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Promoting Corporate Measures to Combat Global Warming:
An Analysis of Innovative Activities in the Field

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Overview

Since the Kyoto Protocol is expected to enter into force in the near future, this report analyzes many corporate programs designed to deal with the problem of global warming, particularly those considered innovative from the point of energy saving.

It examines the characteristics of these different measures and the framework that underpins them, and considers what further action should be taken to encourage corporate activities to contribute to both the environment and the economy.

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Promoting Corporate Measures to Combat Global Warming: An Analysis of Innovative Activities in the Field

Summary

1. Japan's greenhouse gas emissions (of which approximately 90% comprise carbon dioxide [CO_2]) continue to climb: in FY 2000 they stood 14% above the reduction targets set by the Kyoto Protocol. Thus, Japan will need to take further steps to cut emissions in order to meet its obligations. In this regard corporate measures to combat global warming assume prime importance, for the industrial sector accounts for 40% of total emissions (when emissions from industrial use power generation are factored in), and companies are also deeply involved in emissions in the commercial and residential and transportation sectors not only as a direct emitter but also as suppliers of products and services. On the other hand, the Kyoto Protocol in its present form has some limitations as it imposes substantive emission reductions on only certain countries, which together produce a mere 10-20% of the world's total greenhouse gas emissions flow. That not only creates problems in terms of the international competitiveness of companies in carbon constrained countries; it also leads to concerns about the effectiveness of the Kyoto Protocol in preventing global warming. A multifaceted approach is therefore needed.

2. As can be seen from the *Survey of Environmentally Friendly Corporate Activities* compiled by the Ministry of the Environment, Japanese companies differ considerably in the degree to which they are taking measures to combat global warming depending on industry and volume of sales. Current measures against global warming are largely confined to major corporations in certain specific industries. Those measures typically involve rationalizing energy demand by reducing wasteful energy usage; in many cases they are designed at the same time to yield short-term economic returns that do not entail capital investment.

3. Some 80% of Japan's greenhouse gas emissions consist of energy-derived CO_2. That amount is calculated as the product of (1) activity volumes, (2) energy use efficiency, and (3) carbon content per unit of energy. Therefore any attempt to achieve greater reductions than are feasible in the fields of (2) and (3) risks sparking serious economic and social consequences. Energy conservation measures are designed to help strike a balance between environmental protection and the economy, an idea that Japan has made a cornerstone of its thinking, but many obstacles stand in the way of achieving that goal, and the country will need to redouble its efforts to remove them.

4. Despite the uncertain policy climate resulting from the fact that the Kyoto Protocol has not yet come into force, certain companies have thrown off the trammels and taken ambitious steps to fight global warming. The basic frameworks underpinning these efforts can be divided into the following three major factors: (1) incentives (short-term cost reductions, short-tem returns, long-term returns); (2) the internal management structure buttressing those incentives (commitment of top management, employee awareness, mechanism for managing greenhouse gas emissions, personnel, technology, facilities, funding, etc.); and (3) the external business climate in which the company finds itself (government policies, shareholders, consumers, local residents, public opinion, the media, major events, abnormal weather, economic trends, etc.).

These factors interact with one another, and they differ depending on the industry, the size of the company, and the particular circumstances in which it stands. Today, with the future course of government policy still uncertain, internal management structure is a particularly crucial factor. Even if incentives are weak, companies can make progress in implementing measures against global warming as long as their internal management structure is solid.

5. In order to provide a better understanding of the distinguishing characteristics of the innovative measures to combat global warming that companies are currently implementing, we analyze the circumstances in which major industries find themselves based on the above model framework. Specifically, we examine the risk of a carbon tax, capital investment, R&D spending, and the number of certifications for ISO 14001. Considerable differences are to be observed between industries in the level of risk associated with measures against global warming and how easy they are to reduce emissions. Even if a carbon tax is brought in and energy prices rise, it is possible that the manufacturing industry as a whole will not suffer that much impact, but the effect will be considerable on certain branches of the manufacturing industry and the areas where their plants are located.

6. As specific examples of innovative measures to combat global warming, we examine in detail 239 programs that between FY 1997-2001 received awards at a nationwide contest for outstanding energy-saving programs run by the Energy Conservation Center of Japan. The industries that won the most awards were, in order, ordinary steel, four-wheel vehicles, electronic equipment, petroleum, and components and chassis. Companies in these particular industries were consistent winners, but their example has failed to catch on, in part because incentives to fight global warming are at present weak. The majority of winning energy conservation programs focused on rationalizing energy demand. As for means of implementation, most programs made the best use of existing facilities, and there were not so many winners involved installing new facilities. Even companies with a strong commitment to conserving energy to some extent continue to be able to pursue such low-cost measures. There were a fair number of cases of companies restructuring their internal mechanisms for managing energy costs. Many energy conservation programs were implemented from the bottom up, with employees taking the initiative. Almost all the few programs that won awards in the non-manufacturing sector, which lags behind in its efforts, were implemented on a top-down basis and started with a reassessment of the amount of energy the company was using. This suggests that, if more companies are to join the fight against global warming, it is important that first they put in place the necessary internal emission management structure.

7. The above analysis leads us to offer the following three recommendations for encouraging companies to adopt measures against global warming:

(1) Enhance incentives.

Current efforts to fight global warming are confined to major corporations in certain industries. Encouraging the corporate community as a whole to join the fight will require providing stronger incentives to a broad range of players while taking into consideration the current constraints of the Kyoto Protocol. Meanwhile, in order to facilitate development and dissemination of more advanced technology and know-how than is available today, institutional arrangements such as providing various protection for intellectual property rights and pecuniary prizes should be made to enable companies to recover development costs. That will, it is hoped, lead to a proliferation of outstanding technologies and know-how that can be shared by society as a whole.

(2) Furtherance of corporate internal GHG management structure.

Even if incentives are weak, companies can still make progress in implementing measures against global warming as long as they have in place an internal mechanism for managing their GHG emissions — what might be described as corporate infrastructure for the fight against global warming. The conditions also need to be right for bottom-up action, with the company having committed itself to a policy of taking measures against global warming. Companies in the non-manufacturing sector in particular, which currently is doing little on this front and still has plenty of leeway to make reductions, should be encouraged to adopt the necessary internal management structure.

(3) Fair evaluation from outside.

One of the reasons that companies are reluctant to commit themselves to measures against global warming is that they are not always given due credit for serious efforts to help prevent global warming in the long run and for emission cuts as determined by product lifecycle assessments (LCAs). Companies need to be fairly evaluated, and that will require adjusting evaluation benchmarks and granting LCA emission permits.

All three ideas are interrelated and should preferably be pursued simultaneously. By installing the internal infrastructure needed to combat global warming and disseminating outstanding technology and know-how, companies can take the first step to decouple global warming mitigation and economic activities. Let us hope that progress will be steady.

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Introduction

Much concern has been expressed about Japan's ability to achieve the targets for reducing greenhouse gas emissions set in the Kyoto Protocol, which the country ratified in June 2002. With greenhouse gas emissions continuing to climb even after 1990, Japan remains far short of meeting its Kyoto reduction targets despite implementing a series of policies in line with the Guidelines for Measures to Prevent Global Warming (below termed the "New Guidelines") adopted on March 19, 2002, which form the cornerstone of the Japanese government's strategy on preventing global warming. The New Guidelines call for a review of progress at certain key junctures (2004, 2007) based on future emission trends as Japan strives to fulfil its Kyoto obligations, and additional measures will likely come up for discussion.

Japan thus needs to redouble its efforts to fight global warming, and industry will be expected to play a major role. But many sectors and firms have been hesitant to commit themselves to taking action on this front, for the future direction of government policy remains unclear, plus there is the question of the potential costs involved. Nonetheless, certain companies are implementing innovative programs in the field. This report examines specific cases of such corporate programs to combat global warming. It analyzes their background and the framework that underpins them, then suggests the future course of policy for promoting corporate measures against global warming.

Chapter I summarizes certain points relevant to our discussion that pertain to fighting global warming within the framework of the Kyoto Protocol. Chapter II surveys what Japanese corporations are doing to combat global warming. Chapter III identifies the characteristics of these measures against global warming and barriers to their implementation, while Chapter IV examines the mechanisms that buttress innovative measures in the field, identifies key factors involved, and considers how those factors are interrelated. Chapter V looks at the domestic corporate climate: specifically, it analyzes the risk to corporate profits should a carbon tax be introduced and examines investment by different industries in measures to combat global warming. Chapter VI builds on the preceding discussion by scrutinizing further into the question of what exactly characterizes measures against global warming as exemplified by innovative programs in the field and identifying points that they have in common. The paper concludes with three broad recommendations, based on the foregoing analysis, on how to promote corporate measures against global warming.

I Global Warming and the Kyoto Protocol

1. What Is Global Warming?

Global warming refers to the additional rise in the temperature of the earth's surface and atmosphere across the globe caused by increased atmospheric concentrations of greenhouse gases (GHGs) [1] generated by human activity, especially CO_2. It has an adverse impact on the natural ecosystem and human life and indeed threatens the foundations of humankind's very survival. Because its potential impact is so grave, it is considered one of the most serious problems facing the environment today.

According to the Third Assessment Report issued in 2001 by the Intergovernmental Panel on Climate Change (IPCC),[2] the world's most prestigious body in the field, the global average surface temperature has increased 0.6 ± 0.2˚C since 1861, while during the 20th century average global sea level rose 10-20 cm, and regional climate changes have already affected a wide range of physical and biological systems in many areas of the globe. Moreover, the report cites new, more compelling evidence that the warming observed over the past fifty years can be attributed in the main to human activity. As for the future, it projects that the global average surface temperature will rise 0.4-1.1˚C over the period 1990-2025, 0.8-2.6˚C over the period 1990-2050, and 1.4-5.8˚C over the period 1990-2100. It also projects a rise in sea level of 3-14 cm between 1990 and 2025, 5-32 cm between 1990 and 2050, and 9-88 cm between 1990 and 2100. The adverse effects of global warming cited in the report include disruptions in climate, the impact on the ecosystem, outbreaks of infectious diseases such as malaria, and an increase in the number of people who fall victim to flooding. Then there is the impact on the market, which the report measures in terms of the effect on GDP. No matter what the rise in temperature, many developing nations will, the report forecasts, experience a net loss (although this projection is of low reliability), and, if the rise is of more than a few degrees Celsius, the developed economies will suffer a net loss as well (which projection is of low to medium reliability); moreover, the North-South gap will widen.

2. How the International Community Is Combating Global Warming: The Kyoto Protocol

In May 1992, in an effort to stem the problem of global warming, the international community adopted the United Nations Framework Convention on Climate Change, which took force in March 1994. (Japan ratified the treaty in May 1993; to date over 180 countries have ratified.) The convention's ultimate objective as defined in Article 2 is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level, the convention states, should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner. The convention also calls on the developed countries to take the lead in combating climate change in accordance with the principle of "common but differentiated responsibilities."

[1] The Kyoto Protocol calls for reductions in six gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). While the exact breakdown differs from country to country, CO_2 accounts for the largest share of emissions — over 90% in the case of Japan.

[2] The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). The role of the IPCC is to conduct an authoritative assessment, on a comprehensive, objective, open, and transparent basis, of scientific, technical, and socio-economic information on the risk of human-induced climate change, its potential impacts, and options for mitigation and adaptation. The IPCC does not carry out research itself, nor does it monitor climate-related data. It bases its assessment mainly on peer-reviewed and published scientific/technical literature. The IPCC enlists the aid of several hundred scientists from across the globe in compiling its reports, which are reviewed by experts from around the world.

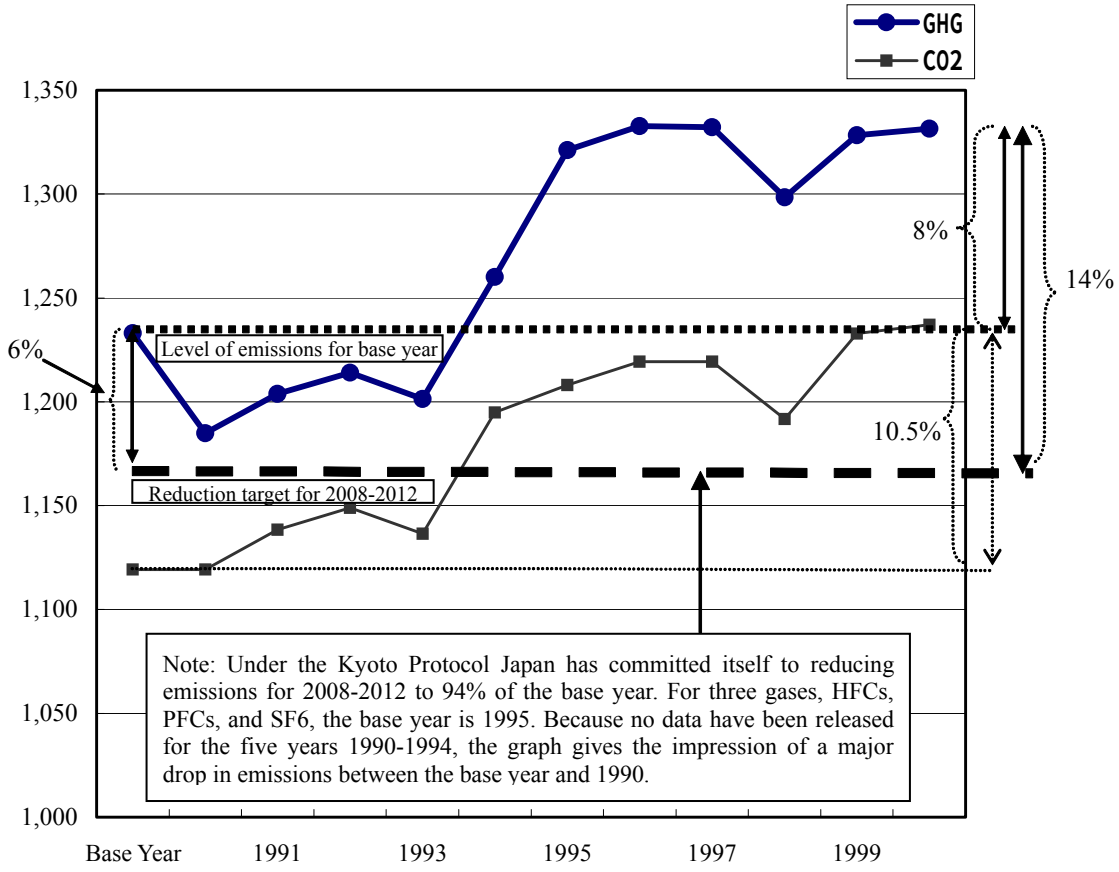

Figure 1-1. Japan's Greenhouse Gas Emissions

Notes: 1. As of FY 2000, Japan's greenhouse gas (GHG) emissions stood at 8.0% above those for the base year, this despite the slump in the economy. Emissions of CO_2 alone (which account for over 90% of the total) were up 10.5%.
2. In terms of individual sectors, emissions were up 0.9% in the industrial sector, 21.3% in the commercial and residential sector, and 20.6% in the transportation sector.
3. Japan is already 14% above its Kyoto reduction target of 94% of the base year.
4. It can however claim a maximum deduction of 3.9% due to absorption by forest management.
5. There are six GHGs covered by the Kyoto Protocol: CO_2, methane, N_2O, and HFC and two other gases.

Source: Compiled by DBJ from government and other data.

As prescribed by this accord, in 1995 the First Session of the Conference of the Parties (COP1) conducted an initial review of whether the commitment made by the developed countries under the convention to return their emissions to 1990 levels by the year 2000 was adequate to achieving the convention's long-term objective. The signatory states concluded that this commitment was inadequate and agreed to adopt a protocol, in which further measures were to be stipulated, by the time of COP3.

COP3, which convened in Kyoto in December 1997, adopted the Kyoto Protocol as the first step in a sustained, long-term strategy to cut emissions of greenhouse gases. The Kyoto Protocol gave legal force to numerical targets for reductions in emissions by the developed countries.

Japan ratified the Kyoto Protocol in June 2002. It thereby made an international commitment to reducing greenhouse gas emissions for 2008-2012 by at least 6% as compared to the base year (basically 1990) (Fig. 1-1).

Yet Japan's greenhouse gas emissions continue to rise. Despite an array of measures and the slump in the economy, emissions for

FY 2000 stood 8% above those for the base year, which means that the country is already 14% in excess of its Kyoto target.[3] Emissions can be expected to rise further as the commitment period of 2008-2012 approaches. Under the Guidelines for Measures to Prevent Global Warming[4] (below termed simply the "Guidelines"), the Japanese government's blueprint for achieving its Kyoto reduction targets, current policies will continue through 2004; then, should they prove inadequate, additional measures are to be implemented in and after FY 2005. No doubt Japan will find itself having to bolster its efforts to meet its obligations with a further series of measures in FY 2005 and beyond.

3. Importance of Corporate Efforts to Combat Global Warming

CO_2 accounts for 93% of Japan's total emissions of the six greenhouse gases covered by the Kyoto Protocol (as of FY 2000). The industrial sector accounts for 40% of CO_2 emissions (when emissions from industrial use power generation are factored in), the energy conversion sector — power stations and the like — 31% (before emissions from power generation are factored in) (Fig. 1-2). In the commercial and residential sector (households, commercial buildings, etc.) and the transportation sector, not only does corporate activity exert a considerable impact per se; products and services supplied by corporations also generate the lion's share of emissions in those sectors. It is therefore of the utmost importance that companies make an effort to prevent global warming on all fronts, not just in their production activities. On the other hand, certain matters lie beyond corporate control, such as consumer preferences, and the scope of companies' product liability should not extend beyond what is reasonable. An effort should therefore be made to achieve a balanced division of responsibilities between company and consumer as determined by what each can best control.

The Guidelines set some rough targets for how much each sector is to reduce emissions by FY 2010 as compared to FY 1990: -7% in the industrial sector, -2% in the commercial and residential sector, and +17% in the transportation sector. As of FY 2000, the industrial sector was 0.9% over the level for the base year, the commercial and residential sector 21.3%, and the transportation sector 20.6%. The commercial and residential sector has thus fallen particularly far behind target.

4. Difficulty of Combating Global Warming under the Kyoto Protocol

Global warming is a truly global problem that transcends national boundaries, and the international community needs to work together in fighting it. In that regard the Kyoto Protocol marks the beginning of a new epoch, for it constitutes the first step in framing an international response to the problem. It has numerous advantages. It makes use of a groundbreaking market-based mechanism to minimize the worldwide costs of combating global warming — the so-called Kyoto Mechanism — in what is a first on the international stage. Nonetheless, the Kyoto Protocol agreed upon by the over 180 signatories to the Framework Convention on Climate Change also possesses many limitations. The United States has withdrawn from the accord, and developing countries such as China, India, and some developed countries such as South Korea face no obligation to cut their emissions, even though together they account for over 40% of the world's total greenhouse gas emissions flow (Figure 1-3). Some have expressed hopes that the US will return to the fold, but it would be wise to act on the assumption that there is little prospect of that

[3] According to preliminary figures released by the General Policy Division of the Agency for Natural Resources and Energy on January 31, 2003 in conjunction with the preliminary figures on energy supply and demand for FY 2001, energy-derived emissions of CO_2 for FY 2001 were down 2.7% from the previous fiscal year, in part because of the worsening economic climate and the effects of a cool summer and warm winter. But that does not mean that emissions have gone into permanent decline, since a rise is projected for FY 2002. According to the same set of figures, energy-derived CO_2 emissions for FY 2001 were up 6.3% over those for FY 1990 — although direct comparison with the figures in Fig. 1-1 is not possible due to changes in how emissions are measured.

[4] The tentative translation of this guideline was "The New Climate Change Policy Programme."

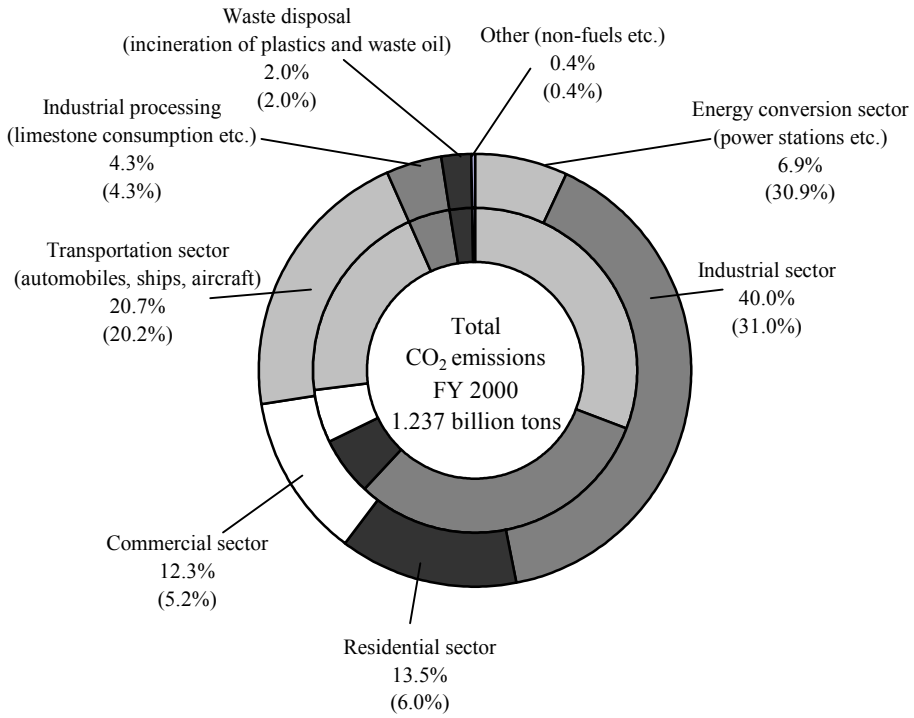

Figure 1-2

Notes: 1. Inner circle: Percentage of direct emissions by each sector (lower figure in parentheses).
Outer circle: Percentage after emissions by power utilities are redistributed to the different sectors according to the amount of power each consumes (upper figure).
2. The percentages do not necessarily add up to 100 due to statistical error and rounding of fractions.
3. "Other" includes consumption of lubricants and such, errors in redistribution of emissions from power generation, etc.

