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Innovation & Sustainable Development

Guiding business innovation towards sustainable development

Innovation management in Japan and Germany

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Contents

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1. Introduction

The 2nd World Summit of the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 declared sustainability the international goal for all future development. The Brundtland report in 1987 defined sustainable development as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). International efforts, the participants promised, would aim for equity not only between developed and undeveloped countries, but also between present and future generations.

Rio was the first time companies were identified as partners who could foster sustainable development by creating new and better products and services. At the same time, a number of companies got together to establish what was then the Business Council for Sustainable Development (BCSD). Today, ten years later, the World Business Council for Sustainable Development (WBCSD) includes more than 150 global players, who developed the concept of eco-efficiency to combine ecology and economy in a bid to increase profit while benefiting the environment. The WBCSD identified seven areas for its members to take into consideration:

1. Reduce material intensity,
2. Reduce energy intensity,
3. Reduce dispersion of toxic substances,
4. Enhance recyclability,
5. Maximize use of renewables,
6. Extend product life,
7. Increase service intensity.

Innovation is one important way of achieving eco-efficiency, the WBCSD holds: “The only hope for sustainability is to change forms of consumption. To do so, we must innovate. … . Human creativity is one resource that is increasing; it must not be misdirected. We need the right framework conditions to guide innovation in eco-efficient directions” (WBCSD 2001: 10). International institutions like the United Nations (UN 1997), OECD (OECD 1998), European Commission (CEC 2001a/2001b) and the World Bank (2000) have recognized the concept’s potential.

Growing numbers of companies communicate their environmental policy in environmental or sustainability reports. Three types of external disclosure purpose are discernible: The market-oriented type presents environmental activities, while the image problem type wants to build trust in products. The management type, in turn, aims to promote environmental management within companies, is little publicized and can be seen as an internal disclosure report (Ranking 2000).

In Germany, 220 environmental reports and 2,300 environmental statements[1] were published in 1999 (Ranking 2000). For Japan, Kino Kankyo, an environmental business association, counts 340 environmental reports published in 2000 (Kino Kankyo 2000).

The Global Reporting Initiative (GRI) is developing an international standard that will enable various players to evaluate economic, environmental, and social performance: institutional investors using environmental information to assess risk, activists trying to enter into dialogue with management, government officials choosing among possible corporate partners, or senior executives seeking to lead an organization to higher levels of efficiency and innovation (GRI

[1] Companies who want to take part in the EG eco audit system have to publish an environmental statement. According to IOW, 35% of those only “compliance” statements (IOW 1997: 28).

2000: 2). The GRI suggests that product and service innovation should be taken into account in assessing and improving management quality (GRI 2000: 26). To highlight the importance of sustainability reporting, the United Nations, leading business and non-governmental organizations (NGOs) launched the GRI as a permanent independent global institution to disseminate a generally accepted framework for voluntary sustainability reporting on the economic, environmental and social performance of corporations and other organizations. Its mandate is to make sustainable reporting as routine as financial reporting (GRI 2002).

The French government has set indicators obliging the 200 largest French companies to report on environmental and social issues apart from financial reporting from 2002 on.

Kofi Annan in 1999 asked world business to enact the nine principles of the Global Compact in their corporate practices (UN 2001). Principle 9 calls for encouraging the development and diffusion of environmentally friendly technologies. So far, 71 companies, 22 business associations and 18 civil societies and environment and development organizations have joined the initiative. In Germany alone, 755,122 companies were registered in 2000 (Federal Statistical Office Germany 2001). In Japan, there were 1,667,639 companies by 1999 (SB&SC 2002).

So far, however, the number of companies committed to environmental and social responsibility who publish related information is quite small. In 2001, according to CorporateRegistraterCom, 519 reports were published (CRC 2002). The Federal Environmental Agency of Germany (UBA), counts 1,600 reports regularly published on five continents (UBA 2002). Nethertheless, where reporting showed signs of environmental awareness in the past, the tendency now is to measure sustainable development in environmental and social reports. The UN and Society of Environmental Toxicology and Chemistry (SETAC) in April 2002 jointly launched an LCA initiative to set a global standard for measuring the impact of products and services (UNEP 2002).

Environmental protection, however, is all too often equaled with end-of-pipe technologies and marketing measures. Studies Ashford and Heaton conducted in the 1980s in the United States, Hartje in 1985, Kemp in 1997, Hemmelskamp in 1997 and Klemmer in 1999 in Germany show that the most common responses are “end-of pipe solutions and non-innovative substitutions of existing technology” (Kemp 2000: 35). But reaching sustainable development, Friedrich Schmidt-Bleek suggested in 1994, requires a shift from environmental protection towards resource efficient services (Schmidt-Bleek 1994). Lovins, Lovins and von Weizsäcker and other authors have shown that technological innovations can support sustainable development, but diagnosed a lack of policies that not only promot, but also assess sustainable innovations (Lovins, Lovins, von Weizsäcker 1995; Fussler 1999; von Weizsäcker, Seiler-Hausmann 1999; Hawken, Lovins, Lovins 1999). Instead, Kuntze, Meyer-Krahmer and Walz have found, "Industrialists and politicians in the leading industrial countries call for accelerated ‘industrial innovations’ as a powerful source of economic growth and wealth, and they usually mean by that technological innovations. Most existing governmental innovation policies are claiming to foster the industrial (technological) competitiveness as a main target. There still seems to be hardly any policy approaches that aim explicitly at innovation processes conducive to sustainability and at technical innovations which would achieve or maintain sustainability" (Kuntze, Meyer-Krahmer, Walz 1998: 3-4).

It is only a matter of time, though. Sustainable development is an accepted international goal, and most consumers in developed countries are aware enough to demand environmentally friendly products. Companies will increasingly find themselves asked about the direction their products and services are taking, and where sustainable development comes into it.

Sustainability is turning into a competitive advantage, and needs to be introduced as an assessment standard. Investing blindly in Research & Development (R&D), in turn, can mean losing a lot of money in the future.

Governments could use market forces to drive companies to produce more sustainably by mandating information not only on financial data, but also on environmental and social impacts. A global label for products and services could globalize a market that supports sustainable products through information given to national governments, shareholders, NGOs and consumers.

Most companies lack instruments to estimate and report internal material flows that tell whether an innovation is sustainable and goes along with future policy regulations. German companies have a knack of calling for such instruments on the operational level while begging politics not to regulate the market by banning specific technologies or setting targets. Katsuhiko Kokubu has compared Japanese companies with US and European practices and finds they lag behind when it comes to internal environmental accounting (Kokubu 2001).

The WBCSD surveyed 80 companies, asking how they incorporate commitment to sustainable development into innovation management. The results showed that senior business managers with responsibility for R&D know about the positive effects of sustainable development, and urge their companies to develop management tools to measure progress towards sustainability. But "the executive suite believes in the benefits but is still in the realm of affirmation", because "the benefits are long-term gains and only the cost savings show up quickly" (Dearing 2000: 111).

Policymakers face a similar dilemma. They have agreed on the aim of sustainable development, but lack controlling instruments. Most laws have little follow-up, and ministries rarely check whether laws go along with main policy goals.

Lovins, Lovins and von Weizsäcker in 1995 called for an efficiency revolution that would double wealth and halve resource use within the next 50 years – the famous Factor 4 was born (Lovins, Lovins, von Weizsäcker 1995). One year earlier, Schmidt-Bleek addressed material input and envisioned Factor 10 for resource productivity within the same time frame (Schmidt-Bleek 1994). Their shared aim was to clarify the concept of sustainable development by setting open targets. The Kyoto Protocol – which has yet to be ratified by the parties – defined a quantitative target for CO_2 emissions, but the Rio conference failed to set up an international quantitative goal. Some national states have determined national CO_2 reduction aims. Germany plans to reduce CO_2 emissions by 25 percent between 1990 and 2005, but the government still subsidizes all kinds of national projects and R&D without knowing if they benefit sustainable development. Last December, the German government finally suggested a national sustainable development policy with 21 indicators and aims to set a framework for sustainable policy development in Germany (Die Bundesregierung 2001).

Morita, Nakicenovic and Robinson compared technological development paths aimed at stabilizing CO_2 emissions and diagnosed the need for an energy efficiency revolution (Morita, Nakicenovic, Robinson 2000; IPCC 2001: 117-164). The Intergovernmental Panel on Climate Change (IPCC) considers technology improvements the most important way of reducing green house gas emissions (IPCC: 83). But so far, the link between the aim of the climate change convention and protocol's aim to reduce CO_2 emissions and technological development remains tentative. Joint Implementation, Clean Developing Mechanism and Emission Trading mark a few first steps. Some companies are getting active. For example, BP has set up company-wide emission trading to achieve their CO_2 emission reduction aim of

10% from a 1990 baseline by the year 2010. This and other actions after five years reduced CO_2 emissions to 10 million tonnes below the 1990 level and saved a lot of money. However, BP's investment in new technology and the savings achieved may owe little to emission trading and much to matter-of-course replacement of old technology. Was the target too low, too easy to reach? Has BP installed common technology or the latest in high technology? At all events, BP has set a new target, to stabilize CO_2 emissions at 10 % below the 1990 level through 2012 (Brown 2002). Other companies try to develop sustainable management instruments, for example BASF with their Eco-Efficiency Analysis and Matsushita Electric Group' Product Assessment Tool. What is missing is an instrument that combines political with company decision-making processes.

Technology, the OECD warns, "is a double-edged sword, and can have both positive and negative impacts on human welfare – meaning new products are a key to solving environmental problems but can also cause new ones. The path toward sustainable development lies in maximizing the positive impacts while minimizing the negative ones. The rate and direction of technological change need to be guided by appropriate public policies for the goal of sustainable development" (OECD 2002).

According to Kemp, studies on innovation and environmental regulations show that

- New technologies are often developed by firms outside the regulated industry;
- The more stringent the regulation, the higher its innovative effect;
- Technology-forcing standards appear to be a necessary condition for bringing about innovation compliance responses
- The search for solutions begins long before regulations are promulgated (Kemp 2001: 35)

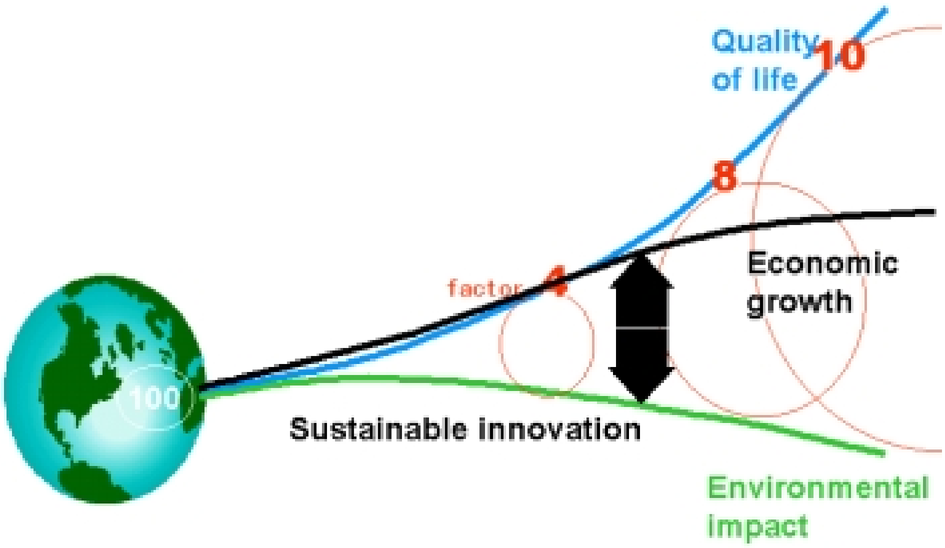
Kemp concludes that technology responses are not simple responses to regulatory pressure, but that the threat of regulation may be a better means of stimulating technological innovation than actual regulations (Kemp 2000: 36).

