore, in terms of an increased eco-efficiency per unit of service rendered, with the simple passage from one passenger per vehicle to two passengers per vehicle, a far better result is achieved than that which corps of engineers could have accomplished by working for years on the technology of engines.

Short-term strategies as 'leapfrog strategies'

Short-term strategies for sustainability are a set of initiatives promoting a direct shift from a non-sustainable mix of product and services to a sustainable one. This definition requires some explanation. In particular some implicit assumptions have to be made explicit:

- what users demand is not products or services, but the results that these products and services permit to achieve.
- given a result, it can be achieved by different combinations of products and services.
- a shift in consumption and behaviour patterns takes place if new and more sustainable combinations of products and services are recognised by users as better answers than existing ones, or because they meet a previously unanswered demand.

Leapfrog strategies in practice

In order to discuss the characteristics and the potential of short term strategies for sustainability, some examples of their implementation follow. They are real and relatively well-known initiatives that have two common denominators. Examples will be grouped on the basis of two approaches: the result-oriented approach and the utility-oriented approach.

The result-oriented approach

Within this approach the objective of a business becomes to sell results rather than physical products. In this framework, which is also defined as the internalisation of the product, it is the producer's economic interest that pushes towards an increased eco-efficiency with the result of extending the life of products, components, and materials, and optimising their utilisation.

The discontinuity that these initiatives put into effect lies mainly on the producer side. In fact, the shift from selling products to offering a mix of products and services asks for a deep change in a company's mission and organisation.

In the thermal management of buildings there now exist forms of contract (Demand-Side Management and Least-Cost Planning) whereby what is offered and guaranteed is a thermal comfort service and not the actual quantity of heating fuel supplied. What is interesting is that in all these cases the economic interest of the producer becomes that of guaranteeing the best possible service by reducing his own costs, that is, by reducing the consumption of fuel.

In the USA, for example, the Energy Service Companies (ESCOs) supply an overall package of services on a turn-key basis. The package comprises: supply of energy resources, identification and selection of conservation measures, and installation, operation and maintenance of the energy supply. Something very similar is happening in Europe: RMM Energy Gmbh is a company that has completed some 200 projects in Germany and in Switzerland since 1987. The Stadtwerke of the City of Hannover is performing one of the most comprehensive LCP projects

financed by the EC in Europe and is co-ordinating 10 LCP pilot programs of other German utilities initiated by the SAVE Programme of the EC. In the Netherlands, the Energy Contract Partners are proposing the same range of services offered by the ESCOs in the USA.

A similar approach has been followed in other fields, such as agriculture, industrial painting, and engineered materials.

In agriculture, a pest-control service can be offered instead of antipest chemicals. For example, Zeneca Group PLC has developed an integrated Pest Management program that can be tailored to the local situation. Its features are to correctly identify pests and natural enemies and to teach farmers when it is absolutely necessary to spray and how to promote non-chemical methods of control.

In the field of industrial paintings, Ciba is moving to become a supplier of colour services to its customers rather than merely selling dyes and pigments. In the field of engineered materials, the Cookson Group PLC's central strategy is to retain the ownership of its product throughout its life cycle. Alpha-Fry, a Cookson subsidiary in Germany, developed a take-back system for their solder paste packaging and a new kind of packaging. This new type of jar is of pure tin which, upon return, is thrown into a melting pot and used as raw material in the manufacturing of solder bars.

The same attitude to selling results rather than products can be found in the field of durable goods and appliances. The most well-known case is that of Rank-Xerox.

Rank-Xerox Gmbh proposed the introduction of a surrounding copy-machine, i.e. a function compound consisting of the copier, its maintenance and repairs, the making of the copies and the collection and delivery of the original documents. This concept, realised for the first time in the head office of the German Henkel KGaA, is now a fundamental strategy of Rank-Xerox. The remanufacturing of old products and reusing of components is to a company's strategic advantage. Today rank-Xerox has no models with only new parts, and the product range consists of newly manufactured products and remanufactured products.

If the case of Rank-Xerox is the most clear, it is not the only one. An Italian company, Bibo, whose initial business was producing mono-use plastic dishes, has since 1993, been providing a service for collective and public restoration services: they supply, take back, and recycle plastic dishes, retaining the ownership of their products through the life cycle.

The result-oriented approach can be extended also to some cases in which the offered result is related only to some aspects of the producer-user relationship, as, for instance, the packaging. These cases are significant because within this approach, some companies significantly change the way in which they operate and the interface that they have with their customers.

For instance, SafeChem is a new company established by Dow to deal with chlorinated solvents. Its activity includes: product stewardship, responsible care and distribution consulting services on how to change equipment to respond to the regulation in Germany and to recycle the used solvent . SafeChem has developed a new type of container, the Safetainer, to answer the demand of an effective closed loop system. These are special containers with an air-tight pumping system which ensure that zero emissions occur during the transport phase and at the point when solvents are transferred from the containers into the distillation equipment. So they now sell de-greasing services rather than solvents. This shifts the incentive from selling more solvents to providing the least (and least toxic) solvents within a broader (and more value-added) package of de-greasing services.

The utility-oriented approach

Within this approach, the objective of a business becomes to promote the leasing, pooling or sharing of certain goods, with the environmental advantage of optimising their use and reducing the quantity of products required to meet a given result. The leap which this approach puts into effect lies mainly on the user side and is the required change in the behaviour and consumption

pattern (the shift from individual use and ownership of products to the leasing, pooling and sharing of services). Examples of new leasing services (do-it-yourself tools, sports equipment, computer and electronic devices) are an improvement of what traditionally exists.

Black & Decker GmbH offers an eco-leasing service for a professional series of mechanical saws, for the private handyman or even some professionals.

Car-sharing initiatives have a long story and have to be considered as forms of entrepreneurial activities. For instance, a car sharing system exists in Leiden under the name Huur-op-Mat, as a co-operation of car rental companies and car dealers, with the support of the local government. In Germany there are 40 organisations which promote car sharing – and there are other schemes in Austria, Switzerland and France.

Car sharing can be related also to car-free-cities projects. The development of these projects is in fact a significant activity that has to be seen as the realisation of a leapfrog strategy: a direct leap to the idea that, for some urban developments and for some specific target groups, being car-free could be an added value.

In Europe, for instance, there are several projects of car-free cities. For instance, Hollerland in Breme includes about 300 buildings and foresees some parking places for car sharing. Westerpark in Amsterdam and Stadthaus Schlump in Berlin are other examples and there are others in Monaco and Vienna.

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Thinking /acting circular, not linear

Thinking/acting circular, not linear is another possible metaphor for change. It suggests the notion of waste as part of a circular rather than the presently perceived linear economy.

In the following excerpts from his presentation, **Dr Klaus Töpfer** (German Minister of Towns, Planning and New Construction at the time of ECO 97, also former German Minister of Environment, former Director, United Nations Commission on Sustainable Development, and presently Executive Director, United Nations Environment Program), presents himself as having moved from being an 'end-of-the-pipe' Minister of the Environment to a more integrated Minister of Urban Affairs, Consultation and Planning, involved in the creation of the new Berlin.

Remarks by Klaus Töpfer

I became Minister of the Environment in Germany in 1987 and before that I was Environmental Minister for two years in one of our states, the länder Rheinlandpfalz. At that time one took no risk at all organising a conference on the environment such as this one, unlike today when it is clearly not an easy task. Back then we automatically had huge audiences asking for very simple topics like waste management, air pollution, water and other things. So looking back, I think things have changed a little bit, especially in Europe and perhaps in other parts of the world, because this is unfortunately no longer the case.

There is of course one explanation: that we succeeded in reaching our aims. As if it were no longer so important to go even further. I was at the Rio Summit of 1992 as head of the German delegation. And then I was the second chairman of the Commission for Sustainable Development, the follow-up institution of the Rio Summit, at the United Nations in New York. Knowing the experience since the Rio Summit, I'm not quite sure that this is the explanation: that we reached all we wanted to do. For example in Germany, I always underline what I see as a significant warning signal needing attention which is that in former days agriculture claimed that it was a green sector. Agriculture lost its green colour to quite another movement, and it is really fascinating to look at the interrelations with all that. So I don't believe, by any means, that the fact we have accomplished our goals is the reason there are so few conferences of this kind.

On the other hand, I have no doubt we face a lot of new challenges since the Rio Summit. For example, we have this historical development of the overcoming of the bipolar world, we have no Soviet Union at all. Hearing this prognosis in 1987, when I was appointed as Environmental Minister for a reunified Germany, I was absolutely convinced that this was impossible, but that changed, and this brings a lot of concrete, new problems. Looking at unemployment, looking at solving the social questions, these are now the top priorities today and therefore organising a conference, such as ECO 1997 is definitely more risky, because people now believe that the environment is number five or six on our priority list of political tasks.

I'm totally convinced this is a grave mistake. I'm absolutely convinced that the feeling and the knowledge and the conviction of the people in my country with regard to environment policy has not changed. True, it is a little bit overruled by actual current problems, but the long-term objectives are absolutely the same. My main aim was, is, and will be, to change the structure of market economy to facilitate ecological progress.

Let's not forget the days of Ludwig Erhard: (in this year on the fourth of February, it was his one hundredth anniversary), who invented the social market economy. And I'm sure that it must come: an ecological and social market economy. I'm a market-oriented politician. It is my belief that we need prices to stimulate development with regard to technologies and behaviour.

The most important problem in the past was that we subsidised the use of the environment's natural resources. Air was used without a price as a dump for CO_2 and NO_x. So nobody asked how to clean the gases coming from a coal power station or from a car, because nobody was forced to invest money for that. So my most important aim is to integrate, wherever possible, the cost of environment into the selling price of the product. That was my most important aim with regard to waste.

We have always had to struggle with the classic working divisions between the company that is responsible for production, the other for packaging, the third for selling, the fourth for consumption and finally at the end of the chain there has been somebody responsible for waste. With such working divisions nobody integrates waste into the conception of how to produce something, because that's not in his budget. The Environment Ministry was always blamed for being only a recycling agency. My main objective was to integrate the handling cost of waste into the selling price of products, thereby creating an incentive to decrease packaging and to develop packaging materials which are easier and therefore cheaper to dispose of later on. If you are only a recycling agency, then forget it. You are only dealing with end-of-the-pipe technology and it is obvious now that that thinking has become completely obsolete.

Our challenge today is to start at the very beginning of the production of the product, not only with regard to packaging, but the recyclability of the entire product. In this regard I was always looking for a solution for to handle used cars. We were not absolutely successful in that. I was aiming at a solution that required the car producers to take back their cars when they were no longer in use, when they became waste. At the same time industry would have the incentive to construct repairable cars that are then recyclable. But if you cannot use the self-interest of the market as an instrument of change, I think you are always at the end-of-the-pipe.

Unfortunately, this life cycle approach is very difficult to handle. We succeeded when I was Environment Minister to adopt a life-cycle law, Kreislaus Wirtschaft Gesetz in German. Of course it was not very easy to convince our industry to come to such an approach, but the most important and most difficult thing was to convince them with regard to the name. Nobody wants to take full responsibility because then they are responsible from cradle to grave. Nobody wants to do that. They were against the name more than the contents of the law because it gave full responsibility to industry to deal with the issues.

The history of how we arrived at this point is revealing. In Germany, we had started a high chimney policy. You didn't have to decrease emissions if you had a better chimney, a higher chimney, and you could do that very easily. So, for a long time in Germany we simply tried to increase the chimneys. And then of course, you had the same thing on the horizontal. I will never forget when I visited my colleague in Portugal. In those days he was very proud about the fact that they collected the water in a waste-water treatment station, which had a 3.5 km-long pipe going to the Atlantic. That was nothing more than a high chimney on a horizontal basis to better distribute and to decrease the specific load of the pollution.

Then the second phase to come was the end-of-the-pipe technology. We integrated filters into the chimneys or we integrated the filters into the waste-water treatment plant design. We were not eliminating the undesirable substance but concentrating it and rendering it easier to handle for landfill or whatever. So we changed the substance a little bit. We went from a gas to water or whatever situation: that was the second phase.

The third was to look at how we could integrate all this into the technologies themselves. We have invented and put into place all the labour saving technologies imaginable, but not environment or energy saving policies, for they were not in the battle back in those days. So we misplaced our resources in highly developing the wrong technologies.

When I was responsible for the CSD (Commission on Sustainable Development), I was always asked, 'How do we come to a better transfer of technologies?' And I always asked, 'Do we have the right technologies in the developed countries for solving the problems in the developing world?' I don't believe so. To export our agricultural technologies, for example, to developing

countries would be a disaster. In Germany agriculture is the second most capital-intensive industry in Germany next to the chemical industry. So we have a very high capital and energy-intensive agricultural business. Is that really the right technology to export to a region where there are a lot of workers who need work? So I have to ask, 'can we not only filter out but integrate?' Isn't it possible to create a new technological environmental framework? I think this is linked to the question of an ecological and social market economy and that is my responsibility now that I'm directly in this field. *As Environmental Minister, I was always the end-of-the-pipe Minister in the German government because I was constrained to look at what was going on in agriculture, wait a minute, environmental assessment analysis; what is going on in traffic, wait a minute, is that right? I was always the end-of-the-pipe Minister.*

Today, however, as Minister of Urban Affairs, Construction and Planning, I am in a situation where I can try to act within the integration model. Let's look for example at cities. I was the head of the German delegation to Habitat 2 in Istanbul last year in June. This was really a good bridge between Rio and Istanbul. It is an absolute must for an environmentalist to concentrate on cities, because cities will be the future all around the world. We are going not, as Marshall McLuan said we would, towards an urban village, but to an urban agglomeration, to an urban city.

More than 50 % of the population will live in mega-cities. How to organise those cities with regard to sustainability, economy, ecological and social questions is the most difficult challenge at hand today For example, the main problem of traffic in the city can not be solved only by a better mode of traffic but by a better settlement structure. How to change this ? We have a lot of unsustainable city structures in Germany and in France too.

In the 1930s European architects agreed on a model which separated the different functions of the city from each other. If you go to Brasilia, the capital of Brazil, you see this model in real structure. But if you segregate, you obviously produce traffic problems. What we need now is to create the city of short distances, to integrate everything again. I have discussed it with architects, with city-planners, and the ideal would be to create something like a new charter of ethics, a new model, a completely new paradigm.

If you come to better integration you decrease traffic needs. We urgently need those cities combined for example with retail shops. But now we are facing the Americanisation of our cities. To have the retail-shops on the highway outside the city brings no answer to the city centre. It only decreases the function of the city centre resulting in social and environmental problems. So we need to integrate environment into city planning.

And then what is the right regional structure? Of course the German history has a better pre-condition for regional structures. We don't have as it is sometimes quoted 'Paris and the desert'. We have a federation of states with their capitals. Munich is the capital of Bavaria and they are proud about that. So we have a better settlement structure. We have to do our utmost to stabilise this. Bringing the government to Berlin for example gives me the absolute necessity to take other institutions out of Berlin. For example our environmental protection agency in Berlin has decided to go to one of our cities in the Eastern part of Germany. But if we can not do that, we will have something like the 'mezzogiorno', night and day, very soon in Germany between the East and the West.

I know that with regard to housing, we need a change and we started to change our policy and of course I've some examples in France too. Our housing-subsidy system brings a premium, an additional incentive to those living outside of the cities. So the result is we really have only the singles left in the city centres. So in the city, not only in the centre but in the city quarters, we want to rearrange it, to create a better subsidy if you are in an integrated place in the city.

Nowadays, another danger is that you can lose your need for the city: we have telebanking we have teleshopping, all that is a telematic city of the future. Negro Ponti, this guru of information and communication at MIT (Massachusetts Institute of Technology) once told me we would have the urban villager. That's the model of what I wanted to underline. So I want more space in the

city. We have now what we call the renaissance of the train stations of former days. Our train system is very intensive in using the land in the cities. So now we are rearranging it that so that there is open land in the city again and we can integrate housing again in the city. We want to do our utmost in this direction. With regard to trade, to retail, it is a hell of a job.

A very wise man once said, 'The difference between developing countries and developed countries is that in the developing countries the slums are on the outskirts of the cities and in developed countries the slums are in the centre of the cities'. And if you go with me to downtown Washington D.C. and to some other American cities, also in Germany, you see this same development arriving. I really want to rearrange this and create sustainable cities.

We are coming to new organisation of retail shops, what they call the factory outlet, outside the city, what they call the big green grass investment. If we can not stop this, we will destroy the cities and therefore we are trying to rearrange our legal basis for that. This government intervention is essential. So I want to underline where my possibility to integrate environmental policy is today. I really believe that if you only have the laisser-faire strategy, we will very soon have an Americanisation of our landscape.

In moving the German capital to Berlin, I want to do my utmost not to create something like a government and parliament ghetto in Berlin. I want the government agencies to be integrated into the city. In order to accomplish this we decided to use only existing buildings with one exception. That is for the new chancellor. We are constructing a new building for the chancellor. But all the other ministries are going into existing buildings. That is acting environmentally, because that is a recycling of buildings. And it is a wonderful experience to see that you have a direct correlation, the older the building the better for recycling. If you see the fine old Prussian buildings, it is wonderful to make a new use for those buildings. If you go to the prefabricated buildings of the 1950s on the other hand, it is a nightmare to change their use and to bring new possibilities to them.

So I want to integrate the city. I want to be directly linked with a different life-cycle of the city and I hope that we can be successful in this field especially with regard to housing. I have to construct 12, 000 housing units for those people coming from Bonn to Berlin. We want to avoid creating the Bonn centre in Berlin where we would have something like a fence around it with all the Bonners living there. So we have pinpointed more than 100 different locations in the city to integrate these people there, knowing of course that the Bonners are much more clever and they are using their own good choices to integrate themselves into the neighbourhoods.

Then we face the problems of globalisation and uniformity. I think the next step will be globalisation combined with regional identity and not with uniformity. I'm quite aware that this is very important for stable development on our globe. If we lose this regional identity, I really believe that it will be a destabilising factor in the overall development in the world. Therefore, and don't misunderstand me, this is not nostalgia, we absolutely must do our utmost in Europe to maintain the real profile of the different regions and the countries. If we misunderstand European unification, as unification also with regard to culture, productivity and whatever, it would be a misdevelopment on a very high scale.

I really believe unfortunately that the question of how to integrate society will be more difficult in the future. I mentioned that we are coming to a more telematic way of life where we are not necessarily linked with our neighbour if we don't want to be. I really believe that this is one of the most intensive problems we will face in the future. There's a high level advisory board to the Secretary General at the United Nations. And under the leadership of our former colleague, Birgit Adal from Sweden, a very, very outstanding woman, they made a good report in this field about what may bring the disintegration of societies in the future. We now have not only global products and global production processes, we also have global information. Wherever you are, you have the same information as everyone else so you have something like a unifying of information around the world. You can have 100 channels on the TV, but they are all very similar.

Therefore I am promoting concentration in the agglomerations. For example, you cannot just live in Mexico City, you can live in a neighbourhood of Mexico City, and you must have some decision making possibilities to integrate people into your neighbourhood, to integrate them into work there.

The feeling of the people is, I think, something like a renaissance of regional feeling. The further you go in the globalisation of the world, the more people are looking for their home, their neighbourhood. In Germany they are now interested again in speaking dialects. Years before it was nearly impossible to do that, but now people are interested in such things, and I think this is also very vital for environment policy. The interest in what's going on with my little river, what's going on with the typical bio-diversity of my region, etc.

There is the story about a holiday camp, with these young Germans and young French students and they gave them a test. And the results showed that with regard to the theoretical questions about CO_2 and what damage it causes and so on, the Germans were much better, but with regard to the practical questions, such as what kind of a tree is this, what makes up the typical landscape, the French were much better.