Source: Ministry of the Environment, *Greenhouse Gas Emissions in FY 2000*

happening, as it would be extremely difficult for that country to meet its Kyoto targets anyway.[5]

So the Kyoto Protocol covers at most a modest 30% of the world's total CO_2 emissions flow. Furthermore, countries in the process of transition to a market economy such as Russia and Ukraine, which generate over 10% of the world's emissions, are not required to make any special effort to achieve reductions, since the Protocol merely imposes a cap far in excess of their current emissions. It is therefore expected that countries like Russia will enjoy massive excess emissions quotas known as "hot air."[6] It has been estimated that Russia could rake in as much as $25 billion in revenue by selling off that excess to Japan and other countries.[7]

[5] According to projections by the White House and the US Department of Energy, by around 2010 US greenhouse gas emissions will rise to over 30% above their 1990 level. That is some 40% in excess of Kyoto targets.

[6] It is projected that, even if Russia makes no effort to achieve reductions, it will still gain an excess emissions quota equivalent to 20-30% of emissions in the base year. That excess is termed "hot air."

[7] Much still remains obscure in this regard, since the amount of revenue generated will depend on the selling price, and it is not clear how much of the excess can actually be sold off. Russia's base year emissions are roughly double those of Japan. Therefore, if, say, 20% of those emissions prove in excess, Russia will have a surplus equivalent of 40% of Japan's base year emissions, or some 500 million tons of CO_2, over the five-year period beginning in 2008. That means that a total of 2.5 billion tons of CO_2 will become available for sale without any special effort on Russia's part. If that amount can all be sold, it is estimated that, assuming a sales price of $10 per ton of CO_2, it will generate total revenues of $25 billion. But many questions still remain. Russia's excess quota is said to exceed total world demand for emission allowances

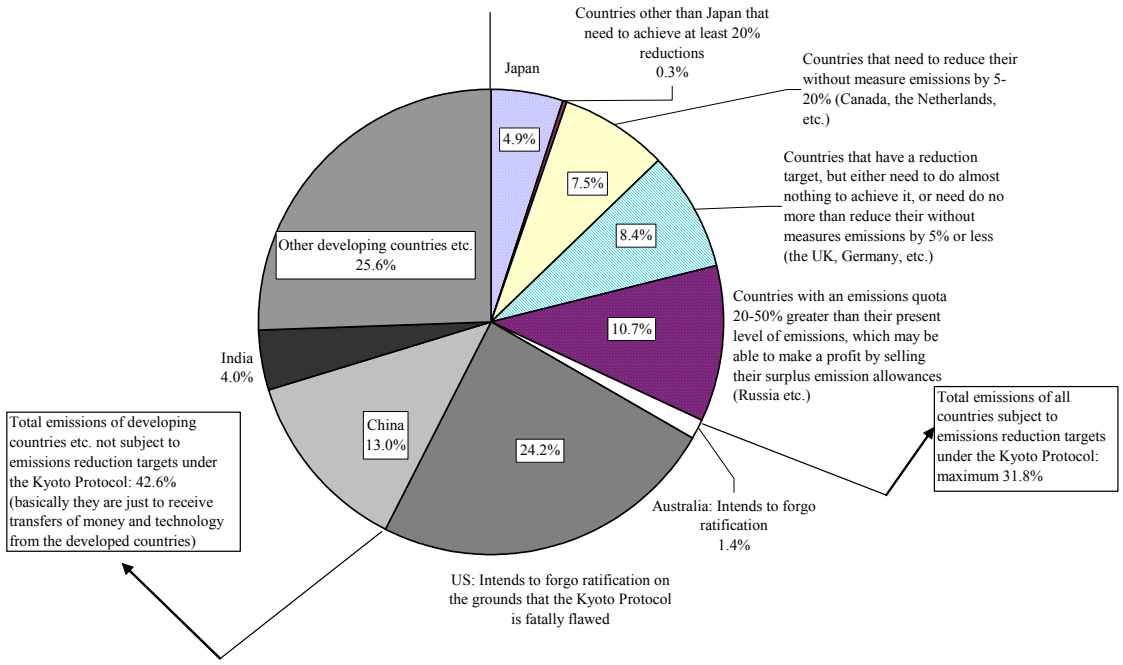

Figure 1-3. Coverage of the Kyoto Protocol

Note: The figures do not add up to 100% due to rounding of fractions.
Sources: Compiled by DBJ from such sources as UNFCCC data, IEA figures on CO_2 emissions for 2000, and Aiba and Saijo, *The Kyoto Protocol and Global Environmental Strategies of the EU, the U.S. and Japan*.

Of the countries that produce the remaining 20% of emissions, i.e., those other than Russia and Eastern Europe, quite a few, including the United Kingdom and Germany, will either almost not have to do anything or, at most, need to reduce their level of emissions by 5% from the business as usual emissions or so in order to meet their targets. Therefore, on a strict estimate, just a few countries accounting for a mere 10% of world emissions flow will have to grapple in dead earnest, like Japan, with the reduction of global GHG emissions; even by a looser definition, only a number of countries producing roughly 20% of global emissions are required to make serious emission abatement effort.

An international agreement that calls on the developed countries to take the lead in fighting global warming stands to reason in light of how the problem first arose and the technical and financial resources required to deal with it. Still, the Kyoto Protocol in its present form imposes substantial emission reductions on only certain countries, which together produce a mere 10-20% of the world's total emissions flow. That has led to concerns not only about the international competitiveness of companies in carbon-constrained countries, but even about the actual effectiveness of the accord itself. Even if a 5% reduction is achieved in 10-20% of global emissions, that is not going to translate into an overall drop in emissions if there is an increase in the remaining 80-90%. In actual fact it is forecast that by 2010 emissions in the US and certain developing countries will rise to over 30%

now that the US has withdrawn from the Kyoto framework; the surplus may command a higher price if kept in reserve until 2013 and beyond, depending on what new reduction targets are set; and Russia may one day need to tap the surplus itself in order to achieve its own reductions. Nonetheless, there is a good chance that Russia will exercise a monopoly on emission allowance thanks to its massive surplus, and by controlling the world market for emission allowance it may be able to demand a high price. A senior Russian official has been quoted as stating that the country will accept no less than $50 per ton of CO_2. It will be interesting to see what moves Japan, regarded as the biggest potential buyer, makes in response.

Carbon leakage is a consequence whereby, when only certain countries undertake measures to combat global warming, greenhouse gas emissions increase elsewhere. The major channels through which this may happen include the following three:

(1) The imposition of high carbon taxes or equivalent regulations in developed countries subject to the Kyoto Protocol induces energy-intensive industries to relocate to developing countries (which makes it harder for them to join the Protocol later).
(2) Even if industries do not actually relocate, production declines in the developed countries subject to the Protocol and increases in the developing countries.
(3) Energy consumption in the developing countries rises as energy prices fall.
Assuming that energy efficiency is high in the developed countries and low in the developing countries as is the case today, overall global emissions could rise due to less energy-efficient production activity in the developing world. In the worst-case scenario, developed countries could end up reducing the value added of their goods and losing jobs, while overall global emissions actually rise.

Figure 1-4. Carbon Leakage

Source: compiled by DBJ.

above their 1990 level. Therefore excessive hopes should not be placed in the Kyoto Protocol's potential benefits in preventing global warming. It will, it is said, merely reduce the rise in global average surface temperature by 0.1-0.2˚C.

Greenhouse gases linger in the atmosphere for 50-200 years; hence global warming is a cumulative problem from the past caused by the ongoing buildup of greenhouse gases. In that regard the developed countries cannot escape responsibility, even if they were not aware that energy consumption causes global warming beforehand. And the international consensus on the need for the developed countries to take the lead in combating global warming makes a fair amount of sense, since they are the ones that possess the technology and money needed to deal with the problem. However, if only some countries around the globe are going to adopt measures to fight global warming, then a number points need to be kept in mind.

According to one theory, if only some countries take action to fight global warming, total global emissions will actually rise due to what is called carbon leakage. There are various channels through which carbon leakage may occur: for example, energy-intensive industries may relocate from regions on which the Kyoto Protocol imposes reduction targets to those with no such targets, or energy consumption could rise in countries not subject to restrictions as measures to combat global warming drive down energy prices (Fig. 1-4). Little practical research has been conducted on the subject of carbon leakage, and much remains to be clarified. Still, the fact of the matter is that Japan has industries like the steel industry, in which energy accounts for a high percentage of the cost of production and which, moreover, is exposed to competition from countries such as the US, China, and South Korea (Fig. 1-5). In the manufacturing industry as a whole, on the other hand, energy does not account for a very high percentage of the cost of fuel and raw materials; one should therefore carefully assess the impact separately for each type of product (see Fig. 5-1).

As illustrated in Table 1-1, which shows the destinations of major countries' exports, most of Japan's exports go to the US and developing countries in Asia and elsewhere, which are not subject to reduction targets under the Kyoto Protocol. Japan is therefore not in a position to undertake emission reduction measures that entail major cost increases. On the other hand, 60% of EU exports go to other EU countries, while the percentage of exports to the US and the developing countries is fairly low; thus, if the countries within the EU pursue

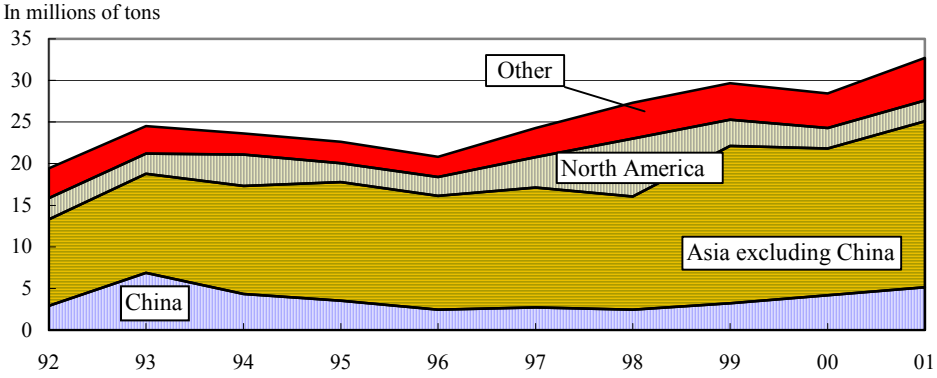

Figure 1-5. Japanese Steel Exports by Destination

Source: Compiled by DBJ based on Japan Iron and Steel Federation data.

similar policies, the impact on them will be relatively limited. Moreover, according to estimates by the European Commission, the marginal abatement cost needed to meet the EU's Kyoto reduction targets is fairly low, and the economic burden should not be that great.[8] By contrast, many observers project that the marginal abatement cost for Japan will be at least two to four times that amount.[9] That cost gap could well become reality if Japan insists on pursuing high-cost measures at home and fails to make use of the Kyoto Mechanism to implement measures that offer a high level of cost-efficiency.

In one way the ideal would be for all countries to demonstrate the same level commitment simultaneously, but there is very little likelihood of that happening, for different countries have widely diverging circumstances and interests. Certain countries therefore need to take the initiative. But the wrong approach will not just do nothing to prevent global warming; it could set a bad precedent.[10] It is not beyond the realm of possibility that, even if Japan succeeds in cutting emissions, overall global emissions could actually rise, so that the country will have ended up merely sacrificing jobs and reducing the value added of its goods. That is not to advocate doing nothing; far from it, it is incumbent upon Japan, as the host country of the Kyoto Protocol, to lead the world in the right direction over the long term. The fact is that, by making effective use of the Kyoto Mechanism, it is possible to implement measures that strike a balance between environmental protection and the economy. Recognizing that fact, Japan needs to examine

[8] See European Commission, *European Climate Change Programme Long Report*, June 2001, and European Commission, "EU can affordably reach Kyoto target according to new report," 11 June 2001, DN: IP/01/816. This report states that the EU can afford to cut emissions by twice the necessary amount with measures costing up to 20 euros per ton of CO_2.

[9] The *Interim Report of the Subcommittee for Establishing a Scenario for Achieving the Kyoto Target*, which was issued in July 2001 by the Global Environment Council of the Central Environment Council, Ministry of the Environment, states as follows: "According to the results of economic analysis using a quantitative model, a 2% reduction in CO_2 emission compared to 1990 could be achieved as of 2010 by imposing a carbon tax of somewhere between 13,000 and 35,000 yen per carbon ton." The figure of ¥13,000-35,000 works out to ¥3,545-9,545 ($30-$80 at a rate of ¥120 to the dollar) per ton of CO_2. According to the bottom-up economic analysis contained in this interim report, which employs the same method of calculation as the above European Commission report, once private-sector investment risk is factored in, measures costing more than ¥100,000 per carbon ton ($230 per ton of CO_2) may in certain cases accomplish no more than reducing emissions to their level in the base year; hence it is possible that Japan will have to take measures costing more than ten times what the EU has to spend.

[10] If, say, trading in hot air results in massive transfers of cash, or reductions in greenhouse gas emissions come merely in consequence of the hollowing out of industry, these could act as bad precedents that hamper future international efforts to prevent global warming.

carefully its policy options and take action across a wide range of fronts in order to help prevent global warming in the true sense of the term.

Table 1-1. Destinations of Exports from Major Countries and Regions

Exporter	To US	To developing world	To EU	To Japan	To elsewhere
EU	7.6%	20.3%	62.9%	1.9%	7.2%
Germany	8.3%	23.5%	58.2%	2.4%	7.6%
UK	13.2%	20.3%	55.3%	2.2%	9.0%
Japan	29.5%	48.0%	17.3%		5.2%
US		42.2%	22.4%	10.0%	25.5%

Note: Average for 1990-2001.
Source: Compiled by DBJ based on IMF, *Direction of Trade Statistics*.

II What Japanese Corporations Are Doing to Combat Global Warming

1. Action by Japanese Corporations to Combat Global Warming

Here we assess what action Japanese corporations are taking to prevent global warming by examining the responses on that subject contained in the *Survey of Environmentally Friendly Corporate Activities* conducted by the Ministry of the Environment in FY 2001. This is the largest survey of its kind in Japan. It was administered to (1) 2644 companies listed on the first and second sections of the Tokyo, Osaka, and Nagoya stock exchanges and (2) 3716 unlisted companies and businesses with 500 or more employees. Answers were received from 48.8% of (1) and 43.2% of (2).

Fig. 2-1 shows what action listed and unlisted companies are taking to prevent global warming. A large percentage of listed companies answered that they have formulated a policy and are taking action to prevent global warming. Over the past three years the number of listed companies in this category has inched up, though the increase has not been large. The same holds for unlisted companies. Since less than 50% of the companies surveyed submitted responses, and it is fair to assume that companies that did not respond lag behind those that did in taking action against global warming, the real number of companies that have formulated a policy and are taking action is probably less than the 45% figure seen in the FY 2001 survey. Conversely, the survey indicates that over 30% of companies are taking no concrete action on this front.

Fig. 2-2 shows what action listed companies in different industries are taking to prevent global warming. There is a fair amount of discrepancy among them. The electricity and gas supply industry in particular stands out, with virtually all companies in the field having formulated a policy and taking action. The manufacturing sector comes in second, with again a relatively large number of companies taking action — though in percentage terms they constitute only roughly half the total. On the other hand, in the services sector, real estate, and banking and insurance around half the

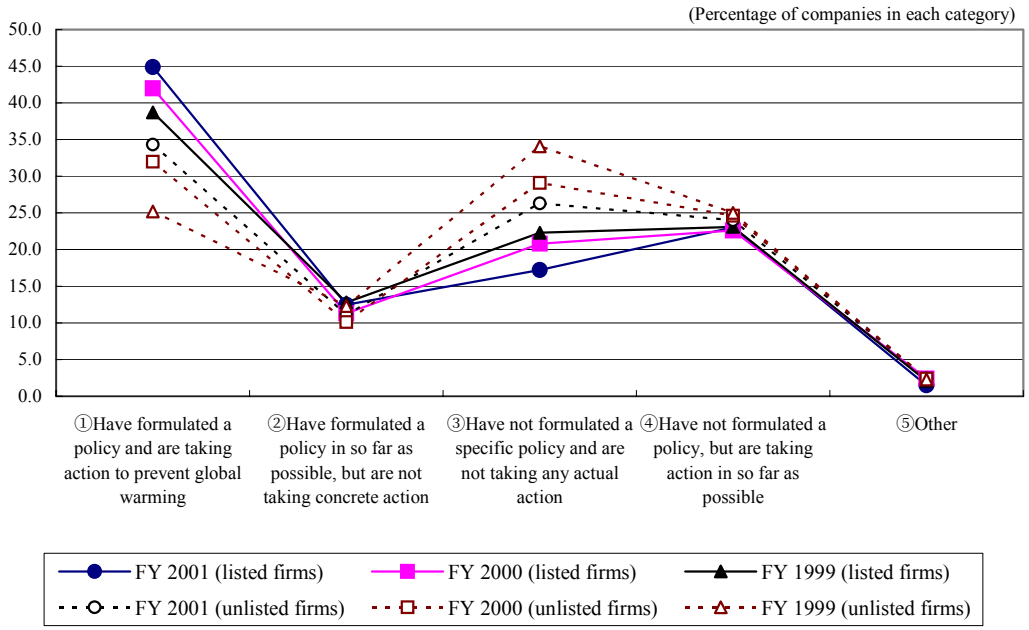

Figure 2-1. Action by Japanese Corporations to Prevent Global Warming as Tabulated by Year

Source: Compiled by DBJ from Ministry of the Environment, *Survey of Environmentally Friendly Corporate Activities*, FY 2001.

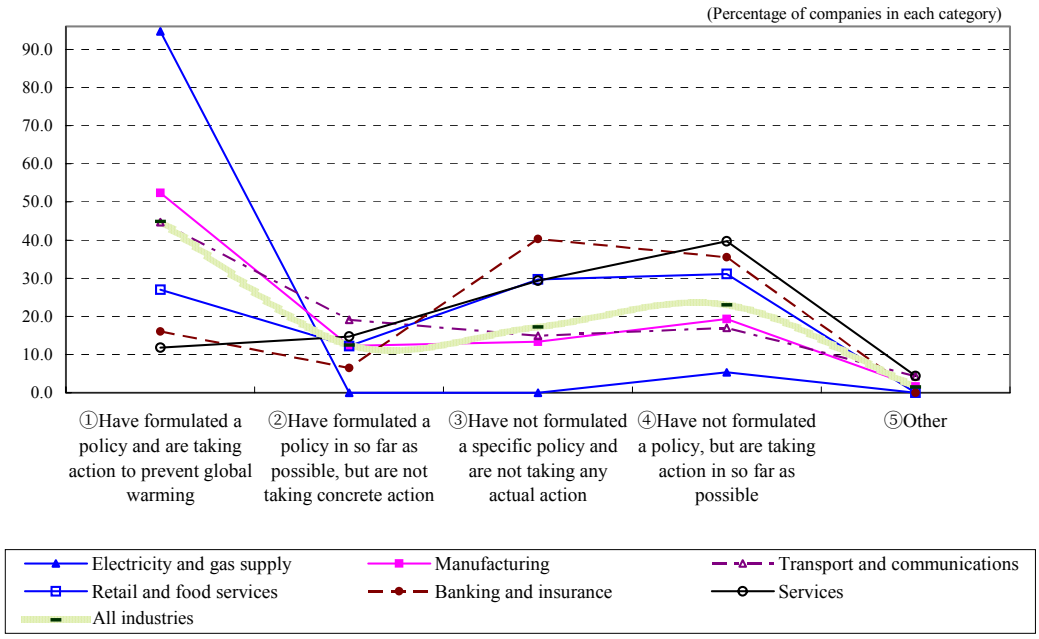

Figure 2-2. Action to Prevent Global Warming: Cross Tabulation of Listed Companies by Industry

Source: As in Fig. 2-1.

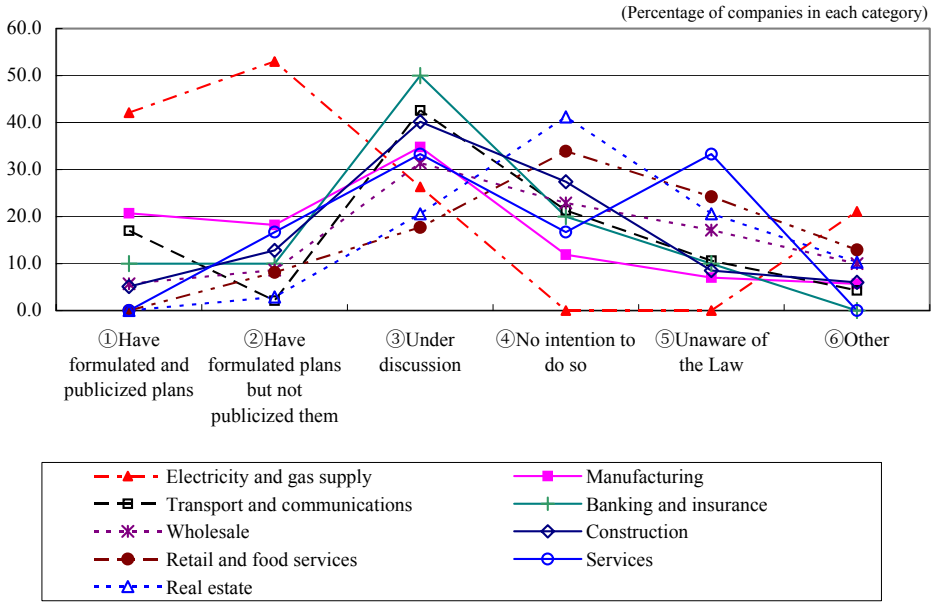

Figure 2-3. Plans to Limit Greenhouse Gas Emissions: Cross Tabulation of Listed Companies by Industry

Source: As in Fig. 2-1.

number of firms are *not* taking any action, and once those companies that failed to respond to the survey are factored in, it may be concluded that the majority are doing nothing. In general, then, the non-manufacturing sector lags behind energy and manufacturing in taking action to prevent global warming, which means it has that much more room for improvement.