Sustainable development requires policies that support technical and social innovation solutions. A change in the system is imperative – Kemp says a policy framework that could support a system renewal has to include "the creation of spaces for learning about new technologies; the establishment of long-term goals; and indicative, adaptive planning to guide private and public investment in new directions"(Kemp 2001: 51)

How can lawmakers and business players boost innovations that respect the limits of the planet, to increase a better quality of life for everyone (see figure)?

Indicators and corresponding aims offer one workable possibility. Much work is currently done in this field by research institutes, institutions, initiatives, governments and international organizations (UNSD 2001b, UN Global Compact, CEC 2001, Eurostat 2001, Die Deutsche Bundesregierung: 2001, Die Österreichische Bundesregierung 2002, GRI 2000, SAM 2002a, b). So far, no political decision has been forthcoming that defines headline indicators above and beyond CO_2 emission.

Sustainable innovation …within the limits of the planet



Source: Fussler 2001.

But the Dow Jones Sustainable Index (DJSI) shows that companies are willing to fill out questionnaires to be listed on the DJSI.

The following figure illustrates the current picture of sustainable development policy.

Policy Levels	Instruments
Global Level = **United Nations** - Overall Goal: **Sustainable Development**	UN Global Compact UN Global Life Cycle Initiative UN Global Reporting Initiative UN Financial Initiative International Standard Organization (ISO) …
134 Sustainable Development Indicators	
Global Stock Market (New York, Tokyo, Europe)	Global Sustainable Assessment of Companies Dow Jones Sustainable Index …
Regional Level = European Union	
63 European Sustainable Development Indicators	EMAS II, …
National Level = Germany/Japan	
21 German National Sustainable Development Indicators	
National Stock Markets	National Sustainable Assessment of Companies
National/Global companies	National Financial Reports Voluntary Sustainability Reports Company Wide Assessment Tools
Company sites, Section, R&D, Process, Product/Service Management	

At this moment in time, given the general awareness of the problem on political, societal and industry levels, research should focus on indicators for state and company assessment, but also take into account the negotiating and decision-making processes that implementing them requires nationally and internationally.

No doubt such a tool would be complex, but just trying to meet the challenge is a major achievement.

1.2 Research Question, Methodology and Outlook

The main research question here focuses on what kind of policies and instruments could steer company innovations, meaning their R&D of new products and services. 1992 marked the beginning of a debate on how companies could achieve sustainable development, and environmental management systems have been invented to support this goal. Most concepts and instruments are technical and formalistic, targeting a micro systematic level to support management decision-making like Environmental Management Systems, Total Quality Management, Ecological Assessment, Life Cycle Assessment (LCA), Sustainable Balanced Scorecard, or Environmental and Social Reporting. But companies are also social organizations whose members need to understand what they are striving for (Schein 1995; Brodner, Ketter 1999). Moreover, they are located in a national and international political context.

To study this question, I chose one German and one Japanese company who have already developed an assessment tool to calculate the environmental impact of products and services and publish a sustainability report: Matsushita, better known in the West as National or Panasonic, and BASF. How have national innovation policies in the countries where those companies' headquarters are located influenced their activities?

The following study mostly draws on external information publicized in environmental, R&D and business reports and company web pages. Due to the translation time lag, English-language material may be slightly dated. Innovation concerns new technologies and services, so much information is strictly confidential. While most of my research is based on external publications like environmental reports, interviews with representatives of Matsushita's R&D and environmental departments also shed a light on internal information. The BASF case study so far bases solely on publications like environmental, research & development and business reports.

While the hypothesis is that innovation can be steered towards sustainable development, this paper merely pinpoints at what stage companies are right now in managing and reporting innovation & sustainable development. This paper focuses on global players, where information is easily accessible. In numbers, however, small and medium sized enterprises (SME) make up the majority of companies, and probably have a considerable influence on sustainable production. Follow-up research is needed to close the gaps in this field, and develop a sustainable innovation management tool for companies and politics.

2. Sustainable innovation and knowledge

This paper defines sustainable innovation policy as a set of policy actions aimed at raising the quantity of eco-efficient and socially responsible innovative activities. 'Innovative activities' refer to the invention, innovation and dissemination of new or improved processes, products or services. These policies can be developed and implemented at various levels (local, regional, national, international).

The problem we face today is that, though we have agreed on the aim of sustainable development or more exactly, on reducing CO_2 emissions, policymakers have not come far on the road to developing effective policies. Companies recognize the scope for improvement, but most of them still cause huge environmental impacts. While eco-efficiency in production processes and products or services is increasing, albeit slowly, an absurd rebound effect causes the environmental impact to rise as extra resources flow into installing end-of-pipe technologies and consumers use ever more products and services. Technical and social innovations could buffer that effect. The aim of sustainable innovation policy therefore should be to promote inventors and companies in developing sustainable technical and social innovations, and encouraging society to change along sustainable lines. Apart from Weaver et al.'s excellent summary of the Dutch Sustainable Technology Development programme, few studies examine the need for sustainable innovation. Innovation theories fail to take the aim of sustainable development into account, and innovation policies rarely deal with sustainable innovation besides mentioning the need for sustainable growth.

Invention happens in garages, research centres and university or company laboratories, without or with financial investment. Sometimes they trigger a new industrial revolution. Until the end of 1998, the World Intellectual Property Organization (WIPO), an international organization that administers 23 international treaties dealing with different aspects of intellectual property protection, counted about 4 million patented inventions. According to the WIPO, an invention

"… must be of practical use; it must show an element of novelty, that is, some new characteristic which is not known in the body of existing knowledge in its technical field. This body of existing knowledge is called "prior art". The invention must show an inventive step that could not be deduced by a person with average knowledge of the technical field. Finally, its subject matter must be accepted as "patentable" under [national] law" (WIPO 2002).

It has been estimated that patent documents contain 80% of the world's accumulated technical knowledge (ITT 2000: 15). How can we use this knowledge to guide companies towards sustainable innovation?

R&D in companies aims at developing new and better products or services to maintain or raise profit. Innovations in companies are limited projects and confined to specialized departments (Hauschildt 2002). Patenting new inventions and innovations secures companies the right to them and reduces costs. Holding patent rights is cheaper than buying them. Most innovations with economic impact in fact recombine existing knowledge into new processes, products or services (CEC 2000c: 3). Recombining knowledge, however, requires easy access to knowledge. But knowledge is stored in the brains of people or the routines and organization of their own or other companies. For companies, sharing knowledge even over patents means losing profit. Sustainable innovation, however, needs codified knowledge to be shared - in digital format, scientific articles, manuals or patent applications.

Company innovations involve three approaches: Basic research results in new products or services, while application research focuses on turning an invention into a saleable product or service. Marketing, finally, promotes the diffusion of the new product or service among firms or individual consumers. Technical problems can never be solved with one innovation alone. New products or services need a set of supporting innovations to work in real life, or form part of a web of existing and new technologies.

Successful industry innovation takes the desire for a product or service as the starting point for developing a technical solution. The opposite direction, having a successful technology and looking for new ways of using it, is rare. New inventions need as long as 30 to 50 years to reach the market.

The mobile phone illustrates this long-term process. The idea was developed in 1947 at Bell Lab, now owned by Lucent Technology (Bell Labs 2002). Motorola manager Martin Cooper in 1973 called his rival at Bell, Joel Engel, with a mobile phone. Nokia owes its leading market position today to an improved mobile communication standard. The Conference of European Posts and Telecommunications (CEPT) in 1982 formed the Groupe Spécial Mobile (GSM) to develop a pan-European mobile cellular radio system. “GSM” later became the acronym for Global System for Mobile communications (Sempere 2002). The world's first international cellular mobile telephone network was introduced in Scandinavia in 1981, and Nokia made the first car phones for it. Nokia did not invent the first portable mobile phones at the start of the 1980s, which were so heavy and huge that the term “portable” was rather misleading. Nokia produced the original hand portable in 1987, and Nokia phones have continued to shrink in inverse proportion to the growth of the market ever since. In 1993, Riku Pihkonen, a Finnish engineering student, sent the first GSM text message, giving the starting signal for a further form of communication (Nokia 2002). Today, the Japanese company NTT DoCoMo is disseminating the third-generation communication standard.

Most so-called low-tech companies are “buying-in” innovations in the form of plants and equipment. New technology does not reach them directly from the academic knowledge base or from in-house R&D. These companies rely on suppliers and advisory services. This slows the dissemination of sustainable processes and products or services.

How could policy support faster dissemination of sustainable processes and products or services for companies? Since the 1990s, the importance of knowledge for the economy grew significantly when the internet allowed it to be transmitted instantly. The “knowledge-driven economy” affects all industries (CEC 2000c: 3). To explain this development, Cowan and van de Paal use a system-based approach originally developed by Soete and Arundel and taken up in the 1st action plan for innovation in Europe (Cowan/van de Paal 2000; Soete/Arundel 1993). Their model locates innovations in a dynamic system that is wide-ranging, involves many different activities, players and institutions. The links between the various players, institutions and modes of innovation are multidirectional and interdependent. Learning plays a central role in this model, occurring in many locations. Learning in the R&D lab, the production line, the marketing department and among consumers informs other learning activities. The system-based approach emphasizes knowledge diffusion (CEC 2000c). What impact does the knowledge-driven economy have on innovation? Knowledge diffusion through information and communication technologies (ICT) plays a major role in this new economy. Codified knowledge, knowledge that has been systematized and recorded in language, whether pre-existing or new, as codes that can be read, stored and/or transmitted, becomes significant for organizing and conducting economic activities (Abramowity, David 1996: 35). A growing number of companies base their business on licensing intellectual property (IP). Take IBM: It was the first company to be granted over 3,000 US patents in a single year (IFI 2002). In addition to selling products and services, IBM uses patenting to capitalize on knowledge, drawing $1.7 billion from royalties in 2001. IBM employs 150.000 engineers and scientists.

According to Cowan and van de Paal, more and more "small companies use patents to demonstrate their in-house knowledge as a bargaining chip in their attempts to acquire venture capital and in seeking alliances with other firms" (Cowan and van de Paal 2000: 11). Today, Esp@cenet, initiated by the European Patent Office, allows free access to a technical on-line library providing information – patents – on 150 million pages. Access to the internet means access to technical knowledge. Cowan and van de Paal call this "learning without formal research". The growing importance of the service sector also underlines the importance of non-formal research learning (Cowan and van de Paal 2000: 13). Innovations are not a monopoly of natural scientists and engineers. While R&D plays a much less important role in the service sector than it does in manufacturing, innovations are not a privilege of manufacturing companies. Innovations take place at every level, for example in banks and insurance companies. Patents, however, cannot protect these non-industrial innovations, whose importance may be expected to grow as societies increasingly rely on ICT. Innovation takes place outside "classical" disciplines and has to be communicated in all areas.