And I think that this is necessary: to come not from a very high level but also from the ranks, to rearrange this feeling of responsibility for your direct environment, for your neighbourhoods, for nature. And if you do that you will have created the customer necessary for those products that you will produce in new industries, that you must produce in the future to save the world market for the future.

This mentality is not accepted or practised now and looking for the practical solutions or the government imposed methods to encourage this is difficult. Look at state autoroute tolls, for example.

In Germany we have very bad pre-condition for tolls because all our cities are linked not with one or two, three routes with the surrounding areas. Instead there are hundreds of streets going in and out. So either you'll have a distribution of the increase in traffic or you'll have to make a lot of toll points to collect the money. It is of course also possible to use other instruments, and if you go to Norway, it is also in Europe not far away, they have some solutions in this field. It is possible to solve these problems. We need intensive research and political decision-making to overcome those burdens.

In the practical field now we are subsidising mobility more and more with the result that the cities are directly linked to subsidised prices. *I always underline that, the structure of today is the result of prices of yesterday and the prices of today determine the structure of tomorrow.* So if we can not start with changing the prices you don't have to wait for the time to come. But if you start now, you punish those people who decided to live outside of the city with their working place in the city, at a time when there was no such price system. Nevertheless I am trying to be a practical politician to try to come to a transformation from one point to another.

Of course we have discussed this very intensely in Germany – increasing petrol prices, for example. Yesterday we had a meeting of our big bosses with regard to this and the opposition asked for an eco-tax to increase the price of energy, especially for fuel up to 20 billion DM. That would mean an increase in the prices of petrol of some 20 pfennig. That's of course a great jump for those people living in the rural areas needing a private car. Those in the city say OK, that's not very difficult, but it's simply not fair.

Therefore we need something like a step-by-step approach. I learned a lot from our British colleagues. They decided to increase petrol prices year by year in 5 % steps so that you can announce that after 5-6 years the price of petrol will be significantly higher. If you have this you can plan for your next car to be a smaller one, and to decrease the use of petrol you can plan to live elsewhere. But if you do it from one day to the other you cause large shocks that stimulate opposition.

I'm therefore asking for slow solutions so you have a clear signal of what's coming. All the wonderful ideas must be visible in a democratic society to convince people that this is the right way to go. We have a lot of other things: we mentioned waste of course. If you have your home in a wonderful skyscraper it is very difficult to be responsible for the waste. So we have to do it step by step to keep the right momentum.

We decided, together with the Berlin Senate, that we will have a limit of 18 to 20 % of individual mobility in the centre of Berlin. Only 20 % individual mobility, 80 % mass transit. It will be a hell of a job, no doubt.

But we have a real chance to accomplish this because if you see this divided city, it was really divided also in their city planning vision on both sides. They all developed the city against unity. We tried to change it a little bit but I really believe that we can decrease the individual traffic in the city, really dramatically to this 20 % share. We are criticised by the opposition and by our friends from the Green party that we are not doing enough in this field and I hope that we can do a little bit more.

Of course there is also the need for better products. We did our utmost to change for example the emission-limit values for cars for NO_x and for particles etc. All that is necessary, but it still thinking 'end-of-the-pipe' .

My main aim is now to integrate environment more and more into the structure, to integrate and not to make this the end-of-the-pipe Minister as I did seven years before.

We have a lot of bad examples and believe me, my open wound was this stupid speed limit question. Whatever I said, believe me, France was much better because it had a speed limit. I didn't and so there was no room, no space for a model.

Looking at all those integration problems, I have to underline again and again that sustainability does not mean not touching the environment. Sustainability means development, economic development. You cannot go to the third world and ask for no development. We had a long discussion in Istanbul over whether or not we should mention sustainable development for cities, and the developing countries asked for that. You see the solution with those prefabricated banlieues in Berlin, and you see the implicit environmental problems we don't want to repeat.

But my main thought today is that we are not signalling to people that environment will be the problem in the next decade. You must stick to this conviction, and I'm very glad that we have to cooperate with industry. I'm totally convinced that those industries not looking for environment-friendly products will lose their markets in the future. If we lose the spirit of Rio then it is a failure. You can not do quite the same year by year because there are other priorities. But if you abandon the whole process and lose the feeling for responsibility, that would be a disaster because that sends the wrong signal to industry to develop new products or production processes, and so on.

In conclusion, I repeat the essentials gleaned from my own personal experience. I started my business life in economic corporation policy. I was in Brazil, I was in Malawi for example, southern part of Africa. The most important thing I learned: to ensure that people have their own identity, that they are really integrated, and I really believe that if we cannot overcome this consequence of globalisation that would really be a disaster. Coming back to industry, I'm totally convinced that it is also another chance for industry because you can develop different types of products, different kinds of direct contact with your consumers in this field. To integrate these regional problems into your global strategy is one of the most important considerations for all businesses.

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Zero emissions

'Zero emission' is a strong metaphor for change, an idea that has gained wide following in Japan. The ECO 97 presentation by **Hiroyuki Fujimura** (President, Ebara Company, Japan), describes their innovative zero-emission concept which deals with industrial ecology, where wastes are redefined as inputs, providing a practical challenge for any engineer or industrial designer. Ebara moved into environmental engineering by way of pump production, then by water and air treatment. The Zero Emission approach makes use of Life Cycle Assessment (EEA, 1998).

Zero Emission: an environmental engineering firm's challenge

by Hiroyuki Fujimura

1. An approach to global environmental problems

In modern society, we have been pursuing economic development that is based on mass production, mass consumption, and mass disposal. As a result, we are now facing serious environmental problems. In order to overcome these problems, industrialised countries must strive to reduce their environmental loads by changing their social/industrial structures and building compatible social and industrial systems.

Developing countries must review both good and bad examples set by the industrialised countries in order to avoid making the same mistakes. Environmental preservation and energy conservation must be placed as top priorities, and long-term development plans must be made, and followed, carefully. Cooperation between industrialised countries and developing countries is vital, and also beneficial to all. Technical assistance including some technology transfer from industrialised nations is a key element here. It will stimulate the change in society.

2. Responsibilities of environmental engineering firms

Japanese industries have begun their efforts to reduce environmental problems. These efforts will be most effective if they are coordinated. Governments may play the role of leader, providing the industries with vision and basic direction. For example, the Industrial Environment Vision, drawn up by the Japanese government, outlines the framework for environmentally friendly industrial activities, based on the new developments in environmental issues.

3. Zero Emission Industrial Systems

Zero Emission Industrial Systems are composed of two levels of systems. They are:

1) clusters of manufacturing processes with minimal environmental loads;

2) clusters of industries linked for net minimum waste and maximum energy conservation.

Zero Emission approach

On top of waste minimisation efforts through conscious choices in daily lives and industrial processes, including recycling, strategic clustering of industry groups are formed for further waste utilisation. Waste from one industry is used as raw material or feedstock for the other.

At the first level of the Zero Emission approach, individual industries must minimise their waste by:

1. using 'Clean Energy' with low environmenta1 load;
2. using 'Green Materials' which are raw materials that can be obtained with minimal disturbance of an eco-system;
3. using 'Clean Materials' which produce minimal waste and environmental impact when processed;
4. improving industrial processes in order to achieve maximum process efficiency with resource and waste reduction;
5. recovery, reuse and recycling of energy and materials;
6. reassessing the fundamental product design with LCA analysis.

Of course, it is also important for industries to make profits. However, we believe that improving processes and cutting energy requirements and waste output will contribute to overall cost reductions.

Now, let us move from the individual industries to the cluster of industries. In the Zero Emission approach, webs of industries are established for even further waste minimisation at the global scale. Waste to one industry may be gold to the other. Keeping the material in the cycle contributes to energy and other resources conservation, and to waste reduction as a whole. The optimum results would be obtained by employing LCA analysis.

4. An environmental engineering firm's challenge

We can compare an industrial infrastructure to the human body. In Japan, we often refer to the business sector that deals with the treatment of industrial wastes as the 'veins of industry'; and the business sector that supplies required energy and materials to the rest of industries as the 'arteries of industry'. Ebara Corporation has many years of experiences in the end-of-pipe waste treatment. Based on this experience, Ebara is now also involved in developing the conversion technologies necessary to provide engineering services for supplying the 'arteries' with the valuable energy or raw materials that are recovered from the 'veins.'

The Fluidised Bed Gasification Process, presently being developed by EBARA, is an example of efficient conversion technologies. This system is vastly superior to the traditional systems in thermal energy recovery efficiency and reduced impact to the environment. Granted, this gasificator still cannot be called 100% Zero Emission system because of the CO_2 release from the stack. These releases, however, are significantly less than releases associated with CO_2 offgassing from the waste, had it been landfilled. Also, there are promising technologies being developed to reduce the CO_2 emission An example is a red diode big-reactor. Other chemical absorption methods are being studied as well, producing promising results.

In addition to thermal recycling, a resource recovery system can be integrated into this gasificator. Besides metals (such as iron, copper, aluminium, and nickel), valuable substances such as Ha, alcohol, methane, gasoline precursors, and ammonia may be recovered from municipal and/or industrial waste. Residual ash can be melted together and utilised as a construction material, or as an input for a cement. Furthermore, the gasification process effectively eliminates HCl at a low temperature: and the attached melting process completely

destroys hazardous chemicals such as dioxins and PCBs with a reduced air ratio at a high temperature.

Advanced pressurised gasification/melting furnace makes it possible to produce ammonia from municipal and/or industrial waste. Ammonia is of value to several industries.

With progressive development of efficient conversion technologies and systems, establishing various Zero Emission industrial systems is becoming a reality.

Below are some examples of Zero Emission systems which may be realised in the near future.

Agriculture is one of the main industries in China. There is a great demand for cheap and productive fertiliser, and we expect that the demand will continue to rise in the future. In 1992, China produced approximately 20 million tons of fertiliser. This is a 230% increase from the quantity produced 15 years earlier. Now the government plans further increases of production, to 30 million tons/year by the year 2000. Presently, about 80% of electricity is generated through fossil fuels, especially cheap and abundant coal. This trend is expected to continue. However, coal-fired power plants produce oxidised sulphurs and nitrogen, a main cause of acid rain, which has a detrimental effect on the environment.

However, based on the Zero Emission concept, Ebara has come up with an innovative conversion system which we call Electron Beam Fuel Gas Treatment System. This system solves the gas emission problem while contributing to the production of fertiliser. Try adding ammonia to the popover plant furnace effluent gas, and then irradiating the electron beam: ammonium nitrate and ammonium sulphate are produced as by-products. Ammonia needed in this system can be obtained from municipal and/or industrial waste. The fertiliser produced from the flue gas and waste can now be used as a valuable material in agriculture. In other words, the system takes care of waste while helping to produce food for people. It becomes a kind of Zero Emission system, which aims at promoting economic development while conserving nature and energy.

5. Economic feasibility of Zero Emission systems

Introduction of Zero Emission systems into our society is beneficial for our present and future environment. Economic feasibility studies have shown that Zero Emission systems can be feasible under the right conditions.

For example, introduction of the electron beam (EB) system in China seems promising. Assume that we built a system in China for a power plant that produces 2 million Nm3/h flue gas. If the price of ammonia is 13 yen/kg, and price of the nitrogen based fertiliser is 10 yen/kg, the break-even point for this EB plant is roughly estimated to be 10 to l5 years. While the EB system was originally built for desulphurisation of the power plant flue gas, it can also produce profit as a fertiliser manufacturing system.

The ammonia to be used in the EB system may be obtained from car shredder dust that is treated by a conversion process with the Gasification/Melting Furnace. Shredder dust, as we know, is yet another industrial waste. In order to produce l000 t/day ammonia, it would take about 900 t/day of shredder dust and 600 t/day of coal. If we get 20 000 yen/t as shredder dust disposal fees from its producers, this system will pay for itself in several years. Therefore, while this system takes care of the shredder dust, it also function as an industrial ammonia manufacturing process.

These examples show that there could be profitable and greener future with Zero Emission strategies.

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Monitoring what matters

Another potential metaphor for change is **'Monitoring what matters'** which includes 'green' GNPs or 'genuine savings' at the level of the economy, or environmental performance indicators and 'green accounting' at the level of the firm. As the opening chapter from the EEA state and outlook report (EEA, 1999) 'Meeting needs, consuming resources' shows, the GNP is an inadequate measure for monitoring overall progress, and the Index of Sustainable Economic Welfare is one of the additional measures that have been developed recently. As President Kennedy observed 30 years ago:

> *'Too much and too long, we seem to have surrendered community excellence and community values in the mere accumulation of material things. Our gross national product, now, counts air pollution and cigarette advertising and ambulances to clear our highways of carnage… It counts the destruction of our redwoods and the loss of our natural wonder in chaotic sprawl…*
>
> *'Yet the gross national product does not allow for the health of our children, the quality of their education, or the joy of their play… It measures neither our wit nor our courage; neither our wisdom nor our learning; neither our compassion nor our devotion to our country; it measures everything, in short, except that which makes life worthwhile.'*
>
> — Robert F. Kennedy, 'Recapturing America's Moral Vision', 18 March, 1968

There are still many statistical, practical and political problems in 'monitoring what matters' at the level of the economy and society, but many countries are now developing 'headline indicators' that try to capture the essence of changes in 'well-being'. The headline indicators being developed by the EEA are briefly described in the opening chapter and the recent proposals for headline indicators from Germany, the Netherlands and the UK are summarised in the table below.

Meanwhile, at the level of the firm there are many innovative proposals to monitor progress with environmental and social impacts, as well as with profitability: i.e. the 'triple bottom line'. The WBCSO (World Business Council for Sustainable Development) is developing criteria and indicators (Box 2) for monitoring progress with eco-efficiency at the corporate level, and these are listed in the opening chapter.

Table 1: Synopsis of national sets of environmental headline indicators

5EAP themes	Environmental Policy Themes & Indicators (the Netherlands)	Environment Barometer (Germany)	Sustainability Counts (UK)	'Gröna Nyckeltal' (Sweden)
Climate Change	Climate change (greenhouse effect & depletion of ozone layer):	Climate: CO_2 emissions	Climate Change: emissions of greenhouse gases	Climate Change: emissions of CO_2
	Index based on emissions of CO_2, CH4, N_2O, and production of Chlorofluorocarbons (CFCs) and Halons			
Acidification and Air Quality	Acidification: Indicator based on depositions of SO_2, NOx, NH3	Air: emissions of SO_2, NOx, and NH3	Air Pollution: days of air pollution (urban and rural sites)	Acidification: emissions of acidifying substances (NOx and SO_2)
Urban Environment	Disturbance: Percentage of Dutch people affected by noise and odour in Neq (noise equivalents)			Urban Air Quality: benzene levels in the atmosphere (winter half-year mean value in various urban areas
Waste Management	Waste disposal: Index based on the total quantity of solid waste dumped annually			Waste: waste for landfill (deposited quantities of waste material in Sweden)
Management of Water Resources		Water: percentage of flowing waters at which the mandated goal of chemical quality class II for AOX and total nitrogen is achieved	Water quality: rivers of good and fair quality (percentage of total river length)	
Coastal Zones	Eutrophication: Index based on emissions of phosphates and nitrogen to soil and water			Coastal Areas & Eutrophication: load of nitrogen and phosphorus into the sea
Protection of Nature and Bio-diversity		Nature: ecological priority areas (absolute and as percentage of non-settled area see also *Soil Chapter*	Wildlife: populations of wild birds (index)	Nature: protected forests (as a portion of productive forest land)
	Toxic and hazardous pollutants: Index based on the dispersion of agricultural pesticides, other pesticides, priority substances (cadmium, polyaromatic hydrocarbons, mercury, dioxin, epoxyethane, fluorides, copper), and radioactive substances			
		Soil: increase per day in area covered by human settlements and traffic routes	Land use: new homes built on previously developed land (percentage)	
	Resource dissipation: not included in Adriaanse	Resources-Materials: resource productivity (GDP per ton raw materials) Resources-Energy: energy productivity (GDP per primary energy consumption)		Energy: use of energy (energy consumption related to GDP), electricity for heating
			Transport: road traffic (vehicles miles)	Transport: environmentally adapted means of transport (the portion of journeys to and from work and school taken on food, by bicycle or public transport), (private transport by car in kilometres per person aged 6-84)
				(Sustainable Enterprises): number of environmentally registered enterprises (EMAS or ISO 14001) (Agriculture): recovery of phosphorus in sludge to agriculture

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'Environmental diplomacy'

Environmental Diplomacy is a relatively new development in foreign affairs which is not widely known outside the rather small group of its practitioners. The term reflects the recent integration of environmental concerns into globalisation and foreign policy.

Following are excerpts from an article by **Bettina Laville** ('Le globe, l'équerre et le diplomate', *Annales des Mines*, April 1996), in which she defines environmental diplomacy. Laville was an expert panelist at ECO 97, and is now Environmental Advisor to the French Prime Minister Lionel Jospin. Further thoughts on the subject and practice of Environmental Diplomacy were provided in the talk at ECO 97 by Ambassador **Mark G. Hambley**, United States Special Representative to the CSD and Special Negotiator on Climate Change. Mr Hambley describes the US State Department's inclusion of the environment into its foreign policy.

The rise of the 'bio-diplomat'

by Bettina Laville

The United Nations Conference on environment and development held in Rio de Janeiro in 1992 gave to international diplomats new and even subtly revolutionary tasks that were perhaps not recognised as such by their governments.

Certainly, as we often hear, nothing will be the same after Rio. But it seems that the debate these days focuses more on the globalisation of the world's economic projects than on the internationalisation of policies assuring its survival. Nevertheless, little note has been taken of the fact that negotiations on environmental questions have left a particular mark on diplomacy. Diplomats in charge of the Rio follow-up appear in some ways to be guardians of things invisible: fragile biodiversity or climate stability. Like the scientist and visionary Ptolemy describing the shape of the earth without really knowing it, today's diplomats are asked to fix limits to the modern world's negative effects on the earth, and this with sometimes weak or even contradictory mandates from their governments. They are often asked to arbitrate between science and politics while displeasing both, even though politicians are often secretly relieved to leave to diplomacy the burden and the precautionary long-term responsibility of securing conditions for future well-being.

As a result, international diplomats are always looking for the most reliable information available concerning current physical phenomena, and the way scientists are used in this process places them under terrible pressure. First, there is the pressure exercised by the industrial sector which, because of economics, resists and shapes to its own logic any technological change demanded by greater planetary survival.

And even though scientists are now present in worldwide summits such as those on climate change, they are often sidelined when it comes time for definitive negotiations or decision-making, due to the make-up of national delegations or the limited financial or diplomatic means of member countries.

But the scientists who play only a consulting role during actual negotiations lose thus their stakeholder role, even though one of the accomplishments of Rio was to make them stakeholders. It is therefore diplomats who must become diplo-scientists and who must consider complex constraints such as scientific data, economic impacts, and geopolitical accords. Instead

of a techno-science, it's a diplo-science that Rio has given us. Diplo-scientists must be *'bio-diplomats'* who master, in the case of climate change, scientific knowledge and industrial interests, and all of this under the vigilant eye of large multinationals.

Is this to say that environmental diplomacy is a multidisciplinary diplomacy, but nonetheless one confined to expert debates which remain inaccessible to the public and sometimes even to government officials? Just as in the sixteenth century, when scientists understood the world better than the politicians who were governing it, today the actors affecting global change reflect better the state of our world than practitioners of classic diplomacy.