Fig. 2-3 shows what action companies in different industries are taking to fulfil their obligation to "make an effort to formulate plans on measures to restrain greenhouse gas emissions

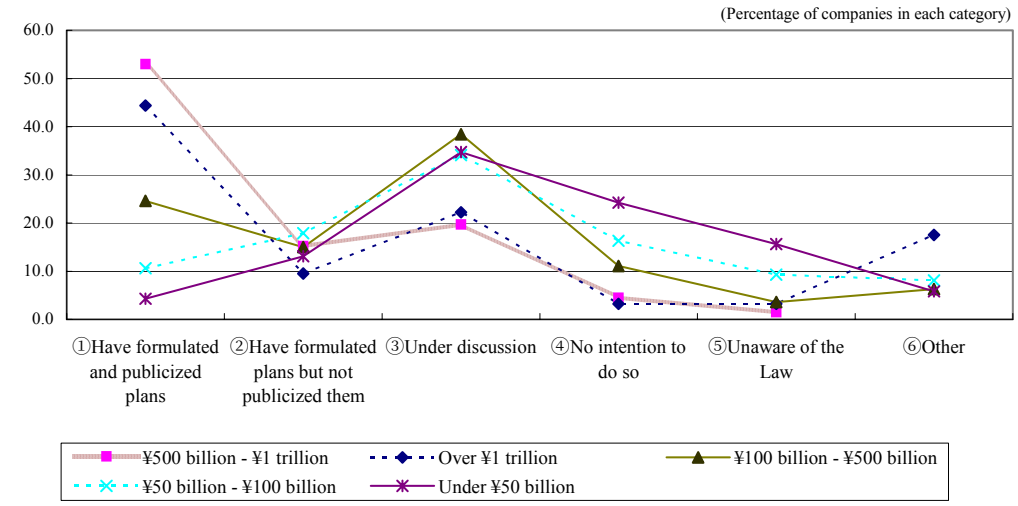

Figure 2-4. Plans to Restraint Greenhouse Gas Emissions: Cross Tabulation of Listed Companies by Volume of Sales

Source: As in Fig. 2-1.

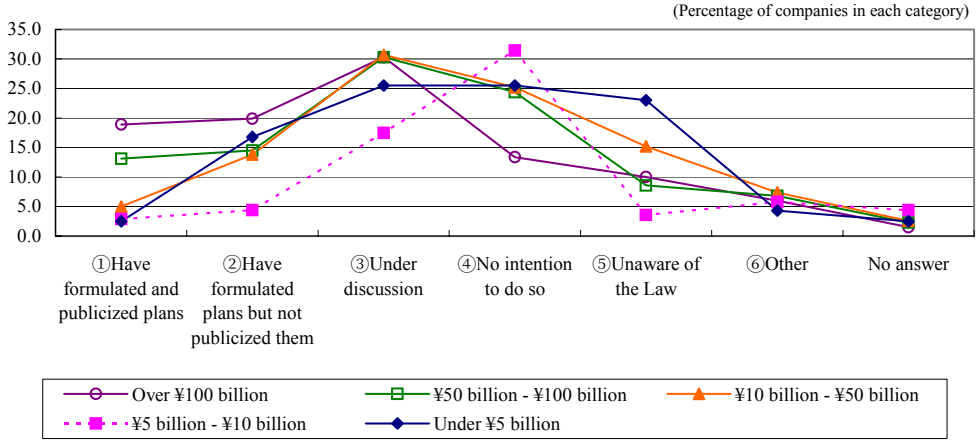

Figure 2-5. Plans to Restraint Greenhouse Gas Emissions: Cross Tabulation of Unlisted Companies by Volume of Sales

Source: As in Fig. 2-1.

and to publicize those plans" as prescribed in the Law Concerning the Promotion of Measures to Cope with Global Warming enacted in 1998. A mere 15% of listed firms have both formulated and publicized such plans. In the case of unlisted firms the figure drops to 7%. Even among listed firms, despite progress in industries like electricity and gas supply, in banking and insurance, services, and retail and food services the number of companies that have both formulated and publicized plans is zero, and many companies have no intention to formulate such plans or are even unaware of the Law.

Fig. 2-4 shows how differences in volume of sales affect corporate action against global warming. It clearly indicates that companies with larger sales volumes tend to be further ahead in dealing with the issue. Roughly half of listed firms with sales of ¥500 billion or more have formulated and publicized plans, but that number slips to one quarter for companies with

sales of between ¥100 billion and ¥500 billion, and a mere 10% for companies with sales of between ¥50 billion and ¥100 billion.

Fig. 2-5 shows the effect of differences in sales volume among unlisted firms. Again, the lower a company's sales volume, the less likely it is to have formulated and publicized plans, and the more likely it is to be at the discussion stage or have no intention of formulating such plans at all. Note in particular that less than 5% of firms with sales of under ¥50 billion have formulated and publicized plans.

As the above overview demonstrates, today the lion's share of action to combat global warming is being taken by major corporations in certain specific industries. Meanwhile small and medium-sized businesses, which make up the majority of companies, and the non-manufacturing sector excluding energy lag seriously behind in dealing with the issue.

2. Characteristics of Measures Companies Are Currently Taking to Combat Global Warming

Here, based on the same Environment Ministry survey, we examine the details of measures to combat global warming that Japanese companies are currently taking.

Fig. 2-6 shows the types of measures that listed companies are taking at the manufacturing stage. The most common measure is (3) Streamlining the manufacturing process, followed by (1) Eliminating wasteful energy usage. These are the kinds of measures that directly translate into short-term profits by cutting costs, and they can be interpreted as not involving capital investment in that they make effective use of existing facilities. In third place comes (2) Upgrading facilities, though in FY 2001 the number of companies pursuing this route dropped by about 10% compared to FY2000. Next comes (4) Stopping use of greenhouse gases, and, finally, (5) Reducing production volumes, which a mere handful of companies chose. These categories appear to cover pretty well all the main types of measures, since only a few firms chose (6) Other.

Fig. 2-7 shows types of measures being taken in the transport sector. The overwhelming favorite is (1) Boosting transport efficiency, followed by (4) Reducing number of runs, (3) Switching to low-pollution vehicles, and (2) Modal shift. Again, measures that make effective use of existing facilities and entail little initial investment appear to dominate. (2) Modal shift accounts for a relatively low percentage, being presumably the most difficult to implement. These categories appear to cover pretty well all the main types of measures in the transport sector, since again only a few firms chose (5) Other.

Fig. 2-8 shows types of measures being taken in the commercial sector. The

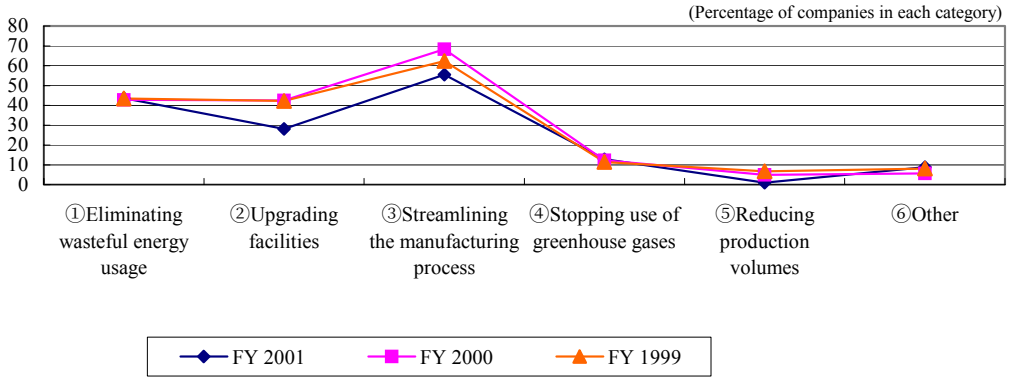

Figure 2-6. Measures Being Taken to Cut and Stabilize Greenhouse Gas Emissions at the Manufacturing Stage: Tabulation of Listed Firms by Year

Source: As in Fig. 2-1.

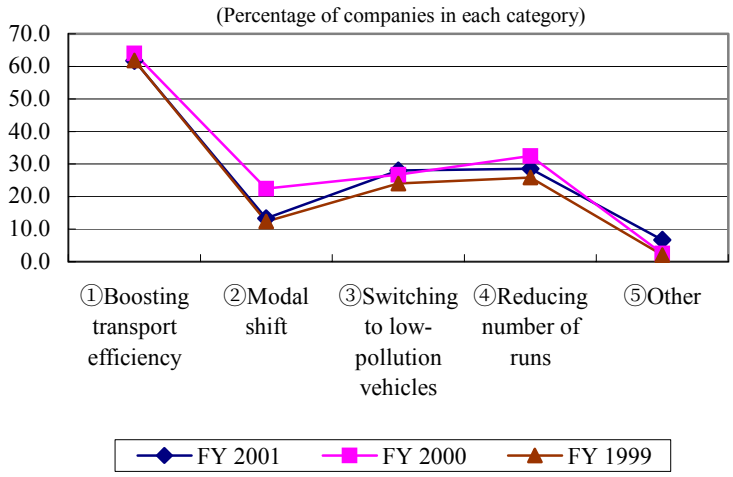

Figure 2-7. Measures Being Taken to Cut and Stabilize Greenhouse Gas Emissions in the Transport Sector: Tabulation of Listed Firms by Year

Source: As in Fig. 2-1.

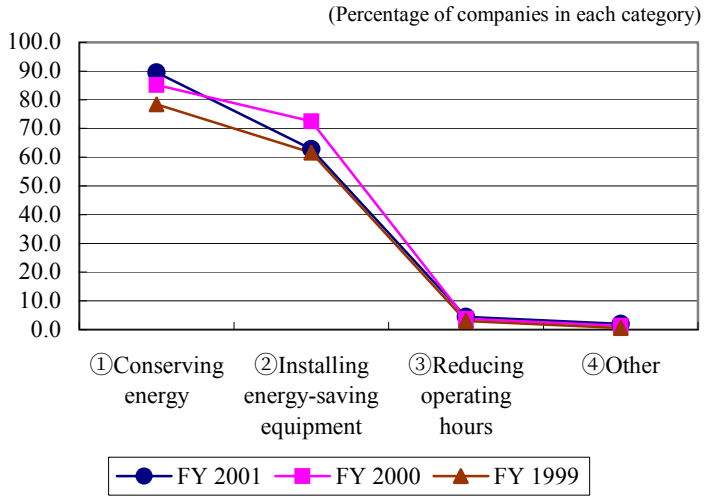

Figure 2-8. Measures Being Taken to Cut and Stabilize Greenhouse Gas Emissions in the Commercial Sector: Tabulation of Listed Firms by Year

Source: As in Fig. 2-1.

overwhelming favorite is (1) Conserving energy, and (2) Installing energy-saving equipment also chalks up a high percentage. A mere handful of companies chose (3) Reducing operating hours. These categories appear to cover pretty well all the main types of measures in the commercial sector, since again only a few firms chose (4) Other. Conserving energy can take many different forms, and one should be cautious about making categorical statements, since it is difficult to know exactly what types of measures are meant; nonetheless, given the fact that (2) Installing energy-saving equipment forms a separate category, it seems reasonable to conjecture that most energy conservation measures in the commercial sector do not involve the purchase of energy-saving equipment and therefore entail little initial investment. (2) Installing energy-saving equipment accounts for a higher percentage of the total in the commercial sector than do similar measures in the manufacturing and transport sectors involving the installation of new equipment; this can probably be attributed to the relatively lower unit price of energy-saving equipment in this sector.

Table 2-1. Characteristics of Measures against Global Warming Commonly Pursued in the Corporate Sector

	Popular measures		Percentage, FY 2001	Designed to rationalize energy demand?	Designed to improve equip-ment efficiency?	Entails capital investment?
Manufacturing Stage	1st	Streamlining the manufacturing process	55.4%	○	△	No
	2nd	Eliminating wasteful energy usage	43.6%	○		No
	3rd	Upgrading facilities	28.1%		○	Yes
Transport Sector	1st	Boosting transport efficiency	61.7%	○	△	No
	2nd	Reducing number of runs	28.6%	○		No
	3rd	Switching to low-pollution vehi-cles	28.0%		○	Yes
Commercial Sector	1st	Conserving energy	89.5%	○	△	No
	2nd	Installing energy-saving equip-ment	62.8%		○	Yes
	3rd	Reducing operating hours	4.4%	○		No

Note: Yes = ○ To some extent = △ No = blank
Source: As in Fig. 2-1.

Table 2-1 classifies the above types of measures being taken at the manufacturing stage, in the transport sector, and in the commercial sector according to three criteria: whether they are designed to rationalize energy demand, whether they are designed to improve equipment efficiency, and whether they entail capital investment. It is immediately obvious that few measures entail capital investment, while the majority are designed to rationalize energy demand by eliminating wasteful energy use. In overall terms, the most common measures are those that involve rationalizing energy demand without the need for capital investment; next come improvements in equipment efficiency, which often do entail such investment.[11] So it is fair to say that most measures being taken to combat global warming today typically involve little cost and are at the same time designed to yield short-term economic returns.

[11] Improving equipment efficiency also includes running existing equipment more efficiently.

III Characteristics of Measures to Combat Global Warming and Barriers to Implementation

1. Characteristics of Measures to Combat Global Warming

So far we have examined what types of measures Japanese companies have been taking to fight global warming. In this chapter we turn to the question of what characterizes measures to combat global warming in general.

Since greenhouse gases come in such variety, measures to combat global warming can take many different forms. Here we consider strategies for reducing emissions of what is the most important greenhouse gas for Japan, energy-derived CO_2, which accounts for some 80% of the country's total greenhouse gas emissions.

Under Article 4.1 and Article 12 of the United Nations Framework Convention on Climate Change, which forms the basis of the Kyoto Protocol, and in accordance with resolutions adopted by the Third Session of the Conference of the Parties (COP3) and the Fourth Session of the Conference of the Parties, each signatory nation is to compile a national inventory of greenhouse gas emissions by sources and removals by sinks using the Revised 1996 IPCC Guidelines. These same guidelines are used in computing emissions under the Kyoto Protocol adopted by COP3, and they form the basis of the Japanese government's calculations as well.

As illustrated in Fig. 3-1, under the guidelines emissions of energy-derived CO_2 are calculated as the product of fuel consumption, net calorific value, and carbon emission factor based on calorific value. This formula can be modified to simplify matters, with emissions calculated as the product of (1) activity volumes, (2) energy use efficiency, and (3) carbon content per unit of energy. Approaches may be

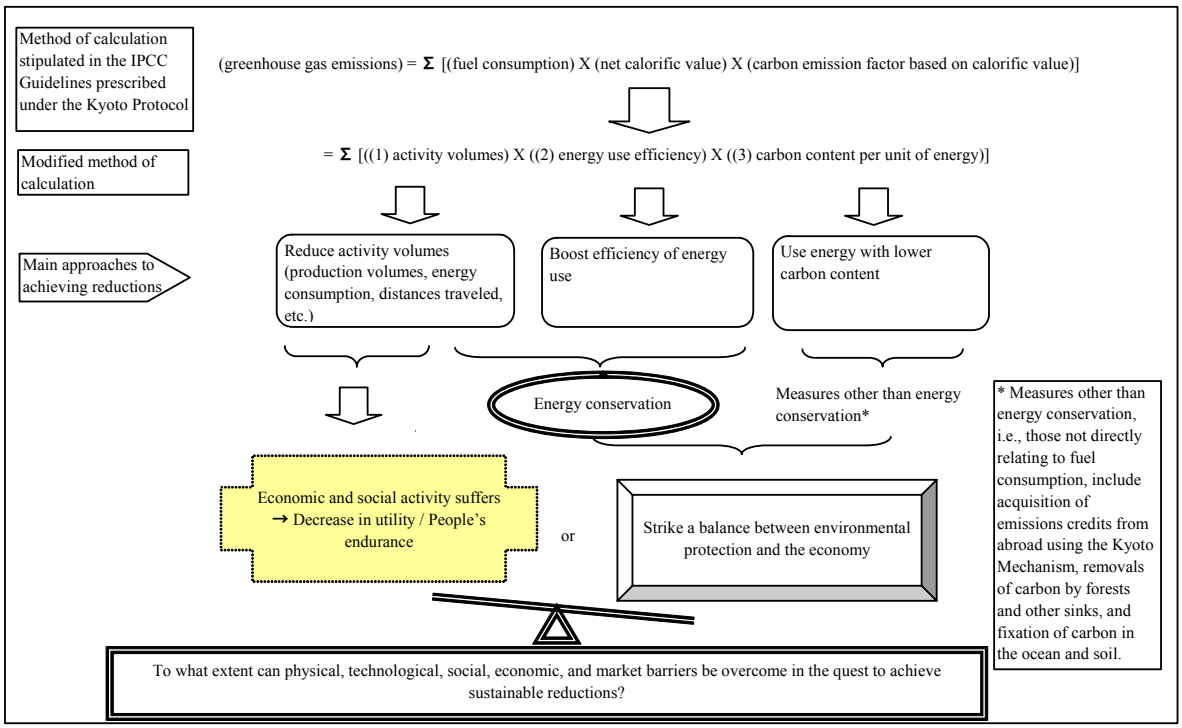

Figure 3-1. Methods of Calculating Fuel-related Emissions of CO_2 Etc. and Approaches to Reductions

Notes: 1. IPCC: Intergovernmental Panel on Climate Change.
2. Using energy with lower carbon content: Using electricity produced using wind power, nuclear power, or biomass generation, switching from coal to natural gas, etc.

Source: Compiled by DBJ.

considered to reducing emissions that target each of these three items. To address Item (1), the possibility of reducing activity volumes (production volumes, energy consumption, distances traveled by car, etc.) presents itself to mind. Eliminating excess activity volumes forms part of energy conservation. Boosting efficiency of energy use is designed to address Item (2). This involves upgrading to more efficient equipment or running existing equipment more efficiently; as such it falls into the category of energy conservation in general. Although certain technologies do exist that offer dramatic improvements in efficiency, generally speaking a 10-20% gain in efficiency is the norm when using available technologies or improving running of existing equipment, and major cuts in emissions are not to be expected. Addressing Item (3) means using forms of energy with lower carbon content. That includes using oil rather than coal and natural gas rather than oil, and tapping such sources as nuclear and wind power and solar rays. Using energy with lower carbon content is a highly effective way of preventing global warming without changing level of energy consumption, but Japan stands at a disadvantage in this regard as compared to Europe and North America. In those countries natural gas with its lower carbon content is available at a fairly low price via pipeline, and they have made much progress in switching over from coal to cheap natural gas[12] thanks to the liberalization of the energy market during the 1990s. Thus prevention of global warming has proceeded naturally. Japan, by contrast, has few sources of natural gas at home or nearby, and so the gas has to be liquefied and brought in by LNG tanker, which drives up the price. There seems to be no immediate way out of this impasse, and Japan will likely be paying more for natural gas than do Europe and North America for the foreseeable future. For Japan the cheapest energy source, and the one most conducive to the country's energy security, is coal, and liberalizing the energy market would end up driving up coal consumption. When it comes to wind power, one of the most promising new sources of energy, Japan is again at a disadvantage, with fewer viable sites than in Europe and North America. Japan is the world leader in the field of solar power, but solar power is expensive, costing six to ten times as much to generate as the equivalent amount of electricity from a thermal power plant. So there is little prospect of solar power making extensive inroads in the near future. Under the Special Law on the Use of New Types of Energy by Electric Utility Companies (the so-called RPS Law), which comes into effect in FY 2003, in FY 2010 power from new energy sources like wind will total a mere 12.2 billion kWh[13] — just 1.35% of Japan's total power generation. On this front as well, then, there is little likelihood of major gains by 2012.

Broadly speaking, therefore, there are three basic approaches to combating global warming targeting respectively Items (1)-(3). However, pursuing strategies (2) (boosting efficiency of energy use) and (3) (switching to energy with lower carbon content) beyond what is realistically achievable could deal a serious blow to the economy and society.[14] There is an economic limit to how much can be done to boost efficiency of energy use. The ease with which improvements can be made on this front varies depending on the industry and type of operation, and the time frame allowed also affects the outcome. Energy-intensive industries find it a formidable task to achieve even a 1% improvement in efficiency per unit of production or sales over the course of a year. On the other hand, certain innovative firms manage to make gains of over 5% in the course of a year.

[12] Natural gas contains about 60% of the carbon of coal. Thus switching fuels from coal to natural gas can help greatly reduce greenhouse gas emissions.

[13] Even if the figure of 12.2 billion kWh is achieved, that will be a fairly expensive way of combating global warming, since emission credit pricing assumes an RPS (Renewable Portfolio Standard) credit may reach around $250 per ton of CO_2.

[14] If (3) is interpreted broadly to include measures to combat global warming not directly related to fuel consumption, then it also embraces acquisition of emissions credits from abroad using the Kyoto Mechanism, removals of carbon by forests and other sinks, and sequestration of carbon in the ocean and soil. All of these have considerable potential, but it is still highly uncertain how effective they may be.

Box 1. The Case of BP p.l.c., a Leader in the Environmental Field

BP was the first major international oil company to recognize the issue of global warming and take precautionary action to deal with it. It thus earned itself a reputation as a leader in the fight against global warming.

In 1998 BP set itself the target of reducing direct emissions of greenhouse gases by 10 per cent from 1990 by the year 2010. It achieved that target by 2001 (90.1 million tons of CO_2 in 1990 $\rightarrow$ 80.5 million tons of CO_2), and engaged two independent outside auditors (KPMG and DNV) to verify the results, making public its emission figures in conjunction with the auditors' report. Since the company had recently merged with Amoco, it had some difficulty coming up with a way of objectively modifying the figures for volume of emissions for 1990, the baseline year. By reducing fuel consumption, combustion, and exhaust gas emissions, it also achieved economic benefits to the tune of $650 million in current net prices (¥78 billion at an exchange rate of 120 to the dollar).

Just under half the measures taken to reduce emissions involved improvements in energy efficiency, while the remainder involved cutting gas combustion and ventilation. Reductions in emissions during exploration and production accounted for the lion's share, it may be surmised, since some 40% of direct emissions in 2001 came from exploration and production of petroleum and the like, while another 40% came from refining and 15% from chemicals. In 2000 and 2001 improvements in energy efficiency accounted for roughly 50% of reductions: in recent years BP appears to be making a shift to boosting energy efficiency, including adoption of cogeneration.