The concept of eco-efficiency emphasizes economic and ecological considerations. To find out more about economic and ecological cost, companies have to analyse the whole production line, "from cradle to grave and back to the cradle". However, the amount of materials used in production and services is huge, and their impact on the environment is not always clear. Cooperation between companies in this field would doubtless achieve the best results and help them gain a bigger market share, but material input information is knowledge, and unlikely to be communicated.

Hawken, Lovins and Lovins identify six main areas where industries could increase energy and material productivity:

- Design,
- New technologies,
- Controls,
- Corporate culture,
- New processes,
- Saving materials (Hawken, Lovins, Lovins 1999: 62).

Though numerous examples show that innovative products and services can net bigger profits and have a positive environmental impact, only a few pioneering companies voluntarily embrace sustainable innovation.

Investments in innovations are options in future profit. Unfortunately, money markets only register short-term profits, without taking into account long-term costs. It is a well-known fact that neither prices nor profits reflect the actual impact a product or service and its production have on the world we live in. Company risk management attests to an awareness of the potential problems, but relies on rather ad-hoc solutions. How can financial markets, venture capital or traditional equity markets, evaluate a company's sustainability? In Schumpeters' definition of innovation, companies who do not seek a higher profit are not innovative. Since Schumpeter's time, only profit-seeking, innovative companies are seen as the real ones. Companies who do not fit the description are categorically dismissed as non-innovative, ignoring the innovative power of non-profit-organizations (NGOs) or public offices. But sustainable innovations are social as well as technical. Immediate profit is not the top priority; longevity and service orientation is.

Some conclusions and recommendations

Inventions are important for the future development of humankind. The German Basic Law guarantees the freedom of science, and patents work to protect intellectual property rights. But the German cabinet has embraced sustainability in a recent decision. Does that mean future patent application will be checked against sustainability indicators? Should national patent laws incorporate the aim of sustainable development? Is that possible?

Codifying knowledge and allowing free and instant access is not enough. To give innovators, researchers and developers further information on the environmental and social impact of resource use I suggest systematizing the technical knowledge contained in patent databases along sustainability indicators. An encompassing international database that includes all patents could reduce costs and increase transparency for lawmakers and business players. The first step is an international material and chemicals database supporting inventors, researchers and developers with vital information about the potential impacts of their projects. To support social inventions, policy-makers should also think of setting up an international database codifying tacit knowledge.

An international network of expertise based on the international patent and material/chemicals databases could help promote investment in sustainable innovations, providing banks and other financing institutions with technical and entrepreneurial facts. Standardised reporting on economic, environmental and social aspects as intended with the GRI would give venture capitalists, banks and private investors a new angle for investment decisions. Obtaining comparable data, however, requires a sustainable innovation tool developed in cooperation between companies and government levels and oriented on long-term goals agreed among policymakers, companies and research institutions (See chapter “Towards a new kind of innovation management”). National law may support or impede such a project; while Japan and Germany fiercely protect knowledge, facts about emission and chemicals are more readily available to U.S. citizens. The following chapter, however, shows that German and Japanese companies are fully aware of the importance such facts will gain in the future, and have started establishing in-house databases.

3. National Innovation Policies in Japan and Germany

3.1 Japan

Introduction

Steep forest-covered mountains dominate Japan's topography; population and economic activities are concentrated in metropolitan areas along the coast and in estuary plains. In the 1990s, economic growth slowed down after the 1980s "bubble", but final energy consumption and energy intensity per unit of GDP increased substantially, as did total road traffic. The Japanese economy very much depends on imports of natural resources such as energy, food and other raw materials (OECD 2002). Japan's total material requirement (TMR) has been increasing since the mid-1970s and now amounts to around 36-46 tonnes per capita, nearly half Germany's TMR, which lies at 64-88 tonnes per capita (WI 2002; Bringezu, Schütz 2001: 111).

Sustainable Development

Landfill capacity is short in Japan. By weight, 78% of municipal waste is incinerated in dioxin-emitting facilities. The Japanese government has therefore focused its industry sustainability policies in a "Basic Law for Promotion of a Creation of a Recycle-Oriented Society" (Schmidt 2001), which bases on the 1993 "Basic Law on the Environment" and the "Basic Plan for the Environment" of the same year. Both aim to reach sustainable development. The "Basic Plan for the Environment" was updated in 2000; its stated overall aim now is a sustainable society (MOE 2000). In 2001, the Environmental Agency was turned into a ministry (MOE), but at a mere 9 billion Yen, its budget is infinitesimal compared to the 250 billion Yen the Ministry of Economy, Trade and Industry (METI) earmarks for environmental protection (Schmidt 2001: 256).

A main law for "Promoting the Creation of a Recycle-Oriented Society" has been set up (MOE 2002). Six laws support this policy:

1. The 1971 "Waste Management Law";

2. the "Law for Promotion of Effective Utilization of Resources" from 2000, which obliges businesses to collect and recycle their products, reduce waste by designing and manufacturing resource-saving and longer-service-life products and to reuse parts recovered from waste products.

3. the "Construction Materials Recycling law (2002);

4. the "Food Recycling Law (2001);

5. the "Green Purchasing Law (2002) (MOE 2000c) and

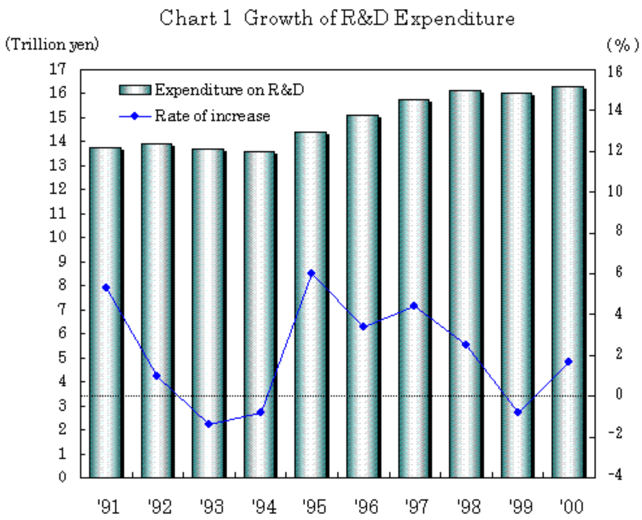
6. the "Container and Packaging Recycling Law".

Passed in 1998, the "Home Appliance Recycling Law" enacted in 2001 has to be seen as one of the most important laws to support the 3R-Society: Reduce, Reuse, Recycle. The main state-financed project in this context is Kitakyushu's Eco town, which aims to build a new recyclable-resource-usage-style industrial society (METI 2002). Since the project has just started, no conclusion as to its success is possible. The same can be said of the new laws. The "Law for Promotion of Effective Utilization of Resources", for example, defines no targets for increasing resource efficiency (Schmidt 2001: 258), but time will tell if it still proves effective.

Research & Development Policy

Japan's total expenditure on R&D during fiscal year (FY) 2000 stood at 16,289 billion yen, showing an increase of 1.7% from the previous year (SB&SC 2001; OECD 2001). The ratio of R&D spending to GDP was 3.18%, almost the same as in the previous year.

Figure: Growth of R&D Expenditure



Source:

Of the total, 10,860 billion yen was spent by companies, an increase of 2.2%; 3,208 billion yen by universities and colleges, about the same at 0.0%; and 2,221 billion yen by research institutions, up by 2.3% compared with FY 1999. The private sector spent 12,684 billion yen, accounting for 77.9% of the total, while the public sector provided 3,541 billion yen.

Shares by type of activity were 14.3% for basic research, 24.0% for applied research, and 61.8% for development. Development dropped by 0.5 points from the previous year.

The amount of expenditures on electrical machinery, chemical products industries and transportation equipment accounted for 64.4% of that of all companies.

As of April 1, 2001, 1,024,800 persons were engaged in R&D activities, a decrease of 1.9% from the previous year. Regular researchers numbered 728,200, down by 1.5% from the previous year. Of regular researchers, male staff accounted for 89.2% (649,600), female staff for 10.8% (78,700), the highest rate ever.

Innovation & Sustainable Development Policies

In March 2001, the Ministry of Education, Culture, Sport, Science and Technology (MEXT) published a new overall "Science and Technology Plan" to update the 1996 one. So far, only an unofficial translation is available from MEXT (MEXT 2001).

The new science & technology policy (S&T) for Japan focuses on three areas:

- creation and utilization of scientific knowledge
- with international competitiveness and sustainable development and
- securing safety and quality of life (MEXT 2001: 9).

Concerning innovation and sustainable development, the S&T plan states that "to maintain economic vitality for sustainable development, it is necessary to foster industries superior in international competition, through providing an environment in which innovations are constantly taking place in processes from the creation of new technologies to the development of new markets"(MEXT 2001: 10).

Environmental science is therefore a priority field in the new national S&T strategy, where it is seen as essential for human beings to maintain their survival base for the future. Taking into account Japan's limited land and natural resources, the S&T plan calls for research in the following areas:

- Introduction of production systems that will minimize both the input of resources and the output of waste, and technology to support recycling in a society where effective use of resources and waste control are achieved by utilizing natural circulative functions and bio-resources;

- Technology to minimize harmful chemical substances for human health and natural ecology, as well as to evaluate and manage them;

- Technology for forecasting global changes that affect human survival bases and the environment, for impact assessment on society and economy, and for global warming prevention such as minimizing green-gas emission.

Furthermore, to reduce the environmental impact, technical evaluation methods like the life-cycle-assessment method and databases offering information for consumers are encouraged (MEXT 2001: 25).

Concerning private companies, the S&T plan wants to promote R&D by applying the national R&D supporting system based on tax and risk deduction (MEXT 2001: 38).

Environmental Reporting

As early as February 2001, the MOE published 'Environmental Reporting Guidelines' and 'Environmental Performance Indicators for Business'(MOE 2001). Currently around 300 companies out of 2,500 listed on the stock market have published an environmental report (Kino Kankyo 2000). The government seeks to encourage environmental reporting to provide information about the environmental burdens companies are generating. So far, companies do not have to publish environmental reports, but the development seems to go in this direction.

The 'Environmental Reporting Guidelines' list R&D under the aspect of Environmental Management. The Environmental Ministry proposes that companies report on the state of research and development of technologies for environmental conservation and environment-conscious products/services, Design for the Environment (DFE) and the state of research and development concerning the Life Cycle Assessment (LCA) method (MOE 2001: 30, 39).

The ministry further suggests that business should show initiative in promoting "research and development of technologies for environmental conservation, and environment-friendly products/services. ... The methods employed in promoting research and development of technologies for environmental conservation, environment-friendly products/services etc., and the resulting outcome is significant information, and it should be mentioned in environmental reporting" (MOE 2001:39).

The ministry is aware, however, that companies come in different shapes and sizes, which makes it difficult to establish uniform evaluation indicators. However, the environmental performance of companies will be assessed according to how they promote R&D for environment-conscious products and services (MOE 2001: 21).

3.2 Germany

Introduction

The high population density and level of industrialization makes environmental protection a major concern and high policy priority in Germany. Strong dependence on fossil fuels, transport and agriculture generates pressure on the environment which the decline of some industries in the new, eastern German states alleviated slightly. The decoupling of economic growth from emissions of several major pollutants during the 1990s indicates Germany's achievements and its continuing efforts to reconcile economic growth and environmental objectives (OECD 2000).