* * *

Environment and security

by US Ambassador Mark G. Hambley

Until relatively recently, environmental concerns took a decidedly second place in the hierarchy of issues attracting the attention of our country's diplomats. Not any more. Nowadays, the importance of the environment has come to be recognised as a key priority for governments, both domestically and internationally. That the world needs to find a better way to sustain its finite resources was at the crux of the United Nations Conference on the Environment and Development in Rio de Janiero in June, 1992.

Since Rio; there has been a significant increase in the level of both multilateral and bilateral diplomatic efforts on environmental issues. Three conventions flowed forth from Rio – on biodiversity, desertification, and climate change. Five follow-on world summits were launched – Cairo on population issues, Copenhagen on social issues, Beijing on women's rights, Istanbul on issues related to habitat, and Rome on food security.

In addition, the Commission on Sustainable Development (CSD) was created by the UN General Assembly as a direct result of the Rio Conference. This organisation has engendered scores of meetings in cities throughout the world. Many of these meetings have been held at the technical experts level, but diplomats are heavily involved in the annual plenaries of the CSD which attempt to promote progress on such issues as sustainable agriculture, technological transfer to developing countries, ways to finance sustainable development, and sustainable forest management.

Environmental issues are now in the mainstream of American foreign policy. There are now global environmental issues which our diplomacy must address in order to preserve a world which is both healthy and sustainable for future generations.

Environment and diplomacy: six areas of concentration

Forests: Forests are a key environmental issue which have acquired considerable diplomatic attention. As the world's largest producer and market for wood products, and the leader in biotechnology, the United States – like many countries – has an enormous stake in the sustainable use of the world's forests. Forest depletion has serious repercussions for global warming (they are huge carbon sinks), biodiversity conservation (they harbour untapped genetic resources), and agriculture (they prevent erosion and siltation).

American diplomacy has been a strong proponent of the UN Commission on Sustainable Development's consideration of a wide range of forest issues under its Intergovernmental Panel on Forests. In concert with other key government agencies, US diplomats have also taken several direct actions in high priority areas to help promote sustainable use of forests on a bilateral basis.

From Eastern Siberia to Suriname, we have participated in efforts to assist local governments to plan the rational use of their forests, often in the face of pressure to trade short-term financial incentives for ecologically damaging, clear-cutting deals in many of the world's remaining virgin forest areas.

Marine Pollution: Marine pollution affects directly the health of fishing stocks worldwide. Pollution of the marine environment is caused by the deliberate dumping in the ocean of wastes, activities on land such as agricultural and industrial runoffs, sewage discharge and vessel discharge.

These issues are addressed in a number of global and regional fora. Vessel discharge issues are addressed in the International Maritime Organisation, dumping is regulated under the Global London Dumping Convention; and, following the 1995 Washington Conference, there is now a global program of action for addressing the land-based activities.

Chemicals: The use of certain toxic chemicals and pesticides (like DDT and PCBs) in areas throughout the world is an increasing health threat, both to the people who use them and to individuals far from the area in which they are used. Because this poses a long-term health and environmental threat to all countries, we have placed a high priority on developing international agreements to regulate the trade, production, and use of the most hazardous of these chemicals and pesticides, also known as persistent organic pollutants (POPS). We are pleased that the UN Environment Program has agreed to sponsor negotiations beginning in early 1998 on a global convention to deal with POPS[2].

Climate Change: Perhaps the leading environmental issue confronting the world today is the question of global warming or climate change as the problem is more accurately described. Given the international nature of the climate issue, and the need to involve all regions of the world in the solution, the Department of State has the lead in the interagency process and for the implementation of policy in the multiple negotiating sessions taking place each year.

The Department of State is committed to taking the lead in each area related to our international environmental concerns. This will be done by bolstering our ability to blend diplomacy with science and to negotiate global agreements that protect our health and well-being.

As part of this process, we are incorporating environmental planning into each of our bureaus and designating key embassies as environmental hubs to address region-wide natural resource and environmental issues. These regional hubs will help coordinate US overseas efforts, and work with national governments, regional organisations, NGOs and the business community to identify environmental priorities. To effectively cover the globe, the Department plans to establish a total of 12 hubs. The first two hubs, in Amman, Jordan, and San Jose, Costa Rica, opened last fall and four more will open by the summer of 1997.

In short, the environment has very much become a key watchword for modern day American diplomacy. We have long defined threats to the nation's economic well-being as security concerns. Retaining access to certain markets, protecting the sea lanes, and ensuring access to economically important resources have long been key security priorities. Certainly climate change, ozone depletion, and biodiversity loss – with their attendant impacts on US agriculture and other significant economic sectors – should be security priorities as well.

* * *

[2] See also the EEA/UNEP Annual Message 2 on the State of Europe's Environment, *Chemicals in the European Environment: Low Doses, High Stakes?* European Environment Agency, Copenhagen, UNEP, Geneva, 1998.

Part 2. Partnerships for change

As in every crisis, the environmental crisis leads all stakeholders to see relationships with their partners as unsatisfactory. They are moved to analyse their dissatisfaction, to see whether the objectives of their current relationships are still sound, and then to redefine new objectives, new partners, and new ways of working together.

Partnerships within industry

In Japan, the Keidanren (Japan Federation of Economic Organisations) announced in 1996, voluntary action by Japanese industry directed at conservation of the global environment in the 21st century. The Chairman of the Committee on Environment & Safety of the Keidanren, **Yoshifumi Tsuji** (also Chairman of the Nissan Motor Co., Ltd.) came to ECO 97 to present the Keidanren's statement regarding voluntary action.

The Keidanren appeal on environment

by Yoshifumi Tsuji

Five years have passed since the Keidanren instituted the Global Environment Charter. During this period, we have deepened our concern about environmental protection and taken positive steps, both at home and abroad, to tackle the matter. Nonetheless, the environmental issue, including global warming, has become increasingly serious in recent years.

For instance, countries concerned are required, under the Framework Convention on Climate Change, to target the stabilisation of the gross carbon dioxide volume at the 1990 level in the year 2000, but the volume has instead shown an uptrend in Japan. As for waste disposal, the Law for Promoting of Sorted Collection and Recyclying of Containers and Packaging has been enacted as a step towards the establishment of a recycle-based society. The realisation of such a community, however, calls for a basic change in the mode of conception, a change that targets 'resources' or 'byproducts' instead of 'waste.' On the other hand, there is a growing international mood for environmental management and auditing, with the ISO14000 series, a voluntary international standard in the private sector, scheduled to take effect this fall.

With the 21st century dawning in just a few years, it is the hope of everyone to hand a well-protected environment and its blessings on to the next generations. We should restructure the 'throw-away civilisation' that leads to the waste of resources and achieve 'sustainable development' so as to meet the needs of the present without compromising the ability of future generations to meet their own needs.

As key words to employ in our efforts in that direction, we therefore attach importance to these three goals: 1) reconfirmation of 'environmental ethics' for individuals and organisations to honour, 2) realisation of 'eco-efficiency,' a factor needed to reduce the environmental load through improved technology and economic efficiency and 3) tightening of 'voluntary efforts' to cope with the environmental issue.

Motivated by this concept, we declare that, in the spirit of the Keidanren Global Environment Charter, which states that grappling with environmental problems is essential to corporate existence and activities, we will take a voluntary, resolute and responsible approach in dealing with important tasks existing in the environmental field.

In facing up to these problems, we essentially need partnership with companies, consumers, citizens, non-governmental organisations and the government. Everyone should be well aware of

being a 'global citizen.' So should every company be aware of being a 'global corporate citizen' and act in concert with the government, consumers; citizens and NGOs.

In order to awaken the people to such necessity, it is effective for enterprises to promote education on the environmental problem and positively tackle environmental enlightenment activities both inside and outside companies.

In the hope of thinking and acting together with the government, consumers, citizens and NGOs as 'global corporate citizens' we will transmit this declaration through the Internet and ask for others' views on our program. We intend to reflect the comments and opinions thus expressed in mapping out industry-wide voluntary action plans aimed at protecting the global environment.

Measures for four urgent issues

1. Measures to cope with global warming

Making it a basic policy to review the 'throw-away economy,' structure a recycle-based society and improve energy efficiency and carbon utilisation efficiency, we aim to maintain the world's paramount level of environmental technology. We also aim to improve energy utilisation efficiency on a global scale through transfer of appropriate technology to developing countries.

Concrete methods

1) Preparing industry-wide voluntary action plans incorporating definite goals and steps towards enhancement of energy efficiency, and periodically reviewing the progress of such actions;
2) Recovery and utilisation of heat exhausted from cities and industries, reduction of natural energy costs, improvement of utilisation efficiency of fossil fuels through co-generation and compound generation, and the safe, effective utilisation of atomic energy;
3) Improvement of energy efficiency through inter-industry collaboration based on the life-cycle assessment (LCA) concept;
4) Cooperation in coping with global warming in the residential and commercial sector through development of energy-saving products;
5) Positive participation in 'activities implemented jointly' to transfer technology to developing countries in close cooperation with the government; and
6) Promotion of forest protection and reforestation projects in developing countries through business corporations themselves and the Keidanren Nature Conservation Fund.

2. Structuring of recycle-based society

In order to review the throw-away-type economic community where resources are liable to be wasted and convert it into a recycle-based society, we will work on 'cleaner production,' designed to attain optimum efficiency in all the processes from product design to disposal. At the same time, we will revise the conventional concept of 'garbage' and treat waste as a valuable resource, transcending the boundaries of individual industries; We will thus address recycling as the most important task in corporate management and make a systematic approach towards reduction of waste and recycling.

Concrete methods

1) Controlling the incidence of waste and re-utilising it from the viewpoint of life-cycle assessment (LCA) and developing products with full consideration given to the degree of recyclability and disposability (e.g. review of the frequency of product restyling),
2) Disposal of waste products by appropriate methods;
3) Structuring systems for recovery and disposal of waste products;
4) Use of waste products as raw materials by developing waste disposal technology through inter-industry collaboration;
5) Simplification of packaging and promotion of recycling; and
6) Positive introduction of products with lesser environmental load and recyclable products.

3. Restructuring of environmental management systems & environmental auditing

We will structure an environmental management system in an effort to address the environmental problem voluntarily, ensure its continuous improvement and perform internal auditing to confirm that the system will steadily work. Keidanren has positively participated in the formulation of the ISO environmental management and auditing standards scheduled to come into effect this fall. It is recommended that Japanese industries, manufacturing or non-manufacturing, should utilise the standards as an effective means of environmental improvement.

Concrete methods

1) Prompt introduction of environmental management and auditing systems into corporations (e.g. appointment of officers in charge of environmental problems, creation of an environmental department and enforcement of internal auditing);
2) Implementation of environmental management and auditing in conformity with the ISO standards or taking steps that correspond thereto, and
3) Playing an active role in the making of environmental labelling, assessment of environmental performance and LCA international standards under ISO.

4. Environmental considerations in evolving overseas projects

International business activities by Japanese enterprises, such as overseas production and developmental imports, are rapidly spreading from the manufacturing industry to banking, physical distribution and service sectors. We will give closer attention to the environment in stepping up and diversifying business activities overseas, as well as observing the 'Ten-Point-Environmental Guidelines for the Japanese Enterprises Operating Abroad' incorporated in the Keidanren Global Environment Charter.

In conclusion, we reaffirm the importance and urgency of every industrialist being a 'global citizen,' and express also as citizens our determination to innovate our lifestyle towards the goal of 'sustainable development.'

* * *

Partnerships between governments and business

In Japan, the integration of governmental and business policy is a clear example of **Partnerships between governments and business.** Following are excerpts from an ECO 97 talk by **Katsuo Seiki** (then Executive Director of the Global Industrial and Social Progress Research Institute, MITI, Japan) about finding the right balance between command and control and voluntary agreements. The MITI is the most powerful Ministry in Japan. It is the MITI that finances, develops, and coordinates, nation-wide, Japanese industrial policy, a policy which has traditionally drawn its strength from its long-term approach that emphasises innovation. MITI has now developed a document called 'The Environmental Vision of Industries' which shapes Japanese industry, sector by sector, according to life-cycle thinking. Instead of a fragmentary approach, this integrated approach seems to put Japan at the forefront of sustainable business strategic development, which requires close partnerships between government and business.

Japan's environmental policies

by Katsuo Seiki

New environmental policies of Japan

What we need today is for both government and private sector to address new environmental problems with their unique features and to modify policy instruments and measures accordingly.

First, environmental issues are increasingly getting across national borders, and becoming 'globalised.' The typical cases include the climate change issue related to the emission of greenhouse gas such as CO_2, the ozone depletion issue caused by atmospheric release of CFC, and the issue of cross-border hazardous waste. Unlike traditional pollution issues, where the adverse effects are normally limited to factories discharging pollutants and the surrounding area, newly emerging issues affect wider regions across borders or globally. It is essential, therefore, to intensify international coordination and cooperation efforts to resolve and mitigate such issues. It means that, in addition to efforts already exerted by developed countries, additional international collaboration will be required between developed and developing countries and between developing countries.

The second characteristic is the longer time frame. Although some degree of lead time did exist in case of past pollution problems between pollutants' discharge and their hazardous consequences, current environmental issues, or those issues expected to intensify in severity in the future would emerge or materialise over a much longer time frame. In the case of the CO_2 issue, for example, its century-long impact makes it difficult to fathom how the CO_2 emitted today would affect human society in the future. It is quite conceivable that, by the time any sign of hazardous effect arises, it will be too late to introduce any effective mitigation measures. In this effect, it will be extremely important to use the precautionary principle for implementation of policies and measures.

The third feature is the involvement of a wider range of human activities as a cause of environmental problems. While traditional pollution followed a simpler formula of a manufacturing plant being the source of hazardous materials, with surrounding community residents as victims, current emerging environmental issues paint a more complicated picture involving wider range of residential and commercial activities. Take the CO_2 issue, for example, any single entity may be emitting CO_2 and, at the same time, a victim of its global impact. Therefore, it is necessary to introduce and promote environmental measures to cover every

entity of economic activities, including citizens, businesses, national governments, and local administrations, all sharing roles equally and fairly.

Fourthly, many of the aforementioned environmental issues begin to introduce the concept of life-cycle of products and services. Concerning the major role of business in the economy, it will be necessary for business to incorporate environmental concerns at each phase of a product cycle, such as raw material procurement, manufacturing, distribution, sales, consumption, and waste disposal, whereas the conventional pollution concept requires the reduction of the environmental burden in the manufacturing process only.

To address such environmental issues and to stipulate the principles of environmental policies, the Japanese Government established the Basic Environmental Law in 1993. Its basic philosophy was to build a sustainable society with less environmental burden. For this, it urges every state and local government, every corporation, every citizen to integrate environmental concerns into daily activities, with a special emphasis on voluntary measures. It also requests national governments to implement necessary measures, such as the institution of technological assistance program, etc.

The Environmental Vision of Industries

MITI has developed environmental measures based on the concept put forward in the Basic Environmental Law. It already introduced policy instruments such as regulatory measures, taxes, and subsidies, as well as the measures to promote voluntary actions by industries to address environmental issues. Since no single policy instrument or few of them can provide a key to resolve any issues, MITI created and implemented a comprehensive package of policy instruments.

To promote voluntary actions by industries, MITI introduced various relevant programs as seen in the establishment of guidance for voluntary actions, institution of eco-labelling, and a campaign to enhance public awareness.

The Environment Vision of Industries, introduced in June of 1994 by MITI, focuses on the industrial sector, a major participant in economic activities. Its purpose is to promote voluntary actions by industries by setting forth guide lines to illustrate what environment-friendly actions can be integrated in their business activities. The guide lines have been published and circulated to encourage public awareness of environmental issues. The details of the Vision are as follows:

First, environmental impacts were analysed and identified for every please of product life cycle in 15 major industries. Life-cycle phases were raw material procurement, manufacturing, distribution, sales, consumption, waste disposal etc. 15 industries include the manufacturing industries of iron and steel, aluminium, non-ferrous metals such as copper, lead, and zinc, processed metals of foundries and forges, chemicals, synthetic textiles, pulp and paper, cement, automobiles, home electric appliances such as TVs, air-conditioners, and refrigerators, and electronic appliances and office machines including personal computers, as well as electric power generation, gas utility, petroleum industry, and distribution industry. These 15 industries share 73% of total production of manufacturing sector, and 85% of CO_2 emission from manufacturing sector as a whole. Therefore, the study of these 15 industries would practically capture major business activities in Japan.

Second, the Vision shoved a way for industry to incorporate environmental concerns to each phase of product life-cycle. Such activities used to be carried individually at each company. MITI has successfully integrated individual efforts, and promoted voluntary action by industries to integrate environmental measures into their business activities; through the establishment of Voluntary Plan for Environment.

Around the time the Environmental Vision of Industries was introduced, MITI also instituted a program to support the establishment of environmental management and monitoring system

under ISO 14000 series, for the purpose of furthering the reduction of environmental burdens through the development of creative measures at industries.

The Environmental Vision of Industries successfully clarified and showed a way for each industry to incorporate environmental concerns into business activities more comprehensively and systematically. Also, it illustrated a way to address particular type and feature of environmental issues. In short, the Environmental Vision of Industries presented a menu of effective measures to reduce environmental burden in 15 industries, and endeavoured to encourage individual corporations' efforts to develop and adopt such measures. This can be seen typically in case of iron and steel manufacturing industry. The Vision encored the development of high-quality steel boards, particularly high tensile steel boards, so to lighten the weight of commodities such as automobiles made from such steel boards, and thereby achieving higher fuel efficiency and reduction in fuel consumption.

Third, the Vision proposed inter-industrial collaboration as a way to reduce environmental burden at every phase of products' life-cycle. It also identified systematic way to promote cooperation between different industries. Examples include the increased use of recycled resources for raw materials as a way to incorporate environmental concern in raw material procurement phase. The establishment of quality standards for recycled materials in cooperation with both manufacturers and consumers of recycled materials also promoted the use of recycled materials. Coal ashes generated from electric popover industry, for example, can be used as a raw material for cement production, and the Vision proposed to establish JIS Standard to standardise quality of coal ashes in order to promote and secure its utilisation.

Follow-up on the Environmental Vision of Industries

The Environment Vision of Industries was proposed to address:

- the need to establish a framework for environmental-friendly business activities;
- the need to develop environmental-friendly technologies;
- the need to establish environmental-friendly social system;
- etc.

Several measures for these have been implemented already. Regarding a framework for environmental-friendly business activities, there has been the introduction of the ISO 14000 series to establish environment management systems, and the establishing of national standards for environmental monitoring. The LCA Japan Forum has been established as a research institute to study life cycle assessment.

In technology development measures, a program to develop recycling technology is expected to promote overall acceptance of recycled materials in the raw-material procurement phase.

In regards to social system buildup, various relations were modified under the guidance of the Environmental Vision of industries, such as those on waste treatment and recycling.

Furthermore, MITI plans to re-review and adjust the Environmental Vision of Industries. The review started last year in view of the international negotiation ongoing for the emission reduction of greenhouse gas such as carbon dioxides as the Third Conference of Parties of UNFCCC approaches. It will focus particularly on carbon dioxide emission reduction and energy saving issues and is to be completed by 12 March of this year. It is expected to list measures for individual corporations, and inter-industries to reduce carbon dioxide emission and to improve energy savings. The establishment and review of the Environmental Vision of industries may have stimulated the institution of the Industrial Environmental Action Plan developed among industries by the Keidanren.

The Industry and Environment Vision, instituted by MITI, has played and will continue to take an important role in showing the future direction for environmental policy-making for the

Japanese Government. It was instrumental in promoting voluntary actions among industries to incorporate environmental concerns into their business activities. It is MITI's intention to reinforce its efforts to promote the incorporation of environment concern in industries, and to encourage inter-industry cooperation, focused on product life-cycle, through a comprehensive package of environmental policies.