In the process of achieving its emissions reduction target, BP set up a trial internal emissions trading system in September 1998 with 12 BP business units, then, in January 2000, launched a full-fledged corporate emissions trading system linking some 150 major BP business units across the globe. During 2000 2.7 million tons of CO_2 were traded at an average price of $7.6 per ton; in 2001 4.6 million tons of CO_2 were traded at an average price of $39.60 per ton (ranging from $7 to $99). According to BP, the cost of emissions abatement did not rise during 2001; rather, the price shot up at certain times of the year due to shortages of sellers resulting from a tougher target set for the year. Money did not actually change hands due to tax issues and other factors, and that too appears to have contributed to the gap between emission reduction costs and selling price. BP suspended this internal trading system in January 2002 after achieving its target. It found it was better for it's business units to fully prepare for the onset of external emissions trading systems such as the scheme that the UK launched in April 2002. Nonetheless, the experience proved valuable, for it enabled BP to play a key role in organizing the British emissions trading scheme and make adequate preparations to join it even before it was launched (the company spent a year and a half setting up its own full-fledged internal trading system).

In 2002 BP set itself a new target: to maintain 2001 emissions levels through 2012. That may sound easy at first, but it assumes around 5% expansion in operations every year, which on a simple calculation translates into an increase in emissions of close to 60% over the course of a decade; drastic cuts in emissions will therefore be required. BP will continue to search for mitigation options available in house, and while it plans to achieve half those emissions cuts by boosting energy efficiency and so forth within the company, it intends to achieve the other half of the reductions through the use of flexible mechanisms such as emissions trading and project based mechanisms. Even a firm of BP's caliber is needing to face the challenge of striking a balance between sustaining business growth and implementing absolute reductions in emissions of greenhouse gases.

Sources: Compiled by DBJ based on BP's environment and social reporting for 2002 and Beyond Petroleum: Business and the Environment in the 21st Century, a speech delivered by Lord Browne, CEO of BP, on March 11, 2002.

The case of BP described in Box 1 involved both (1) reducing wasteful energy use and (2) boosting efficiency of energy use, and at the outset the strategy offered numerous economic benefits as well. But such cheap, low-hanging-fruit measures are quickly exhausted, and at the present level of technology companies are going to find it difficult to achieve medium- to long-term business growth at the same time as implementing absolute reductions in emissions. Companies should be induced to compete with one another in combating global warming in order to promote development of new technologies. So adding point principle is better than widespread deducting point principle in this field.

Japan has committed itself to reducing average emissions for the years 2008-2012 by 6% as compared to the base year (basically 1990). But it is projected that, emissions will rise to 1.2 times those of the base year by about 2010 without measures; [15] therefore Japan actually needs to cut emissions by roughly a quarter. Of course, the exact prospects vary between different sectors and players. Still, Japan already boasts just about the highest level of energy efficiency in the world, for ever since the oil shock it has done everything it can to conserve energy, and it is going to have a hard time cutting emissions by a whopping one quarter, without damaging to the economy, just by pursuing (2) and (3) (excluding the Kyoto Mechanism) alone.

(3) (switching to forms of energy with lower carbon content) in almost all cases entails additional costs, and it is often of limited practicality. That is because, since the days before fighting global warming became a major concern, many companies have been switching to coal and otherwise striving to minimize their energy costs, and changing their energy structure now would in many instances result in increased costs.

Therefore, if companies are obliged to cut back their emissions drastically, they could find their activity volumes restricted. But reducing activity volumes beyond what is necessary would lead to dwindling production and sales and a decrease in utility. Individuals may be able to make do with less and just endure over the short term, but such an approach is not going to be a sustainable or effective way for companies to fight global warming, which requires a commitment of decades. Herein lies the real reason that companies are so adamantly opposed to cap & trade.[16] Activity volumes are not going to be that restricted as long as trade in emission allowances runs smoothly, the market for those allowances is sufficiently liquid, and they are always available at a reasonable price in the quantities that firms need. Still, it is little wonder that companies are worried that their activity volumes could be restricted if concerns about market liquidity arise and they are unsure whether they will be able to obtain the allowances they need when they need them, or if they face the prospect of paying an exorbitant price to get them.

For many firms sustainable development means sustainable growth. But, given the current state of technology, it is certainly going to be difficult for companies to pursue simultaneously, over the medium to long term, both cuts in absolute volume of emissions and ongoing revenue growth (expansion in business activities). Yet, if companies fail to achieve sustainable growth, then Japan can hardly claim to have struck a balance between environmental protection and the economy, an idea that the government has made a cornerstone of its thinking in the Guidelines for Measures to Prevent Global Warming.

If increased corporate operations result in an increase in the absolute volume of emissions, then it will be necessary to demonstrate that those operations, at least, observe the highest global standards of efficiency. Say Company B is able to perform a particular operation with fewer emissions than Company A. Obviously

[15] Study Committee for Establishing a Scenario on Technologies for Reducing Greenhouse Gases, Global Environment Bureau, Ministry of the Environment, *Report on Discussions for Establishing a Scenario on Technologies for Reducing Greenhouse Gases*, March 2001.

[16] A system for trading emissions whereby each company is allocated an emission allowance, or cap; companies can then trade allowances by selling off any surplus they generate through reductions in emissions or buying extra if their present quota is not enough.

Company B is the better choice. However, in order to make the comparison more objective, it is better if Company B observes the highest global standards of efficiency in implementing its operations; otherwise it will be difficult to justify the increase in emissions. An interesting case in point in that regard is how, in the cement industry, leading companies from around the world have risen above national boundaries and come together to take such action as developing a common yardstick for measuring efficiency of emissions.[17] In businesses where practices vary widely, it will not be easy to establish a single international yardstick. Nevertheless, it needs to be kept in mind that, unless companies can develop their own yardstick to serve as objective proof, they will run the risk of seeing restrictions placed on their ability to pursue sustainable growth.

In order to prevent such an outcome, it is important that companies steadily implement energy conservation measures and the like in order to address (2) and (3). But numerous barriers and constraints stand in the way, including those enumerated above; therefore it will be difficult to achieve, in the span of a decade, even the kind of reductions in emissions that may seem technological feasible.

2. Barriers to Implementing Measures to Combat Global Warming

When the question of how to combat global warming arises, there is a tendency to focus on the technological potential for achieving cuts in emissions. But it is an established fact that, as a general rule, the level of cuts that can actually be realized on the market is far lower than what is technological feasible, for a host of barriers stands in the way of adopting technologies and practices that might contribute to the fight against global warming.

Fig. 3-2 reproduces the chart "Penetration of environmentally sound technologies (including practices): a conceptual framework" from the *Third Assessment Report* of the IPCC. It shows how, because so many types of barriers exist, there are different levels of potential, and those potentials that can actually be realized in a market economy constitute but a fraction of the whole. Feasibility of implementation steadily narrows at each level, from socio-economic potential as embodied in behavior, lifestyles, and socio-economic structure and institutions, through economic potential as limited by market failures etc., and finally market potential as manifested in actual implementation of technologies on the market. The maximum potential that can be achieved on a sustainable, long-term basis is the market potential, which is highlighted in color in the chart.

The Kyoto targets also face rigid time constraints in that they must be achieved by 2008-2012. Yet power stations and buildings frequently have a life of more than thirty years; thus such facilities have an extremely long replacement cycle.

The *Interim Report of the Subcommittee for Establishing a Scenario for Achieving the Kyoto Target* issued by the Central Environment Council points out that in many cases little progress has been made in implementing technologies for fighting global warming even when the cost of doing so would be negative (i.e., adopting them would result in a profit) (Table 3-1). The Report cites the following reasons for this:

- Not enough information is available on mitigation technologies.
- Institutional and social constraints stand in the way.
- Certain costs and drawbacks have not been factored in.
- Equipment currently in use has not yet fully depreciated.
- The technology in question has only just emerged, or resource constraints prevent enough of a supply to meet demand.
- Companies are forgoing capital investment because production volumes are down and their future is uncertain.

Therefore further promoting corporate action against global warming will require

[17] The Cement Sustainability Initiative, which is being pursued under the helmsmanship of the Working Group Cement (WGC) of the World Business Council for Sustainable Development (WBCSD). See *The Cement Sustainability Initiative – our agenda for action* unveiled by the WBCSD in July 2002.

identifying what barriers exist to achieving technological and other potentials, determining how to remove them, and then doing so one by one. Thus further analysis is needed on such barriers and how to overcome them.

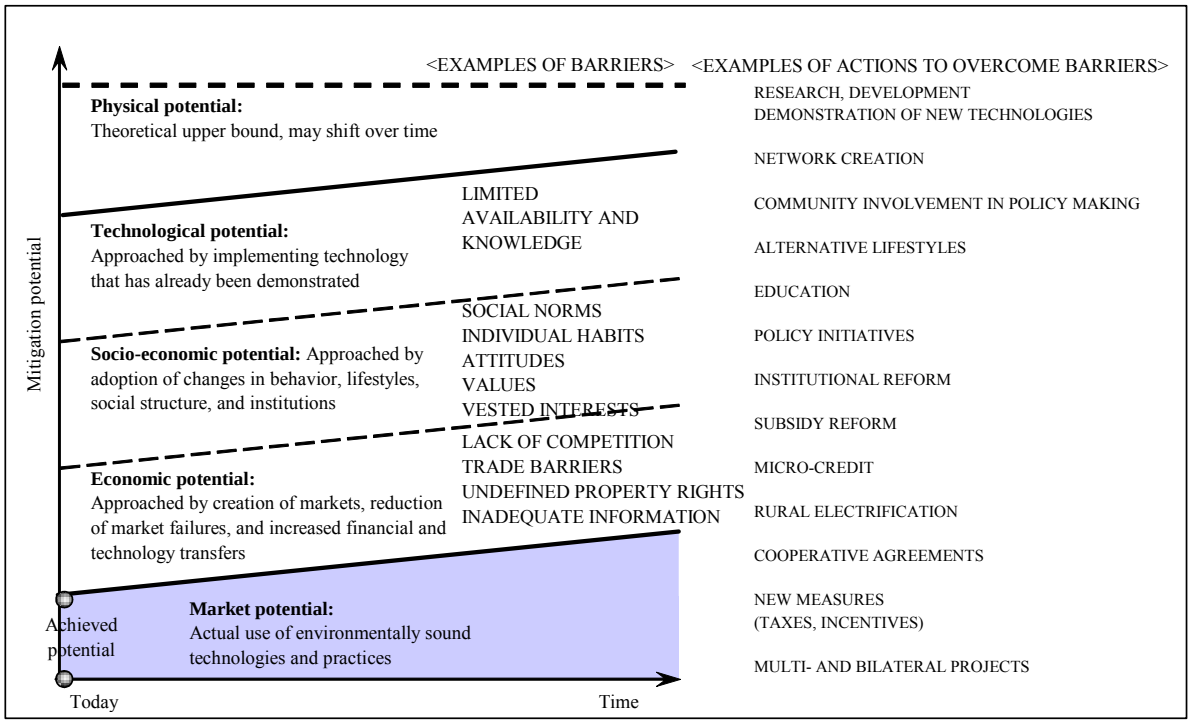

Figure 3-2. Penetration of Environmentally Sound Technologies (Including Practices): A Conceptual Framework

Source: Climate Change 2001: Synthesis Report – Contribution of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (Cambridge University Press, 2001), Figure 7-1: Penetration of environmentally sound technologies (including practices): a conceptual framework (p. 111).

Table 3-1. Technologies for Fighting Global Warming Whose Cost Is Estimated To Be Negative (I.e., Adopting Them Would Result in a Profit)

Sector	Technology to be adopted	Cost of additional reductions (yen per ton of CO_2)	Mitigation potential ('000s of tons of CO_2)	Issues to be addressed
Industrial	High-performance industrial furnaces (which cut energy use by over 30% using hot air combustion; commercially available in the form of regenerative burners)	-8,182	8,300	Quality preservation risk involved in overhauling equipment, since 80% of industrial furnaces are not general-purpose. Initial cost etc.
Com./res.	Reducing standby power (the technology now exists to cut it to 1/10)	-70,909	4,100	Standby power is invisible to consumers. Products with low standby power requirements need to be labeled or otherwise identified etc.
Industrial	Recycling waste plastics into raw material for blast furnaces (using waste plastic as a substitute for the reducing agents coke and pulverized coal)	-4,909	2,700	Processing capacity of facilities for crushing, sorting, and dechlorination of waste plastics. Dechlorination technology. Waste plastic recovery systems. Siting of facilities that use waste plastics etc.
Com./res.	Household water boilers that recover latent heat (recovering latent heat from exhaust boosts efficiency from 85% to 95%)	-9,545	2,100	Incentives to scrap existing boilers and purchase the new type. Initial investment etc.
Industrial	Converting waste plastic into raw material and fuel for cement plants	-8,727	1,900	Chlorine bypass in kilns. Preprocessing (dechlorination). The Containers and Packaging Recycling Law forbids use of waste plastics from non-industrial garbage in making cement etc.
Non-energy	Mixed cement (blast furnace cement, fly ash cement, limestone filler cement)	-1,145	1,400	Falling purchase price of granulated blast furnace slag. Cost may not be negative in some areas. Quality of fly ash etc.
Com./res.	Conserving energy used by vending machines (54% energy savings are possible)	-70,909	1,300	Economic benefits of conserving energy fail to trickle through, since beverage firms rent out vending machines to operators, who then pay the electricity bill etc.
Industrial	Combined generation (using a gas turbine and heat from exhaust gas)	-6,000	1,300	Relaxation of regular inspections and plant planning. Relaxation of siting restrictions. Relaxation of environmental assessment operations etc.
Industrial	Reducing electric furnace power consumption by feeding scrap iron into steel converters	-8,727	840	Problem of inferior converter steel quality. Facilities for removing impurities. Fluctuating price of scrap iron. Market-share balance between blast furnaces and electric furnaces etc.
Com./res.	A cooking stove with inner flame vents (locating the flame vents inside improves heat efficiency by 18%, plus enhances safety)	-54,545	780	Incentives to scrap old models of cooking stove and buy the new type etc.
Non-energy	Promoting use of eco-cement (made with ash from incinerating municipal garbage)	-5	500	Siting restrictions under the Factory Location Law. Obtaining consent of communities where facilities are to be located. Generating demand and developing sales channels. Processing ash over a wide enough geographical area etc.
Conver-sion	Reducing power loss during transmission and distribution through installation of low-loss pole transformers	-10,364	420	The slump in the heavy electric machinery industry makes it difficult for transformer manufacturers to invest in switching to low-loss equipment. Initial cost etc.
Industrial	Highly efficient anaerobic effluent treatment technology (which recovers methane gas from effluents for use as a supplementary fuel in boilers)	-7,364	360	Initial cost etc.
Com./res.	High-luminance guide lights for emergency exits (switching from a conventional fluorescent lamp to a cold cathode fluorescent tube reduces power consumption to 1/4)	-70,909	310	Phasing out sales of conventional lamps etc.
Industrial	Recovering electricity from ethylene plant gas turbines	-12,000	300	Optimizing each plant and selecting the best model of gas turbine for it. Securing contracts to sell off surplus power etc.
Com./res.	Water boilers that recover latent heat (these boost efficiency from 80% to 95% by recovering fuel gas exhaust from gas boilers)	-54,545	250	User awareness (hotels and other accommodation facilities, hospitals, restaurants and bars) etc.
Com./res.	Conserving energy used by elevators (by installing machine-roomless elevators, which also saves space)	-51,818	190	Switching over from manufacturing the old style of elevator etc.
Com./res.	Installing ultra-high-efficiency transformers (amorphous transformers cut total loss to 60%)	-40,909	170	Falling equipment costs. Initial cost. Transformers have a nominal life of 30 years but are often in service for longer etc.
Com./res.	Economizers for water boilers (which save 10% energy)	-51,818	160	Replacing existing boilers is a problem. Awareness on the part of manufacturers and users etc.
Com./res.	Inverter control of water supply treatment facilities (power for water pumps)	-21,000	140	Initial cost etc.
Com./res.	Daylight saving time (moving the clocks forward one hour between April and October to reduce lighting and air conditioning demand)	-463,636	85	Establishing special provisions for working hours on the day clocks switch over and making the necessary adjustments in transport timetables. How to interpret the provisions of non-life insurance and other agreements that specify times. What to do about the times specified in fisheries agreements etc.
Industrial	Boosting efficiency of separators inside vertical mills (for producing cement)	-10,091	58	Profitability may fall in the case of plants that supply all their own power. Initial cost etc.
Com./res.	Inverter control of sewage treatment facilities (air blowers for anaerobic reactor tanks)	-491	15	Initial cost etc.

Notes: 1. Sectors are abbreviates as follows: Industrial = industrial sector; Com./res. = commercial and residential sector; Non-energy = CO_2, CH_4, and N_2O emissions from non-energy sources; Conversion = energy conversion sector.
2. Estimated volume of additional reductions in emissions (mitigation potential) is calculated using the average emissions factor for all power sources.

Source: Compiled by DBJ from Global Environment Council, Central Environment Council, Ministry of the Environment, *Interim Report of the Subcommittee for Establishing a Scenario for Achieving the Kyoto Target.*

IV Mechanisms Underpinning Innovative Measures to Combat Global Warming

1. Motives for Adopting Innovative Measures to Combat Global Warming

Despite the uncertain policy climate resulting from the fact that the Kyoto Protocol has not yet come into force, certain companies are already taking ambitious steps to fight global warming. The basic frameworks underpinning these innovative efforts can be divided into three major factors:

(1) Incentives (short-term cost reductions, short-tem returns, long-term returns, etc.)
(2) The internal management structure buttressing those incentives (commitment of top management, employee awareness, mechanism for managing greenhouse gas emissions, personnel, technology, facilities, funding, etc.)
(3) The external business climate in which the company finds itself (government policies, shareholders, consumers, local residents, public opinion, the media, major events, abnormal weather, economic trends, etc.)

These factors vary depending on the industry, the size of the company, and the particular circumstances in which it stands. Table 4-1 shows in matrix format the chief motives that prompt companies to adopt specific measures to combat global warming as revealed from interviews and other sources. The symbols (◎, ○ and △) indicate the degree to which each motive applies. Motives are often intertwined, and it is sometimes difficult to determine how exactly they interrelate.

At the present stage direct incentives appear to constitute a major motivation — "The energy-saving advantages are considerable," "The economic risks will be considerable if government policies are strengthened in the future," "New business prospects exist and first mover advantage stands to be significant," and so forth. Emissions allowance brokers, certification agencies, accounting firms, consulting firms and the like, which are motivated by the prospect of new business opportunities and the profits to be enjoyed by first-comers, are particularly enthusiastic about fighting global warming, for a virgin market awaits them and they have nothing to lose. But with the Kyoto Protocol yet to take force the market for their services is still not that large.

Under current conditions — the Kyoto Protocol has not come into force, nor has the government implemented any sweeping policies such as imposing a heavy carbon tax — most firms are choosing to follow a "no regrets" strategy that involves simultaneously pursuing short-term cost cuts. Other companies, eager to achieve sustainable growth, are laying the groundwork for long-term profits down the road with up-front investment designed to build an image as an eco-friendly corporation or establish good relations with environmental NGOs and local residents.

However, incentives on their own do not materialize into actual corporate action. An internal mechanism to underpin such action is also of the essence. Particularly today, when incentives remain weak, it is vital that companies possesses the proper internal management structure, or what might be described as the corporate infrastructure for the fight against global warming. As long as they have such a structure in place, they will find it reasonably easy to take actual action even if incentives are somewhat weak. The question is, how committed is top management, and what stance has the company adopted to fighting global warming. If it has obtained ISO 14001 certification or has Type 1 designation under the Energy Conservation Law, it presumably has already made a fair amount of progress in setting up an internal system for managing data on energy use and for formulating and implementing measures for reducing emissions; it will then be in a far better position than other firms not so well prepared in this regard. If a company does not know how much emissions it is actually producing, or, even if it does know, has no way of formulating and implementing a strategy in response, then it is not going to make much headway.

Some of the motives in Table 4-1 fall into two or more of the categories "Incentives," "Internal structure," and "External climate."

Incentives are often swayed by the external climate: outside developments have a critical impact on incentives alongside internal company considerations, and that impact typically takes the form of the circumstances of a particular industry. Again, companies motivated by "incentives" frequently have an "internal structure" already in place, for which reason the two tend to overlap. Companies that set up such an internal structure do so because taking action against global warming is important to their business; thus their motivation often lies in the particular circumstances in which they find themselves.

Table 4-1. Chief Motives for Taking Measures to Combat Global Warming

	Motives	Incen-tives	Internal structure	External climate	Applicable businesses
Industry	The energy-saving advantages are considerable.	◎			Energy-intensive industries
	The economic risks will be considerable if policies are strengthened in the future.	◎		○	Energy-intensive industries
	New business prospects exist and first-comers stand to profit.	◎			Emissions allowance brokers, certification agencies, accounting firms, consulting firms, trading firms, certain energy-intensive industries, etc.
	Subsidies are available.	○		○	Energy-intensive industries etc.
	Competitors have taken actions already.	△		○	Electrical power, electrical machinery, transport equipment, trading firms, etc.
	An increase in domestic production seems unlikely, so there is room to achieve absolute reductions in domestic emissions.	○		○	Industries that conduct a high percentage of their production overseas, e.g., transport equipment and electrical machinery
	Easily accessible technologies and options are available.	○		○	Non-manufacturing industries, non-profit organizations, etc.
	Reaction of buyers of goods and services; corporate image.	○		○	Electrical machinery, transport equipment, etc.
	Taking ecological measures is important for business.	○	○	○	Electrical power, chemicals, etc.
Size of company	The energy-saving advantages are considerable because the company is so large.	○	△		See Figs. 2-4 and 2-5.
	As a large corporation the firm has the human resources and organization to keep abreast of developments abroad.		○		
	As a large corporation the firm needs to take ecological measures and disclose information by, e.g., publishing an environmental report.			○	
	As a large company the firm has a heavy social responsibility.			○	
	The firm has an international presence and is affected by, e.g., environmental policy in Europe.			○	
Particular company circumstances	Commitment of top management	△	○		
	Taking action against global warming is an important aspect of corporate strategy.	○	○		
	Employee awareness (corporate culture etc.)		○		
	The firm has an internal mechanism in place for managing energy use, e.g., it has received Type 1 designation under the Energy Conservation Law.	○	○	○	Energy-intensive industries (before being revised in spring 2003, the Energy Conservation Law applied to only five sectors: manufacturing, mining, and supply of electricity, gas, and heat), large corporations
	The firm has ISO 14001 certification.	○	○		Varies also depending on the industry.
	The firm conducts extensive R&D and can easily adopt new technology.	△	○		Varies also depending on the industry.
	The firm conducts extensive capital investment and turnover of facilities is rapid.	△	○		Varies also depending on the industry.
	It was time to upgrade facilities anyway.	△			Varies also depending on the industry.