Sustainable Development

Nearly ten years after the earth summit in Rio, the German government decided to formulate a national sustainable development strategy and a Council for Sustainable Development was set up (RNE 2002a).

In December 2001, the German government published the first draft of a national sustainable development strategy (Die Bundesregierung 2001) setting up 21 indicators to measure national sustainable development. The cabinet approved the decision on April 17, 2002 (Die Bundesregierung 2002).

Figure: 21 Indicators for the 21st Century

	Indicators	**Aims**
	Fairness for future generations	
1	Resource conservation (energy/material)	Increase by a factor 2 until 2020 baseline 1990/1994, afterwards a factor 4 is targeted
2	Climate protection (CO2 emission)	Reduction of 21% by 2010 baseline 1990
3	Renewable energy (primary energy/electricity)	Increase from 2.2 to 4.2%/12.5% by 2010
4	Land use	Reduction from 130 hectares to 30 hectares a day by 2020
5	Biodiversity	Increase of species to the 1995 baseline
6	National debt	Balanced state budget by 2006; decreasing national debt from 2007on
7	Sustainable economy (state/companies)	Investment around 23% compared to the Gross Domestic Product
8	Innovation (state/companies)	Increasing of investment to 3% of the Gross Domestic Product
9	Education	Reduction of high-school dropout rate from 12% to 4%, increase of university enrollment to 40% of high school graduates in 2010 compared to 30% in 2000.
	Quality of life	
10	Economic prosperity	Sustainable increase of the Gross Domestic Product
11	Mobility (Cargo and passenger traffic)	Reduction of transport intensity by 5%/20% by 2020 baseline 1999; doubling of the rail transportation by 2015 and ship transportation by 40% baseline 1997
12	Food	Increase of organic food production to 20% by 2010 compared to 3.2% in 2000; Reduction of the nitrogen from 116 kg/ha to 80 kg/ha by 2010
13	Air quality (SO2, NOx, VOC, NH3)	Reduction of 70% by 2010 compared to 1990
14	Health	Increasing of average age beyond 65 years
15	Crime prevention	Continuous decrease of crimes; Reduction of apartment break in of 10% by 2010 compared to 2000
	Social context	

16	Employment	Increase of the labor force participation rate to 70% by 2010 compared to 65% in 2000
17	Family support	Increase of daytime nursery school and primary schools
18	Equal opportunities	Adjustment of payment rates of women compared to men
19	Integration of immigrants	Reduction of school dropout rate of immigrants from 16% in 1999 to 8% in 2020
	International responsibility	
20	Development aid	Increase of development aid to 0,7% of the Gross Domestic Product; Increase by 2006 to 0,33% of the GDP
21	Free trade	Increase of imports from developing countries

Source: Die Bundesregierung 2002, own compilation

The government plans to publish a biannual report on the status of sustainable development in Germany to assess policies along these indicators and aims.

Innovation is listed as one main indicator of economic development. The German government aims to increase state and private investment for innovations to 3% of the Gross Domestic Product by 2010 to promote sustainable development. This is the average invested in Japan since the 1990s (WB 2001). However, the indicator does not tell whether such investment achieves the desired effect. Nor does an indicator referring to the number of applications for patents, as suggested by the German Council for Sustainable Development (RNE), shed light on the patented invention's sustainability or service-orientation (RNEb 2002: 9). Adding a sustainability criterion to the national patenting law would allow relating investment and number of patent applications.

Research & Development Policy

The German government wants innovation investments to increase by 0,5% from around 2,5 to 3% of the GDP, and has made sustainability its guiding principle. But how can the government ensure that further investment goes into sustainable R&D projects? In 2000, German companies invested two thirds of R&D expenditures, around EUR32.7 billion or 65,5% of total investment, in innovations. In 2000, the government financed EUR15.9 billion in total and provided out of this EUR2.6 billion to company research projects. That means German companies financed their R&D primarily on their own. While the government supports 34,5% of the total investment in R&D, every EUR3.5 of R&D investment in German companies goes to third party commission. And every EUR5 of company investment on R&D goes to German universities (BMBF 2002c: 206). The influence of the German government on R&D seems to decrease over time. Compared to the Japanese government, however, which invested 0.59% of the GDP, the German government invested 0.82% in 1998 (CEC 2000c: 31). Company R&D investment, in contrast, is higher in Japan than it is in Germany, and the same hold true in the US, where companies also invest two to three times more in R&D than the government does (CEC 2001b: 26). German companies apply for fewer patents in the US than Japanese companies. In the European Union, Germany and Japan generally apply for the same number of patents.

Figure: European Innovation Scoreboard 2001

Indicator	EU	D	J	USA
Government expenditure on R&D/GDP/1999	0,66	0,75	0,70	0,56
Business expenditure on R&D/GDP/1999	1,19	1,63	2,18	1,98
European Patent Office h-tech patent application/per million population 1999	17,9	29,3	27,4	29,5
US Patent and Trademark Office h-tech patent application/per million population 1999	11,9	14,4	80,2	84,2

Source: CEC 2001c: 26

Innovation & Sustainable Development Policies

The overall research policy goal of the Federal Ministry of Education and Research (BMBF) is to support research "to promote sustainable growth, societal development as well as cultural diversity" (BMBF 2000). In particular, policy focuses on the following goals:

"Research is to benefit the people:

Surveys have revealed that German citizens are concerned not only about job security but also about health and the environment. Research for the people must therefore focus on these issues. The BMBF supports health research ranging from basic research to medical applications. It supports innovative techniques for preventing environmental pollution and promising concepts designed to help society keep pace with rapid structural changes in technology, industry and services.

Research is to promote sustainable management:

Planet Earth must remain a place suitable for living. We must therefore limit the consumption of energy and natural resources. Industrialized nations in particular are obliged to develop techniques and products which conserve natural resources and do not exceed the planet's carrying capacity even when used on a global scale" (BMBF 2002a).

The Division 4 "Research, Environment" of the BMBF therefore defines four priority fields:

- Regional approaches to sustainable management;
- Research for cleaner production and sustainable products;
- Research on global change including environmental impact research, and
- A re-institution of peace and conflict research. (BMBF 2002b).

Right now the BMBF supports a series of projects in the context of its Sustainable Development Programme, among them one called "Innovation - A Precondition for Sustainability" focusing on set-up conditions for sustainable innovations (BMBF, Fona 2002).

Environmental Reporting

Environmental reporting in Germany is based on voluntary company action. In the European Union, German companies take the lead in publishing reports. An environmental company association and an environmental institute have been compiling rankings of German companies since 1994 (Future/IOW 2002) and publish the results in a big business magazine (Capital 2000). The ranking bases on 14 head and 41 under-criteria, none of which concern R&D or sustainable development reporting, however (RER 2002d).

The European Eco-Management and Audit Scheme (EMAS) used to be restricted to companies, but from 2001, it has been open to other organizations (EP/EC 2001). In Mid-February 2002, 3,928 sites received EMAS certificates; 2,692 EMAS site registrations came from Germany (ECE 2002b). The EMAS environmental statement goes beyond the classical environmental report because it bases on an EC law, and the data are assessed by external verifiers. However, the standards are lower than for example the voluntary national ranking in Germany and, similar to German environmental reporting standards, EMAS does not regard information on R & D and sustainable development.

3.3 Interim conclusion

Though Japan spends more money on innovation, Germany draws more profit from its investment. Both governments spend less money on R&D than the companies do. Japan manages R&D with a 'National Science and Technology Plan'. In Germany, R&D policy bases on general statements and programmes In 2002, Germany finally set up a national sustainable development strategy with indicators and aims which will, in the future, guide national R&D policy. Both countries recognize the importance of supporting research in the areas of sustainable management and assessment. Japan and Germany seem dedicated to innovation & sustainable development policy. These policies are currently under construction in the area of R&D. So far, environmental and social reporting happens exclusively on a voluntary basis in Germany, while Japan is already discussing national reporting guidelines.

4. Case study of Japanese and German companies

4.1 Matsushita Electric Industrial Co., Ltd. – National/Panasonic

Introduction

Matsushita has a long tradition in producing electric appliances. Established in 1918 by the founder Konosuke Matsushita, the company today employs around 290.000 staff who produce and maintain services in 170 countries under the brand names National, Panasonic, Technics and Quasar. In the fiscal year 2001, their net sale was 7,681,561 million Yen (US$ 61,452,488 Million), and net income after tax was 41,500 million Yen (US$ 332,000 Million) (Matsushita 2001a: 26).

In 1932, Mr. Matsushita formulated the mission of his company:

"Only after there is a limitless supply of material goods as well as spiritual peace of mind will man achieve true happiness. I believe that here is the manufacturer's true mission of Matsushita Electric. I would like you all to keep in mind that the true mission of Matsushita Electric is to produce an inexhaustible supply of goods, thus creating peace and prosperity throughout the land. To this end, 250 years from today on will be devoted to fulfilling this mission" (Matsushita 2001b: 66).

Some cultural context may have to be kept in mind to assess such statements. Today Matsushita President Kunio Nakamura adds to the founder's vision:

The 20th century is marked by an accelerated chase after material contentment in the pursuit of an affluent society. The modern civilization, which delivers materialistic prosperity, has unfortunately disrupted our life-supporting nature, as seen for example in global warming, bringing great damage to our irreplaceable earth. In the 21st century, said to be the Century of the Environment, 'Coexistence with the Global Environment' has become the most important issue facing mankind" (Matsushita 2001b: 5).

The company therefore has to be transformed into an innovative "Super Manufacturing Company" that emphasizes customer-orientated services, says Mr. Nakamura, adding that "the era of mass-production, mass-consumption, and mass-disposal has gone; the values have changed. Increasingly, manufacturers will be asked by customers to provide services and functions to help solve the issues they face, that is, to provide solutions for their daily lives" (Matsushita 2001b: 6).

Environmental Protection

The 1991 Environmental Charta marked the beginning of Matsushita's environmental policy. In November 2001, they published the first Environmental Sustainability Report explaining their vision for Zero Emissions, that is, minimized CO_2 emission and waste generation. The Green Plan for 2010 sets all factories the aim of reducing CO_2 emissions by 10% (Japan 7%) on baseline 1990. The energy use of new products throughout the entire life cycle should not increase by more than 50%, resource use by 70% during that period (Matsushita 2001b: 8, 37). Matsushita has set ambitious company-wide aims and also product aims; in a Japanese ranking of environmental reports using the same criteria as the German ranking, Matsushita came in fifth in 2000 (Kino Kankyo 2000).