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Journalist **Lawrence J. Speer** covered ECO 97 and wrote about the Argentine Campana-Zarate Project, an example of a partnership between governments and industry, in *International Environment Reporter*, March 5, 1997. Key points are summarised below.

The Campana-Zarate environmental care agreement in Argentina

by Lawrence J. Speer

In Argentina, where environmental priorities are particularly focused on air and water pollution in the main metropolitan areas and industrial waste treatment and disposal, a new cooperative project between industrialists and local government in an industrial area north of Buenos Aires may provide the future model for self-regulation.

The Campana-Zarate (CZ) Project is a voluntary private sector initiative to incorporate sustainable development principles into industrial policy across the region, which is home to some 180,000 people, according to Julio Garcia Velasco, environment and technology director of the multinational Techint Group. (Garcia Velasco presented his project at ECO 97.)

Techint Group, which operates a steel factory in the region, is a founding member of the CZ Project, which has 15 major industrial members, including chemicals producers and refineries. The project runs an environmental resources and planning centre, which has conducted technical studies on air and water pollution, noise measurement, and potential impacts of new factory installations.

In 1993, the CZ Project made a major step towards self-regulation with the drafting of an Environmental Care Agreement, committing members to permanent impact minimisation, compliance with all environmental laws, open communications policies, and cooperation with government in policy-making and control.

Today, the project members hope 'to make the self-regulatory approach a reality in Argentina,' Garcia Velasco said, adding that 'implementation of ISO 14000 is a major part of this effort.'

Although the government has made moves towards simplification, CZ Project members maintain that a lack of coordination among the various levels of government creates problems dealing with an environmental code that remains both confusing and contradictory. The multiple compliance checks demanded by a host of regulatory agencies are costly, both in terms of paperwork and employee time, Garcia Velasco said, and could be eliminated under a self-regulatory framework. Among the points CZ Project members hope to negotiate with the Argentine government is the incorporation of a single regulatory compliance inspection for ISO 14000-certified firms.

* * *

The proposed book of papers and proceedings of the ECO 97 and ECO 99 Conferences will include other chapters on Partnerships between Business and Stakeholders (e.g. with suppliers, customers, employees and the financial community); partnerships within communities; and partnerships between researchers and users.

Part 3. Tools for change

Policy packages of taxes/subsidy reform, regulations, voluntary agreements, 'right to know' initiatives and government purchasing, are just some of the tools for change that are being used to help achieve sustainability.

Nearly twenty years ago, the OECD's environment directorate introduced the polluter-pays principle into the debate, and since then the directorate has continued to conduct research on strategies for integrating environmental concerns into the economies of the world. In working for all member countries – the club of developed nations – the OECD does an analysis and evaluation of the environmental policies of each country, leading the way in its role as dispenser of rational wisdom. Following are excerpts from a talk by **Bill Long** (OECD Director of Environment at the time of ECO 97) on tools and strategies for environmental management.

An overview of tools and strategies for environmental management

by Bill L. Long

The tools of environmental management have evolved very rapidly over 25 years; and today policymakers have at their disposal an extensive arsenal of strategic and technical instruments. Further, the pace of change is accelerating ... for there is under way in OECD countries what amounts to a **large experiment** to develop a 'next generation' of management tools to cope with a new generation of environmental challenges.

To make some general observations at the outset:

- interest and activity has shifted markedly in recent years
- in most cases, individual policy instruments are being used in combination, and many 'hybrids' are evident;
- the choice of instruments for **common** problems is likely to vary quite markedly from country to country.

Taken together, these tools for environmental management – as applied within a market economy – have a number of interrelated objectives:

- to get the prices right (and send the right price signals to the market) – to stimulate technological innovation and diffusion
- to change behaviour
- to better inform the 'buyers' and 'sellers' of goods and services about environmental costs and benefits.

Regarding the oft-quoted policy objective of changing behaviour, we might consider for a moment the question, 'Whose behaviour are we trying to change?' There are, in fact, a range of 'actors' that environmental management tools influence ... either directly or indirectly. I will simply note the high degree of attention being paid at the moment to the so-called 'greening of **government**', particularly with respect to procurement policies and operation of facilities, and also to the **international** implications of the environmental policy tools being introduced at the domestic level.

Since the early 1970s, the evolution in the choice and design of environmental management tools has been striking. This evolution is a reflection of ...

- the changing nature of environmental management priorities;
- the need for policymakers to achieve greater **economic** efficiency in the pursuit of environmental objectives;
- the need to avoid and eliminate **conflicts** between economic and environmental policies; and
- the experiences (good and bad) of government and industry in environmental management over some three decades.

Several years ago, a CEO of a large multinational corporation described the changes as the '3 Ds'. He observed that, in the 1970s, the 'D' represented industry's **denial** that it was the villain as it resisted government pressures to change; in the 1980s, the 'D' stood for **data,** with government and industry battling over whose data was better, as a basis for deciding how much change was necessary and what tools to use; but ... in the l990s, the 'D' stands for **dialogue**, with industry and government agreeing that it is better to work together, than to fight apart. Some might argue that this is an overly optimistic view of the current situation; but it does, in my view, describe quite accurately an encouraging general trend towards effective industry/government 'partnerships'.

It is important to examine some of the details of this changing panorama. For this purpose it is useful to consider what has happened over the years with environmental **regulation** ... government 'command-and-control' strategies. Regulation is worth looking at for at least three reasons: (1) it was the first tool employed by OECD countries as they addressed environmental issues in late 1960s; (2) regulation continues to form the bedrock of environmental management .. and will likely do so well into the future; and (3) **reform** of government regulation across all sectors is a current preoccupation of virtually all OECD countries.

Regulation was the natural tool for policymakers to grasp when environmental problems began to command attention in the late 1960s. This was a time of responding to crises: pesticide contamination of wildlife; highly-publicised marine oil spills; 'killer' smog incidents in London and Pittsburgh; and reports of 'dying' lakes and rivers from industrial wastes. OECD governments, operating in a crisis management mentality, turned to command-and-control strategies and policy instruments which they judged to be quick and sure.

Attacking environmental pollution and resource degradation was also perceived in **legalistic** terms – as a 'crime and punishment' undertaking. Today, the mentality is more inclined towards achieving an efficient and equitable **balancing** of national economic and environmental policies.

Nonetheless, for three decades, a rule-based, regulatory approach to environmental management has pervaded and persisted. This is, in part, because regulatory approaches have certain intrinsic strengths; in part because each alternative to regulation has its own weaknesses; and, in part, because of government inertia. Industry support for regulation has been uneven. Some large firms have found that regulation provides good opportunities for bargaining and negotiation; and others have sensed that it can be a vehicle to increase market shares if they can get regulators to favour their approaches or technologies ('regulatory capture').

In the 1970s, first-generation environmental regulation focused on **remediation** ... and on correcting past 'wrongs' that posed risks to human health and were degrading the quality of air, water and land resources. Industry was perceived as the villain, with most regulations targeted at pollution and wastes emanating from fixed industrial installations.

By the early 1980s, governments were beginning to get a grip on the traditional sources of pollution – environmental 'insults' that could be seen, smelled or heard. At the same time, regulators were coming to share industry's complaints about the stifling 'cumulative impact' of the command and control approach. Protests were heard about both the rapid expansion in the

number of regulations and their growing complexity. And, in particular, regulations were springing up in an uncoordinated fashion from independent air, water and solid waste divisions of the same national environment agencies.

By the mid-1980s, 'reform' – aimed at rationalising and improving regulatory machinery and procedures – was under way in many OECD countries. One of the goals (one that continues to receive attention) was to compress and streamline regulations in order to reduce the administrative burden and other costs to industry.

A second major goal of regulatory reform in the 1980s was to design a 'next generation' of policy tools. These were needed:

- to manage pollutants that existing legislation was just transferring from one medium to another (requiring new integrated, multimedia strategies);
- to influence industry to move away from end-of-the-pipe capture of pollutants in favour of reduction-at-the-source, 'preventative', manufacturing processes; and
- to cope with widely dispersed **non-point** sources of pollution (e.g., agricultural runoff; environmental impacts of transportation systems).

Thus, by the mid-1980s, environmental regulators were showing stronger interest in using **market-based** strategies and tools – to improve economic efficiency and environmental effectiveness, and to promote technological innovation.

The need to modify regulatory approaches, and to find new tools for new challenges, was reinforced in the second half of the 1980s as concern grew over **global-scale** environmental threats, specifically stratospheric ozone depletion and climate change. And, at the same time, environmental policymakers were being challenged aggressively by economic interests – in government, and in industry, to take better account of the **economic consequences** of environmental policy measures for trade, competitiveness, investment and employment.

This began to define the **international** dimension of environmental policymaking, which includes a continuing quest to 'harmonise' and otherwise coordinate environmental policy tools at regional and global levels.

Through the decade of the '90s,government efforts to improve the quality of environmental regulation, and to find new management tools, has accelerated. This is partially due to continuing pressure from industry for regulatory relief in a period of widespread budget deficits and intensifying international competition. Industry clearly has found a more receptive audience in this climate than in earlier years.

Today, environment policymakers in OECD governments are under heavy pressure to demonstrate – to industry, to economic counterparts in other ministries, and to the general public – that their policies are efficient and 'delivering value for money'.

The pressure to find new management tools also comes from recognition that the environmental challenges of the future are likely to be much more difficult than in the past. The costs of cleaning the air and water continue to rise. Further, the international economic (and political) impacts of environmental protection measures are likely to become more consequential in this 'age of globalisation'. Bearing testimony to this are the concerns that developing countries are voicing about real or perceived economic consequences (for them) of OECD country eco-taxes, eco-labels on traded products, and emerging policies to deal with climate change.

As the decade of the 1990s comes to a close, environmental policymaking – and the tools to implement it – is in a distinctive, and dynamic, third generation.

Government efforts are moving down three tracks. First, streamlining and upgrading of the quality of existing regulations is receiving high priority. The second track involves an intensive search for **non-regulatory alternatives –** with a focus on utilising **market-based incentives,**

voluntary measures and **expanded information about environmental risk** to bring about changes in environmentally-damaging processes and behaviour. The third track involves a search for the best **mixes** of policy instruments for dealing with particular problems (i.e., command-and-control instruments used in combination with economic instruments and voluntary approaches).

Experience gained over three decades indicates that there are few common solutions to environmental problems ... and certainly no 'silver bullets'. The 'correct' policy tool depends heavily upon national cultures, public attitudes about environmental threats, legislative and administrative structures, and other characteristics that can vary widely from county to country. For example, why is it that Austria and Switzerland can apply the same level of 'eco-tax' to fertilisers and pesticides to decrease their use and get strikingly different results? (The answer in this case seems to be the association of an aggressive public information campaign in one of the countries.)

An important factor in the evolution of environmental management tools in the late 1990s is the **enhanced reputation that industry enjoys** as a positive force for environmental improvement. This results from increased public acceptance of industry's message that it is possible to be both 'clean and profitable'. Examples are growing of companies which have turned the necessity of improving their environmental performance into a profitable virtue, rethinking their processes and products, and coming up with solutions that have not only benefited the environment but also improved their products, sales and raw material consumption.

This has opened up an array of new opportunities for government policymakers. Prominent among them is the possibility of entering into **voluntary agreements** with industry, with a much better likelihood of gaining public support. This is allowing regulators to shift their attention from the environmental leaders in industry (invariably the larger firms), and to focus more on stimulating and assisting improved environmental performance by **medium and small-size firms**.

To this point I have painted a broad panoramic view of environment policy tools, and have traced their general evolution since the late 1960s, using changing attitudes towards government regulation as the principal reference point.

I now propose to address the **alternatives and complements** to regulation ... and then to conclude by referring to several specific applications of environmental policy tools which highlight current attitudes and directions.

Economic instruments

OECD surveys indicate that, among the array of market-based tools for environmental management, **taxes, charges and deposit-refund systems** are in widest use today – and their use is expanding in our Member countries. Significantly, this is also occurring beyond the OECD family of nations. As one very notable example, last year Chinese authorities approached the OECD to initiate a dialogue on the 'use of market-based instruments for environmental management' ... and a programme of cooperation with China is now under way.

Many creative efforts to apply economic instruments are under way in OECD countries. Take, for example, OECD's newest Member ... South Korea. Until 1994, the sale of bottled water in Korea was illegal, as the government did not wish to alarm the public about water quality. Now, there is a 20% charge for producers and importers of bottled water, with the revenues applied to groundwater and drinking water protection.

Korea has also introduced a volume-based charge for household waste. Consumers purchase plastic waste disposal bags from the grocer, and are then charged on the basis of the number of bags set out for collection. Recent data indicate that urban household waste has been reduced by 37%, and recycling increased by 40%. Increased burning of waste by households has, however, emerged as a quite serious air quality problem.

There is also a trend towards the **creation of markets** – particularly in the form of 'permits' (for pollution releases or for fish catches) which can be bought, sold and traded among various parties. Tradeable permits are getting a 'hard look' as a possible tool for coping with climate change on an international level. As with other economic instruments, permits can provide strong incentives for polluters and resource users to improve technology on a continuing basis.

Deposit-refund schemes were originally applied to returnable bottles, and have proved to be quite effective. Within the past five years, the related and more expansive concept known as 'Extended Producer Responsibility' has begun to take hold. The philosophy is that the manufacturer should bear responsibility for a broad range of products from cradle to grave ... for example, by reclaiming cars, refrigerators and other appliances from consumers after the product's useful life. To cite Korea again, under a system introduced in 1995, both producers and importers of certain products pay a deposit which is refunded when the products are reclaimed. Government figures indicate that this has resulted in a 49% recovery of used tires; a 47% recovery of batteries; a 23% recovery of lubricants; and an 8% recovery of beverage containers. This is pressuring manufacturers – in Korea as well as in other countries – to design products with longer lifespans, and/or which can be disassembled easily for reuse or recycling. At the same time, the **international trade** implications of Extended Producer Responsibility strategies has emerged to become a matter of considerable debate and analysis.

It is noteworthy that – despite their well-publicised theoretical advantages over command-and-control approaches – the application of economic instruments for environmental management has been rather slow in developing. These advantages include delivering environmental benefits at lower cost, and providing a continuing incentive for technological innovation (i.e., their 'dynamic efficiency' function). One of the difficulties they face is the political reality that – unlike government regulation – the costs of economic instruments (especially charges and taxes) are strikingly visible to consumers and to firms. Further, industry often expresses the concern that 'eco-taxes' will merely be additive to the regulatory compliance costs they face, rather than a substitution; and that environmental taxes too often are used by government to raise new general revenue rather than to achieve environmental objectives.

This aversion to new taxes has given rise to the concept of 'green tax reform' – including major modification of national tax systems – whereby the rising costs of environmental protection (e.g., through new taxes on pollution and resource consumption) are offset by reduced taxes on labour and capital. Such 'revenue neutral' approaches have been (and are being) studied by high-level government commissions in a number of OECD countries, notably Sweden, Netherlands, Norway and Denmark. OECD believes that fiscal and environmental policies both should and can be made mutually reinforcing.

Current government efforts to **reform markets** – especially to reduce **subsidies** in the sectors of energy, agriculture and transport – have important implications for environmental management. For example, pressures for government **regulation** should lessen as elimination of production subsidies leads to reduced use of pesticides and fertilisers, and decreased cultivation of marginal lands. And, the move away from subsidisation of agricultural production towards direct income support, and agri-environment payments, to farmers (to maintain the countryside and wildlife) is another implicit market-based instrument for environment management.

On the other hand, market liberalisation and regulatory reform have the potential to exacerbate and create environmental problems. For example, in the energy sector, de-regulation could trigger expanded use of low-quality fossil fuels. And, the implications for energy efficiency programmer, and for the expansion of renewable energy, are unclear. In light of the heavy pressures governments are under to liberalise markets by*, inter alia,* dismantling regulatory structures, the possible environmental costs of such strategies to promote economic growth need close scrutiny.

An OECD paper being prepared for the June 1997 Special Session of the UN General Assembly on Environment and Development contains these conclusions about 'economic instruments' as applied in the field of environment:

- By harnessing the power of the market, economic instruments contribute to the integration of environmental concerns into economic policies by bring market signals closer to their socially desirable levels – a necessary condition for sustainable development;
- Economic instruments have, to date, generally been introduced as supplements to regulation, with a view to collecting revenue, rather than to change the environmental behaviour of economic agents;
- There continues to be little systematic evaluation of the performance of economic instruments on environmental policy, or of policy instruments more generally;
- An important element of promoting sustainable development is ensuring that existing government policies do not encourage unsustainable behaviour. A review of existing subsidy schemes and taxes that serve as disincentives to sound environmental practices will contribute to this goal. A key challenge will be to identify clear cases for 'win/win' situations, in which both the environment and the economy can benefit from policy reform.

Voluntary approaches and negotiated agreements

Voluntary agreements between industry and government have been increasing rapidly in the 1990s in OECD countries. Their potential for achieving environmental goals without the administrative and transaction costs of regulatory and economic instruments makes them attractive policy choices. In many instances, industry is agreeing to take measures that go beyond existing regulatory requirements ... in exchange for commitments by governments to provide various types of regulatory 'relief', for example in the form of simplified permitting processes or diminished frequency of reporting and inspections.

In some cases, the agreements are not exactly 'voluntary'. The New Zealand Environment Minister, for example, gave domestic firms three years to 'voluntarily' meet a national target for CO2 reduction – after which he would regulate if 'voluntarism' does not work.

The political acceptability of voluntary (or 'negotiated') agreements today depends on public confidence that industry is both fully committed, and able, to meet its end of the bargain. The chemical industry's unilateral 'Responsible Care' initiative launched by Canadian industry in 1985 set the stage for a 'new partnership' with government. The US Environmental Protection Agency's '33-50 Programme' demonstrated in the first half of the 1990s that industry could indeed meet, and even exceed, tough negotiated targets for reducing the use of a broad array of toxic substances.

To date, voluntary agreements have mostly involved larger firms, usually the environmental 'pathfinders'. Co-operation provides corporate leadership with greater 'ownership' of environmental commitments; and also the enhanced public visibility which can come from good performance. However, many firms that are willing, in principle, to enter into voluntary arrangements are conditioning their participation on government's ability to provide a minimum base of **regulation** to prevent 'free riding' by their competitors. This is another example of the trends towards the judicious use of 'mixes' of policy tools to address environmental problems.

Information-based approaches

I recall an advertising slogan played repeatedly on the radio in the US in my younger years: 'An informed consumer is our most cherished customer'. (The fact that this message was delivered on behalf of a manufacturer of fur coats probably should not be revealed to this audience.) It makes a good point, however: 'working with the grain of the market' to protect the environment clearly requires knowledgeable buyers and sellers of goods and services.

This philosophy lies at the heart of a broad spectrum of information-based tools that have emerged over the past two decades. These include eco-audits, eco-labelling, pollutant release inventories, cost-benefit analysis, and life-cycle analysis.

Public disclosure of environment-related information by industry, either voluntarily or under legislative mandate, is rapidly becoming a widely-used environmental management tool. 'Community-right-to-know' programmer, designed to provide greater public access to information about the sources and nature of industrial emissions, are providing a powerful stimulus for improved environmental stewardship by industry .. and in countries beyond the OECD.

The Government of Indonesia and the World Bank have recently reported successful results from a pilot effort on 'public disclosure'. This involved publishing in local newspapers the names of the most egregious industrial polluters. This approach was taken when it became clear that, at present, Indonesia lacks the institutional and financial capacity to rigorously monitor and enforce compliance with its pollution control legislation.