Sources: Compiled by DBJ based on interviews and various documentation.

2. The Framework Underpinning Innovative Measures to Combat Global Warming

Fig. 4-1 shows the interrelationship between the different factors identified in Table 4-1.

The incentives that directly trigger corporate action to fight global warming are rooted primarily in the pursuit of short-term returns such as lower costs. Then come considerations of long-term returns such as the profits awaiting first-comers and questions of social responsibility and reputation.

The internal management structure for pursuing those incentives is also important. The term internal management structure as used here embraces the mechanisms for managing emissions of greenhouse gases, the commitment of top management, employee awareness, the presence on staff of people with the necessary expertise and technical ability, the availability of technologies and facilities to implement steps to combat global warming, and access to the required funds. Even if incentives are the same, different companies' ability to overcome obstacles and implement concrete measures to combat global warming will ultimately be determined by their internal management structure. This internal management structure, which can be characterized as corporate infrastructure for the fight against global warming, costs money to sustain, and firms below a certain size will find it difficult to afford. This is among the reasons for the difference in level of corporate action against global warming that we noted in Chapter II between companies of different sizes.

The external climate in which companies operate also exerts an impact in various forms: national and local governments, the media, shareholders, local residents, NGOs, economic trends such as energy prices, major events like the Kyoto Conference on Global Warming, and abnormal weather such as unseasonably warm winters. Rapidly emerging new developments like environmental rating and the issuing of environmental reports are also having an impact. Fig. 4-2 plots crude oil prices side by side with number of submissions to the contest for

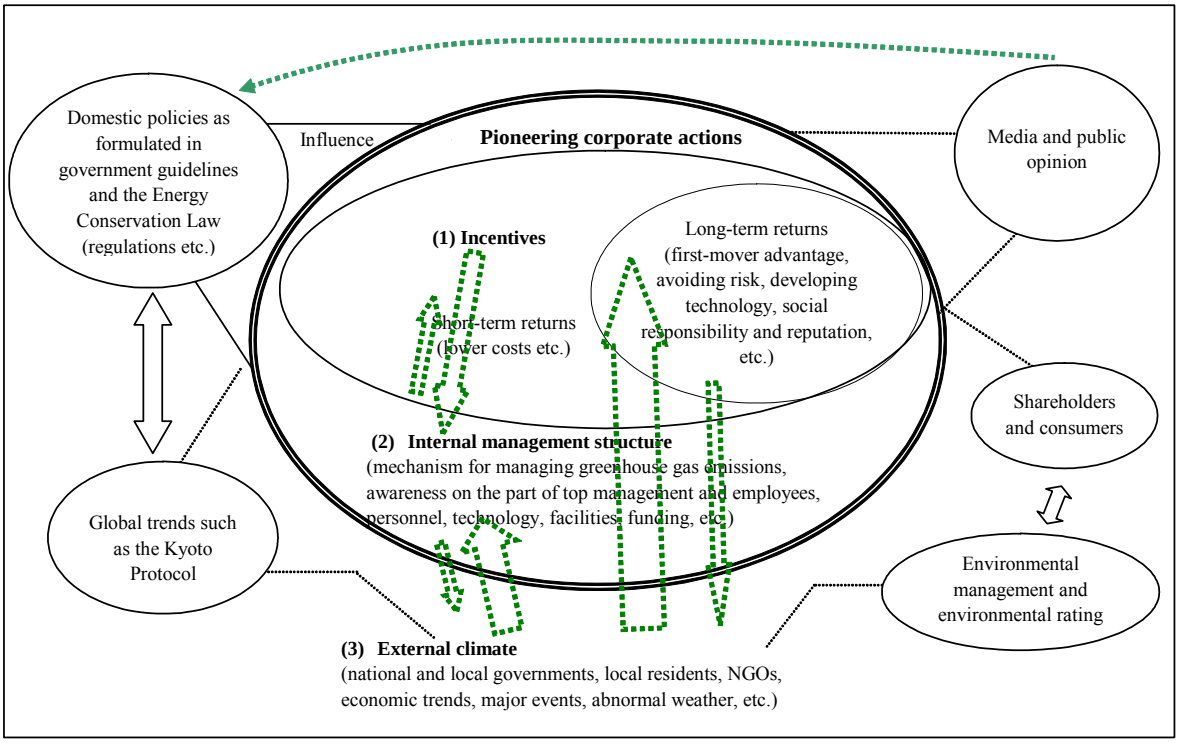

Figure 4-1. Conceptual Diagram of the Framework Underpinning Innovative Corporate Measures to Combat Global Warming

Source: Compiled by DBJ.

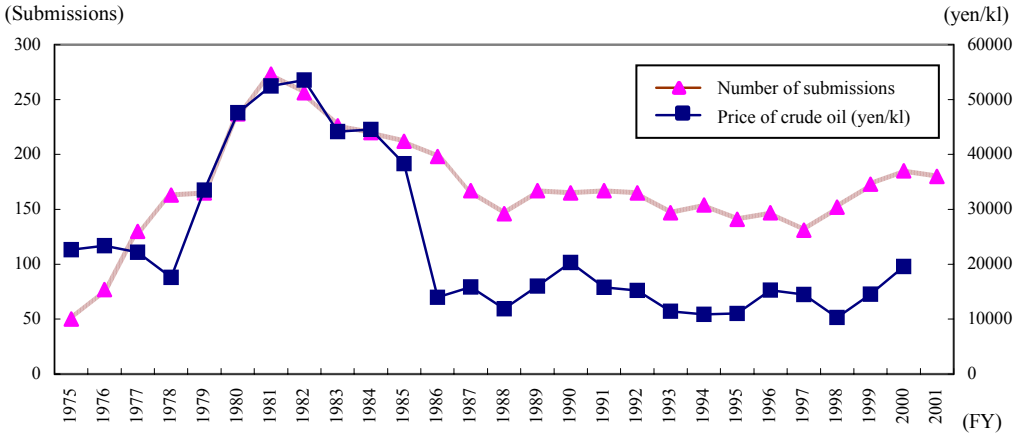

Figure 4-2. Crude Oil Prices and Number of Submissions to the Contest for Outstanding Energy-saving Programs

Notes: 1. Price of crude oil gives the CIF price.
2. Number of submissions gives the number of submissions to the nationwide contest for outstanding energy-saving programs run by the Energy Conservation Center of Japan (see Box 3).

Sources: Compiled by DBJ based on Energy Data and Modeling Center, Institute of Energy Economics, Japan (ed.), *EDMC Handbook of Energy & Economic Statistics in Japan* (2002 edition) and documentation from the Energy Conservation Center of Japan.

outstanding energy-saving programs run by the Energy Conservation Center of Japan. It suggests that external factors like skyrocketing crude oil prices triggered by the oil shock and the December 1997 Kyoto Conference on Global Warming have a major impact on corporate behavior.

The three major factors underpinning corporate measures against global warming — (1) incentives, (2) internal management structure, and (3) external climate — interact with one another as indicated by the arrows in Fig. 4-1. In some cases incentives emerge from government policy or some other facet of the external climate; in other cases, conversely, companies will lobby the government in pursuit of a particular incentive such as the goal of developing a new field of business. If the incentives exist, companies will make progress in installing the necessary internal management structure, while the existence of such a management structure may affect incentives. External climate may lead companies to set up an internal management structure, as when policies like the Energy Conservation Law spur them to take such action, while on the other hand the development of an internal management structure may have an impact on the external climate. These factors thus interact, though the exact degree of their impact may vary. At present, as the size of the arrows indicates, the biggest impact is that of the external climate on incentives and internal management structure; this is followed by the impact of incentives on internal management structure.

Today, with the Kyoto Protocol yet to take effect and the government's long-term policies still up in the air, companies' short-term incentives are not that strong, as demonstrated by the fact that fewer than half of firms have taken any action to date. The policy uncertainty has a tremendous impact, since the fight against global warming may involve the government limiting emissions of greenhouse gases, which until now have cost nothing, by putting a price on them. Companies often complain that the lack of a clear signal from government is making it difficult to take action. Far from leading to new business opportunities, many of the measures available today would have a negative impact on the bottom line in that they entail extra costs, and that fact makes companies all the more susceptible to the

effects of uncertainties in the external climate. Domestic policy and international developments that affect it thus assume prime importance.

Also important is sending the right signals to the corporate sector by means of policy (external climate). Nobody will take the initiative in fighting global warming anymore if companies that have for many years been making a conscientious effort to save energy are given no credit for their pains but are required to achieve the same level of cuts as other firms that have done nothing, and they thereby end up sustaining a loss by having to make a greater economic sacrifice. The ideal situation is one in which all parties vie enthusiastically to combat global warming, and creating that situation will require sending the proper signals from outside. Companies should be encouraged to compete in reducing the absolute level of greenhouse gas emissions they generate per unit of production. Those that lag behind should be given incentives to catch up to the head of the pack, those out in front to vie with one another in achieving further cuts. Ideally costs should be heavier for the stragglers and lighter for the front runners. The first task will be to develop an objective yardstick that enables international comparisons of greenhouse gas emissions per unit of production.

The arrangement that is becoming the norm in emissions trading in Europe — assigning emission allowance for free based on past levels of emissions — provides dead the opposite incentives to the system outlined in the preceding paragraph. A scheme that rewards inefficient companies in this way could well end up distorting long-term efforts to fight global warming.

Sending the right signals to companies from outside means not just promoting measures in individual sectors like industry and transport, but also providing incentives to cut total emissions by means of lifecycle assessments (LCAs). For example, manufacturing fuel-efficient vehicles such as hybrid cars results in significant reductions in emissions once emissions on the road are factored in on top of those during assembly, as revealed by an LCA;[18] but, when viewed in isolation, emissions on the assembly line actually increase because of the need for additional components and extra steps in the manufacturing process. A system like the present one, which only requires manufacturers to cut emissions at the manufacturing stage and does not give due credit to efforts to reduce emissions during actual vehicle operation, provides companies with no incentive to design products that perform better throughout their lifecycle; thus it may end up actually discouraging truly desirable corporate behavior.[19] One option would be to grant LCA emission permits (equivalent to the amount of emissions cut over the course of the product lifecycle) to companies that manufacture and sell products with lower LCA emissions. If a specialized outside agency measured amount of emissions based on objective criteria and every year companies were then assigned an allowance *ex post facto* equivalent to the amount by which their products reduced emissions, they could be properly rewarded for their efforts on the ecological front. Such a system would be compatible with existing

[18] For example, Toyota's Prius and Estima Hybrids and Honda's Civic Hybrid produce approximately 30% fewer CO_2 emissions over the course of their lifecycle than do conventional vehicles, according to data from environmental reports, but hybrid cars produce more emissions during manufacture.

[19] Under the present Energy Conservation Law a system already exists for encouraging manufacturers to design more efficient products. Under this system, known as the top runner standards, the government sets standards of energy efficiency for certain products that consume large amounts of energy, basing them on the highest level of efficiency then available on the market, and requires manufacturers and importers to meet those standards by a specific target year. While this arrangement shows some promise, it has its drawbacks. Its regulatory nature makes it inflexible. It fails to provide adequate incentives to develop products that surpass those currently designated the best in their class (manufacturers could end up putting their own head in the noose, for the more outstanding the products they develop, the harder they will be to match). It is difficult to incorporate the highest standards current at any particular point in time. And the system fails to adopt an LCA-based approach. A scheme for granting LCA emission permits is superior in that it would offer greater flexibility and provide companies with rewards commensurate with their efforts.

voluntary action plans and as such would be reasonably easy for companies to adapt to.

The most effective way to cut emissions will be to furnish incentives to those who are in the best position to manage emissions over the course of the product lifecycle. In this particular instance that means the companies that manufacture and sell hybrid cars. But each case needs to be considered on its own merits. Unreasonably extending product liability to areas that manufacturers have no ability to control, it should be remembered, could cause corporate activity to stagnate and result in other problems as well. The decision whether or not to buy and drive a hybrid car depends to a large extent on the consumer, who thus bears a considerable responsibility. It is to be hoped that consumers too can somehow be incorporated into the LCA emission permits system in such a way as to enhance their awareness of their own responsibilities.

V The Domestic Corporate Climate

1. Energy Use in Different Industries and the Risks of a Carbon Tax

In this chapter we further analyze the characteristics of the innovative measures to combat global warming being implemented today based on the motives identified in Chapter IV and the structural model presented there. First we examine data for different industries.

Fig. 5-1 shows the percentage of fuel and raw material costs that energy accounts for in each industry. In major manufacturing industries this percentage dropped sharply over the course of the 1980s, then leveled out during the 1990s. On those grounds it is sometimes argued that Japanese companies exhausted all the possibilities for conserving energy during the 1980s. This graph gives the percentage of energy costs in ceramics and other major industries, but it omits aluminum smelting, which one would assume has the highest percentage of all, since the number of firms concerned has become so small. Ceramics has the highest percentage, followed by iron and steel, pulp and paper, and chemicals. In energy-intensive industries like these energy costs account for a considerable proportion of total manufacturing costs; hence energy conservation programs and other measures to fight global warming assume considerable significance. Conversely, in the manufacturing sector as a whole energy costs make up not even 4% of the total, and slight fluctuations either way may not exert that great an impact. But they will have an extremely serious effect on energy-intensive industries and the areas where their plants are located.

The risks associated with policies to combat global warming are affected by the percentage energy costs of the industry in question, the quantity of energy it consumes, and the carbon content of that energy.

Fig. 5-2 shows the proportion of final energy consumption within the manufacturing sector accounted for by different industries. Until the 1980s iron and steel was the biggest energy consumer, but it was overtaken by

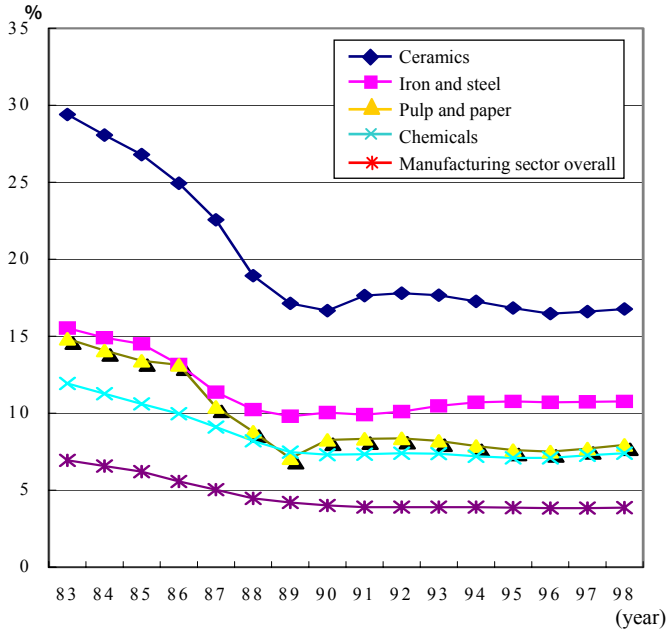

Figure 5-1. Energy Costs As a Percentage of Fuel and Raw Material Costs

Notes: 1. Fuel and raw material costs equal the sum of the cost of raw materials, fuel, and electricity.
2. Energy costs equal the sum of the cost of fuel and electricity.

Source: Compiled by DBJ by working out the three-period backward moving average for data from the Ministry of Economy, Trade and Industry, *Census of Manufactures* as processed by the Energy Conservation Center of Japan.

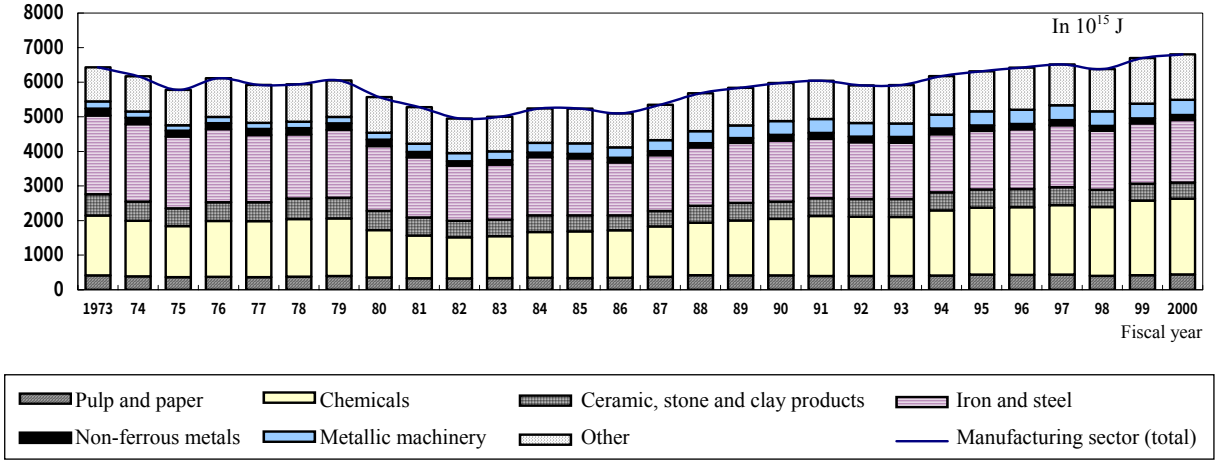

Figure 5-2. Breakdown of Final Energy Consumption within the Manufacturing Sector

Source: Compiled by DBJ from Agency for Natural Resources and Energy, *General Energy Data.*

chemicals in the 1990s. Chemicals and iron and steel are followed by ceramic, stone and clay products, pulp and paper, metallic machinery, and non-ferrous metals.

Figs. 5-3 through 5-8 give breakdown of energy consumption within each industry. As would be expected, in the chemical industry petroleum products account for a high percentage of the total (Fig. 5-3). In the iron and steel industry coke and coal account for the overwhelming percentage; hence the risks it faces would be considerable should a carbon-emissions tax be imposed or similar policies implemented to combat global warming (Fig. 5-4). In the case of ceramic, stone and clay products, coal has come to account for a dramatically higher percentage since the oil shock, so the risks associated with a carbon tax are high (Fig. 5-5). Pulp and paper has not increased use of coal that much and depends to a large extent on electric power and new energy sources; it therefore faces a relatively low risk from a carbon tax (Fig. 5-6). Metallic machinery and non-ferrous metals both

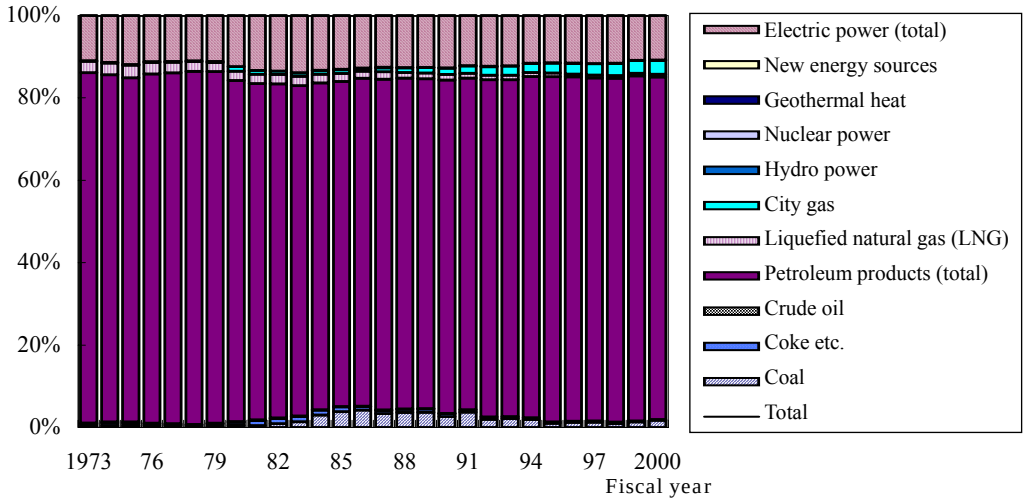

Figure 5-3. Breakdown of Energy Consumption: Chemicals

Source: As in Fig. 5-2.

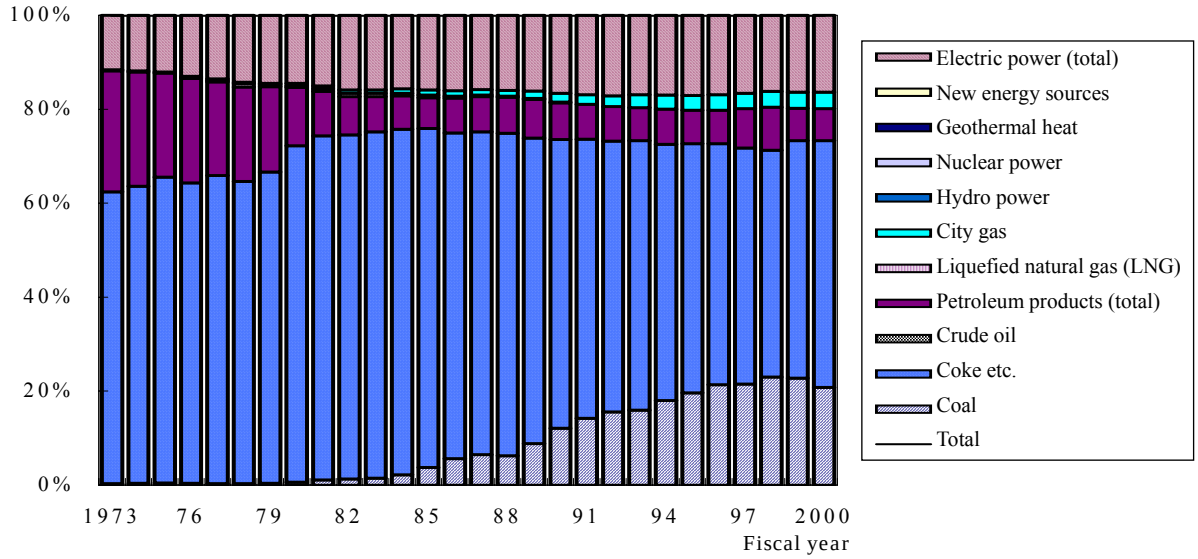

Figure 5-4. Breakdown of Energy Consumption: Iron and Steel

Source: As in Fig. 5-2.

rely to a considerable degree on electric power, and they could be seriously affected depending on how policies to combat global warming treat electric power. If the electric power industry is obliged to make serious cuts and passes on the costs in utility bills, then these two industries will end up bearing a heavy economic burden (Figs. 5-7 and 5-8). Thus for industries like iron and steel that have high percentage energy costs and use forms of energy with high carbon content, the latent risks of being located in Japan could become very real as the government strengthens policies to fight global warming.