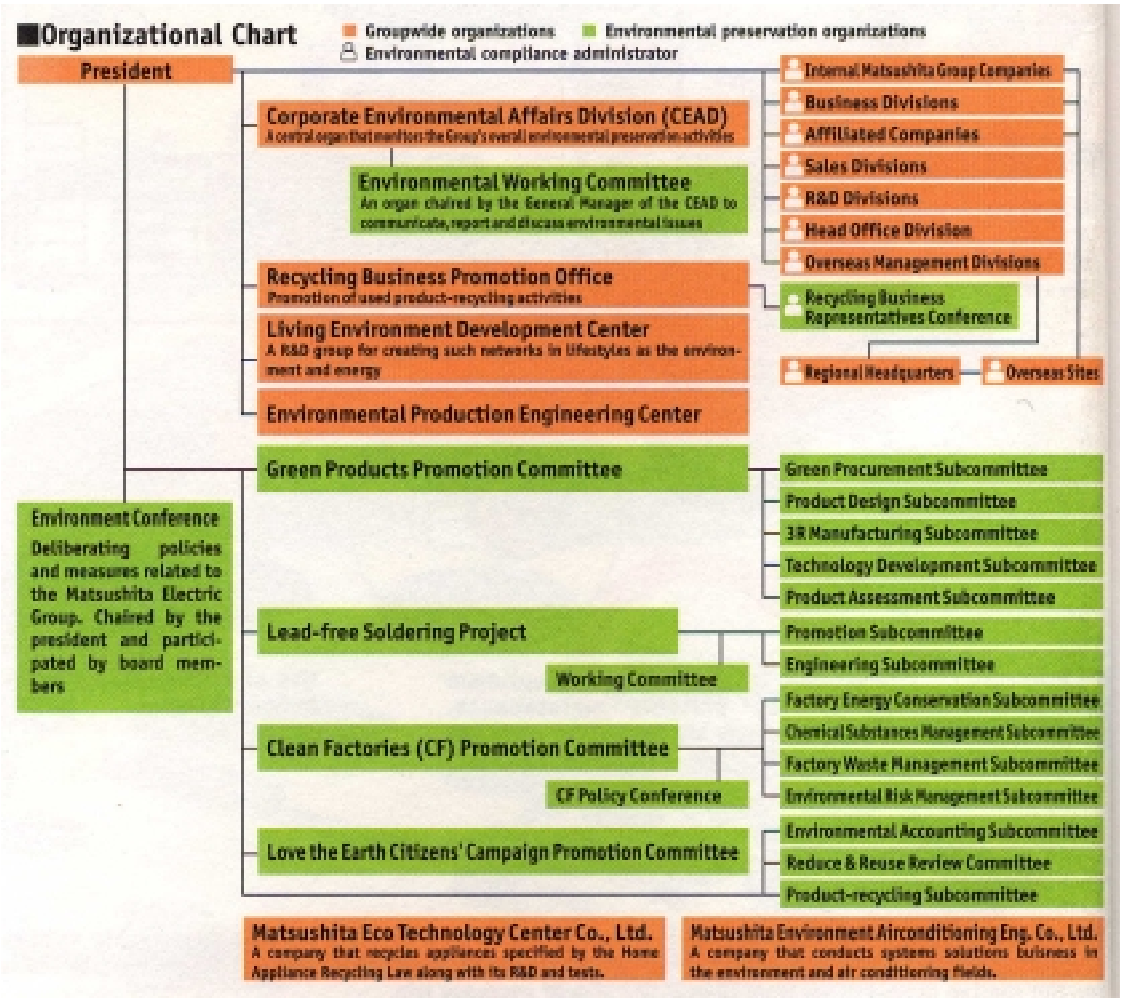
That same year, however, Matsushita was responsible for 1,2% of Japan's total CO_2 emissions and, in correlation to Japanese companies, Matsushita was even responsible for 10% of CO_2 emissions. CO_2 emissions in 2000 increased by 9% compared to the 1990 level, so there is still a long way to go for the Green Plan for 2010.

Research & Development

The organizational chart of Matsushita Sustainability Report 2001 shows the R&D department as part of the business section. There seems to be no direct link between the business divisions and the Corporate Environmental Division. Matsushita publishes no information about R&D, so the Sustainability Report is the main source on R&D at Matsushita.

According to Matsushita's 2001 Annual Report, the company invested 543,804 Million Yen (4,350,432 Million US$) in R&D. The three-year "Growth Strategy" focuses R&D on five new business areas including software development, networking technology, materials and process engineering, semiconductors and environment and energy (Matsushita 2001). The Annual Report and the Environmental Sustainability Report do not say much about R&D besides naming the new business field "Networking of products".

Figure: Organizational Chart Matsushita Electric Group



Source: (Matsushita 2001b: 15)

Matsushita received 1,440 US patents in 2001 and ranked sixth in the United States Patent and Trademark Office list (USPTO 2002). Matsushita owns more than 100,000 patents worldwide (EPO 2002). Though the Japanese economy is in a recession, larger companies continue to rank among the winners of new patens - a sign that they have not lost their innovative edge. But Japanese companies are making no profit from patents. In total, the patent deficit amounted to US$645.4 million in 2001, according to the Finance Ministry (see table; Belson 2002). In the mid-1990s, the cost of maintaining patents became onerous. "The electronics makers have since dropped more than two-thirds of their patents and are increasingly judicious about filing out new ones" (Belson 2002). While companies in other parts of the industrialized world earn revenues from their innovations, says Belson, three-quarters of Japanese patents are not used commercially. Japanese companies have also started putting more effort into turning patents to good financial account. Royalties doubled in 2001, and if the development continues in 2002, the companies will for the first time earn more from royalties than they paid.

Figure: Japan's Shrinking Patent Deficit

Year	Paid	Received	Percent Change	Deficit
1995	$6.94 billion	$4.42 billion		-$2.51 billion
1996	$8.35 billion	$5.67 billion	+30.3%	-$2.68 billion
1997	$9.09 billion	$6.91 billion	+21.8%	-$2.18 billion
1998	$9.15 billion	$7.55 billion	+9.3%	-$1.60 billion
1999	$8.76 billion	$7.27 billion	-3.6%	-$1.49 billion
2000	$9.27 billion	$8.61 billion	+18.4%	-$654.7 million
2001	$10.53 billion	$9.89 billion	+14.8%	-$648.4 million

Source: Japan Ministry of Finance

Innovation & Sustainable Development

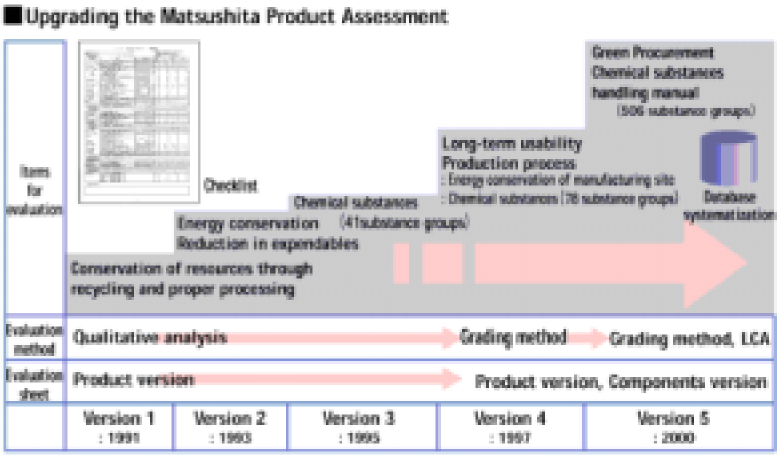
The environmental sustainability report says little about innovation & sustainable development. On the web page about "Management Style in the IT Era", the president is quoted as saying that "we can only first say that the real 'Digital Network Era' has arrived when we have overcome the problems of the balance between real and cyber, those of privacy and security, and furthermore have applied IT to 'Coexistence with the Environment' and 'Support for the Aging Society'" (Matsushita web page). No further information was forthcoming in personal interviews. In March 2002 the company introduced its CFC-free refrigerator on the Japanese market, ten years after Greenpeace and a German producer jointly developed a hydrocarbon refrigerator and 15 years after the creation of the 1987 Montreal Protocol (Japanese Times 2002).

Sustainability Assessment of Products and Services

Matsushita developed and continually refines a product assessment tool after the government enacted a law promoting recycling in 1991 (Matsushita web page). So far, around 2,500 evaluations have been completed, less than 1% of the components of the estimated 100.000 to 1.000.000 components Matsushita produces.

Evaluation follows a standard system for green products. Basic guidelines can be found in the "Green Procurement Standards" (Matsushita 1999) manual and the "Chemical Substances Management Rank Guidelines" (Matsushita 2000). The "Environmentally Conscious Products Design Guidelines" and the "Matsushita Eco-design Guide Book" have not been published, so no information is available on how R&D applies eco-design guidelines. The "Chemical Substances Database System" is also only for internal use.

Figure: Upgrading the Matsushita Product Assessment



Source: Matsushita, http://www.matsushita.co.jp/environment/en/file/e_data/ed_f_0014.html

Figure: The Matsushita Product Assessment Method

Source: Matsushita web page, http://www.matsushita.co.jp/environment/en/file/e_data/ed_f_0016.html

Matsushita for example assessed its mobile telephone model G450. According to the energy usage index, production of the 2001 model caused 3.5 times less CO_2 emissions than of the 1998 model, and resource consumption was 2.5 times less intensive.

So far, the assessment uses no social indicators. This could be problematic in the long run as in a wider context, for example on the European level, corporate social responsibility is being discussed as an important element of sustainable enterprises (Source CSR).

Figure: Product Assessment – Mobile Phone

Source: Matsushita: Environmental Forum 2001hold in Freiburg, Germany.

Education of Employees & Sustainable Development

The sustainability report says engineers in charge of research and development of products were educated to improve their environmental awareness. In fiscal year 2000, a training course was held on how to design environmentally conscious products according to environmental laws and Matsushita's product assessment system. Around 400 out of 290.000 employees participated (Matsushita 2001: 16).

4.2 BASF AG

Introduction

In 1865, Friedrich Engelhorn founded the Badische Anilin- & Soda-Fabrik AG (BASF) to produce coal tar dyes and precursors, gaining a leading position in the world dye market within only a few decades. Today BASF is one of the largest chemical companies. As of March 2001, 92,364 employees worked at BASF. In 2000, sales expanded by 22 % to EUR36 billion and increased profits by 15.3 % to EUR3.4 billion (BASF 2000).

Environmental Protection

In 2000, BASF published its first Social Responsibility Report (CSR) to complement the annual report and Environment, Safety and Health Report (EHS). Together they give a wide overview over BASF activities.

BASF's has set up Vision 2010, which describes a path for the coming years along seven "values" and supporting "principles":

1. sustainable profitable performance,
2. customer-oriented innovation,
3. safety, health, and environmental responsibility,
4. intercultural competence, mutual respect and open dialogue,
5. integrity and
6. a BASF compliance program.

The first "value" is more closely defined by emphasizing that "… ongoing profitable performance in the sense of Sustainable Development is the basic requirement for all of our activities". "Innovation in the Service for our Customers" does not mention sustainable development, but points to innovation to augment customer satisfaction. The third "value" states that "we act in a responsible manner and support the Responsible Care® initiatives. Economic considerations do not take priority over safety and health issues and environmental protection". Participants in worldwide Responsible Care® follow the guiding concept of sustainable development as agreed in 1992 at the UN Conference in Rio and commit to continuous improvements in the fields of health, safety and environmental protection. Commitment to Responsible Care applies to the BASF Group worldwide and includes all its affiliates, businesses, services and products (CCPA 2002), reflecting the code of practice of Responsible Care® initiatives:

"Companies must ensure that R&D operations are handled in a way that protects people and the environment from hazards. No new product may be introduced and no research or development considered unless it is done in accordance with this code. Once the product is introduced into the marketplace, customers must be provided with information about hazards and associated risks to help ensure that they handle, use and dispose of the product properly"(CCPA 2002).

BASF also subscribes to the UN Global Compact promoting the development and diffusion of environmentally benign technologies. Another current project concerns an environmental code of conduct based on BASF values and principles that will be binding for all employees (BASF 2000: 10).