The OECD is also supporting information-based, non-regulatory approaches, a recent example being the negotiation last year of an OECD Council Act on 'Pollutant Release and Transfer Registers'. This consists of a set of principles, and discrete procedures and actions, for government and industry to follow to provide citizens with expanded information about sources and potential impacts of industrial pollution. Although this was developed as a **recommendation** to OECD governments, several of our Members are moving to place the 'PRTR' approach on a statutory footing. Further, chemical firms in North America and Europe are beginning to use the results from PRTR programmes – which were set up to register pollution – as a new tool in production design as well as in their occupational health programmes (safer alternatives) and factory safety plans (accident prevention).

International interest has grown rapidly in recent years in **standardised 'environment management systems'** for use by industrial firms. This builds on the experience previously acquired by industry in carrying out **'eco-audits'** of plant operations. Firms continue to report that 'eco-auditing' is enabling them to both better control pollution emissions and increase profitability by conserving raw materials formerly wasted.

Particular attention is being focused at the moment on a new set of voluntary environmental management standards from the International Organisation of Standardisation (ISO). Many in industry, and in government environment agencies, see these standards – known as the **'ISO-14000 series'** – as a promising framework for redesigning the way that industry is regulated. While waiting for ISO 14000, European businesses have been registering their facilities under the European Eco-Management and Audit Systems (EMAS), or the British Standard on Environmental Management Systems. Some 400 firms are currently registered under EMAS, 293 headquartered in Germany.

Companies, and particularly those with big export businesses, envision important competitive advantages accruing from obtaining 'certification' under such schemes, as well as the prospect of regulatory relief and better credit rating from financial institutions. At the same time, government environment agencies are enticed by new opportunities for regulatory reform emerging from ISO 14000. One difficulty – which has generated opposition from non-governmental environmental groups – is that ISO 14000 is a **voluntary** management standard: it does not set performance targets; nor does it require public disclosure of the steps taken by firms in response to the standard, nor of the actual effects on the environment. Strong **compliance monitoring** will undoubtedly have to be part of any regulatory track based on such environmental management systems.

Information-based environmental management tools also include 'eco-labels'. The use of labelling to identify 'environmentally-friendly' – or 'friendlier' – products is growing, including in developing countries. This is despite the concern registered within the trade community, and by developing countries, that such labelling creates non-tariff trade barriers. The OECD is presently

studying how trade concerns are being – and could be – addressed in the design and conduct of eco-labelling.

Another tool which has attracted considerable attention in the last few years is **'life-cycle analysis'**. This concept was advanced, in part, by interest in eco-labelling since, 'How can one decide if a product is friendly to the environment unless one investigates its environmental impacts from the generation of the raw material inputs through the product's final disposal?' **Methodological** problems in carrying out life-cycle analyses are considerable, however – as attested to by the experience of the European Commission, and an array of OECD governments and various private firms. Nonetheless, it can be a powerful tool for controlling pollution at the source, even in the absence of a complete analysis. For example, the AT&T corporation has adopted a 'life-cycle' **philosophy and approach** even though it has encountered difficulty with rigorous life-cycle **analysis**, given the delays that comprehensive analysis were causing in bringing products to market. The corporation's approach at present is to assemble company experts who would operate at key points along the design, production and consumption chain of a proposed new product to discuss where the major environmental problems might crop up ... and to wrestle with the question, 'What if we did it this way instead?'.

Case studies

I will conclude by citing examples of current trends and directions in the use of environmental management tools.

(1) Ozone protection in the United States

In January 1996, the United States, the world's leading consumer of ozone-depleting chemicals, met the international deadline for phasing out production of CFCs for domestic use. This was done on schedule, and without devastating the national economy, or destroying industrial firms, as some had predicted. Today, US industry has developed alternatives for virtually all CFC applications; and the public has not been denied popular products. In case after case, firms eliminated CFCs at faster than predicted rates, at lower cost, and with greater technological improvements than anyone had foreseen.

Two innovative, market-based tools were used to accomplish this. One – initiated in 1988 by the Environment Protection Agency – involved the use of a **permit system** that controlled the production and importation of CFCs. Permits (called 'allowances') were allocated to US manufacturers and importers on an annual basis. They were fully traceable (i.e., could be bought and sold); and the number of permits was reduced each year to squeeze down total national production and consumption. This was coupled with a **tax** on ozone-depleting chemicals, which was increased each year, raising revenue in the process and giving users a financial incentive to conserve the chemicals and to adopt alternatives.

In a recent evaluation of this experience, the Washington-based World Resources Institute drew five conclusions that are useful lessons for the design and use of environmental management tools more broadly:

- It is crucial to have management tools that can be adjusted to reflect new scientific information. (In the case of CFCs, the international community kept adjusting its phase-out targets as accumulating scientific evidence confirmed the seriousness of the problem.)
- Economic instruments can help government and industry achieve environmental goals with greater flexibility and at lower cost.
- Innovative government initiatives can remove barriers that keep industry from solving environmental problems cost-effectively. (The US Environmental Protection Agency worked closely with industry, serving as an information-broker to help firms find alternatives to CFCs, and accelerating the approval process for CFC substitutes.) ,

- Given the opportunity, industry leaders can find ways to innovate and gain competitive advantages in response to environmental challenges.
- Initial cost projections often far exceed the **actual** cost of complying with environmental regulations, principally because they fail to reflect the technological innovation that environmental tools can stimulate.

(2) Norwegian Green Tax Commission

In late 1994, a 'Green Tax Commission' was established by the Norwegian Government. Comprised of both finance and environment experts, the Commission has considered the scope for new **eco-taxes** to improve the effectiveness and efficiency of Norway's approach to environmental management. It has also assessed how environmental policies might contribute to macro-economic goals, including employment, and the potential for reducing environmentally-damaging subsidies and distortionary taxes. One of the Commission's conclusions is that a broad-based 'green tax reform', with a gradual shift in taxation away from labour and towards environmentally-damaging products – together with reduced subsidisation of products and activities – will help to strengthen the environment of Norway!

With respect to the question of **what policy tools** are likely to be most cost-effective in addressing Norway's priority environmental problems, the Commission concluded (not surprisingly) that greater reliance should be placed on the use of economic instruments, often in combination with regulation. What was rather surprising was the large number of times that the Commission concluded that maintaining the existing **regulation**-based approach to coping with particular environmental problems was the best approach. The Commission's conclusions were consistent with a general view across OECD countries regarding regulatory reform: the goal in the field of environment (unlike other fields, such as telecommunications) should Ad be seen as the **dismantling** of regulation, but rather as the improvement of the **quality** of environmental regulation.

(3) Water pollution in the European Union

The European Commission has recently proposed a framework directive that would make all water users pay the **'full economic cost'** of water – in a drive to eliminate serious water pollution and to reduce waste. A major focus is on dispersed pollution from agricultural operations, with farmers expected to pay the full cost of the degradation caused by the use of fertilisers and pesticides. The draft directive defines the 'full' cost of water as including a charge for environmental costs on top of operational and management costs, capital costs and reserves for future investment. This typifies expanding efforts in many OECD countries to include environmental damage costs in the price of goods and services.

It is also noteworthy that the European Commission believes that the directive can only be fully successful if carried out in conjunction with reform of the Common Agricultural Policy, a policy which encourages over-production and excessive use of agricultural chemicals. This illustrates both the importance of policy reform as a vital environmental management tool, and the use of different tools in combination to achieve environmental objectives most efficiently.

-Whether this particular directive will ever be adopted within the European Union is unclear. However, the fact that a policy instrument of this scope and content is even being considered is noteworthy; and it reflects trends and thinking in environmental management well beyond the EU.

(4) Environmental effects of transport

Controlling the environmental impacts of transport appears to many observers to be the **ultimate** environmental challenge. Many strategies and tools are being tried, with no one claiming much success to date. In a contribution being prepared for the UN General Assembly

Special Session on Environment and Development scheduled for next June, the European Conference of Ministers of Transport (an OECD affiliate) has set out some of the current thinking in the transport community environmental policy.

The ECMT paper states that ways must be found to pass on to users, **as directly as possible**, the environmental costs of transport services, if individual behaviour is to be changed significantly. While observing that this will require a mix of regulatory and pricing instruments, the ECMT concludes that this does not necessarily mean increased prices (since road transport is already heavily taxed in some countries). Rather, prices should be better structured and targeted to provide stronger incentives for behavioural change. The paper goes on to say that **road pricing** is the most promising instrument for internalising environmental costs over the long term; and that this should involve varying charge rates according to the time of day (higher charges for peak times) and also to the specific pollution characteristics of the vehicles. It is noteworthy in this.

Regarding the choice of instruments, the ECMT states that, although introducing market forces is likely to be the most effective approach to improving efficiency in transport, complementary regulatory interventions will be required. These regulations must, however, be designed to minimise perverse secondary effects (such as discouraging technical innovation or retarding adjustments to changes in commodity or labour markets). While regulations have proved successful in reducing the levels of some pollutants from the transport sector, they have proved less efficient at influencing fuel efficiency and CO_2 emissions; and economic instruments are likely to offer better results. One approach that the ECMT endorses is product labelling **combined** with higher taxes for certain CO_2 sources. The ECMT paper also notes the importance of **land use and development planning** as an essential part of broader efforts to reduce the environmental impact of the transport sector.

Sweden is working within the European Union to push the frontiers for bringing cleaner vehicles into the marketplace. It has proposed a new **environment rating system** for cars, lorries and buses which could provide the basis for differentiated road taxes and help manufacturers in marketing 'green' vehicles. Sweden's Environmental Protection Agency claims that existing approaches – in Sweden and throughout Europe – deal with 'yesterday's problems' – such as nitrogen oxide and particulates. What is needed are policy measures to address global warming, emission of pollutants which cause asthma and allergies, and end-of-life management of vehicles. The rating system being designed would award points for factors such as emission of CO_2, emissions of specific pollutants considered hazardous to health, the efficiency and durability of a vehicle's emission control system, and the potential for recovery after scrapping. For example, some vehicles might be exempted from annual road taxes for up to five years, depending on the environmental characteristics.

(5) Climate change management in Canada

In 1992 Canada established a multi-stakeholder 'Canadian Economic Instruments Collaborative' (EIC) to investigate the application of economic instruments to air quality issues. In a recent report, the Collaborative addressed the climate change issue. It recommended that providing economic incentives to reduce greenhouse gas emissions requires, as a first step, eliminating subsidies and other policies which serve as barriers to 'no regrets' actions, and concurrently moving towards full-cost pricing for energy. After considering specific economic instruments, particularly carbon taxes and emission trading, the EIC proposed a two-part 'hybrid' instrument, one that would combine the flexibility of **traceable credits** with a **charge** levied on CO_2 emissions from large stationary sources, as well as on the carbon content of fossil fuels used by small stationary and mobile sources, to provide a clear price signal.

(6) Life-cycle impacts of automotive parts

The US Environmental Protection Agency is recommending to car manufacturers that they develop methods to measure the 'life-cycle impact' of the parts they assemble into finished automobiles. According to the EPA, cooperation between parts suppliers and auto assemblers could lead to a reduction in the use of environmentally-damaging materials, boost the use of recycled materials, lead to process designs that encourage recycling, and minimise environmental burdens across the life cycle of parts.

Advocates of this approach point out that, if auto manufacturers begin to collect data related to life-cycle impacts of parts, they could exert tremendous pressure on suppliers to reduce environmental impacts. The motivating factor for manufacturers would be not only environmental responsibility and obligations, but also the idea that a less environmentally-damaging product is often the most efficiently produced one. Manufacturers might also see this as a way to reduce environmental liability. EPA argues that, 'Environmental responsibility should be shared along the supply chain; final manufacturers should not have to bear the entire burden'.

At the same time, EPA acknowledges that the concept is limited at present by the severe lack of data – on energy, solid waste and emissions – for each life-cycle stage of most products. Most data collection for environmental purposes is currently driven by regulatory reporting requirements, and does not lend itself readily to life-cycle analysis applications.

From OECD's surveys of Member countries, and case studies such as the foregoing, it is possible to identify a **range of considerations** that policymakers are taking into account today as they design and select environment management strategies and tools:

1. environmental effectiveness
2. economic efficiency
3. incentive function (pollution reduction, technology innovation)
4. flexibility
5. simplicity of operation
6. cost of implementation (monitoring, licensing, enforcement)
7. integration in sectorial policies (cost internalisation, removal of policy conflicts)
8. social equity (minimisation of regressive distributional effects)
9. economic impact (prices, employment, industry profitability, economic growth)
10. trade and international competitiveness impacts
11. conformity with international agreements
12. political acceptability.

While each and every policy instrument cannot be expected to score high in every category, nonetheless these considerations are all weighing heavily today in the design and selection of policy tools for environmental management. This represents a considerable step forward from the early 1970s when the approach was largely one of deciding on which regulation would control a particular environmental problem in the shortest period of time.

* * *

On the questions of environmental financing and taxes, France has made some interesting moves, creating fiscal mechanisms for financing environmental agencies engaged in specific tasks. For example, the ADEME is financed partly by a tax on waste emission, certain water districts function in the same way: There is a fiscal penalty levied on industrial emissions in order to apply pressure to reduce them. In the case of the ADEME, the continued production of certain industrial wastes leads to funding for research or activities seeking to mediate their production: the polluter-pays principle. Such earmarked taxes function well when the collection and use of such funds is constantly monitored. Indeed, how are French earmarked taxes working now after 15 years' operation? Is the idea exportable? Following are excerpts from a presentation by **Jacques Vernier**, President, French Environmental Agency ADEME at the time of ECO 97.

Taxes earmarked for environmental protection: the French experience

by Jacques Vernier, ADEME

Environmental taxes have become unbeatable instruments for environmental politics, unbeatable in the way they can raise money for environmental investments, unbeatable in the way they marry the 'polluter-pays principle' to the rule that he who doesn't pollute or who invests in order to avoid polluting is given a fiscal reward. Yet such taxes are not implemented randomly but via a large, varied, and integrated structure of regulation, regional or departmental urban planning, and financial and technical tools. Many different public bodies are involved: the state, regional groups, water agencies, plus the ADEME (the Agency for Environment and Energy Conservation). The agencies are at the heart of the collection and dispersal of tax monies regarding water, air, waste, oil, and airport noise.

Use of taxes earmarked for environmental protection began in France in the 60s, first in the water sector, with the creation of legislation in 1964 and then application to water pollution beginning in 1969. In the 1980s, the practice was extended to air pollution, with a tax on atmospheric pollution established in 1985 and continued in 1990 in 1995 with modifications of the areas and the tax rates. Household waste became subject to a tax for treatment and disposal with the 1992 law, and since 1995, industrial waste taxes contribute to a special fund for the rehabilitation of polluted sites. There are other instruments, such as those used by Eco-Emballages, S.A., in which fees paid by businesses cover the costs of separated waste collection and sorting of waste packaging. Other earmarked taxes relate to airport noise and development that maintains natural open space.

The growth in earmarked taxes is part of and a reinforcement of environmental policy which implements national policy, European policy, and international commitments made by France.

The need for earmarked taxes can be found in ambitious management and pollution-prevention objectives. Most funding for national spending on the environment – by the Ministry of Environment, or by other Ministries or agencies working with the Ministry of Environment – comes from taxes on air and water pollution, and on waste.

To take some examples: in 1997, the budget of the Environment Ministry was approximately 2 billion francs; the monies from taxes on air and noise pollution, oils and waste managed by the ADEME was 1.1 billion francs. The budgets of Water Agencies reach 50.9 francs (from user fees, from industrial and domestic pollution, and from repayment of infrastructure loans).

Earmarked taxes are often criticised in the name of neutral, any-use fiscality, because such taxes are assessed by decree on specific sites and source points and are often maintained at the same level for several years. It would of course be best if interministerial negotiations took the public

interest to heart when it came to environmental protection, but national budget deficits can undermine the best efforts of the Environment Ministry when it comes to any-use monies. Indeed, what one sees is a general reduction of general-fund monies as earmarked monies increase. The ADEME can attest to this in regard to its budget, and it is thus that energy conservation, even at this crucial moment, has become the poor relative of other environmental policies.

With regard to the annual versus pluri-annual budget, the advantage for environmental agencies lies in the visibility and need for a possible long-term when it comes to the considerable investments required. Short-term funding would simply not suffice. And, furthermore, there is some democratic control over even long-term taxes: the tax on atmospheric pollution was re-considered in 1990 and 1995 before being re-applied long-term. Other democratic controls include water-basin commissions or commissions charged with managing taxes on air pollution or waste, along with regional authorities, non-governmental organisations.

So it is difficult to imagine today what system might replace earmarked taxes as a means of reinforcing environmental protection, and, as a matter of fact, most stakeholders approve of the system.

Small earmarked taxes linking the polluter-pays principle and the principle of aiding those who invest to avoid polluting are part of a complex system of regulation and incentives. These taxes, 35 francs per ton of household waste in January 1997, twice that for industrial waste, or 180 francs per ton of, for example of nitrates, exist in place of the less-accepted eco-taxes which might more accurately reflect environmental costs.

Realistically, there is no agreement on the real economic costs of certain activities on the environment or on human health. Further, the introduction of genuine eco-taxes is still a politically, socially, and economically unacceptable solution. Issues of competitiveness in the absence of international harmonisation of standards, costs, and prices are problematical. Many arguments exist in opposition to economic environmental theory as put forward by international institutions such as the OECD. Yet we are even now on the verge of having an eco-tax on CO_2 emissions. Earmarked taxes are an evolution in the right direction.

While not everyone is in agreement about the respective merits of various economic incentives versus harsh regulations, almost every agrees to the need to send a signal to the market about the costs of environmental degradation. Thus, modes of production and consumption which cause less damage to the environment are encouraged, and other more destructive modes are discouraged. Fiscal instruments available to accomplish such ends go beyond earmarked taxes to include tax deductions or lower taxes on processes that respect the environment. The simple fact of having the environment a factor in taxation plays a major role. Investors are made aware of the best ways to avoid pollution or to treat emissions, discharges, and general waste, or else they pay according to the damage caused. Logically, revenues from environmental taxation ought to end up as part of the state's general funds, thus avoiding a specific administration for earmarked taxes.

But things are not so simple. The facts show that, over the long term, the tax on petroleum products which raises the price of fuel to the consumer in France has had a beneficial effect on technological choices. This doesn't mean there have been no problems, such as when this kind of tax goes counter to good environmental sense, such as when prices go up on un-leaded gas and down on gazole.

On the other hand, if we were to suddenly introduce genuine eco-taxes, internalised within costs, even if we were to satisfactorily settle questions of international harmonisation, of neutrality, the situation would still be brutally abrupt, leading to the need for a new collective mobilisation to re-finance in accordance with environmental objectives. The goal of environmental protection might not be reached, and no level of taxation could immediately ameliorate real environmental damage. With environmental demands simply a budget item in the general budget, we are back to arbitrating amongst various public needs.

Earmarked taxes which fund specific environmental objectives appear to have several advantages:

1) They signal the public interest in pollution prevention; there is both a clear interest in dealing with certain kinds of pollution and an availability of funds.
2) They apply the polluter-pays principle at an acceptable level.
3) They favour economic and environmental efficiency with a tax that is low and because those who invest to reduce pollution are aided.
4) Because they are graduated according to the level of pollution or use (as in the tax on waste), they are clear and allow the user to adapt and anticipate.
5) They allow for financing of intervention programs and encourage innovation.