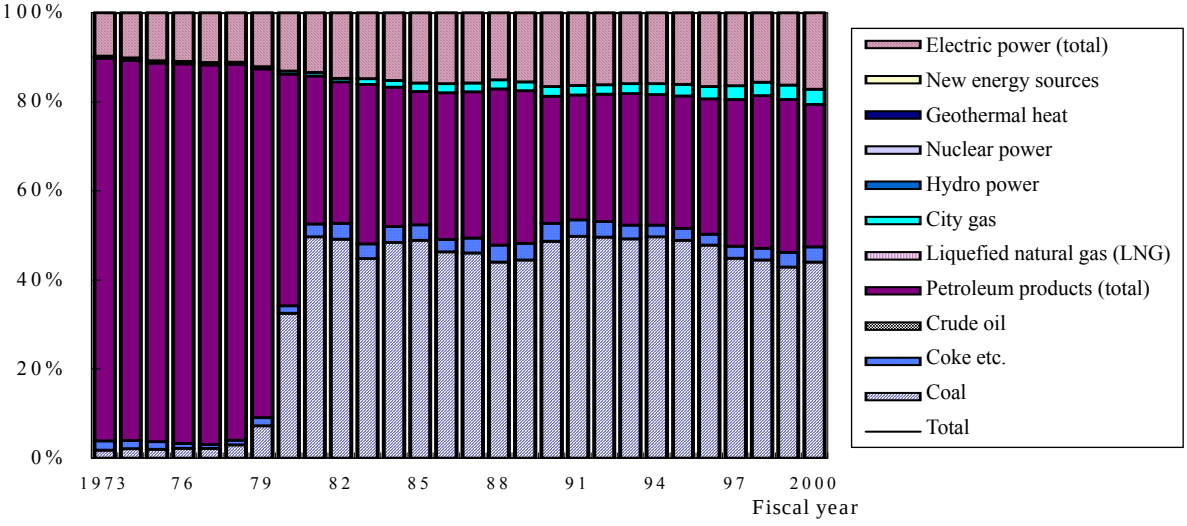

Figure 5-5. Breakdown of Energy Consumption: Ceramic, Stone and Clay Products

Source: As in Fig. 5-2.

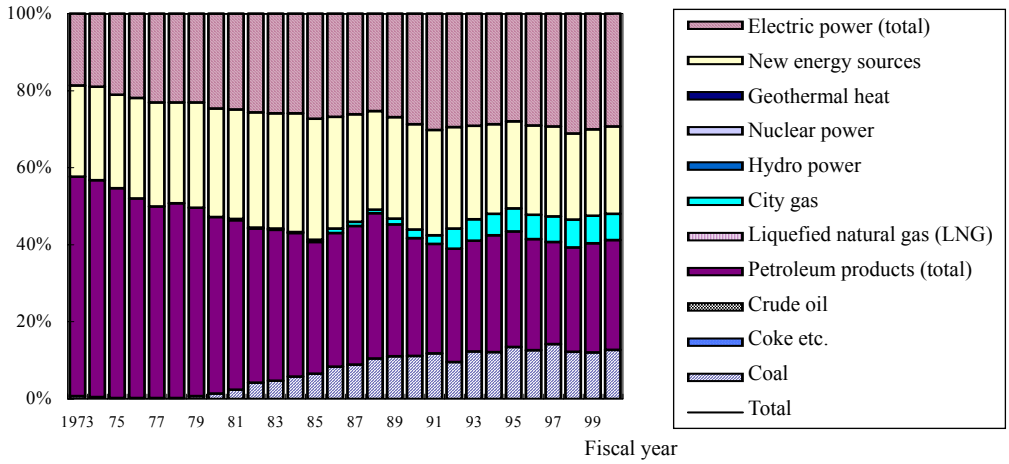

Figure 5-6. Breakdown of Energy Consumption: Pulp and Paper

Source: As in Fig. 5-2.

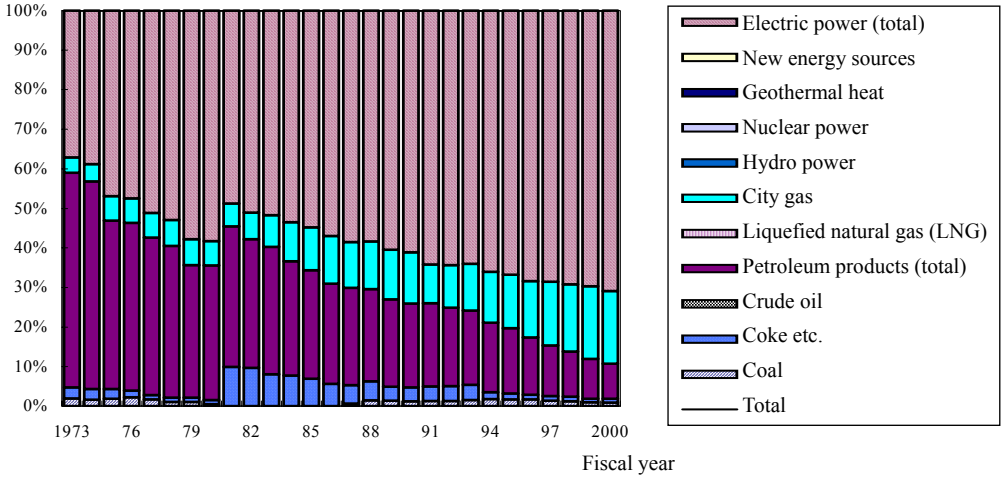

Figure 5-7. Breakdown of Energy Consumption: Metallic Machinery

Source: As in Fig. 5-2.

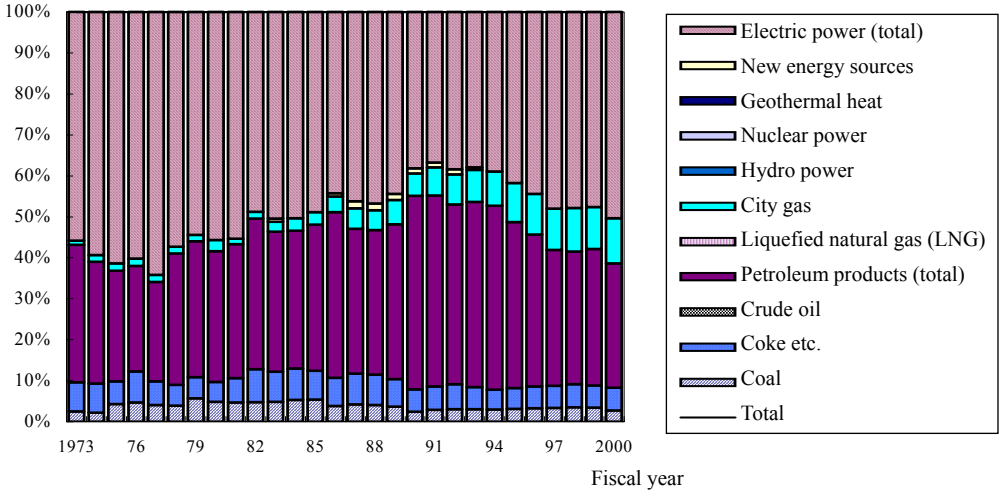

Figure 5-8. Breakdown of Energy Consumption: Non-ferrous Metals

Source: As in Fig. 5-2.

Table 5-1 gives estimates of how much major industries would pay should a carbon tax be introduced. It assumes a tax of ¥3000 per ton of carbon (¥818 per ton of CO_2), which is said to be fairly low and is actually under consideration, and shows the cost to each industry assuming the same volume of emissions as in FY 2001. If the tax cannot be passed on in the price of goods and services, the electric power industry will pay the heaviest price, followed by iron and steel, chemicals, oil refining, pulp and paper, and cement. In order to gauge roughly how heavy the tax would be, we have also worked out what percentage it represents of the average ordinary profits registered over the past three years by listed companies in each industry. Since these figures are for listed companies only, they do not accurately represent profits for each industry as a whole; nonetheless, it is fair to say that iron and steel, cement, rolled aluminum, dyeing and finishing, and the hotel industry could face a fairly heavy burden. Oil refining, electric power, and pulp and paper will not get off lightly either. On the other hand metallic machinery, automobile parts, supermarkets and convenience stores, construction and housing, and automobiles will not have to fork out that much compared to their level of ordinary profits. Thus the risks associated with policies to fight global warming (i.e., a carbon tax) vary tremendously from industry to industry.

Table 5-1. Estimated Burden of a Carbon Tax to Major Industries

(in billions of yen)

		Estimated burden of carbon tax: a	Ordinary profits: b	a / b (%)
1	Electric power	255.3	1,038.1	24.6%
2	Iron and steel	145.7	132.3	110.2%
3	Chemicals (excluding pharmaceuticals)	68.0	857.6	7.9%
4	Oil refining	35.8	101.7	35.2%
5	Pulp and paper	24.0	108.1	22.2%
6	Cement	19.5	18.2	106.7%
7	Electrical machinery	14.3	923.2	1.6%
8	Automobile parts	8.5	335.2	2.5%
9	Supermarkets / convenience stores	7.8	459.0	1.7%
10	Hotels	7.2	13.8	52.1%
11	Construction and housing	6.3	747.1	0.8%
12	Automobiles	4.8	967.1	0.5%
13	Non-ferrous metals	4.1	61.4	6.7%
14	Mining	4.1	60.8	6.8%
15	Dyeing and finishing	2.3	3.2	70.8%
16	Rolled aluminum	2.2	2.7	82.6%
17	Department stores	2.0	54.3	3.7%
18	NTT Group	1.9	756.4	0.3%
19	Rubber	1.8	163.1	1.1%
20	Pharmaceuticals	1.8	970.6	0.2%

Notes:
1. Estimated burden of a carbon tax has been calculated by DBJ assuming a tax of ¥3000 per ton of carbon (¥818 per ton of CO2), which is said to be fairly low comparing to estimated marginal abatement cost. The calculations are based on figures for each industry's CO2 emissions during FY 2001 as contained in a document of January 31, 2003 prepared by the Joint Follow-up Subcommittee on the Keidanren Voluntary Action Plan on the Environment the Industrial Structure Council and the Advisory Committee for Natural Resources and Energy, Ministry of Economy, Trade and Industry. For those industries whose intra-industry emissions coverage rate of the Voluntary Action Plan is clear from this document, overall FY 2001 emissions have been worked out based on that rate.
2. Figures for ordinary profits give the average for the past three years. They are taken from Development Bank of Japan (ed.), Handbook of Industrial Financial Data. Note that these figures are for listed companies only; they may be lower than profits for each industry as a whole.
3. The figure for estimated cost of a carbon tax to the electric power industry assumes that that industry is taxed for all emissions produced during power generation. The figures for other industries assume that each is taxed proportionate to the emissions from the electricity it buys. These emissions are thus factored in twice.

2. Level of Investment by Different Industries in Combating Global Warming

The ease with which a particular firm can implement measures to fight global warming is determined to some extent by its level of investment in the necessary facilities and the state of its R&D programs.

Table 5-2 shows level of investment by major industries in combating global warming as a percentage of their total investment. Since there is no clear definition of what exactly constitutes investment in combating global warming, here we examine the percentages of total capital investment over the past three years channeled into three areas: environmental conservation, energy conservation and new energy sources, and streamlining and labor-saving.

Investment in environmental conservation constitutes around 3% of total investment and does not differ that greatly between the manufacturing and non-manufacturing sectors. Iron and steel displays the highest level of investment in this area, followed by pulp and paper, oil refining, chemicals, electric power, ceramic, stone and clay products, electrical machinery, and automobiles.

Investment in energy conservation and new energy sources stands at only half the level of that in environmental conservation. In the non-manufacturing sector heat supply stands out for its high percentage of investment in this area, but overall the non-manufacturing sector shows virtually no difference from manufacturing. In addition to heat supply, iron and steel, gas, pulp and paper, and oil refining also direct a high proportion of investment to energy conservation and new energy sources.

Investment in streamlining and labor-saving, which merge seamlessly into the kind of measures to combat global warming by eliminating wasteful energy usage often seen today, stands at over double the percentage of that in environmental conservation. The level of investment differs greatly between the manufacturing and non-manufacturing sectors, with the former registering a far higher percentage. The figure for iron and steel is especially high, followed by pulp and paper. Ceramic, stone and clay products, electrical machinery, automobiles, and oil refining also show percentages in the double digits.

Overall, iron and steel records a high

Table 5-2. Level of Investment by Major Industries in Combating Global Warming as a Percentage of Total Capital Investment

In percent	Environmental conservation		Energy conservation and new energy sources		Streamlining and labor-saving
All industries	3.1	All industries	1.6	All industries	7.9
Manufacturing	3.1	Manufacturing	1.5	Manufacturing	13.4
Non-manufacturing	3.0	Non-manufacturing	1.6	Non-manufacturing	2.1
Iron and steel	6.8	Heat supply	15.6	Iron and steel	28.5
Pulp and paper	5.8	Iron and steel	8.7	Pulp and paper	22.0
Oil refining	5.6	Gas	6.4	Ceramic, stone and clay products	18.2
Chemicals	5.1	Pulp and paper	4.5	Electrical machinery	16.3
Electric power	4.1	Oil refining	2.8	Automobiles	13.2
Ceramic, stone and clay products	2.7	Electric power	1.5	Oil refining	11.6
Electrical machinery	2.5	Chemicals	1.0	Chemicals	8.6
Automobiles	2.2	Ceramic, stone and clay products	1.0	Electronic equipment	7.6
Electronic equipment	0.8	Electrical machinery	0.5	Wholesale/retail	5.6
Gas	0.2	Automobiles	0.5	Services	3.9
Wholesale/retail	0.1	Electronic equipment	0.4	Electric power	1.7
Services	0.0	Wholesale/retail	0.0	Gas	0.9
Heat supply	-	Services	0.0	Heat supply	0.0

Note: Percentages give the average for the three fiscal years 2000-2002.
Source: Compiled by DBJ from Ministry of Economy, Trade and Industry, *Capital Investment Survey* (June 2002).

Table 5-3. Corporate Research Spending on the Environmental and Energy Fields in Major Industries

Environmental field	(billions of yen)	Share	Energy field	(billions of yen)	Share
All industries	350.7	100.0%	All industries	343.5	100.0%
Manufacturing	323.7	92.3%	Manufacturing	254.6	74.1%
Transport equipment	191.4	54.6%	Transport equipment	135.3	39.4%
Machinery industry	37.3	10.6%	Transport, communications and public utilities	65.8	19.2%
Electrical machinery	27.5	7.8%	Electrical machinery	59.3	17.3%
Chemicals	27.0	7.7%	Petroleum and coal products	15.2	4.4%
Construction	12.2	3.5%	Non-ferrous metals	13.3	3.9%
Iron and steel	9.2	2.6%	Machinery industry	11.7	3.4%
Transport, communications and public utilities	8.9	2.5%	Chemicals	8.1	2.4%
Precision machinery	6.1	1.7%	Mining	7.6	2.2%
Ceramics	4.7	1.3%	Construction	5.0	1.4%
Publishing and printing	4.2	1.2%	Precision machinery	3.2	0.9%
Petroleum and coal products	3.7	1.1%	Ceramics	3.1	0.9%
Plastics	3.3	0.9%	Iron and steel	2.8	0.8%
Mining	3.0	0.9%	Plastics	1.7	0.5%
Foods	2.7	0.8%	Specialized services	0.7	0.2%
Software and information processing	1.9	0.5%	Wholesale	0.6	0.2%

Note: Academic research institutes have been excluded.
Source: Compiled by DBJ from Ministry of Public Management, Home Affairs, Posts and Telecommunications, *Scientific Technology Research Survey*, 2002.

percentage in all three fields, followed by pulp and paper, oil refining, chemicals, and ceramic, stone and clay products. Electric power, electrical machinery, and automobiles also display fairly high percentages.

Measures to combat global warming today constitute an aspect of corporate capital investment that can no longer be ignored, as demonstrated by a survey of attitudes to capital investment conducted by DBJ in conjunction with its August 2002 survey of capital investment trends among major corporations throughout Japan. In this survey, to which 1,971 companies responded, 21.8% of companies cited "action on the environment" as an area of investment which, for strategic or other reasons, they placed in a separate category and gave priority, even though such investment can not surpass usual hurdle rate on return. Of those companies, 17.5% stated that they gave greater priority to measures to combat global warming than to other forms of investment on the environment, while 65.3% said that they assigned them the same level of importance. Although 17.2% said that they regarded such measures as less important than other forms of investment on the environment, the fact remains that the great majority of companies consider combating global warming at least as important as other forms of investment on the environment.

Table 5-3 shows the percentage of company research funds spent on the environmental and energy fields.

As a general rule, companies with larger R&D budgets find it easier to develop and adopt new technologies; they should also therefore be in a better position to take steps to combat global warming, though Environmental R&D is only a paltry 3% of the total R&D spending. Of all the different industries, transport equipment invests far and away the largest amount in the environmental field. It is followed by machinery industry, electric machinery, and chemicals. Transport equipment also accounts for the biggest share of investment in the energy sector, followed by transport, communications and public utilities and, in third place, electrical machinery.

The above discussion is based on R&D spending for FY 2001. It should be kept in mind, however, that there is a time lag between

when a company invests in R&D and when it harvests the rewards, and in some cases companies may be in a position to take measures to combat global warming thanks to the cumulative results of research over a number of years, even though they have not invested that much money during the particular year in question.

3. Progress of Different Industries in Meeting ISO 14001

ISO 14001 certification is one indicator of how solid an internal management structure a company has to deal with environmental issues. Some firms have testified that obtaining ISO 14001 certification has raised employee awareness of environmental issues and made it easier to take action to fight global warming.

Table 5-4 gives number of certifications for ISO 14001 as of the end of December 2002. Out of a total of 10,952 certifications, the electrical machinery industry accounts for the largest number with 13.9%. Next come services, chemicals, construction (general contractors), metal products manufacturing, transport equipment, general equipment, waste treatment, and local governments.

Since it can be assumed that industries with more establishments are going to obtain more certifications, we have gauged different industries' progress in meeting ISO 14001 based on the relative ratios of the ISO certification ratios and the number of establishment ratios by industry. As Table 5-5 shows, the industries that have made the greatest progress are, in order, non-ferrous metals mining, metals mining, chemicals, gas, petroleum products, electrical machinery, and electric power. The least progress has been made in forestry, food services, construction (special trade contractors), real estate, medicine, merchandise retailing, insurance, inns and other accommodations, schools and education, merchandise wholesaling, services, and national public service. Certifications have been on the increase of late in the non-manufacturing sector, including services, but the number of certifications as a percentage of the total number of establishments within each industry remains low.

Box 2. What Is ISO 14001?

ISO 14001 was developed by the International Organization for Standardization (ISO) to serve as a model Environmental Management System (EMS) for corporations to adopt. EMS is a voluntary tool that enables companies to enhance their awareness of environmental issues as they relate to business and adopt ecologically sound management practices that reduce impacts on the environment.

First top management formulates an environmental policy, which prescribes both a code of practice and a set of targets for the EMS. This is disclosed to the rest of the organization and the public at large. On that basis the organization assesses the impact of its various operations on the environment and identifies those impacts that are particularly serious, decides to what extent and in what way to mitigate those impacts, assigns responsibilities and sets a definite schedule, then develops a mechanism for managing, auditing, evaluating, and rectifying environmental performance. An outside audit is conducted on a regular basis to ensure that the system is maintained in working order.

Table 5-4. Number of ISO 14001 Certifications as of the End of December 2002

Industry	Number of certifications as of end of Dec. 2002	Share: a	Number of establishments	Share: b	a – b
All industries	10,952	100.0%	6,350,101	100.0%	
Electrical machinery	1,519	13.9%	42,164	0.7%	13.2%
Services	1,004	9.2%	1,038,354	16.4%	-7.2%
Chemicals	850	7.8%	9,101	0.1%	7.6%
Construction (general contractors)	809	7.4%	247,780	3.9%	3.5%
Metal products manufacturing	669	6.1%	81,548	1.3%	4.8%
Transport equipment	650	5.9%	25,756	0.4%	5.5%
General equipment	576	5.3%	73,782	1.2%	4.1%
Waste treatment	484	4.4%	17,519	0.3%	4.1%
Local governments	416	3.8%	38,718	0.6%	3.2%
Plastic products	352	3.2%	28,120	0.4%	2.8%
Merchandise retailing	327	3.0%	1,403,482	22.1%	-19.1%
Merchandise wholesaling	311	2.8%	403,802	6.4%	-3.5%
Precision machinery	255	2.3%	11,794	0.2%	2.1%
Food products manufacturing	240	2.2%	57,557	0.9%	1.3%
Pulp and paper	237	2.2%	15,272	0.2%	1.9%
Ceramic, stone and clay products	212	1.9%	28,152	0.4%	1.5%
Other manufacturing industries	211	1.9%	36,757	0.6%	1.3%
Publishing and printing	194	1.8%	57,383	0.9%	0.9%
Transport	189	1.7%	136,719	2.2%	-0.4%
Construction (installation of fixtures)	179	1.6%	143,345	2.3%	-0.6%
Beverages etc.	168	1.5%	9,064	0.1%	1.4%
Textiles	126	1.2%	86,690	1.4%	-0.2%
Rubber products	123	1.1%	7,798	0.1%	1.0%
Non-ferrous metals	119	1.1%	5,830	0.1%	1.0%
Iron and steel	92	0.8%	7,662	0.1%	0.7%
Electric power	70	0.6%	2,008	0.0%	0.6%
Communications	60	0.5%	15,400	0.2%	0.3%
Petroleum products	57	0.5%	1,379	0.0%	0.5%
Furniture and fixtures manufacturing	57	0.5%	33,350	0.5%	0.0%
Gas	52	0.5%	775	0.0%	0.5%

Sources: 1. The number of ISO 14001 certifications is as tallied by the Japanese Standards Association (Environmental Management Standards Council Administration Center).
2. The number of establishments is taken from Ministry of Public Management, Home Affairs, Posts and Telecommunications, *Establishment and Enterprise Census 2001*.
3. Compiled by DBJ.