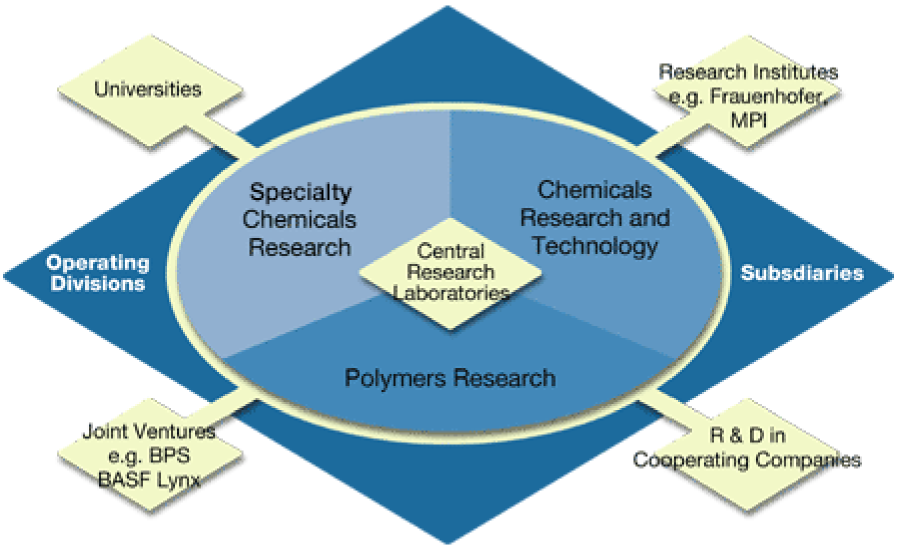
Though BASF has set up goals, there seems to be no CO_2 reduction goal for the whole group. According to the ESH report, energy-related CO_2 emissions in 1990 amounted to 4.7 million metric tonnes. The goal for German sites is to reduce energy-related CO_2 emissions from the 1990 level to 3.6 million metric tonnes, 97% of which had been achieved by 2000. No target year is mentioned, however (BASF 2000: 59). BASF publishes extensive information, but a ranking of environmental reports in 2000 places the group 22nd, behind Henkel (5), Degussa Huels (15) and Bayer (19) (RER 2000b).

Research & Development

BASF states that innovative products drive its research. In 2000, EUR1,526 million was spent worldwide on R&D.

BASF research activities are organized around the central, corporate research laboratories at Ludwigshafen, Germany. Collaboration with universities and research institutes, joint ventures with highly specialized high-tech companies and in-house Centers of Excellence give the company access to new knowledge and new technologies.

Figure: BASF Research Organization



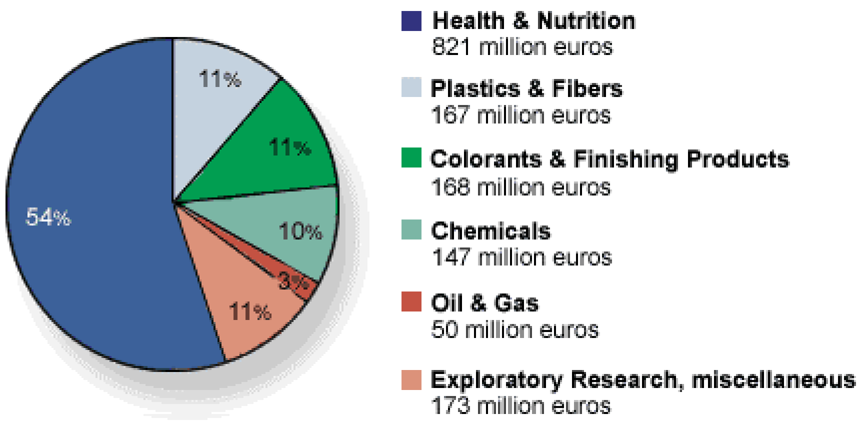
Source: BASF, http://www.basf.de/en/corporate/innovationen/fakten

Worldwide, more than 8,000 BASF employees work in R&D.

BASF states that 50% of their research budget is earmarked for developing innovative products, another 20% for improving established products, 25% for new and improved processes and 5% to research into new methods.

BASF submitted 1,110 patent applications worldwide in 2000. Currently, BASF holds about 110,000 patents and patent applications (EPO 2002). In the US, BASF received 510 patents in 2000 and was listed on 26th rank (IFA 2001). Around half the turnover achieved in 1996 came from products developed or manufacturing methods improved in the last 15 years (BASF 1996: 78).

Figure: BASF-Group Research Investments in 2000



Source: BASF, http://www.basf.de/en/corporate/innovationen/fakten

Compared to Matsushita, the web presentation of BASF on Safety & Environment and for innovation is extensive, offering the Environment, Health and Safety Report and a new Social Responsibility Report first published in 2000 for downloading[2]. BASF presents R&D activities under on the innovation pages, which list realized innovations, explain them and say what kind of work is in progress. Facts at R&D include a history of R&D, a publications list of scientific articles and books and brochures for downloading as pdf-files.[3]

Innovation & Sustainable Development

BASF presents innovation & sustainable development as the guiding management strategy. Sustainable development and innovation are defined as a responsibility of the BASF board and part of the "vision". A sustainability council chaired by a board member was set up. The ESH and CSR reports name sustainable development as a management goal. Sustainable development is defined as a strategy to increase and sustain BASF corporate value, and sustainable innovations are seen as another means to that goal. Innovation is to base on

- continually reviewing products and processes,
- offering customers creative system solutions, and
- capitalizing on the broad potential of the chemistry (BASF 2000b: 20).

As early as 1996, BASF stated in their research brochure that R&D at BASF is oriented on human needs. According to the head of R&D, the concept of sustainable development challenges BASF to develop products and technologies that use natural resources more efficiently and strive to satisfy current needs without affecting future generations. Research at BASF seeks to find innovative product solutions and at the same time safeguard the environment and resources, a result that, BASF says, requires many single steps (BASF 1996: 46).

BASF also encourages employees to be creative and innovative. Outstanding achievements are rewarded with the BASF's Innovation Award, smaller suggestions with a bonus. In 2000, employees made around 40,000 suggestions for improvements that saved the company EUR29 million.

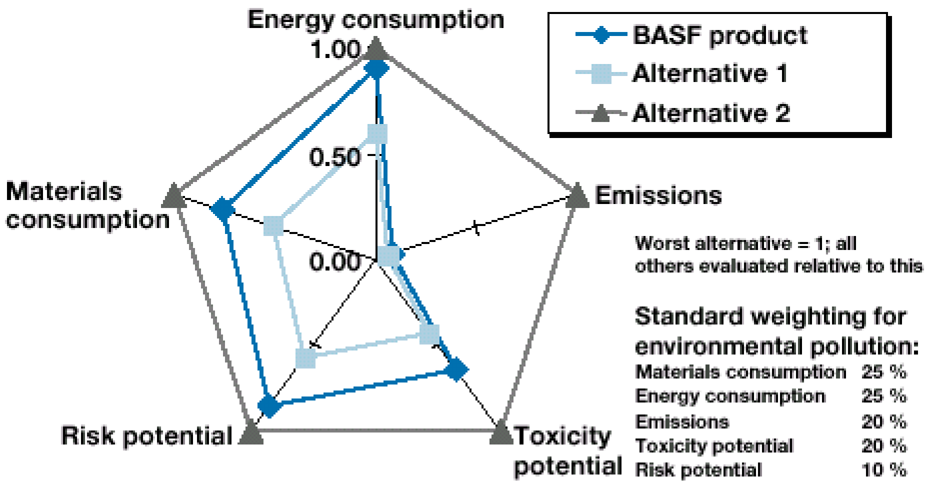
[2] See http://www.basf.de/en/corporate/environment
[3] See http://www.basf.de/en/corporate/innovationen

Sustainability Assessment of Products and Services

In 1996, BASF introduced eco-efficiency analysis as a decision aid tool (BASF 2000), which it presented to the public in a conference in 2000 and a round table with the environmental speakers of Germany's main political parties (BASF 2000). Eco-efficiency analysis was developed to allow BASF "to consider both economic and environmental aspects in the product development and optimisation process and then to choose the most eco-efficient solution".

Five main indicators outline the environmental impact of a service, looking at raw materials consumption, energy consumption, air and water emissions and disposal methods, potential toxicity and potential risks.

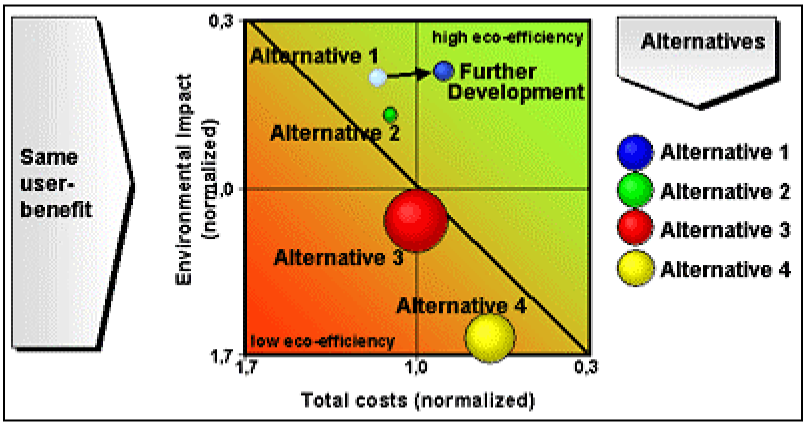
Figure: The BASF Ecological Footprint



Source: BASF 2000: 2

This information is then combined with economic data to allow eco-efficiency comparisons. Economic and ecological data are plotted on an x/y graph. The total costs of the service are shown on the horizontal axis and the environmental impact is shown on the vertical axis. The graph reveals the eco-efficiency of a product or process compared to other products or processes. This enables BASF to make strategic decisions, and it also helps to detect and exploit potentials for ecological and economic improvements. BASF also claims that the system allows defining and monitoring research and development targets, for example where several options for refining a product exists.

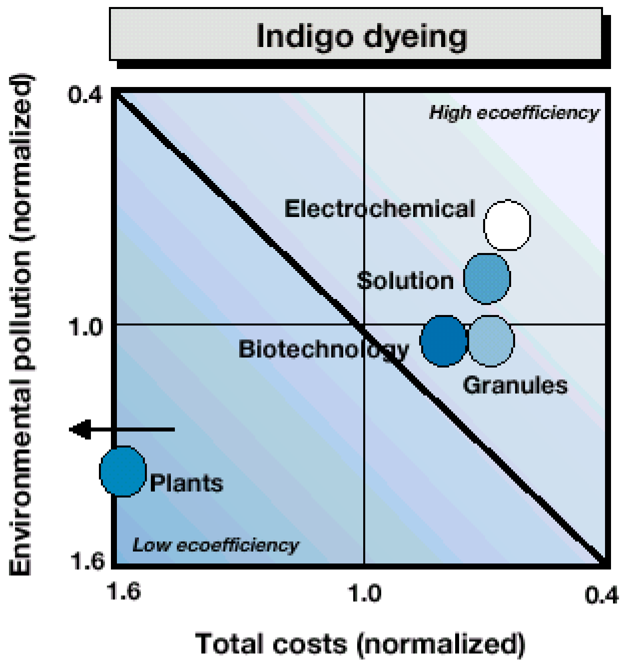
Figure: Alternatives of Eco-Efficiency



Source: BASF, http://www.basf.de/en/umwelt/oekoeffizienz/oeko

One example of eco-efficiency analysis that BASF published concerns indigo production. Four different production methods are looked at: extraction of indigo from indigo plants, indigo granules synthesised chemically in a process developed by BASF, biotechnology production and a synthesis variant also developed by BASF yielding a 40% aqueous solution of pre-reduced indigo. The latter variant has the advantage that the dyeing process can dispense with a considerable proportion of the chemical reducing agent hydrosulfite. In addition, an electrochemical dyeing process was taken into account that is still in the development stage but could replace hydrosulfite (BASF 2000: 5).