* * *

At the corporate level environmental management systems and tools (LCA, Risk Assessment, eco-design, eco-labelling and company environmental reporting/ranking are some of the tools for change being used by increasing numbers of companies. Ira F. Feldman of GT Strategies + Solutions is a consultant in Environmental Management and former director of the US Environmental Protection Agency's Environmental Leadership Program. He conducted a workshop on Strategic Environmental Management at ECO 97. Among those participating was **Valérie Martin** of the French Agency for Environment and Energy Conservation. Following are excerpts from her report.

Transition of the 90s

by Valérie Martin

Businesses are subject to growing external and internal pressures to integrate environmental considerations into their strategies: increasingly aware citizens, elected officials and administrations, client pressures, the development of international standards, the evolution of regulations, the growing interest from the financial sector. Environmental awareness can also be seen as part of the social role of business with the new emphasis on environmental quality as part of working conditions.

The Brundtland Report, 'Our Common Future,' by the Global Commission on Environment and Development, headed by Gro Harlem Brundtland, was published in March, 1987. It warned of the dangers implied by environmental deterioration and identified poverty as its major cause, and, thus, environmental protection took on a new international role. Analysing the politics of each country, the report showed that environmental concerns must be part of development in order that development be sustainable. Sustainable development was defined as development which meets the needs of the present without compromising the capacity to meet the needs of future generations. The report became a basis of the 1992 Rio de Janeiro Summit.

The United Nations Conference on Environment and Development at Rio adopted its Declaration, Action 21, and Principles in June, 1992. The Declaration consecrated the interdependence of ecological, economic, and social problems. It advanced the importance of a global partnership, involving all citizens, to protect planetary resources. It proposed principles of equality and solidarity among nations, along with the precautionary principle. Significantly, many from the worlds of business and industry were associated with Rio. Action 21 constituted

the action plan approved by the Rio Conference, underlining the need for $70 billion a year by the year 2000. The convention on climate change was also developed; nations ratifying the convention would confirm their willingness to adopt a precautionary position in regard to atmospheric and greenhouse gas conditions.

The Brundtland Report and the Rio Summit were strategically significant for both governments and industry and became the basis for environmental politics moving into the 21st century. Many economists and politicians believe that the next thirty years will be definitive for the future (Gore, Al, *Earth in the Balance*, Harper Row, New York, 1992). In Europe, the legislative advances of the 90s (the European Directive on urban waste water, 1991, the French water law of 1992, the French waste-treatment law of 1992, etc.) are evidence of a transition from a system based on repairing damage to the environment to a system to prevent damage. New recognition of environmental questions has also come from the business sector: the International Chamber of Commerce Declaration, eco-labels, eco-audit regulation, the ISO 14000 series, etc.

Up until the present moment, most national environmental policies have been based on the 'Command and Control Approach.' As Jean Philippe Barde describes it in his book *Economy and Environmental Policy,* command and control is the mechanisms of environmental policy which include laws, emission standards, permits, etc. This approach is characterised by an administrative and regulating force, which sets objectives, general principles, procedures, and implementation procedures. Difficult to establish, and to change, such mechanisms have the advantage of offering certain guarantees and results.

Progressively, public officials are engaged in promoting new structures which encourage rather than penalise, which make environmental concerns a factor of development rather than a constraint factor. Among the changes envisioned is the involvement of various economic players in both the definition and application of environmental policy. In this domain, for many stakeholders, the ISO 14000 standardisations will lead to full participation in environmental management.

Example: Japanese policy in environmental management

National consideration of issues on the economic/environment interface is undertaken by the Ministry of Trade and Industry (MITI). In addition, Japanese businesses are expected to follow legislation put forward by the Ministry of Environment. There is now a rapidly-growing eco-business sector as a result of the Japanese public's interest in environmental questions and of the fact that a majority of large firms have environmental directors and environmental strategies. After the ISO 14001 standards were published in 1996, the MITI created the Japan Small Business Corporation for the purpose of informing and assisting small and medium-sized businesses with ISO 14000. It is notable, however, that such a written prescription is rather unusual in a culture where the general tendency is for tacit agreement. Nevertheless, the Ministries of Construction and of Health depend heavily on ISO 14001. Sometimes the motivation for adopting environmental management standards lies abroad, particularly in Europe, where, for example, Canon Brittany was one of the first companies in France to be certified in conformance with ISO 14001. In general, the interest in Japan in environmental management is high: ¾ of all businesses claim to seek ISO 14001 certification (especially the large groups along with export groups). 50% of Japanese businesses feel that the lack of certification will be held against them. The Ministry of Environment has created an Environmental Performance Evaluation Program which trains consultants who in turn train small and medium-sized businesses.

* * *

With environmental management spreading rapidly throughout the world, the issue becomes how to reconcile industrial strategy and environmental policy. Environmental concerns are entering into industrial strategies. The questions are these: What is at stake when a business adopts environmental management? What is the role of various environmental management tools? How do these tools compete with one another? Can a business get along without them?

Towards a new norm of business management

As a means of responding to public demand for an environmentally-responsive business sector, businesses must reconcile profitability with environmental awareness. Voluntary action on the part of the business sector is the crucial factor here.

a) Why integrate environmental management into business strategy?

Various business motivations are:

- to assure better internal organisation, identification of tasks and actors;
- for managers, to develop a better knowledge of the factory and its work flow;
- to increase environmental awareness and to anticipate future regulation;
- to be recognised as a good-citizen business, to be socially responsible;
- to integrate environmental soundness as a driving factor equal to quality.

Within a community, motivations are:

- to better integrate the business into the community;
- to create confidence and good will for the business vis-à-vis the local power structure;
- to improve communication with the media (and not get caught short).

In the marketplace, motivations are:

- to meet the demands of large clients;
- to beat the competition;
- to assure the final buyer of the environmental quality of the product and the business.

b) Different possible responses to the environmental challenge

Faced with this new challenge, strategies adopted by various businesses are multiple. A. Louppe and A. Rocaboy (Louppe Albert, Rocaboy, Anne, 'Green consumerism and Marketing,' *French Management Review*, n. 98, March-April-May, 1994), distinguish between five possible strategies: a hostile response (all ecological concerns are by nature uneconomical), a defensive response (the environmental factor is considered a threat), an accepting attitude (the environmental factor is a legitimate social concern but not the responsibility of business), a cooperative response (a willingness to be involved in environmental objectives), and a proactive response (managers integrate environmental soundness into their quality objectives). The latter is still a rare response.

Nevertheless, increasingly, large corporations are becoming aware of the notion of sustainable development. Many of them have developed improved relationships with their sub-contractors requiring environmental awareness in products and processes, and directors of environment are now part of the leadership team.

In 1990, the Worldwatch Institute of Washington DC gave the world only forty years to move towards an environmentally-stable society. 'If we don't accomplish this within the time limit, environmental deterioration and economic decline will grow together, throwing the world into

social decline as well.' (*Courrier International*, n. 341, Tom Althanasiou.) It is generally agreed that environmental questions go beyond classical management solutions. Thus, the development of environmental management is entrusted to specialised managers, which clearly is an entirely new response suited to a 21st century challenge. Georg Winter, in his classic book *Business and Environment: A New Synergy,* McGraw-Hill, 1989, states that 'every CEO seeking to guarantee the long-term existence and profitability of his business must as soon as possible integrate environmental management into his thinking.'

In terms of organisational structure, the integration of environmental principles leads to new positions in every division, thus altering hierarchical dominance. Indeed, the pyramid structure often found in both American and European businesses required strict centralisation and little opportunity for cooperation within separate division in a business. Businesses organised in a structure characterised more by a horizontal shape seem to be more flexible when it comes to environmental management, specifically because of their openness to collective communication.

According to the Japanese economist M. Aoki, one of the determining factors in an organisation's capacity to react is the availability of information. The organisation of a typical Japanese firm, characterised by its horizontal informational structure, facilitates communication within the company. This structure leads to improved sharing of information among different divisions. Further, employees become active stakeholders as problems are treated at every level. Integration of environmental preoccupations is thus generally superior, given that they are often new or complex questions.

c) The willingness on the part of business to face change and progress

The growth of the new environmentally-aware culture within the business world is encouraged by leading CEOs. Frequently, they establish new trade or sector associations which work towards a better relationship between economic development and environmental protection; at the same time, they enhance a 'sustainable' corporate image. The 16 principles put forth by the International Chamber of Commerce in April, 1991 regarding environmental management systems and sustainable development are the following:

1. high priority for business
2. integrated management
3. process of improvement
4. training of personnel
5. continuous evaluation
6. products and services
7. consumer advice
8. new activities
9. research
10. preventive measures
11. sub-contractors and suppliers
12. emergency plans
13. technology transfer
14. building a common effort
15. remaining open to dialogue
16. respect for objectives and information.

The Business Council for Sustainable Development, led by S. Schmidheiny, has played an important role; a non-governmental group made up of company leaders seeking to play a catalyst role, they have advocated integration of environmental concerns into management. Created in 1990 in preparation for the Rio Summit so that the business point of view could be included in discussions organised by the United Nations Commission on Trade and Development, the group anticipated the major themes developed at Rio. In Europe, organisations such as the International Network for Environmental Management, Entreprises pour l'Environnement, and OREE all encourage environmental management.

Progressively, programs promoting voluntary agreements are appearing in industrialised countries, in varied forms. In Japan, for example, voluntary agreements are essentially local agreements between municipalities and industrial groups; in the United States, they often elaborate upon the voluntary programs for pollution reduction as outlined by regulatory agencies; in the European Union, the coexistence of more than 300 voluntary agreements recognised by the authorities, with special attention to the Dutch 'covenants.' Essentially tools for implementing regulation, the covenants, which relate to both products and the production process, are one of the major elements of new Dutch environmental policy. They are implicated in the permit system (relating to levels of emissions in factories), because their objectives are integrated in the permit system. The goal of the Dutch authorities is to develop a shared responsibility for environmental protection.

Voluntary agreements can be defined as missions undertaken by a single firm or by accords signed by a group of firms. Various kinds of accords have been identified, depending on three variables: the nature of the industry, the weight given to the public authorities in the agreement, and the type of sanctions levelled on those not respecting the accord. Voluntary agreements – collective accords negotiated with public authorities but without judicial status, are thus the most common.

d) Environmental management – the advantages and disadvantages

The advantages:

1) reduction of costs (reduced use of primary resources, accident prevention, etc;)
2) improved quality
3) reduction of liabilities and complaints
4) anticipation of regulation
5) involvement of all employees
6) stimulation of innovation
7) improved image.

The disadvantages:

1) start-up costs
2) increased bureaucracy
3) potential conflicts with existing management systems.

Some facts about environmental management
(Source: International Federation of Consulting Engineers – Bernd Kordes)

Number of companies involved worldwide: 100 000

Number of sites per company: 2

Average cost per site: $50 000

Average annual cost per site after start-up: $10 000

Use of outside services: 20%

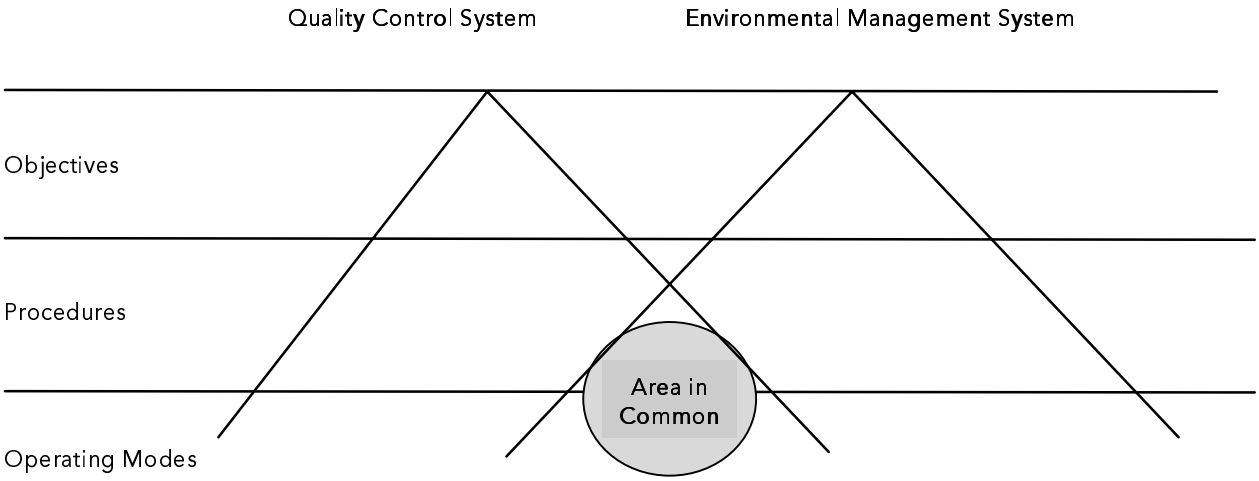
Total market for start-up: $2 000 000 000

Total market for operation: $400 000 000 per year

Starting up an Environmental Management System: standards, regulations, tools, etc.

Starting up an environmental management system often involves two types of problems: a pre-existing and incompatible quality-control system or the inability (due to absence of personnel or methodology) to start up a new system.

In the first case, many businesses try to annex an environmental management system onto their pre-existing quality-control system. The following graph shows where commonalities might exist:



Thus, the ISO 9000 standards (quality) emphasise elements related to process, while the ISO 14000 standards (environmental management) emphasise business strategy, objectives, and communication. ISO 14000 standards insist on pollution prevention and performance improvement. But the two systems are similar in their functioning.

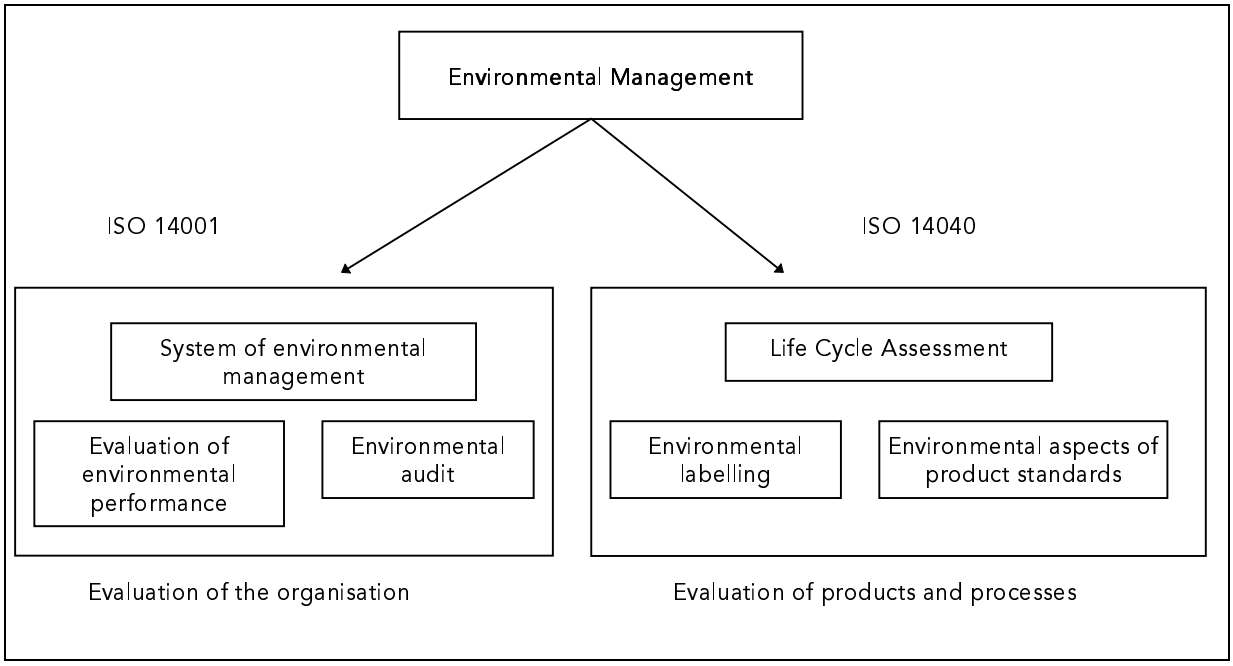
Certain experts believe today that the pre-existence of an ISO 9000 system doesn't hinder the start-up of an ISO 14000 but instead accelerates the latter for four reasons: a system (policy, objectives, programs, procedures, training, document management, performance review) is already in place; a means for establishing procedures already exists and it is easy for the business to add paragraphs related to the environment; the business already has a system of working meetings related to quality, progress or improvements, and, thus, questions concerning environment can simply be added to this structure; procedures for treating non compliance already exist so they can simply be applied to environmental non compliance.

On the other hand, the pre-existence of an ISO 9000 system has a tendency to reduce or simplify radically the specificities of an ISO 14000 system.

Origin and history of the ISO 14000 standards

ISO 14000 standards have become more accessible as a result of all the work done on them by various experts. The International Standard Organisation (ISO) developed the ISO 14000 standards through the work of the Technical Committee 207 whose objective was to provide interested organisations with a common approach to environmental management.

Organisation of Technical Committee 207

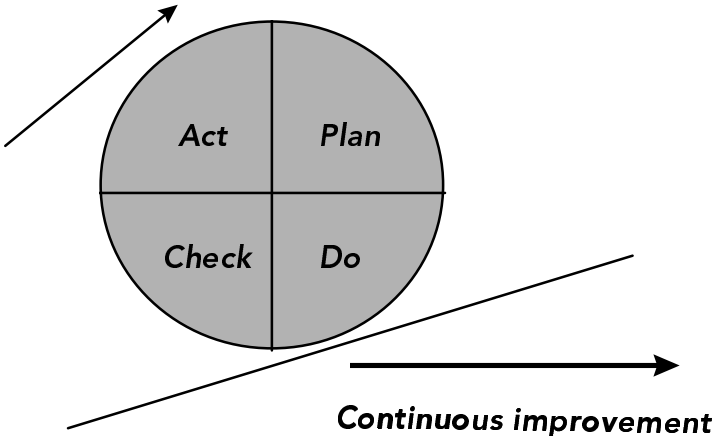


The European system EMAS was also a significant step in the development of tools.

a) The ISO 14001 standards

Technological warning system, tool for observing competitors or for protecting one's products, window onto technical evolutions – these descriptions are all attributed to the standards. Further, unlike regulations, a standard is a voluntary action. In a few brief years, standardisation has completely changed. Formerly protectionist and purely technical, it has become a strategic and marketing tool. Now the principle of environmental management looks like this:

Deming's Wheel



Plan: Decision by Management
Policy/Objectives/Planning/Program

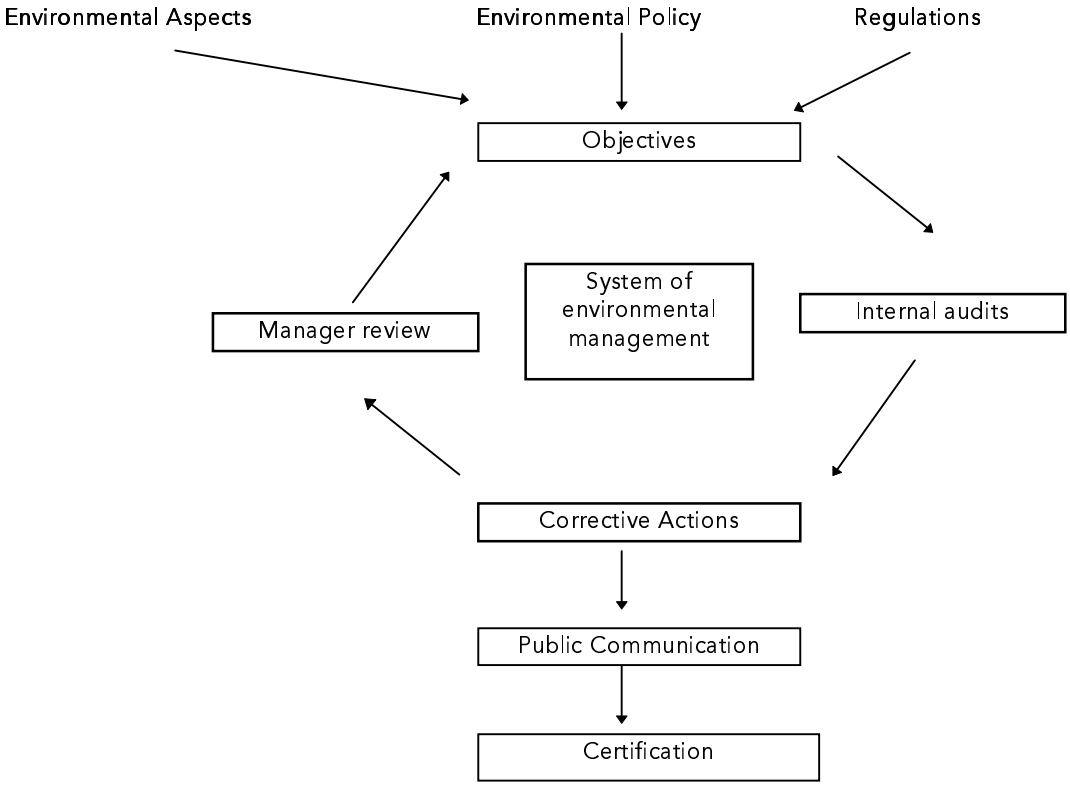
Do: Start-up of elements

Check: Review/Audit

Act: System Review
System Efficiency
Modification of Objectives/Reactions

The ISO 14000 standards 'directives for a management system' define the principles and the recommendations for starting up an environmental management system. The ISO 14001 'specifications and instructions for use' define the requirements a system ought to satisfy. They become the means by which a third party can certify that a business is demonstrate its capacity to control environmental impacts. All businesses, whatever their size or their sector, can obtain an ISO 14001 certification. It can apply to a particular site or to the whole business. Local governments can also apply such standards to waste treatment plants, to industrial zones or to the maintenance of open spaces. The philosophy of ISO 14001 is based on its voluntary nature, and on its definition of objectives and targets.