Table 5-5. Progress in Meeting ISO 14001

Top 20 sectors	Progress: a/b	Rank
Non-ferrous metals mining	927.7	1
Metals mining	245.3	2
Chemicals	54.2	3
Gas	38.9	4
Petroleum products	24.0	5
Electrical machinery	20.9	6
Electric power	20.2	7
Waste treatment	16.0	8
Transport equipment	14.6	9
Precision machinery	12.5	10
Non-ferrous metals	11.8	11
Beverages etc.	10.7	12
Rubber products	9.1	13
Pulp and paper	9.0	14
Plastic products	7.3	15
Iron and steel	7.0	16
Local governments	6.2	17
Metal products manufacturing	4.8	18
General equipment	4.5	19
Ceramic, stone and clay products	4.4	20

Bottom 20 sectors	Progress: a/b	Rank
Forestry	0.0	1
Food services	0.0	2
Construction (special trade contractors)	0.0	3
Real estate	0.1	4
Medicine	0.1	5
Merchandise retailing	0.1	6
Insurance	0.1	7
Inns and other accommodations	0.2	8
Schools and education	0.3	9
Merchandise wholesaling	0.4	10
Services	0.6	11
National public service	0.6	12
Agriculture	0.7	13
Construction (installation of fixtures)	0.7	14
Transport	0.8	15
Textiles	0.8	16
Timber and wood products manufacturing	0.9	17
Furniture and fixtures manufacturing	1.0	18
Banking and trust	1.1	19
Construction (general contractors)	1.9	20

Notes: Each industry's progress in meeting ISO 14001 has been gauged by determining the share of ISO 14001 certifications it has obtained as a percentage of the total number of such certifications, then dividing that figure by its percentage share of all establishments.
The simple percentage share that a particular industry has of total ISO certifications does not provide an accurate picture of how much progress it has made in meeting ISO 14001, since industries with more establishments are going to have more certifications.
If an industry's percentage share of both ISO 14001 certifications and number of establishments is identical, then it will have a score of 1. If its share of certifications is greater, then it will have a score of more than 1. A higher score indicates a greater commitment to meeting ISO 14001.
It should be noted however that these numbers give no more than a very rough idea, because in some cases several hundred different establishments may together receive a blanket certification, while in other cases a single establishment may be granted its own certification; yet both count as a single certification. Strict comparisons are therefore not possible.

Sources: As in Table 5-4. Compiled by DBJ.

VI Characteristics of Measures to Combat Global Warming As Exemplified by Innovative Programs in the Field[20]

1. Survey of Winning Entries to the Nationwide Contest for Outstanding Energy-saving Programs

Chapter V examined the domestic business climate in which corporations operate today. It analyzed what kinds of companies are taking innovative measures to combat global warming amidst that business climate and what the characteristics of those measures are.

Here we examine the details of 239 programs that between FY 1997-2001 won various awards at the Nationwide Contest for Outstanding Energy-saving Programs run by the Energy Conservation Center of Japan, including the Minister of Economy, Trade and Industry Prize, the Director General of the Agency for Natural Resources and Energy (ANRE) Prize, the Director General of the Regional Bureau of Economy, Trade and Industry Prize, and the Chairman of the Energy Conservation Center of Japan Prize. These programs exemplify how companies have overcome a host of obstacles to implement innovative measures to combat global warming. As described in Box 3, the Nationwide Contest for Outstanding Energy-saving Programs is a prestigious contest that has been held for over a quarter of a century now. It is designed to encourage the adoption of outstanding energy practices, and descriptions of winning programs are posted on the Internet.

Conserving energy is the cornerstone of the fight against global warming, and programs that have won awards in the contest may fairly be considered to exemplify innovative approaches to combating global warming. After all, they have been recognized by a panel of experts as being outstanding on several fronts: they conserve energy, are economical, are innovative or original, can be adopted by companies in the same and other industries, and are ecologically sound.

As can be seen from Table 6-1, the contest receives roughly 150 entries annually, of which around 30% win awards, though the exact numbers vary from year to year. Before submitting entries some companies hold a pre-screening in house to select programs likely to win. Therefore the outstanding programs analyzed here are taken from a far larger statistical population than the total of 821 contest entries; that population may be conjectured to number in the thousands at the very least.

The winning entries are examples of innovative programs that have successfully overcome a host of obstacles. It should be noted however that they do not encompass the full range of action that companies are taking to conserve energy, since all these programs have been submitted to the contest for the express purpose of achieving public recognition, and the submitting firms do not care if a certain amount of technical information about them leaks out.

Box 3. The Nationwide Contest for Outstanding Energy-saving Programs

The Nationwide Contest for Outstanding Energy-saving Programs was launched in 1975 by the precursor of the Energy Conservation Center of Japan as a way to encourage the manufacturing industry and all sectors of the economy to take concrete steps to save energy, which it does by enhancing awareness of energy issues and promoting advances in energy-saving technology. It provides an opportunity for businesses throughout Japan to share techniques and insights for conserving energy.

Entries are judged on a comprehensive basis by a panel of experts for the degree to which they conserve energy, are economical, are innovative or original, can be adopted by companies in the same and other industries, and are ecologically sound.

[20] In analyzing the Nationwide Contest for Outstanding Energy-saving Programs for the purposes of this chapter, I received a great deal of help from many individuals with the Energy Conservation Center of Japan. I would like to take this opportunity to thank them.

Table 6-1. Number of Winning and Other Entries to the Contest for Outstanding Energy-saving Programs

(number of entries)

Type of entry	FY1997	Share	FY1998	Share	FY1999	Share	FY2000	Share	FY2001	Share	Total	Share
Winning entries	47	36%	56	37%	42	24%	48	26%	46	26%	**239**	29%
Other	84	64%	96	63%	131	76%	137	74%	134	74%	**582**	71%
Total entries	131	100%	152	100%	173	100%	185	100%	180	100%	**821**	100%

Note: Of those companies that submit entries, 1-2% are awarded the Minister of Economy, Trade and Industry Prize, 3% the Director General of the Agency for Natural Resources and Energy Prize, 10% the Director General of the Regional Bureau of Economy, Trade and Industry Prize, and 12% the Chairman of the Energy Conservation Center of Japan Prize. For FY 1997 and 1998 recipients of the Incentive Prize and Excellent Program Prize are also counted as winning entries.

Source: Compiled by DBJ from data on winning programs available on the Energy Conservation Center of Japan's home page.

Table 6-2. Winning Entries Classified by Industry

Total FY 1997-2001	Winning entries
Ordinary steel	39
Four-wheel vehicles	35
Electronic equipment	29
Petroleum	27
Components and chassis	21
Electronic components etc.	18
9 big power utilities	14
Electrical equipment	11
Other electric power	5
Industrial machinery	5
Metal products	5
Organic chemicals	4
Commercial office equipment	3
Smelting of non-ferrous metals	2
Brewing and distilling	2
Other ceramic, stone and clay products	2
Other iron and steel	2
Pulp and paper	2
Real estate	1
Construction	1
Rolling of non-ferrous metals	1
Communications	1
Other textiles	1
Retail	1
Glass	1
Gas	1
Synthetic fiber	1

Source: As in Table 6-1.

Table 6-2 shows winning entries classified by industry. The industries that won the most awards were, in order, ordinary steel, four-wheel vehicles, electronic equipment, petroleum, components and chassis, electronic components etc., the nine big power utilities, and electrical equipment. Industries like real estate and communications received but a handful of prizes. Perhaps a certain degree of lopsidedness in which industries win prizes is inevitable given the fact that the contest is run by the Energy Conservation Center, which comes under the aegis of the Ministry of Economy, Trade and Industry.

Table 6-3. Classification of Winning Entries by Broader Sector

Total FY 1997-2001	Winning entries
Electrical machinery	58
Transport equipment	56
Iron and steel	41
Petroleum	27
Electric power	19
Other	8
General equipment	8
Metal products	5
Chemistry	4
Non-ferrous metals	3
Pulp and paper	2
Foodstuffs	2
Gas	1
Communications	1

Source: As in Table 6-1.

Table 6-3 reclassifies winning companies into broader sectors for ease of comparison with Chapter V. The top-placing sectors are electrical machinery, transport equipment, iron and steel, petroleum, and electric power. Other sectors have received relatively few awards.

Table 6-4. Number of Prizes for Outstanding Energy-saving Programs Won by Different Industries, FY 1997-2001

FY 1997	Prizes	FY 1998	Prizes	FY 1999	Prizes	FY 2000	Prizes	FY 2001	Prizes
Four-wheel vehicles	8	Ordinary steel	9	Ordinary steel	8	Four-wheel vehicles	8	Four-wheel vehicles	7
Petroleum	8	Four-wheel vehicles	8	Electronic equipment	7	Electronic equipment	8	Electronic equipment	6
Ordinary steel	8	9 big power utilities	5	Petroleum	6	Ordinary steel	8	Ordinary steel	6
9 big power utilities	6	Petroleum	5	Four-wheel vehicles	4	Electronic components etc.	6	Components and chassis	6
Electronic equipment	3	Electronic equipment	5	Electrical equipment	4	Petroleum	3	Petroleum	5
Components and chassis	3	Electronic components etc.	5	Components and chassis	4	Components and chassis	3	Electronic components etc.	4
Electronic components etc.	2	Components and chassis	5	9 big power utilities	3	Brewing and distilling	2	Electrical equipment	3
Other iron and steel	1	Other electric power	2	Gas	1	Industrial machinery	2	Pulp and paper	2
Other electric power	1	Metal products	2	Other electric power	1	Commercial office equipment	2	Other iron and steel	1
Other ceramic, stone and clay products	1	Industrial machinery	2	Industrial machinery	1	Electrical equipment	2	Other electric power	1
Metal products	1	Electrical equipment	2	Commercial office equipment	1	Metal products	1	Synthetic fiber	1
Organic chemicals	1	Organic chemicals	2	Communications	1	Real estate	1	Metal products	1
		Glass	1	Electronic components etc.	1	Rolling of non-ferrous metals	1	Construction	1
		Other textiles	1			Smelting of non-ferrous metals	1	Retail	1
		Other ceramic, stone and clay products	1			Organic chemicals	1		
		Rolling of non-ferrous metals	1						

Source: As in Table 6-1.

Table 6-4 gives ranking of industries by number of prizes won for each of the past five years. Certain industries have been constant winners. Ordinary steel places consistently in the top three, four-wheel vehicles in the top four. Also noteworthy is how electronic equipment has maintained second place for three years in a row starting in FY 1999.

Table 6-5 provides details about the companies that have been the biggest winners within these top-placing industries. A description follows of the characteristics of those industries that have garnered the most prizes.

In the field of ordinary steel, Nippon Steel Corporation has won overwhelmingly the largest share of prizes. Many of the measures in this field have come from the bottom up, having been devised by workers on the production line. Also, almost half the winning programs have involved developing new technologies, and new facilities have been installed for many of them.

In the field of four-wheel vehicles, the Toyota Motor Group has been similarly predominant. Again, a bottom-up approach is common, with most programs involving making the best use of existing facilities rather than harnessing new technology. Energy-saving efforts in this area typically involve minimizing wasteful energy usage by rationalizing demand.

As for components and chassis, the Aisin Seiki and Denso Groups — both affiliated with Toyota — have dominated. There has been more of a tendency to develop new technologies than has been the case in the automobile sector, and energy conservation efforts have focused on rationalizing demand.

The Matsushita Electric Industrial Group has dominated in the field of electronic equipment and also won quite a few prizes in the field of electronic components etc. In both industries programs that make effective use of existing facilities have been common, while efforts to develop new technologies have been rare.

Table 6-5. Notable Winning Entries in the Nationwide Contest for Outstanding Energy-saving Programs

Industry	Firm or group	Prizes, FY 1997-2001	Examples of winning programs
Ordinary steel	Nippon Steel Corporation	Total 16 prizes incl. 1 Minister's Prize and 3 Director General of the ANRE Prizes	Making effective use of discarded carbon and iron by developing and implementing technology for recycling surplus dust from steel production as raw material for blast furnaces.
			Improvements involving the use of diagnostic technology on obsolescent heating equipment.
			Development and installation of a small ignition furnace at a sintering plant that supplies sintered ore to blast furnaces.
			Reducing energy use by upgrading compressed air nozzles and installing valves.
	NKK Corp.	Total 6 prizes incl. 3 Minister's Prizes	Minimizing energy use during the iron- and steel-making process by developing and implementing technology for measuring the temperature of molten metal in the taphole of blast furnaces.
			Developing a heat storage burner for use as a thermal rolling continuous heating furnace or steel plate batch heating furnace.
			Highly efficient recovery of waste heat by using a heat storage burner as a heater for electrical furnace ladles.
Four-wheel vehicles	Toyota Motor Group	Total 19 prizes incl. 2 Minister's Prizes and 1 Director General of the ANRE Prize	Conserving energy in conjunction with ISO 14001 by upgrading measuring equipment and improving production equipment operation, plus pooling information on individual operations on a cross-departmental basis; using outside air in cold climates and setting air conditioning to lower temperatures etc.
			Conserving energy through automatic control of boiler operation and better maintenance practices.
			Reducing the number of melting furnaces in operation by establishing technologies for adjusting content, e.g., techniques for melting additives.
	Mazda	Total 5 prizes incl. 1 Minister's Prize	Making more efficient use of the approx. 250 air blowers in the Engine/Mission Manufacturing Department by, e.g., reducing the number of objects to be blown and altering nozzles to move, as well as through adjustments to the blow points.
Components and chassis	Aisin Seiki Group	Total 8 prizes incl. 1 Minister's Prize	A comprehensive review, with the goal of saving energy and resources, of design and production procedures in connection with the development and manufacture of a new automatic transmission for small cars. This achieved a 30% cut in electrical power consumption.
	Denso Group	Total 8 prizes incl. 1 Minister's Prize	Automated start-up and shutdown of equipment, controlled operation of cleaner air blowers, regular inspection and repair of air leakages.
Electronic equipment	Matsushita Electric Industrial Group	Total 20 prizes incl. 2 Director General of the ANRE Prizes	Achieving fresh energy savings on the production floor — where previous such efforts had hit a ceiling — by establishing and systematically implementing diagnostic energy conservation technologies that utilize specially developed measuring equipment.
			Monitoring of real-time energy consumption by production line and facility.
			Introduction of heat-storage combustion equipment with waste heat recovery equipment to treat exhaust gas from solvents.
Electronic components etc.	Matsushita Electric Industrial Group	Total 9 prizes incl. 2 Director General of the ANRE Prizes	Upgrade of obsolescent air compressors and air conditioning equipment to high-performance models; upgrade of transformer equipment to an energy-saving design; better management of length of time that equipment is in operation; etc.
			A program implemented with participation of all staff in conjunction with ISO 14001, involving improvements in the control of water supply and drainage and hot water pumps in clean rooms, the use of air from outside during winter, and reductions in energy losses.
	NEC Group	Total 4 prizes incl. 1 Director General of the ANRE Prize	Boosting efficiency of turbo freezers by setting cooling tower fans to a lower temperature; reducing freezer load by using outside air to chill cooling water during winter and transitional seasons; etc.
Electrical equipment	Toshiba	Total 3 prizes incl. 1 Minister's Prize	Series of measures in connection with ISO 14001 certification involving cutting peak power consumption in conjunction with the adoption of cogeneration technology, making effective use of waste heat generated during chilling of freezer refrigerant, and establishing an energy-saving pattern of freezer operation.
Petroleum	Idemitsu Kosan	Total 14 prizes incl. 3 Director General of the ANRE Prizes	An energy-saving program involving restructuring the overall design of hydrogen generators by having operators of the equipment participate in the design process and relaxing constraints.
			A systematic energy conservation program involving all staff that achieved rapid results by quantifying hidden losses on site in the form of a utility loss map.
			Compiling a troubleshooting manual and using it to systematically identify problems and set priorities.
	Cosmo Oil	Total 7 prizes incl. 1 Director General of the ANRE Prize	Energy-saving measures implemented by several subcommittees charged with the task of promoting energy conservation at all the company's refineries; reducing amount of steam used by improving operation of reformer unit benzene splitters.
9 big power utilities	Shikoku Electric Power	Total 2 prizes incl. 1 Director General of the ANRE Prize	Reducing the amount of sludge left over when drainage from desulfurizing equipment is treated using drainage treatment equipment by recovering it for reuse in the desulfurizing equipment, thereby cutting power consumption.
	Tohoku Electric Power	Total 2 prizes incl. 1 Director General of the ANRE Prize	Reducing heat loss during plant startup by lowering the deaerator heating temperature at startup times and improving clean-up procedures for plant startup after a weekend stoppage.

Source: As in Table 6-1.

Idemitsu Kosan has been similarly dominant in the petroleum field. Many of its programs too have come from the bottom up and entailed making effective use of existing facilities. It has consistently overwhelmed the competition, with its Chiba refinery winning prizes 17 years in a row. Energy conservation endeavors are deeply permeated through its operations.

Thus just a handful of players — Nippon Steel, the Toyota Motor Group, the Matsushita Electric Industrial Group, Idemitsu Kosan — have snatched up the lion's share of prizes. Awards have not been distributed evenly among the companies in each industry; rather, a few firms have dominated. This suggests that, of the various motives identified in Table 4-1, particular company circumstances exert considerable influence.

Box 4 describes the case of Aeon Co., Ltd., one of the few companies in the non-manufacturing sector to have received an award for its energy-saving efforts. Aeon started out its campaign, which it launched on a top-down

Box 4. How Aeon Co., Ltd. Won the Minister of Economy, Trade and Industry Prize for FY 2001 by Developing an ESCO System for Comprehensive Conserving Energy

This initiative, which Aeon implemented in coordination with the revised Energy Conservation Law and ISO 14001, pursued cost-effectiveness across the board using several approaches. Chief among them were improving operation of food refrigeration equipment and air conditioning equipment in stores and restoring them to top working condition by keeping them clean. Steps were also taken to save energy in management of energy demand and operation of lighting equipment. These measures were implemented in 200 of Aeon's approximately 400 stores over a seven-year period starting in FY 1995. The goal was to save ¥900 million annually.

The campaign, which was launched on a top-down basis, started out by assessing energy consumption in each of the company's stores and determining such details as its total floor area and hours of operation. A chain of command was established for executing the necessary steps, and division of duties was clearly defined. A manual was compiled that included details on energy-saving designs and implementation procedures; this enabled information on energy conservation techniques to be shared throughout the company.

By analyzing current operating conditions, Aeon determined that it needed to take the following steps: (1) Establish an overall energy conservation strategy for each store as whole, with each store installing its own semi-made-to-order energy-saving equipment. (2) Manage energy use based not just on costs but amount consumed as well, with company headquarters keeping track of data on all stores on a centralized basis. (3) Carefully select manufacturers whose equipment can be depended on to save energy. (4) Monitor energy-saving equipment once installed for how effective a job it does. (5) Optimize operation of that equipment and maintain it properly.

Specific measures include: cutting peak energy consumption by assigning priority levels to different operations and rotating energy cut during peak times; inverter control of large motors; automatic control of gas pressure in refrigerated showcases in accordance with the temperature inside the case; and restoring the outside units of air conditioning systems to top working order by keeping them clean. According to available figures Aeon has invested ¥15-44 million per store and thereby achieved an average of around 8% in energy reductions in 60 major stores. Fifteen stores achieved reductions of less than 5%, 18 of at least 5% but below 10%, 22 of at least 10% but below 15%, and five of 15% or thereabouts. Five stores recovered their investment in less than 1.5 years, 12 in 1.5-2.0 years, 10 in 2.0-2.5 years, 22 in 2.5-3.0 years, and 11 in 3.0-3.5 years; thus the cost of the measures has in almost all cases been recovered in one to three years. As this case goes to show, by keeping proper track of data and working together efficiently as a single coordinated team, a company can achieve impressive results at little cost.

Source: Compiled by DBJ from data released by the Energy Conservation Center of Japan.

Table 6-6. Number of Designated Type 1 Energy Management Factories under the Energy Conservation Law, by Industry (As of the End of March 1999)

Industry	Chemicals	Electrical equipment and devices	Transport equipment and devices	Ceramic, stone and clay products	Iron and steel	Pulp, paper and paper products	Food-stuffs	Non-ferrous metals	Electric power supply	Textiles	Other	Total number of Type 1 factories
Number of Type 1 factories	588	490	310	305	263	204	200	188	180	176	734	3638
As percentage of all establishments	6.5%	1.2%	1.2%	1.1%	3.4%	1.3%	0.3%	3.2%	9.0%	0.2%	0.2%	0.6%

Sources: Compiled by DBJ from data in Energy Conservation Center of Japan, *Analysis of State of Energy Consumption*, FY 1994-98, and Ministry of Public Management, Home Affairs, Posts and Telecommunications, *Establishment and Enterprise Census*, FY 2001.

basis, by determining the amount of energy the company was using overall. This should prove an instructive example to industries that lag behind in this area, for it demonstrates the importance of first determining how many emissions your firm is producing. At a cost of ¥15-44 million per store, Aeon has achieved an average of around 8% in energy reductions in 60 major stores by better controlling operation of energy-related equipment and cutting peak energy consumption. That investment has been recovered in one to three years — which goes to show that there are still some surprisingly cheap, economical ways to save energy left.

