THE STRATEGY OF JAPANESE OIL COMPANIES UNDER GLOBAL WARMING

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ABSTRACT

Global warming is becoming a greater issue for human beings. People's life has become rich, comfortable and convenient, especially in developed countries. The rich life is supported by huge energy consumption and the energy consumption by human beings destroys natural balance of the earth. As consumption of oil is one of the highest contributors of greenhouse gases emissions, we need to reduce oil consumption in order to cope with global warming. For oil companies, this is a tough business circumstance. Oil demand will diminish and oil companies will face severer competition and need to contribute energy conservation as well.

This thesis analyses business circumstance of oil business in Japan and competences of ExxonMobil Japan and argues its future strategy. The analysis found that a competition in Japanese oil industry is a price competition and core competencies are all to compete price competition. The competition will be keener due to diminished oil demand. The argument suggests that the company should change its product from oil to service related to oil. Though the differentiation of oil product is difficult because of the quality regulations, services can be differentiated. As services can be improved by the feedback from customers, getting information on customer needs is another key issue. The thesis recommends that the company should collaborate with other industries and provide services beyond the current industry boundary.

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And lastly, I would like to express my gratitude to my family, especially to my wife, for supporting and encouraging me while at MIT as a fellow in the Management of Technology Program.

1. Introduction

Global warming is a critical issue for all nations, and global collaboration will be required in order to cope with this issue. Although industrialized countries are enjoying rich lives through the use of huge amounts of energy, such richness diminish and eventually disappear if measures are not developed now to deal with global warming.

I am interested in the strategies being pursued or developed by oil companies to deal with global warming. It seems to me that on its face such measures generally conflict with the inherent interests of oil companies. If one agrees that global warming is caused by the emission of greenhouse gases, and that carbon dioxide—the greatest contributors to global warming—is emitted as a by-product to the use of fossil fuels, i.e., coal and oil, then measures taken to reduce global warming must require a reduction in the amount of oil consumed—an apparent direct threat to the well-being of oil companies worldwide. In Japan, demand for oil has grown steadily throughout the 1990s, even during the present economic recession.

However, if society in general manifests a complacent belief that it is not worried by global warming, then do we need to worry about the oil industry?

The reality is that the Kyoto Protocol will be ratified in 2002, and the Japanese government will commit to reducing greenhouse gases by 2.3% from 1990 levels. Although the Japanese government has said officially that it will reduce greenhouse gases emissions by 6%, in fact at the seventh Conference of the Parties (COP7), Japan was given permission to include in the 6% reduction a 3.7% reduction by sinks, which is absorption of greenhouse gases by forests. The difference, 2.3%, looks small but greenhouse gases emissions are estimated to increase by about 20% from 1990.[1]. This means Japan will need to reduce its greenhouse gas emissions by more than 20%—and a 20% reduction is obviously a drastic change. Therefore, oil companies in Japan must consider the impacts on their future business of actions taken to reduce global warming.

A decline in the demand for oil is a difficult business condition for all oil companies. However, if they choose to do so, this entire scenario could be taken as an opportunity for the oil companies. This possibility, and the requirement that some kind of action be taken, are reasons why I have chosen to pursue this theme.

The thesis is structured as follows:

Chapter Two spends some time defining global warming and the various components that create it. Then I briefly outline the Kyoto Protocol, its expectations, and impacts on society and corporations.

Chapter Three offers a broad overview of the Japanese oil industry: its current situation, the outlook for the future, and the anticipated impacts of compliance with the Kyoto Protocol. It is here that I make use of Porter's Five Forces Model to analyze the Japanese oil industry and make some assessments for its future. Thereafter, I look in greater detail at one specific oil company, ExxonMobil Japan.

Chapter Four considers possible scenarios for how Japan might deal with its

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[1] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.59

requirement to comply with the Kyoto Protocol, and still maintain the health of its oil companies. Forecasts for demand and production of oil products are offered, followed by the subsequent impact on market conditions as demand and production ramp up and/or down as compliance becomes more intense.

Chapter Five discusses strategies and measures that could be taken by oil companies and refineries as they work to comply with the Kyoto Protocol and also to meet customer demand and maintain corporate well-being. This discussion includes an analysis of the industry using the Hax/Wilde Delta Model.