Figure: BASF alternatives of Indigo Production



Source: BASF 2000: 5

BASF awards the synthesis variant the highest eco-efficiency marks while conceding that the new electrochemical process could improve efficiency even further. BASF took those findings to invest in solution option and has set up a joint venture to further develop the electrochemical dyeing process. The analysis does not take into account social aspects, for example the impact on indigo farmers.

By 2000, BASF had analysed more than 100 products and manufacturing processes. By 2002, they plan to analyse at least one key application in each of their 100 business units. BASF says that this figure does not correspond to the 8,000 products sold by the company since it started comparing applications (BASF 2000a: 38). But 100 product analyses make up only 1,2% of the whole product range, 1% more than Matsushita but still no reliable basis for management decisions.

Education of Employees & Sustainable Development

BASF invests around EUR145 million per year in further training. The rationale is that employees are a key to success, so the company supports employees willing to learn. On average, every employee takes an annual 3.4 days of training. The ESH and CSR reports, however, give no information on sustainability education.

4.3 Interim conclusion

Matsushita disclosure practice concerning R&D is reserved. Compared to the size of the company, the sustainability report is slim, comprising a mere 66 pages where information is always presented very clearly. Innovation plays a key role in this company, but how goals will be transformed into products remains vague. Today, mass products like the mobile phone, washing machines, or refrigerators for single households are the selling products. Matsushita sees the need to reduce resource intensity but so far, has not come up with products that reduce material input and require less electricity needed in use. The company's CO_2 emissions increased significantly in 2000.

While Matsushita seeks to manage innovation & sustainable development, the sustainability report and talks with Matsushita have shown that they still have a long way to go where product assessment and workable indicators are concerned. One main issue is the calculation of resource consumption.

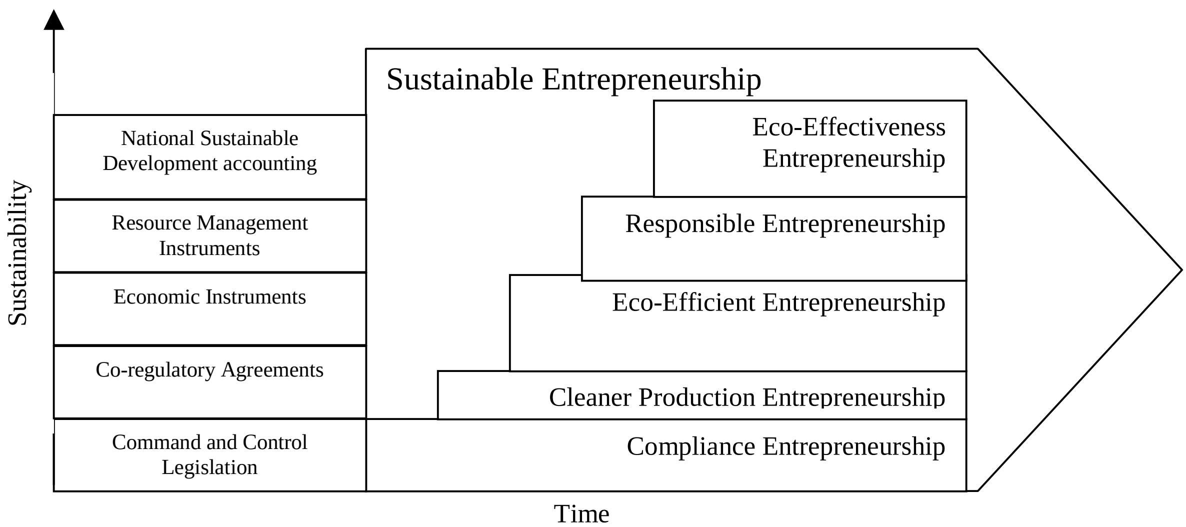
BASF disclosure practice concerning R&D is satisfying. Innovation is presented as a main source of profit but also as a way of reaching sustainable development. BASF lacks a company-wide CO_2 reduction aim, and the assessment tool fails to take social indicators into account and is not transparent either. Neither companies publishes its guidelines for steering R&D.

5. Towards a new kind of innovation management

Companies need a new kind of innovation management tool to achieve sustainable development, and politics needs a management tool to assess national sustainable development. National indicators like economic growth, unemployment and inflation have to be supplemented with sustainability indicators. The two case studies show that even if companies measure the impact of their products and services along indicators developed on the political level, the sheer amount of materials used in production almost defies management. The innovation management tool, therefore, also has to direct material flows towards sustainable materials.

Environmental regulations inspired management tools responding to environmental problems, resulting for example in ISO 14001, Environmental Management System, Environmental Reporting, Life Cycle Assessment, Cleaner Production, Eco-Efficiency, Material Input per Service Unit, Ecological Footprint, Factor 4, Factor 10, Sustainable Technology Development, Eco-Effectiveness, Natural Capitalism, Natural Step Framework and Zero Emissions. Now it is time to operationalise a method that integrates and applies a set of tools to influence management decisions on long-term innovation in the context of achieving a specific societal goal – sustainable development – rather than to advance or influence the management of a specific technology. According to a study by Robert et al. on different management tools, cooperation between the different management tools developed so far is possible and brings synergies because they focus on the same goal – sustainable development (Robert et al 2002). Cooperation will generate sustainable entrepreneurship integrating social and environmental concerns into conventional economic motivations. Sustainable entrepreneurship unites various approaches in actively inventing and innovating sustainable products and services.

Figure: Sustainable Entrepreneurship

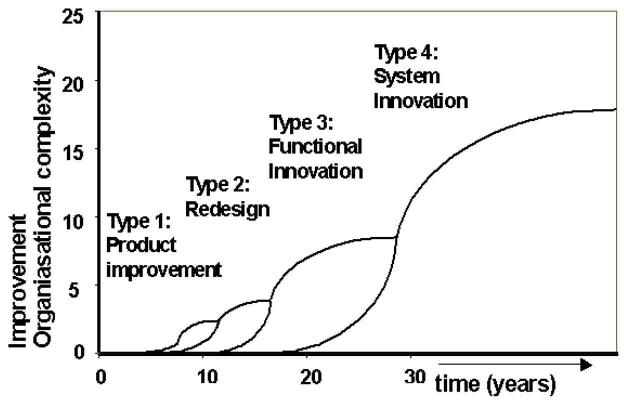


One concept that tries to solve the problems related to innovation and hazardous material management is the eco-effectiveness concept developed by William McDonough and Michael Braungart. They postulate "waste equals food" as one main innovation principle, saying that no toxic materials should be used in products and services so they can re-enter the cycle or return to nature (McDonough 1998).

Inventing and innovating products and services is no longer enough. New innovations have to prove that - McDonough says - they regenerate rather than deplete. The design of products and services has to incorporate “interdependence with other living systems”, taking a cradle-to-cradle rather than a cradle–to-grave perspective. Sustainable innovation management means reusable products with no toxic materials, in other words, zero waste and zero toxic materials. In addition, McDonough calls for inventions and innovations to respect regional diversity. saying design must be flexible and allow changes, and points to renewable energies and solar energy for production and use (McDonough 2001).

To reach this level of sustainable innovation management, companies have to follow the road of constant innovation from product improvement over redesign to functional innovations. System innovations may need the support of governments but will be most effective.

Figure: Sustainable Innovation Curve



Source: adopted from Brezet 2000 and von Geibler/Kuhndt

Innovation improvements may take place at different levels, by small steps or by large changes, as illustrated above. The figure indicates the link to the time horizon. The optimisation of existing systems concerns decisions with a short-term horizon, while the change of product systems and improvements to existing technologies concern decisions over a medium-term horizon. Fundamental changes of several technologies or concepts pertain to long-term decisions between 30 to 50 years.

Currently, environmental improvements in our society are still in the lower left corner of this diagram, i.e., basically in the ‘improvement of existing concepts’ stage. The reason that more far reaching improvements are much more difficult to address is basically that such environmental breakthroughs go beyond the scope of individual companies. They involve not only processes or products but, more critically, other organisations and whole systems whose infrastructures are decisive for success or failure.

These organisations and infrastructures are to a large extent controlled by other stakeholders who cannot be expected to share norms and values in the way which is usual within the bounded social system represented by a company. Therefore, as decisions move outside a single firm, they come to rely more on the kind of decision processes required in the public sector. That system innovations are possible, however, is evident from the example of Rohner

Textil AG which, together with the producers in the chain, developed non-hazard textiles (Kaelin 2002).

To identify which technologies might help meet which sustainability goals, sustainable innovation management tools need to incorporate national and international policy goal setting and law development as well as considering commercial, social and technical changes. Which kind of operation structure benefits sustainable innovation management most? In the 1970s, many large companies separated the management of their R&D and business operations. R&D was often equated with innovation and treated as a corporate responsibility that involved generating new options for business units while keeping an eye on the horizons of science and minimizing technology-related risk and environmental impact. Business units were responsible for understanding the evolving markets and requirements and for creating products from the options available to them.

In many companies, this separation of roles disappeared towards the end of the 1980s as their core technologies matured and market forces required greater integration of product and technology development. At the same time, innovation came to be seen as much more than the product of R&D.

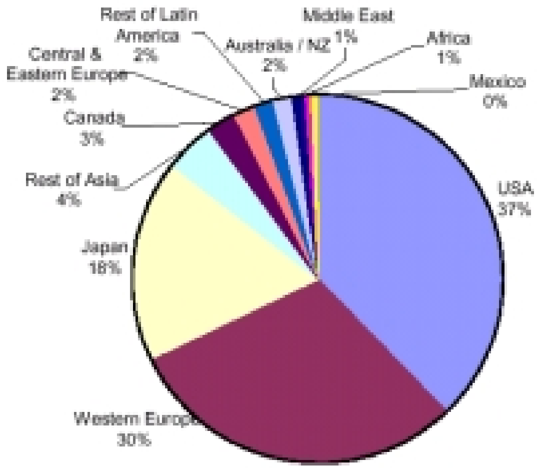
Sustainable innovation management works best with an inside network between R&D, EHS and other sections, and an outside network with the public at large, creating an innovation situation where technical and social innovation come together and bring up new and better solutions for sustainable development. An interface combines basic research with interdisciplinary application research.

A sustainable innovation management tool should give policymakers the possibility to influence innovation processes and outcomes in favour of accelerating the development of technologies and maximizing the contribution that technology can make toward sustainable development. The fact that it takes decades to develop an option for sustainable technology up to a viable product in the market is an essential consideration here. Experience gathered with the Netherland’s Sustainable Technology Development tool (STD) could be useful. STD focuses on planning and reaching objectives through multi-actor interactive processes. Cooperation between public policymakers, business, and knowledge institutes closes the gap between the businesses’ need for ‘short’-term profit and the societal need for R&D on sustainable options in the long run. STD applies a set of tools, including ‘back casting’, ‘factor x’, ‘life-cycle assessment’, ‘constructive technology assessment’ and ‘social niche management’. STD enables companies to achieve sustainable development and policy-makers to design sustainable politics and connect policy oriented R&D with business and knowledge institutions (See Weaver/Grootveld/Speigel/Vergragt 2000).