Table 6-6 gives the number of factories in each industry that have been designated Type 1 energy management factories under the Energy Conservation Law,[21] along with the percentage that figure represents of the total number of establishments within the industry in question. This is in order to test the hypothesis that industries with more Type 1 factories should win more prizes. The industries with the most Type 1 factories are, in order, chemicals, electrical equipment and devices, transport equipment and devices, ceramic, stone and clay products, iron and steel, and pulp and paper. This ranking clearly differs from that of industry performance in the contest for energy-saving programs. Were the hypothesis correct, we would expect chemicals and ceramic, stone and clay products to have attained a few more prizes than they actually have. Conversely, petroleum and iron and steel have displayed greater zeal than other industries in proportion to the number of Type 1 factories they have and their total number of establishments.

[21] Designated Type 1 energy management factory under the Energy Conservation Law: a factory in the manufacturing, mining, electrical power supply, gas supply, or heat supply industry with electricity consumption of 12 million kWh or fuel (heat) consumption of 3000 kl.

2. Characteristics of Winning Energy Conservation Programs

Table 6-7 provides a somewhat more detailed overview of the characteristics of winning energy conservation programs. It classifies 239 programs that have won citations over the past five years based on information available on the Energy Conservation Center's home page.

(a) Targeted operation

First there is the question of what aspect of operations energy-saving programs target. The great majority of winning program over the period 1997-2001 — 83% to be exact — targeted the production line, but in recent years there has been an increase in programs targeting other areas. It makes sense that so many programs target the production line since designated factories under the Energy Conservation Law are frequent participants in the contest. Nonetheless, a growing number of programs these days, even those implemented in factories, target areas other than production such as air conditioning systems, perhaps because new ways to conserve energy on the production line are becoming increasingly hard to find.

Table 6-7. Characteristics of Innovative Energy Conservation Measures As Exemplified by Winning Entries in the Contest for Outstanding Energy-saving Programs

	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Total
Winning entries	47	56	42	48	46	239
(a) Targeted operations						
Production line	91%	88%	80%	76%	77%	83%
Other	9%	13%	20%	24%	23%	17%
(b) Energy saving approach adopted						
Rationalizing energy demand	37%	44%	69%	71%	57%	55%
Boosting equipment efficiency	39%	25%	19%	19%	33%	27%
Recovery of waste heat etc.	23%	31%	12%	10%	11%	18%
(c) Did the program start out by reassessing energy consumption?						
Yes	17%	21%	5%	4%	59%	21%
No	83%	79%	95%	96%	41%	79%
(d) Facilities used						
Made effective use of existing facilities	82%	65%	83%	92%	62%	76%
Involved installing new facilities	18%	35%	17%	8%	38%	24%
(e) Did the company overhaul its internal mechanism for managing energy costs?						
Yes	53%	20%	2%	2%	24%	21%
No	47%	80%	98%	98%	76%	79%
(f) Did the program involve developing and implementing new technology?						
Yes	13%	13%	40%	17%	33%	22%
No	87%	88%	60%	83%	67%	78%
(g) Top-down or bottom-up?						
Top-down	0%	0%	5%	2%	11%	3%
Bottom-up	100%	100%	95%	98%	89%	97%
(h) Was the program implemented on a cross-departmental basis?						
Yes	17%	14%	7%	15%	37%	18%
No	83%	86%	93%	85%	63%	82%

Notes: 1. When a winning entry consists of more than one type of measures, the main measures in question are used as the basis for classification.
2. Percentages do not necessarily add up to 100 due to rounding of fractions.

Source: As in Table 6-1.

(b) Approach adopted

In Table 6-7 approaches to conserving energy are classified into three general categories — rationalizing demand, boosting equipment efficiency, and recovery of waste heat etc. — and each program is sorted according to which category it best falls into. By this classification the majority of programs involved rationalizing demand. Boosting equipment efficiency came a distant second, accounting for barely half that number. Here too, then, rationalizing demand, which can be accomplished at minimal cost, predominated as opposed to boosting equipment efficiency, which often entails capital investment.

(c) Did the program start out by reassessing energy consumption?

As the case of Aeon demonstrates, assessing your energy consumption is the first step in implementing an energy-saving strategy. We therefore examined whether the typical winning program started out by determining level of energy consumption. However, many of the winners were designated Type 1 factories under the Energy Conservation Law or had ISO

14001 certification, and they did not need to take this initial step because they already had an idea of how much energy they were using. Even so, in FY 2001 the number of programs that did involve this initial step crossed the 50% mark. Determining level of energy consumption is the key to rationalizing demand, and even if a firm has a rough notion of its energy use based on existing mechanisms, it may be able to identify new potential cuts by conducting an in-depth reassessment of its exact energy use patterns.

Further, as Figs. 6-1 and 6-2 show, even designated Type 1 factories have room for improvement in their energy management practices, since their monitoring procedures may leave much to be desired. Some 40% of designated Type 1 factories have only a minimal grasp of their energy consumption, have numerous gaps in their information, or exercise management over only an extremely narrow range. Plus over 20% of Type 1 factories do not have adequate equipment to conduct proper monitoring. The problem could be even more serious in non-Type 1 factories, and improvements are very much in need. Japan, it is argued, has already done just about everything it can to cut back on energy use, but this is one area where potential gains are still to be made.

(d) Facilities used

In Table 6-7 (d) programs are classified into two categories depending on whether they made effective use of existing facilities or involved installing new facilities. The majority of programs made effective use of existing facilities, with not that many programs involving installation of new facilities. This suggests that even companies with a strong commitment to conserving energy still have a certain amount of room for taking low-cost measures of this type. However, in FY 2001 the

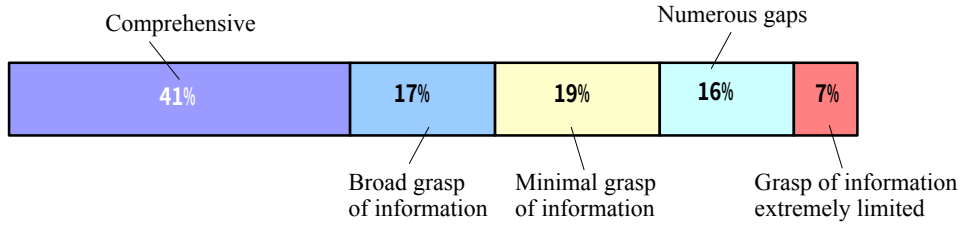

Figure 6-1. Scope of Management of Facilities and Operations

Source: Ministry of Economy, Trade and Industry, *Analysis of State of Energy Consumption*, FY 1994-98.

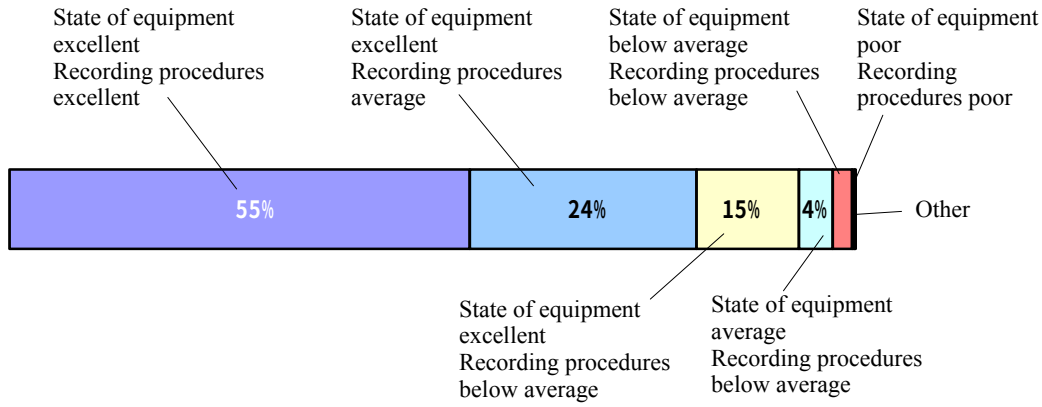

Figure 6-2. Monitoring and Recording Practices

Source: As in Fig. 6-1.

number of programs involving installation of new facilities showed a definite increase, which could mean that there is not that much scope left for making use of existing facilities. Still, making effective use of existing facilities remains an option for medium- and small-sized firms as well as big corporations that have strayed behind in the fight against global warming and do not have an adequate infrastructure to support implementation of the necessary measures. Steps will be needed to disseminate such expertise and technology to make best use of existing facilities.

(e) Did the company overhaul its internal mechanism for managing energy costs?

When implementing energy-saving measures, it is better if authority for managing energy use lies in the same hands as exercise authority over the production operations that consume energy. Sure enough, a fair number of the winning programs involved overhauling the internal company mechanism for managing energy costs. There were cases, for example, of a centralized form of management being replaced by a system in which the production group assumed control of energy costs.

(f) Did the program involve developing and implementing new technology?

Not that many of the winning energy-saving programs involved developing and implementing new technology. That may be because this contest fails to attract many programs that entail high development costs, since companies end up having to make public much of the technology and know-how that lie behind winning programs, even though no monetary awards or other forms of compensation are offered. For example, the chemicals industry garners few prizes, yet a chemical plant is literally bristling with patents; perhaps the industry is by its very nature unsuited to competing in this type of prize competition for public recognition. Entering the contest requires unveiling data on amount of energy used and temperature and pressure levels in order to demonstrate how a particular measure has helped conserve energy. For a chemicals firm, disclosing that kind of information could put corporate secrets about, say, its production system at risk.

(g) Top-down or bottom-up?

More of the winning energy conservation programs started from the bottom up — at employee initiative — than from the top down — at the bidding of management. This probably reflects the fact that, at companies that are frequent prize winners, taking measures to conserve energy is already considered an integral part of the work force's functions under the Energy Conservation Law or ISO 14001.

(h) Was the program implemented on a cross-departmental basis?

An increasing number of energy-saving programs are implemented on a cross-departmental basis, i.e., they are not self-contained within a single department. Implementing measures on a cross-departmental basis offers greater freedom and increases potential energy savings as compared to programs carried out independently within individual departments. There are cases, for instance, of companies cutting overall energy consumption by giving equipment operators a say in the design of their equipment.

The non-manufacturing sector, which lags behind in its energy-saving efforts, claimed few prizes, making generalizations difficult. But almost all the few prize-winning programs were implemented from the top down and started out with a reassessment of how much & in what way the company was using energy. This suggests that, if more companies are to join the fight against global warming, it is important that they first put in place the necessary internal emission management structure on a top-down basis.

3. Features Common to Innovative Programs in the Field

Here we bring together the different strands of our analysis so far by identifying what features these innovative programs have in common.

The vertical axis of Table 6-8 lists degree of achievements in innovative measures to combat global warming, the direct incentives

Table 6-8. Features Common to Innovative Programs to Combat Global Warming

		Electrical machinery	Transport equipment	Iron and steel	Petroleum products	Electric power	Chemicals	Ceramic, stone and clay products
Innovative programs	Outstanding energy-saving programs	◎	◎	◎	◎	◎	△	△
Direct incentives	Energy-saving advantages	△	△	◎	◎	◎	◎	◎
	Risks of a carbon tax	△	△	◎	◎	◎	○	◎
Internal structure	ISO 14001	◎	◎	○	◎	◎	◎	○
	R&D	◎	◎	△	△	○	○	△
	Capital investment	○	○	◎	○	○	○	○

Notes: ◎ = High ○ = Moderate △ = Low
Source: Compiled by DBJ.

that we have been able to identify in our analysis, and internal structure, while the horizontal axis names major industrial sectors. Each point of intersection is marked with a symbol (◎, ○, or △) depending on the extent to which the item on the left applies.

Here we use the number of entries that won prizes at the contest for outstanding energy-saving programs to gauge the degree of achievements to which a particular industry is taking innovative measures in the field. However, as already noted, chemicals and ceramic, stone and clay products have garnered fewer prizes than expected.

Under (observable) direct incentives, ceramics, iron and steel, and chemicals have all been given a ◎, since as we saw in Fig. 5-1 energy costs comprise a high percentage of their fuel and raw material costs.

Under risks of a carbon tax, electrical machinery and transport equipment have both been assigned a △ based on Table 5-1 and Figs. 5-2 though 5-8.

As this analysis indicates, electrical machinery and transport equipment have implemented a large number of innovative programs even though their direct incentives are not that great. Conversely, chemicals and ceramic, stone and clay products have attained few prizes despite having plenty of direct incentives. As already argued, it may be that these industries are by their nature unsuited to competing in this type of contest. That direct incentives do indeed play a role is suggested by such industries as iron and steel, petroleum products, and electric power. However, given the current uncertain policy climate, those incentives do not have as much urgency as they might.

Next we compare internal management structure as illustrated by level of ISO 14001 certification, capital investment in measures against global warming, and research and development (R&D) spending in the environmental and energy fields.

Most of the industries reviewed here were relatively enthusiastic about obtaining ISO 14001 certification, with little difference among them. After all, many of the companies concerned are already tightly managed under the Energy Conservation Law and have in place a fairly rigorous internal management structure. But the chemicals industry, despite its enthusiasm, won few prizes.

The majority of winners were presumably designated Type 1 factories under the Energy Conservation Law, which are expected to maintain a fairly solid management structure: they must have on staff qualified energy management experts who have passed a national exam, they must compile and file regular reports and future plans, and they are subject to on-site inspections by regional bureaus of economy, trade and industry. ISO

14001 does not require firms to keep energy management experts on staff, but it still demands that they monitor ecological impacts fairly closely and maintain an ongoing program of measures.

There was not that great a discrepancy in levels of capital investment, perhaps because few programs to combat global warming entailed installing new facilities. Nonetheless, iron and steel registered a high level of investment in global warming measures, reflecting the fact that many of its initiatives involved adopting new technology.

On the other hand iron and steel, along with petroleum products, did not spend that much on R&D, in sharp contrast to transport equipment and electrical machinery. This is not quite what one might have expected: iron and steel invested little in R&D yet brought in many new technologies, while transport equipment and electrical machinery spent plenty on R&D yet adopted relatively few new technologies. Several factors may be at work here: there is quite a time lag before R&D yields concrete results, plus by its very nature the Nationwide Contest for Outstanding Energy-saving Programs attracts few large-scale initiatives that entail extensive R&D spending. In the electrical machinery and transport equipment industries R&D does appear to have exerted a positive effect on certain fronts.

The above analysis suggests that, while an internal management structure is a necessary condition for implementing measures to combat global warming, it is on its own not enough.

Thus it is hard to say there exist simple correlations between direct incentives and internal management structure on the one hand, and innovative measures to combat global warming on the other.

The particular circumstances in which a firm stands, which may be obscure to the outside observer, also appear to exercise a considerable influence, as suggested by the way that a relatively small number of companies have dominated the contest. Even if incentives are weak, companies can still make progress in implementing measures against global warming as long as they have in place an internal mechanism for managing their energy consumption — what might be described as corporate infrastructure for the fight against global warming — and the conditions are right for bottom-up action, with management having committed itself to a policy of taking the necessary steps.

4. Fostering Further Innovative Measures to Combat Global Warming

In this chapter we have analyzed innovative measures to combat global warming as exemplified by winning entries in the Nation-wide Contest for Outstanding Energy-saving Programs. It should be remembered however that there are cases of innovative programs not featured in this contest.

Fig. 6-3 provides an overview of technologies and know-how that could be of considerable value to society as a whole even though they do not appear in the contest for outstanding energy-saving programs.

This contest provides no monetary compensation. The most that it offers is the public recognition that comes from winning the prestigious Minister of Economy, Trade and Industry Prize. Yet entering the contest entails a considerable amount of effort and requires firms to share valuable technology and know-how in the public arena, where it will be accessible to rivals. Therefore companies may choose to unveil only certain elements of their overall energy-saving strategy, keeping under wraps those that they judge will not yield enough benefits to justify the cost of entering them in the contest. Of the programs not featured in the contest, those that would stand little chance of winning anything anyway because they do not save that much energy (α2 in Fig. 6-3) require no further comment. The problem lies with Category α1: outstanding technology and know-how that are of considerable value to society, which however if entered in the contest would cause the firm that developed them to lose more than it would gain. These days companies in industries where competition is severe tend to be wary about disclosing too much information, since rival firms not just in Japan but in the rest of Asia as well are eager to get their hands on lucrative

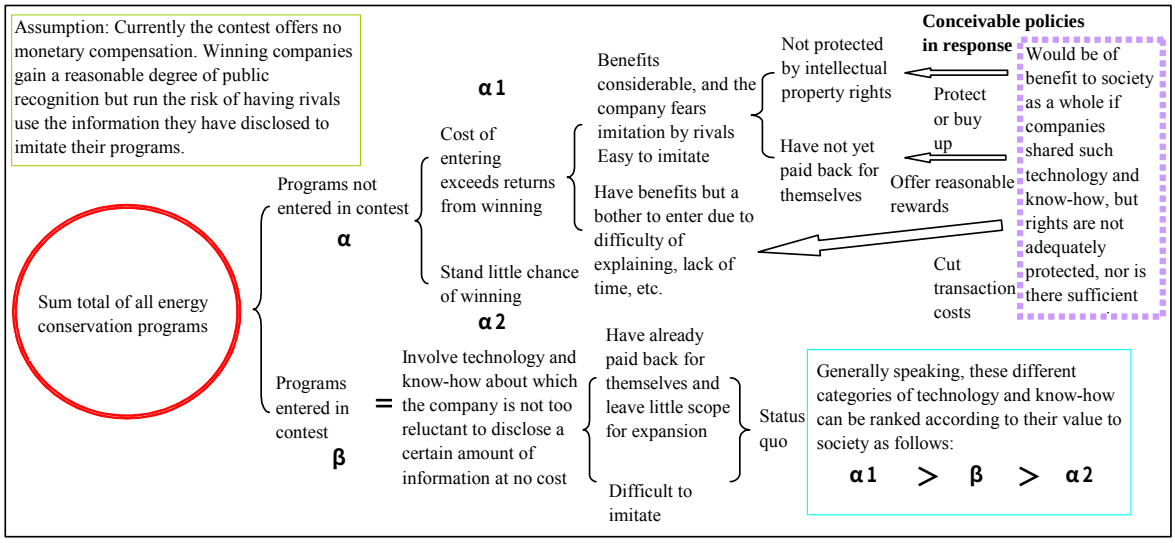

Figure 6-3. Position of the Entries to the Contest for Outstanding Energy-saving Programs in the Overall Context of Energy Conservation in Japan

Source: Compiled by DBJ.

technology and know-how. Category α1 may also include programs that are not protected by intellectual property rights or have not yet paid back for themselves. Category β — programs entered in the contest — may consist of either fairly old programs that have already paid back for themselves or programs that other companies will find hard to imitate. Thus, as shown in the lower right-hand corner of Fig. 6-3, these different categories of technology and know-how can be ranked according to their value to society in the order α1 > β > α2. Raising the overall level of energy conservation in Japan will require promoting widespread adoption of the most valuable forms of technology and know-how — those that fall into Category α1. To that end proper protection needs to be afforded to intellectual property rights under the patent system. But that is not all. Other policies also come to mind. A public agency could buy up outstanding technology and know-how at a fair price, then make it available to other Japanese firms at low cost; appropriate pecuniary incentives could be offered (in return for which companies would have to disclose enough information on the relevant technology or know-how to enable it to be transferred); and the business costs involved in entering the contest or releasing and transferring technology could be reduced or government subsidies provided to help defray them. Some of these policies may be difficult to implement, but the fact remains that a dose of ingenuity could accomplish a great deal in promoting the widespread adoption of outstanding know-how and technologies.

Conclusions

Based on the above analysis, we offer the following three recommendations for encouraging companies to adopt measures against global warming along the lines of the model outlined in Fig. 4-1:

(1) Enhance incentives.

Current efforts to fight global warming are confined to major corporations in certain industries. Encouraging the corporate community as a whole to join the fight will require providing stronger incentives to a broad range of players by sending as clear a signal as possible about medium- to long-term policies while taking into consideration the current constraints of the Kyoto Protocol.[22]

Meanwhile, in order to facilitate development and dissemination of more advanced technology and know-how than is available today, institutional arrangements such as providing various protection for intellectual property rights and monetary prizes should be made to enable companies to recover development costs. That will, it is hoped, lead to a proliferation of outstanding technologies and know-how that can be shared by society as a whole. Developing and disseminating advanced technology and know-how is indispensable to promoting action by Japanese corporations to combat global warming over the medium to long term. That will require not just removing barriers in so far as possible but also providing positive incentives.

(2) Furtherance of corporate internal GHG management structure.

Even if incentives are weak, companies can still make progress in implementing measures against global warming as long as they have in place an internal mechanism for managing their energy consumption — what might be described as corporate infrastructure for the fight against global warming. The conditions also need to be right for bottom-up action, with the company having committed itself to a policy of taking measures against global warming. Companies in the non-manufacturing sector in particular, which currently is doing little on this front and still has plenty of leeway to make reductions, should be encouraged to adopt the necessary internal management structure. Since smaller firms are likely to find the cost of developing and maintaining such a structure a strain, one sensible option might be to establish a mechanism that would give large numbers of firms access to energy management experts at low cost.

(3) Fair evaluation from outside.

One of the reasons that companies are reluctant to commit themselves to measures against global warming is that they are not always given due credit for long-term measures to help prevent global warming and for emission cuts as determined by product lifecycle assessments (LCAs). Companies need to be fairly evaluated, and that will require adjusting evaluation benchmarks and granting LCA emission permits. It will be necessary to create a mechanism that ensures companies that take the lead in implementing pioneering measures do not lose out for their pains. But that is not all. A system should be developed on a worldwide basis whereby effective medium- to long-term measures to combat global warming are properly rewarded.

As shown in Fig. 4-1, all three ideas are interrelated and should preferably be pursued simultaneously. By installing the internal infrastructure needed to combat global warming and developing and disseminating outstanding technology and know-how, companies can take the first step to decouple global warming mitigation and economic activities. Let us hope that progress will be steady.

[22] For example, when offering incentives to a particular industry, every effort should be made to minimize negative impacts such as carbon leakage, taking into consideration the state of international competition in each product category and the degree of industry's energy efficiency comparing to international standards. For instance, in industries where international competition is intense and efficiency is high, incentives could be provided that yield economic advantages, while in industries where international competition is virtually nonexistent and efficiency is low, incentives could be provided that impose an economic cost.

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