The necessary steps are as follows:



The basic ISO 14001 standards were published in September, 1996, and therefore established the existence of environmental management systems. Such systems do not replace regulation, but can, as Ira Feldman of GT Strategies + Solutions points out, aid and stimulate industry in developing beyond regulation.

The use of ISO 14001 standards can be seen in four ways:

1. internal functioning, interrelationship between divisions concerned with environmental questions;
2. creation of inter-site leadership (competition between sites);
3. external assistance, as in winning contracts where certification is a requirement;
4. the certification itself as a source of competitive advantage.

Environmental management is occurring in both developed and developing countries, even though at first it was perceived as an obstacle in trade within certain developing countries. In fact, it is facilitating trade. In the United States, certification is spreading rapidly. In France, it is not. In Japan, certification has grown rapidly, with more than 100 businesses (1997) certified in the electronics industry and more than 400 expected by 1998.

Ira Feldman points out four major points that attract businesses to ISO 14001 certification:

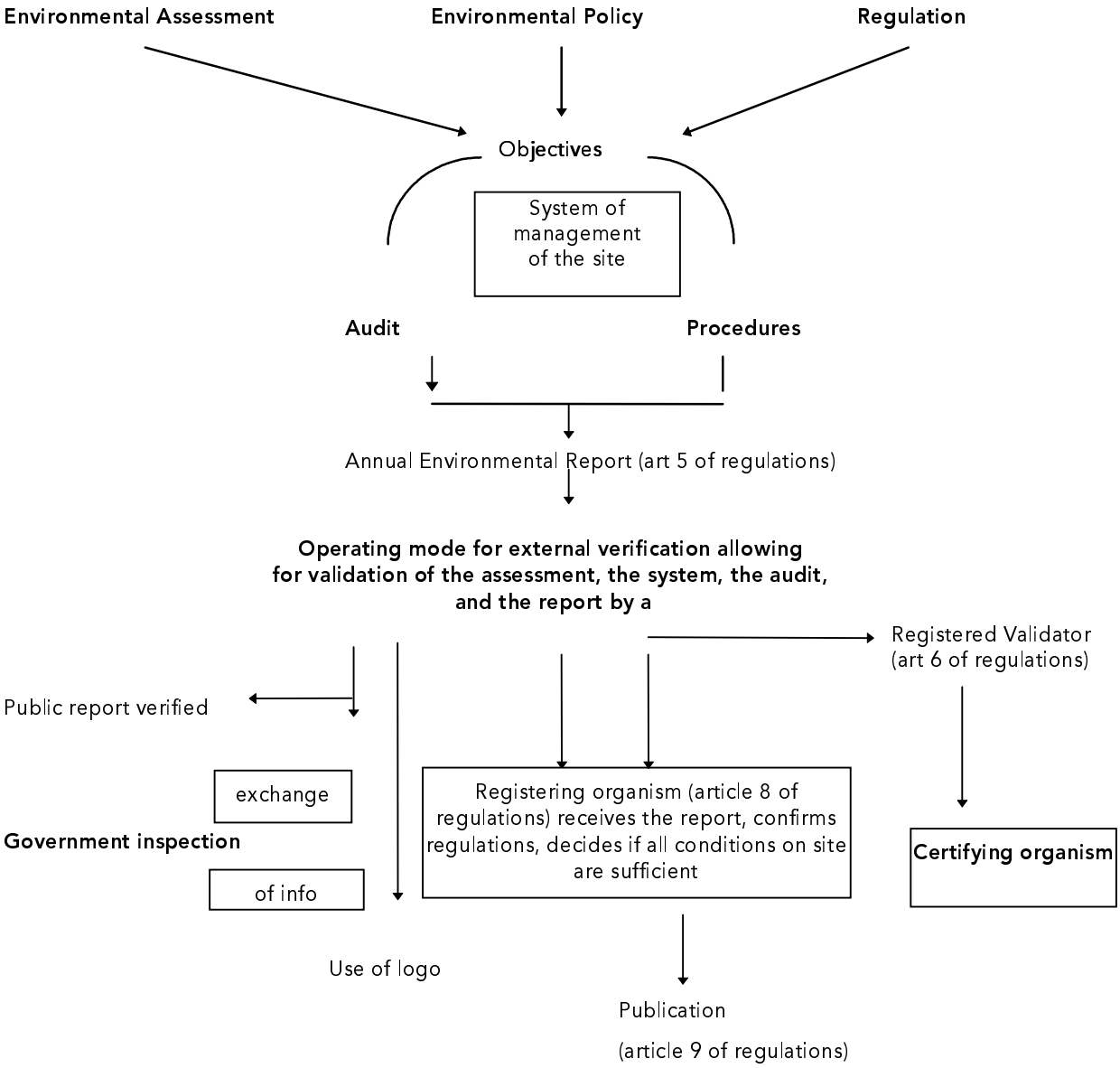
1. staying in the race;
2. improving efficiency and reducing costs
3. anticipating regulation
4. obtaining preferential treatment from banks and insurers

b) The European Eco-Audit System (EMAS)

The European Eco-Audit regulations were original in their legalistic structure and in their operation. After various systems were developed throughout the European Union (British BS 7750 standards, French X 30-200 standards, Irish IS 310 standards, Spanish UNE 77-801 standards, etc.), the European Council adopted in June, 1993 a system of regulation allowing for voluntary participation on the part of businesses. This system is in effect since April, 1995. Its objective was to encourage industrialists to adopt site-based environmental management systems and to communicate about them with the public. The system is entirely voluntary. At present, EMAS concerns only industrial production sites, with plans to extend it to transportation, tourism, banking and insurance.

J. C. Binetti of Gut GmbH describes the specific objectives of EMAS as multiple: to promote continuous improvement in environmental performance through establishing policies, programs, and management systems; to establish a systematic, periodic, and objective evaluation; and to furnish adequate information about the subject to the public.

In order for a site to be registered in the EU's environmental management system, the business must do the following:



The EMAS logo cannot be placed on products involved. EMAS will have been revised in 1998, and the European Commission was to look at the question of logo use. Further, the Commission will have also examined the question of making the system obligatory.

In Germany, 595 companies are certified EMAS, and most large German companies already have an environmental management system and adhere to EMAS. Why is certification so dense in Germany? A study by the Friends of the Earth for Enterprises pour l'Environnement (a study of Germany, France, Netherlands, and United Kingdom, Bénédicte Achard, September, 1997) shows that EMAS is popular in Germany and the United Kingdom because of tight relations between industrialists and the administrative organisation, leading to relaxing of regulation as well as infrequent unexpected inspections; and because the technology is transferred readily to small and medium-sized businesses. In France, the administrative system is cumbersome, and the industrial community is unconvinced of the system's value.

For all of Europe in June, 1997, the Ministry of Environment in France provides the following figures on registered EMAS sites:

	Registered sites	Certified inspectors
Germany	595	148
Austria	74	10
Belgium	3	0
Denmark	27	4
Spain	4	0
Finland	4	2
France	9	10
Greece	0	0
Ireland	3	0
Italy	0	0
Luxembourg	0	0
Norway	18	4
Netherlands	14	3
Portugal	0	0
United Kingdom	34	9
Sweden	62	3
TOTAL	847	193

According to J.C. Binetti, arguments in favour of EMAS adoption include the reduction of risk, respect for the law, competitiveness, reduction of costs, and improved general organisation.

Comparisons between EMAS and ISO 14001

The differences are twofold: EMAS requires a more complete initial environmental review as well as a declaration of compliance from a third party. This leads to substantial performance evaluations. EMAS attaches much more importance to improvement of environmental performance than ISO 14001, which emphasises primarily start-up and improvement of the system itself.

It is interesting to compare the growth of the two systems. In Europe, the regulations are changing in six ways:

1. registered companies are adopting standards;
2. systems throughout Europe are being harmonised;
3. tools are being developed for sites of fewer than 250 employees;
4. assistance is becoming available;
5. promotion and awareness campaigns are developing;
6. EMAS and ISO 14001 are becoming compatible.

Application in the developing countries

In developing countries, the United Nations Environment Program (UNEP) and the International Federation of the Engineers Consultants (FIDIC) notice that the increase in use of environmental management systems (and particularly ISO 14001, which has an international scope) is due to a long period of 'command and control'. This change seems to be very positive,

even if it would not be good to have only voluntary standards. On the contrary, they should develop along with 'command and control' in order to guaranty environmental performance.

c) The development of environmental management tools beyond certification

In 1990, following the reflections that led to the elaboration of the National Plan for the Environment, the Ministry for the Environment, the ADEME wished to set up a partnership with the economic sector. The Environment Enterprise Plan is the tool of this policy. The originality of the partnership is that it concerns all companies whatever their status, activity sector or size, as well as their functions: supply, production, distribution, finance, human resources, research and development, organisation, marketing. We can present the Environment Enterprise Plan as a tool aimed at the creation of strategic business policy as well as information and communication.

The Environment Enterprise Plan is:

- a tool for structuring the environmental policy of a company, which can define, grade and quantify the objectives as well as elaborate an action plan;
- a methodological and conceptual frame to conceive and initiate an environmental policy.

ADEME has the mission to adapt the Environment Enterprise Plan to small enterprises (SME/SMI). To adapt it to small and medium-sized businesses required adaptations to make it more accessible; the objective of ADEME is to help all economic actors anticipate better the evolution of regulations, to aid their decisions and to ameliorate the efficiency of their environmental management.

There still a last point to develop: whether or nor choosing an external consultant to assist in the start-up of an environmental management system. One must underline the fundamental importance of the implication of all company employees in this decision. For training in the process, UNEP, the ICC and the FIDIC have developed a kit for environmental management systems.

Conclusion

Environment appears for some companies as a strategic opportunity. Environmental questions can be transformed into new commercial opportunities and represent one a rare opportunity to distinguish oneself from competitors. Environmental management can be a means for a company to position its products and to show an 'eco-citizenship' towards its employees, clients, and shareholders. Environmental management is a genuine technical and organisational innovation, particularly because of the major economic issue that a better integration of environment into public and private strategies represents. However, in order to **fix permanently** the place of environmental questioning within companies, it is important that companies develop an integrated strategy in order to gather all involved partners together around a more positive and pro-active vision of environment. Also, the set-up of an environmental management system should facilitate access to financial markets. The main goal of this specific system is the optimisation of global and environmental results. To achieve this, a system must be periodically re-evaluated and revised. The existence of such a system can offer certain guarantees to investors and insurers. The question of outside certification is problematical. Some companies have created excellent internal audits. The purpose of the system is to have a state-of-the-art standard recognised by all. It is generally voluntary and shows the user's desire to meet certain standards.

But aren't environmental standards really a means of creating hidden trade barriers or tariffs? En fact, the proliferation of national, regional, and international standards, even those based on public demand, reinforces obstacles to free trade. But environmental regulations will have an increasingly important role in future markets and will thus effect competitiveness. Environmental performance will take its place within business alongside human resources; the two are equal partners in sustainable development.

* * *

Within five years of its founding, Ecobilan was the world leader in matters of applied life-cycle assessment. The company now has branches in five countries, and is therefore a privileged observer of the development of environmental policy in the large industrial groups. Ecobilan also functions as a proselytiser for the techniques of life-cycle analysis as applied to industrial strategy. What are their tools? LCA involves accounting for all consumption and emissions during the life cycle of a product or of several alternative products fulfilling the same function, from the extraction of primary materials through the treatment of wastes. Today, life-cycle analysis is ISO standardised, but its uses and forms constantly evolve. At ECO 97, **Jean François Bensahel**, President of Ecobilan at the time, presented a new method and information system (EIME) developed with several large industrial groups for the designing of sustainable products. The system proved interesting far beyond this consortium. Among the first clients were Kodak and Eriksson, and now (spring, 1999), major automobile manufacturers are studying the system for use in automobile design. Further, the Fédération de la Plasturgie has launched research on the development of an adaptation of Ecobilan's EIME system for their sector.

It's clear, though, that sound product conception is not just a question of software. As constraints increase, industrial conception processes pose particularly demanding management problems: how to coordinate into concurrent engineering the growing number of experts with possibly contradictory points of view ? How to steer the process towards a technical compromise that is innovative yet goal-oriented in terms of quality, cost, and design deadlines ? How to efficiently articulate research objectives and solutions and the actual product-conception phase ? All of these questions are at the heart of integrated eco-conception of products and are the subject of a three-year joint research project Ecobilan/Centre de Gestion Scientifique de l'Ecole des Mines de Paris in cooperation with an electronic sector group.

What is Environmental Information Management Explorer (EIME)?

by Jean François Bensahel

Overview

More and more concerned with manufacturing products with improved environmental profiles, companies strive to integrate environmental constraints early in the design phase. This ensures the efficient use of natural resources and minimisation of environmental impacts, the acknowledgement of increasing product-based regulations and standards such as Ecolabels, the fulfilment of customer needs, and the consistent implementation of the company's environmental policy.

That is why IBM, ALCATEL, LEGRAND, SCHNEIDER and THOMSON Multimédia decided to join forces and select the Ecobilan Group to bring forward a new software design tool, database, and environmental management system - E.I.M.E.™ - Environmental Information and Management Explorer. This flexible, user-friendly, yet powerful Design for the Environment (DFE) tool:

- provides real time access to distributed data;
- can be used concurrently by several persons and allows for the sharing of design data;
- allows the comparison of the environmental profiles of different design alternatives;

- gives contextual warnings and 'to do' reminders during the product description process;
- allows for the determination of environmental target values to be used by designers in benchmarking their design alternatives.

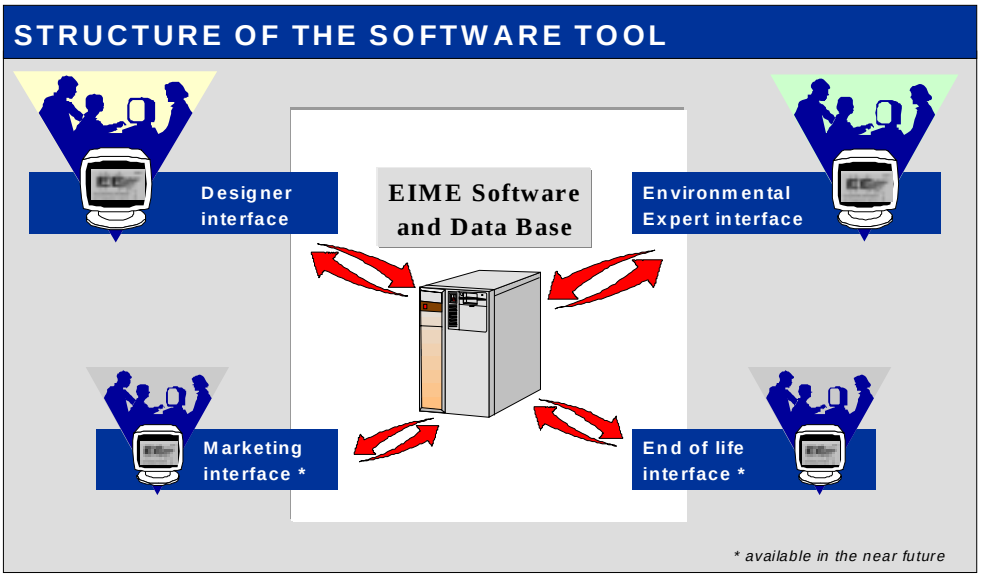
The Ecobilan Group is the proprietor of the EIME code. Developments and advances in regulatory aspects, impact assessment methodologies and decision analysis methods will be reflected in future versions of the tool.

This tool differs from Life Cycle Assessment (LCA) in that LCA is used to obtain very detailed results of the environmental impact of a specific option and requires an in-depth knowledge of the technique. Often, the scope and breadth of an LCA precludes it from being systematically used in the design of new products. LCA is then used to derive general guidelines applicable to a broad range of products sharing similar issues.

DFE is complementary and geared towards the actual implementation of such general life cycle guidelines and therefore involves many participants in an organisation. Furthermore, not only is quantitative life cycle information addressed in DFE, but also non-LCA information such as toxicology, regulatory, end-of-life and dismantling aspects.

Different interfaces for different users

EIME is built on a client-server architecture. Different interfaces have been developed in order to answer to different needs from different departments inside the company: design, environment, sales and marketing, recycling ... All these interfaces have access to the same database.



Who will manage the tool?

The company's environmental experts, by:

- feeding and updating the database;
- specifying internal environmental policy (target values per family of products, etc.);
- updating regulatory information;
- preparing and managing tutorials;
- certifying the environmental quality of the designer's work.