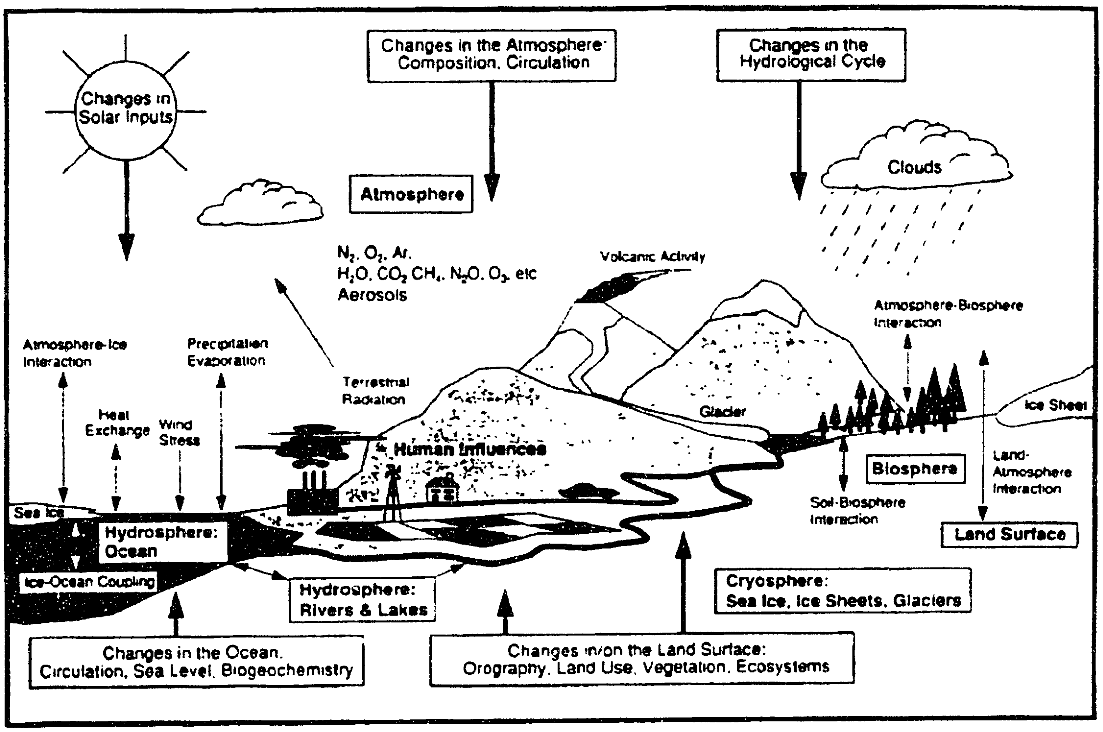
Chapter Six presents a summary and conclusions drawn from the thesis research.

2. Mechanism of Global Warming

2.1 THE CLIMATE SYSTEM[2]

The climate system consists of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface, and the biosphere (see Fig. 2-1).

Fig.2-1: Schematic view of the components of the global climate system[3]



The ***atmosphere*** is the most unstable and rapidly changing part of the system. It is composed primarily of nitrogen (N2, 78.1 vol/%) and oxygen (O_2, 20.9 vol/%). These gases do not interact with the infrared solar radiation emitted by the earth. On the other hand, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) absorb and emit infrared radiation. Although the composition of these gases is less than 0.1 vol/%, these gases, called "greenhouse gases", play an important role in the energy balance of the earth. In addition to these gases, water vapor (H_2O) is also a natural greenhouse gas. Its volume ratio is typically about 1%. As these greenhouse gases

[2] Intergovernmental Panel on Climate Change, 2001, "The Climate System" pp.87-89
[3] Intergovernmental Panel on Climate Change, 2001, "The Climate System" pp.88

absorb the infrared radiation emitted by the earth and then emit infrared radiation upward and downward, they raise the temperature near the surface of the earth. In addition, solids, liquid particles, and clouds in the atmosphere interact with the incoming and outgoing radiation. Water affects climate in various ways, such as water vapor, cloud droplets, and ice crystals, and water vapor is the strongest greenhouse gas.

The ***hydrosphere*** contains all liquid surface and subterranean water, including river, lakes, aquifers, and oceans. The oceans cover approximately 70% of the earth's' surface, storing and transporting quantities of energy and storing huge amounts of carbon dioxide. The hydrosphere is circulated by a combination of vaporization and rainfall, and its slow circulation speed damps the variability of the earth's climate.

The ***cryosphere*** includes ice sheets and permafrost on the surface of the earth. Its high reflectivity of solar radiation and low thermal conductivity directly affect the earth's climate. As ice sheets store huge amounts of water, the cryosphere affects the climate indirectly by adjusting the balance between water and ice.

The ***land surface*** controls how much solar energy is returned to the atmosphere. Its most important role is evaporation of moisture in the soils on the land surface. The land surface reduces surface temperature by evaporating the energy of soil moisture. Dust blown by the wind also interacts with the atmospheric radiation.

The marine and land ***biosphere*** influences the uptake and release of greenhouse gases. Plants store significant amounts of carbon from carbon dioxide through the photosynthetic process. Therefore, the biosphere plays a major role in the carbon cycle. Plants also emit volatile organic compounds (VOC) that affect atmospheric chemistry and the climate.