6. Conclusion

Investment in innovation is rising, R&D has become more market-oriented and research cycles have shortened and become more closely tied to business strategies. OECD expenditure on R&D is more than 2.2% of OECD-wide GDP. The global Environmental Market in 1999 was already worth around EUR550 Billion - with Europe making up 37% and Japan 18% of the marked (EBJ 2001).

Figure: The Global Environmental Market in 1999



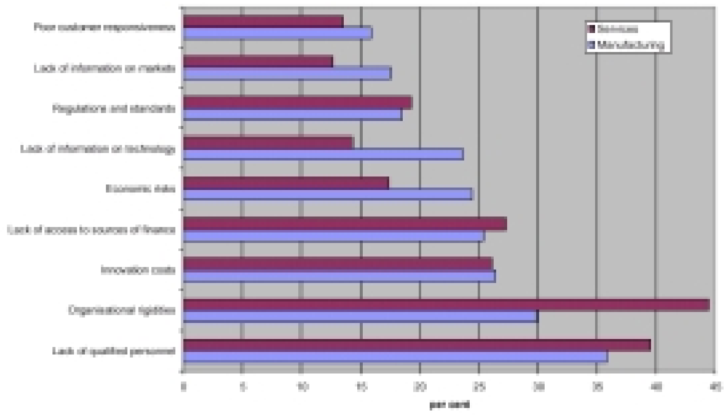
Source: CEC 2002, COM (2002), 122 final, p.9.

Sustainable innovation could expand this market even further. The potential of sustainable technologies is significant, but much of this potential remains unrealised. Many of the barriers to the introduction and diffusion of new sustainable technologies are common to other new technologies. In the development phase, lack of finance for development, risk aversion and uncertainty, insufficient information about the efficiency of the technology, and lack of the necessary expertise are among the factors that limit development (see figure). These problems are worse if the regulatory environment is unpredictable. Economic risks and innovation costs play a key role, particularly for small and medium size enterprises (SME), but market segmentation and lack of competition can also delay the diffusion of new technologies (CEC 2000, COM (2000) 567). So what can policy do to foster sustainable innovation?

The OECD concludes:

"Making innovation contribute to sustainability requires internalising the dynamics of innovation-led growth, and integrating sustainability into the economic and research systems. Although the current socio-economic system does not provide sufficient incentives for sustainable innovation and technological change, governments and businesses have begun to adopt innovative public policy and corporate initiatives to diffuse cleaner technologies and enhance environmental performance. Because relevant process and product innovations often encompass networks that extend beyond specific firms and sectors, innovations require a transdisciplinary and intersectoral approach to problem solving. Public policy has an important role to play in this process in addressing market failures and systemic difficulties, as well as promoting integrated R&D" (OECD)

Figure: Factors delaying innovation projects



Source: (CEC 2000)

Regulatory policies will have to address specific market failures that stem from subsidies, non-internalised costs and ineffective taxes as well as information deficits. Governments have to develop a framework to support sustainable innovations. Subsidies, for example, currently constitute a complicated network of indirect funding that must be restructured along the lines of the national sustainable policy, and generally thinned out in the long term. Wuppertal researchers have suggested shifting taxation from labour to resources (Wuppertal Institute 2002). The European Union calls for setting the prices right with the help of economic instruments (CEC 2002, COM (2002) 122: 16). According to Kemp, a wide range of instruments is available to promote sustainable innovations in companies, but each instrument requires specific framework conditions. Sometimes the threat of regulations can be the simplest and best way of stimulating technological innovation (see appendix). The national patent systems needs to be harmonized in one international system that reduces the cost of gaining patents and increases transparency for enterprises and inventors (CEC 2000c).

Specific forms of regulation will have to be developed to foster the dissemination of innovations and the development of new products and services. Market introduction, technology transfer as well as science and education policies will have to play their role. These regulatory policies will differ in the various national innovation systems, markets (Nelson 1993; Hill XY, pp. 119-131), and cultural contexts. There will be no one-fits-all policy, but globalisation will put more and more companies under a company-wide innovation management tool incorporating different national policies and cultural variety.

Time, notably natural investment cycles, is important for sustainable innovation policy. Incorporating environmental progress is least costly when equipment needs to be replaced in the course of the normal investment cycle. The life cycle of heavy process industry investment is 20 to 30 years, with the moment of investment being an important determining factor for the technology's environmental performance. Choosing the right time to introduce a new technology ensures that company growth is not affected negatively.

The WBCSD has identified key measures that should frame sustainable innovation policy (WBCSD 2000: 24-25):

- Identifying and eliminating perverse subsidies: In many countries, unsustainable behaviour is still supported with subsidies which should be reduced and eventually removed.

- Internalising environmental costs: In several economic sectors, considerable cost caused by environmental pollution and social damage is still not included in the price of goods and services. Until this changes, the market will continue to send wrong signals and polluters will have no incentive to adapt the performance of their products and processes.
- Shifting tax from labour and profit to resource use and pollution: To avoid destructive economic effects, tax shifts should be implemented in a predictable way.
- Developing and implementing economic instruments: These include emissions trading as an incentive for companies to implement eco-efficient measures.
- Promoting voluntary initiatives and negotiated agreements: Governments should negotiate agreements and support voluntary initiatives designed to promote sustainability in particular in sectors or market areas.

To ensure that this framework gives the right incentives, national governments should follow Germany's example and develop national strategies on which they can measure sustainable development. The sustainable technology management tool developed by the Dutch government could then be used to involve companies and society in identifying sustainable ideas and realize the national sustainable strategy in 30 to 50 years from now.

The WTO sees a need to liberalize trade for environmental goods and services, especially to enhance the technology transfer to increase technology flows to developing countries (WTO 2001). On the international level, a sustainable innovation network should therefore provide governments and companies with information about the impact of all materials in production and services, about sustainable products and services and their dissemination.

7. Recommendations for sustainable R&D policy

Governments should focus future R&D policy on the following main points:

1. Start an international debate on setting up a sustainable innovation network
2. Support institutional and company R&D to develop a database on the impact of resources on the environment (resource- and chemicals databank);
3. Support business R&D with tax money only if it focuses on more sustainable products and services;
4. Introduce taxes that stimulate innovation; reduce company taxes if they invent or innovate sustainable products or services;
5. Evaluate sustainable invention, innovation and dissemination (see European innovation scoreboard (ECE 2000c).
6. Harmonize the international patent system: Reduce costs of gaining a patent and increase transparency for enterprises through labelling of sustainable innovations and a web page set up by the World Intellectual Property Organization (WIPO)[4]; developed countries should support developing countries and especially least-developed countries (LDC) using sustainable patents by financing license fees and royalties.
7. Label sustainable products and services through a web page set up by the United Nations.

Business recommendations

Businesses should focus future R&D investments on the following main points:

- Invest in R&D that goes along with the aim of sustainable development
- Develop an innovation management tool that allows reducing the environmental impact and databases offering information for consumers
- …

[4] See World Intellectual Property Organization, http://ipdl.wipo.int

Appendix

Figure: Policy instruments promoting the development and use of environmentally friendly technologies in different contexts

Policy Instrument	General inherent characteristics	Purpose for which they may be used	Context in which they may be applied
Technology-based environmental standards	• Effective in most cases (when adequately enforced • Uniform standards give rise to inefficiencies in case of heterogeneous polluters	• Technological diffusion and incremental innovation	• When differences in the marginal costs of pollution abatement are small and economically feasible solutions to environmental problems are available
Technology-forcing standards	• Effective (in focusing the attention of industry on environmental problems) • Danger of forcing industry to invest in overly expensive and sub-optimal technologies • Problem of credibility	• Technological innovation	• When technological opportunities are available that can be developed at sufficiently low cost • When there is a consensus about the appropriate compliance technology
Innovation waivers	• Same as technology forcing standards	• Technological innovation	• When technological opportunities are available and when there is uncertainty about best solution
Eco-taxes	• Efficient • Uncertainty about industry response • Danger that they provide a stimulus which is too weak and indirect • Total environmental costs for industry are likely to be high • Limited political attractiveness	• For recycling and material and energy saving • Technological diffusion and incremental innovation	• In case of heterogeneous polluters that respond to price signals • When there are many different technologies for achieving environmental benefits
Tradeable permits	• Effective • Cost effective (which means that environmental benefits are achieved at lowest cost)	• Technological innovation and diffusion	• Same as for taxes • Costs of monitoring and transaction should not be prohibitively high
Covenants and technology compacts	• Uncertainty about wheter industry will meet agreements; should be supplemented with penalty for non-compliance • Low administrative costs	• Technological diffusion	• In case of many polluters and many technological solutions • When monitoring environmental performance is expensive
R&D subsidies	• Danger of funding second-rate projects • Danger of providing windfall gains to recipients	• Technological innovation	• When markets for environmental technology do not yet exist and when there is uncertainty about future policies • When there are problems of appropriating the benefits from innovation • When there are important knowledge spillovers • In case of large social benefits and insufficient private benefits
Investment subsidies	• In conflict with polluter pays principle • Danger of windfall gains • Politically expedient	• Technical diffusion	• When industry suffers a competitive disadvantage due to less strict regulations in other countries

Communication (e.g. eco-labels)	• Helps to focus the attention of firms and consumers on environmental problems and available solutions to these problems	• Technological diffusion	• When there is a lack of environmental consciousness • When there are information failures
Environmental management and auditing systems (EMAS)	• Enhance environmental knowledge and competence • Little coercive power	• Technological diffusion, product improvement and good housekeeping	• In case of lack of environmental knowledge and competence
Internationalized Standardized Environmental and social reporting	• Enhance environmental knowledge	• Green Investment, Stock Market	• Increase environmental and social knowledge
Network management	• Creates a platform for learning and interaction, to stimulate alignment and co-ordinate interdependent activities solutions may be tailored to specific needs • Requires technological understanding of processes and products	• Technical diffusion and innovation	• When there are information failures
Societal debates on environmental issues	•	• For stimulating mutual understanding and learning about values and belief systems • For improving processes of anticipation	• In case of controversies over problems and solutions
Sustainability foresight studies	• Broadens processes of assessment • Enhances strategic orientation	• For learning about sustainability options (beyond eco-efficiency) • For altering fixed ideas and mind sets	•
Setting of goals and use of indicative planning	• Provides clarity and (strategic) orientation	• For shaping business expectations and guiding strategic decisions	•
Game management	•	• Radical innovations with significant sustainability benefits that do not offer a win-win solution	• In case of oligopolies engaged in strategic behaviour over environmental issues
Strategic niche management	•	• For learning about radical innovations and for stimulating processes of eco-evolution	• For pathway technologies to a more sustainable system • In case of attractive application
International database for patents with information on sustainable issues	• Provide transparency at low cost and knowledge about sustainable invention	• Technological innovation, product improvement and diffusion	• For pathway technologies to a more sustainable system

Source: (Kemp 2000: 52-54 and compilation)

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