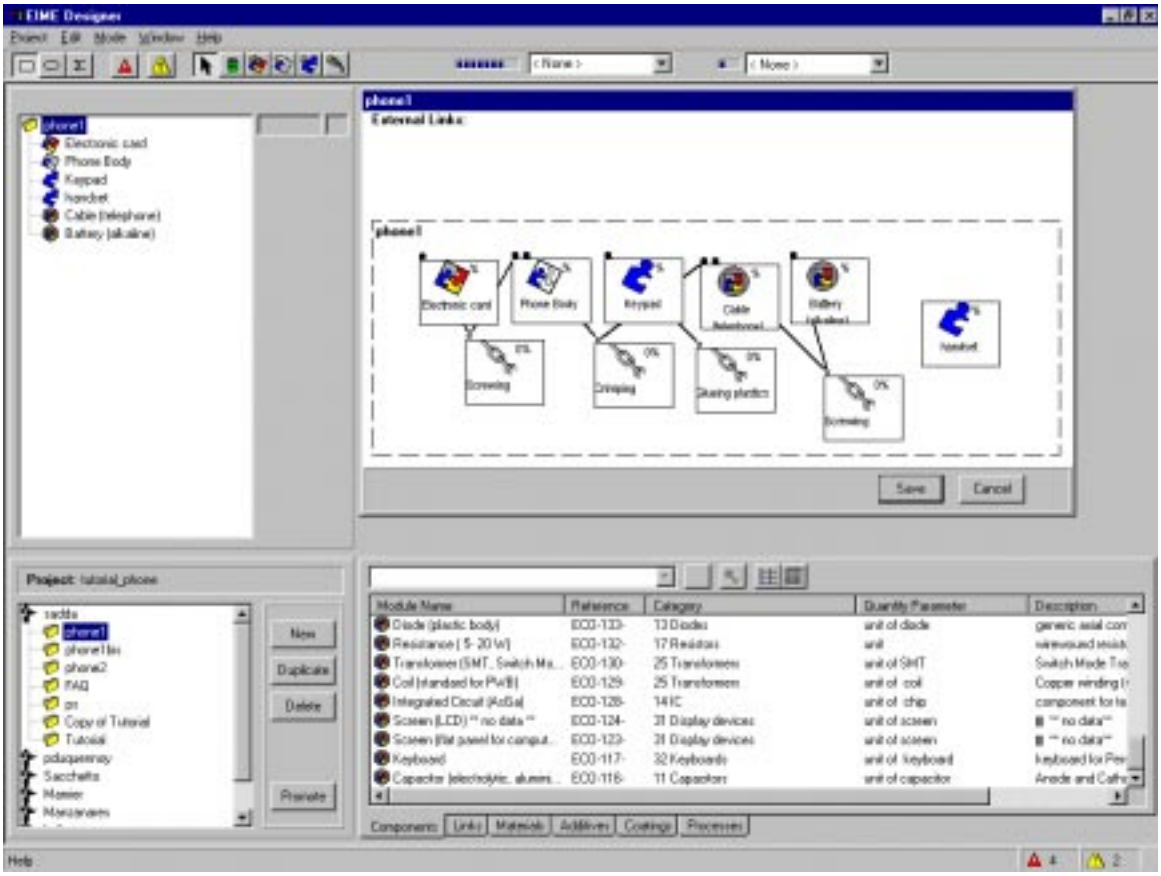
What will be new for the designers?

The designers will be empowered to easily evaluate the environmental impact of their design alternatives, improve them, and be sure that they are in compliance with clients' specifications, internal environmental requirements, and regulations. They will not need to be environmental experts, LCA literate nor will they need to collect data. Their principal input will be placing product descriptions into generic parts and processes present in the database.

Through the use of client/server technology, this tool will also provide the added benefit of enhancing communication between marketing, R&D, and environmental staff.

EIME™ designer interface

Designers create product designs by dragging and dropping materials, components, links, and processes from the extensive EIME™ database as shown in the following figure.



The top right window is where the graphical interface of the product design is shown. Below is where the database is contained. Here designers choose from a wide variety of materials, processes, links, additives, and electronics components. The bottom left window is the project management window where the one can see the different users that have access to EIME™ as well as the different projects associated with the users. The top left window shows product design in a hierarchical or tree structure showing the different assemblies and subassemblies of the design.

Designers can evaluate and eventually improve the environmental profile of their products through metrics. Environmental impact and design metrics are shown both in tabulated form and in graphical form. Tabulated life-cycle impact indicators can be shown as follows for a product design.

EIME Designer

Project Edit Mode Window Help

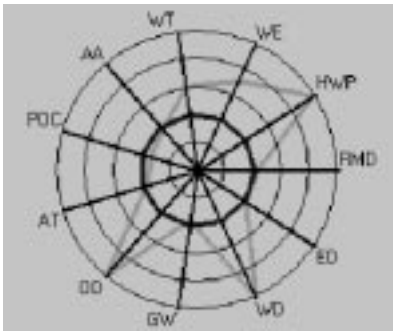
Compute Value Mode Absolute

Indicators	Short	Unit	phone1 (1,000 unit)			
			S=M+D+U	M	D	U
Raw Material Depletion	RMD	Y-1	1,27E-13	1,25E-13	5,81E-16	1,55E-15
Energy Depletion	EDTST	MJ	1,11E+03	2,87E+02	4,60E+02	3,65E+02
Water Depletion	WD	dm3	2,12E+02	7,85E+01	1,20E+02	1,38E+01
Global Warming	GW	g ~CO2	5,08E+04	1,21E+04	2,03E+04	1,85E+04
Ozone Depletion	OD	g ~CFC-11	9,96E-04	2,31E-04	6,20E-04	1,45E-04
Air Toxicity	AT	m3	4,65E+07	6,97E+06	3,17E+07	7,88E+06
Photochemical Ozone Creation	POC	g ~C2H4	9,26E+01	2,69E+01	3,73E+01	2,85E+01
Air Acidification	AA	g ~H+	1,29E+01	3,74E+00	4,49E+00	4,65E+00
Water Toxicity	WT	dm3	2,64E+03	1,95E+03	4,49E+02	2,40E+02
Water Eutrophication	WE	g ~PO4	1,06E+00	7,30E-01	2,31E-01	9,88E-02
Hazardous Waste Production	HWP	kg	1,15E-01	1,10E-01	4,48E-03	6,06E-04

Impact Indicators | RMD1 | EDTST2 | WD3 | GW4 | OD5 | AT6 | POC7

Impact Indicators | Design Indicators | Bill of Materials

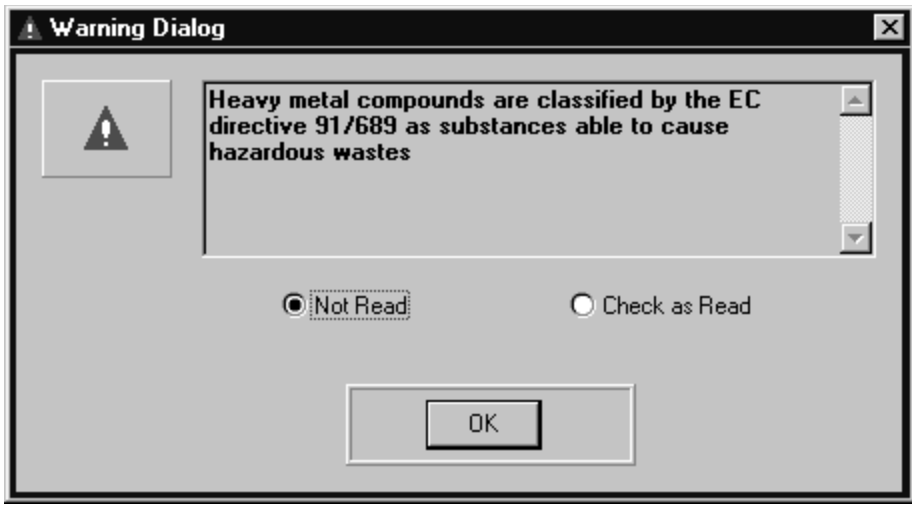
They can also be shown graphically using a radar graph. In this case, two different product designs can be compared with respect to the different impact indicators.



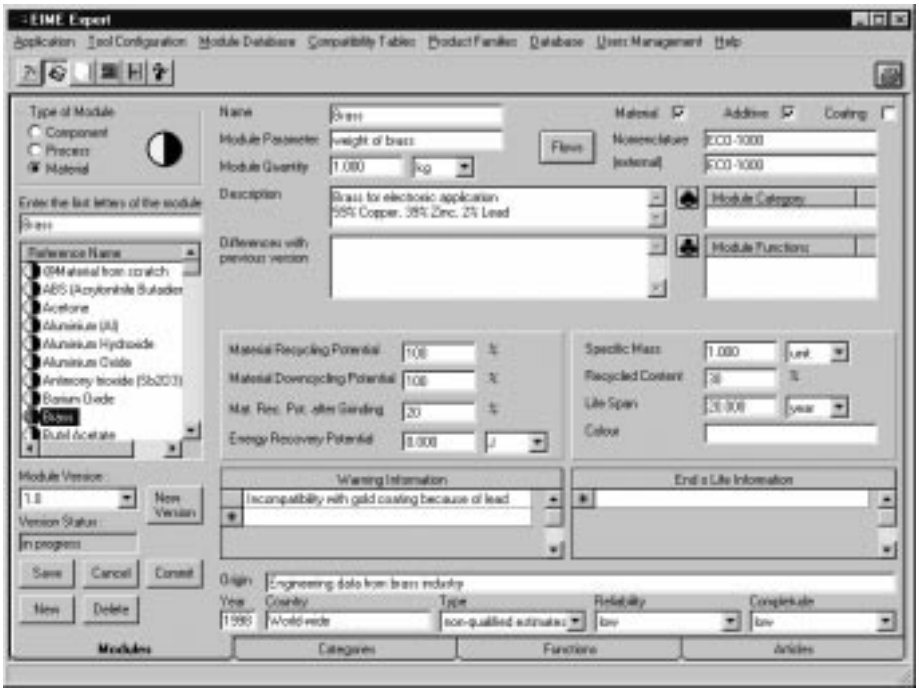
Also, design indicators such as number of hazardous materials, number of distinct materials, and number of parts are also tabulated for a particular design.

EIME™ expert interface

Within EIME™, designers and environmental experts each have their own interface. 'Experts' use their interface to customise the software for the designers. Environmental experts can use the software as an environmental management tool to pass along environmental regulations, company targets, or environmental news to designers. Experts can also provide 'pop-up' warnings to designers so that they receive instant feedback during the design process.



Environmental indicators can also be customised so that each company can use the indicator(s) that is best suited for them. Finally, the expert can customise the module database and add into the database the components specifically used within a respective company.

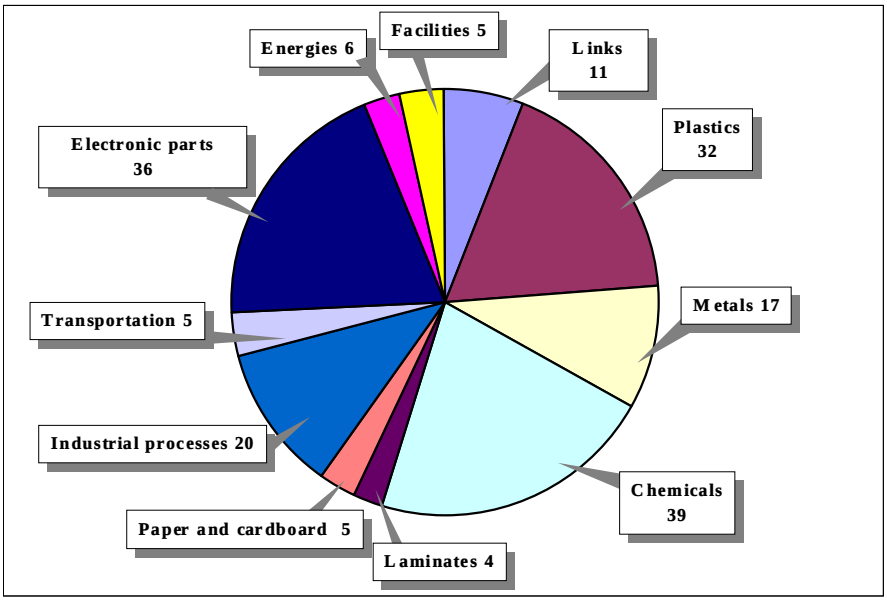


Database

The embedded database contains 181 modules on the most commonly used materials and sub-components within the electronic and electric industry. It specifically contains: 32 plastics; 39 chemicals; 4 laminates; 17 metals; 5 paper and cardboard modules; 5 facilities; 6 energies; 36 electronic parts (such as resistors, capacitors, batteries, integrated circuits, diodes, quartz, and capacitors); 20 industrial processes; 11 links; and 6 transportation modules. Company specific modules can be added as well, either by using other in-house databases or by compiling and customising more complex modules out of the starting database.

Some of the data comes from the Ecobilan Group database, some from raw material producers and public databases, and most of the data for the electronics components and parts comes from the five industrial partners and their suppliers.

These data include generic quantitative life-cycle flows, toxicology and regulatory information, product descriptions and end-of-life aspects. The embedded life-cycle data has been peer-reviewed by LCA professionals external to this DFE project, and will further be validated by external international experts (completed end of 1998).



Metric

Three types of output metrics:

- **Environmental Impact Indicators:** manufacturing, use and distribution
  - Material depletion
  - Potential impacts in the air
  - Potential impacts in water
  - Production of Waste
- **Design Indicators**
  - Physical Characteristics
  - Use phase information
  - End-of-life information
- **Bill of Materials**

Some indicators are customisable. Indicator contributors can be modified, and indicators can be combined to create more general 'Eco-indicators'. The environmental expert will be able to select part of the indicators, which are relevant for a given family of products.

Life Cycle Indicators

Material depletion

The **RMD** (Raw Material Depletion) indicator calculates the depletion of natural resources, taking into account the size of the reserve for that resource in the ground and the consumption rate of today's economy.

The **ED** (Energy Depletion) indicator indicates the consumption (or use) of energy, either derived of the combustion of fuels (fossil or not) or from other sources (hydroelectricity, tidal, solar, wind). Nuclear electricity is included in energy from uranium fuel. The indicator also considers the latent energy in materials (which is produced during the combustion of the material, typically at the end of its life).

The **WD** (Water Depletion) indicator calculates the consumption of water, i.e. the sum of any kind of water source or quality (drinkable, industrial,…).

Potential impacts in the air

The **GWP** (Global Warming Potential) indicator calculates the contribution to the global warming of the atmosphere by the release of specific gases.

The **OD** (Ozone Depletion) indicator calculates the contribution to the depletion of the stratospheric ozone layer by the release of specific gases.

The **AT** (Air Toxicity) indicator calculates the air toxicity in a human environment, taking into account the usually accepted concentrations tolerated for several gases ant the quantity released.

The **POC** (Photochemical Ozone Creation) indicator calculates the potential creation of troposheric ozone ('smog') by the release of specific gases which will become oxidants in the low atmosphere under the action of the solar radiation.

The **AA** (Air Acidification) indicator presents the air acidification by gases released to the atmosphere.

Potential impacts in water

The **WE** (Water Eutrophication) indicator calculates the water eutrophication (enrichment in nutritive elements) of lakes and marine waters by the release of specific substances in the effluents.

The **WT** (Water Toxicity) indicator calculates the water toxicity taking into consideration the usually accepted concentrations tolerated for several substances and the quantity released.

Production of waste

The **HWP** (Hazardous Waste Production) indicator calculates the quantity of hazardous waste produced for a given product. It is added to the flows of the LCA inventory which correspond to hazardous waste.

Design Indicators

Physical characteristics

The ***Computed weight*** of the product sums the specified weight of every module (Material, Component, Process) that compose the Product, excluding those for the distribution and use phases (Packaging, Installation components, Consumable).

The ***Recycled Content*** indicator is the sum for all modules in the Product of their weight of recycled material, divided by the total weight.

The ***Special Handling Substances in Composition*** is the weight ratio of substances in the product which belong to the list of Special Handling Substances independently of the ratios. It deals only with the product (it does not include packaging material or anything related to the distribution and use phases.

The ***Volume*** is the value that you may have specified in the Product data.

The ***Number of parts*** (or elements) sums the value specified for every Part, every Component module and every Simplified Subassembly that compose the Product, without Consumable & Maintenance nor Installation components.

Use characteristics

Power consumption, Electromagnetic radiation and noise level.

End of life characteristics

The End of Life valorisation indicators are computed for the Product without its Packaging nor Installation components nor Consumable & Maintenance. The algorithm is quite complex but could be simplified based on the following principles.

The product (without its packaging nor use phase materials) is sorted into four categories depending on the scenario chosen for its end of life. The elements are determined by an algorithm that simulates the dismantling or grinding of the product, taking into consideration the links between the parts. The sort depends on the reusable, recyclable and hazardous properties of the elements as well as on the compatibility of the constituents of each element.

The end-of life indicators are listed below:

- Weight ratio of extractable special handling components
- Weight ratio of reusable components
- Weight ratio of recyclable components
- Weight ratio of waste
- Number of problematic links
- Number of distinct materials

Bill of Materials Indicator

The **Bill of Materials** indicator makes the inventory of all the materials used in the case and this for each phase: manufacturing, distribution and use.

* * *

The book of papers and proceedings from ECO 97 and ECO 99 Conferences will have a fourth section: 'Democracies for Change' which will include sections on the role of the media, community actions such as Local Agenda 21 and the implications for democracy of sustainable development, public awareness, information and participation.

Meanwhile, to end this collection of papers, Todd Gitlin, who was a moderator at ECO 97, had much to say about the difficulty of finding serious environmental coverage in the media. The author of seven books, lecturer, columnist, **Todd Gitlin** is a professor at New York University in communication, journalism, and sociology, as well as Senior Fellow at the Media Studies Centre in New York. Following are excerpts from an interview with Gitlin which appeared in the *Wild Duck Review*, Vol. V No. 1, Winter, 1999 (Nevada City, California). 'Don't leave environmentalism to the pure-of-heart,' he warns. This might be worse than leaving politics to the politicians.

A comment on ECO 97

by Todd Gitlin

...Political institutions, including the press, more or less collude in keeping huge questions off the agenda, either because they're blind or because they're wilfully deceptive and exclusionary. Then it takes social movements to bring these questions to the fore. Only then do we get a necessary debate. This is the case now with environmentalism.

...To me, the question is, where can the debates take place? Obviously they're not going to take place on ABC TV, and they're not going to go on in the *Wall Street Journal* or *The New York Times.* I'm holding in suspense the question of whether the right ideas exist somewhere on the planet. But surely a great deal is known about strategies for healthy systems, and the various positions ought to contend if there are going to be democratic decisions....I have been involved in conversations enough over the last few years to know there are debates, there are proposals, and that these are global. What is frustrating is that you'd have no idea, from moment to moment, as a US citizen, let alone as an activist, of the range of these discussions.

...For example, in 1997 I was invited to a conference in Paris called ECO 97. The approach of this conference was to bring people together who were either business or political powerhouses, and discuss practical schemes in Europe, US, Japan, and South America, schemes that are either in place or contemplated and promising. The emphasis was on pragmatism. Now, I found it extremely interesting, very different from the abstractions so gaily and formulaically tossed around on the left. I was invited simply to ask tough questions of the panelists, as was Mark Hertsgaard, the journalist. The two of us were lobbing questions at EEC figures, the German Environmental Minister, the French Environmental Minister, Clinton Administration people, executives from Dow Chemical, AT&T, Nissan Motor, and so on. I came away somewhat heartened by the knowledge that there were powerful people talking about practicalities – what is actually doable, on this side of some millennial fantasy of revolution. I don't know if I'd call it a dialogue, but at least there was a respectful expression of positions. Some participants were promoting forms of industrial activity that seemed to be common knowledge to the specialists but were new to me. The so-called eco-efficiency arrangements are not out in the open for public discussion. The people who organised the conference worked hard to get out the word about what they were doing, to get press coverage, but unfortunately without much success. There's a second such conference in Paris this June, ECO 99, and I hope the media pay more attention, though I am not holding my breath. There's a specific example of a framework for thinking that is constructive – not millennial, but constructive – and is simply unknown to Americans.

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