Over and above these five major components, the interactions among these components are also important. For example, the atmosphere and hydrosphere exchange energy through evaporation and condensation. The atmosphere and hydrosphere also exchange carbon dioxide. Plants intercept solar energy into the land surface. They all interact with each other and those interactions are highly complex. Therefore, when we consider global warming, an analysis of one component is not sufficient; rather, a multi-dimensional analysis is essential.

2.2 SOLAR POWER BALANCE[4]

The ultimate source of energy is radiation from the sun. About half of the radiation is visible short-wave and the other half is near-infrared. Thirty-one percent of solar radiation is reflected back into space by clouds, the atmosphere, and the surface of the earth. The remainder is absorbed by the atmosphere and the land and ocean surfaces. The surfaces return radiation to the atmosphere in the form of infrared radiation, sensible heat, or water vapor, which release their heat through condensation into the higher part of the atmosphere.

A stable climate requires a balance between incoming solar radiation and outgoing radiation. This energy balance can be seen in Figure 2-2. The left-hand side of the figure shows incoming solar radiation and right-hand side shows how much

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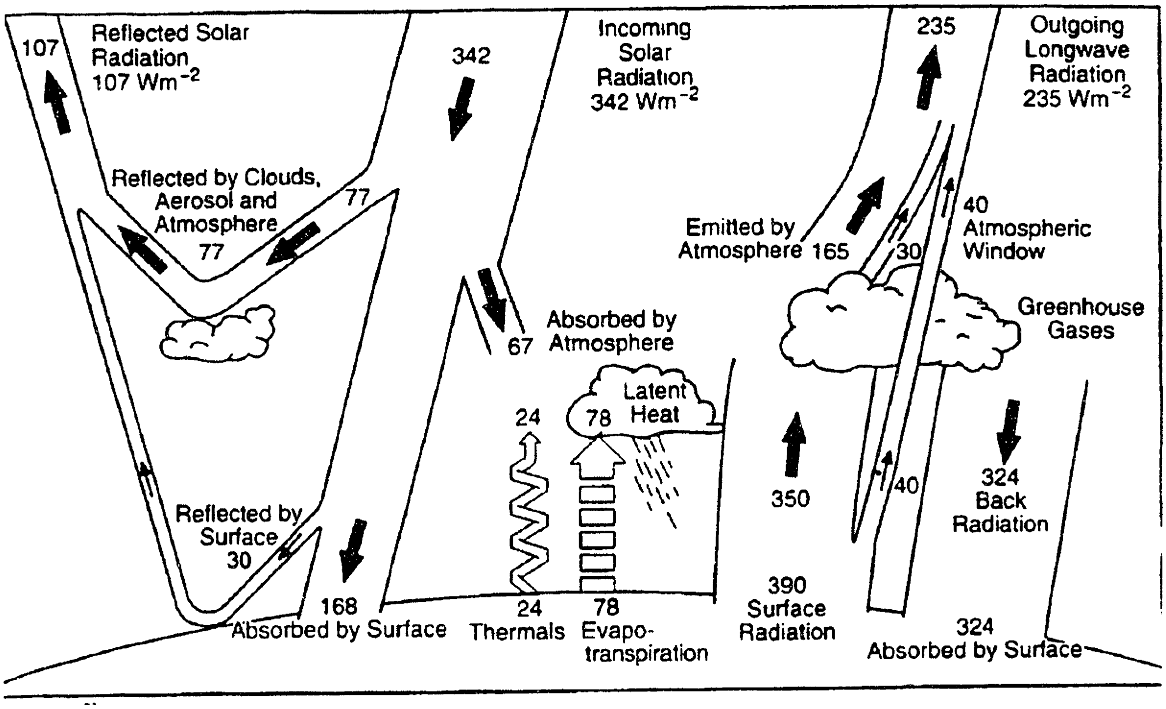
[4] Intergovernmental Panel on Climate Change, 2001, "The Climate System" pp.89-91

outgoing infrared radiation the atmosphere emits. There are several greenhouse gases in the atmosphere and they absorb infrared radiation which is emitted by the surface, atmosphere, and clouds. There is an additional transparent part of the spectrum called the "atmosphere window".

Fig.2-2: The Earth's annual and global mean energy balance[5]



Clouds also play an important role in climate by contributing to warming the earth through absorption and emission of infrared radiation. Clouds also reflect solar radiation and cool the climate. The net effect of clouds is generally a slight warming.

Other factors, such as solar radiation and the large amount of aerosols ejected by volcanic eruptions into the atmosphere, also cause variations in the climate. Their effects may be negative or positive, but either way the climate reacts to balance these changes.

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5 Kiehl and Trenberth, 1997, Earth's Annual Global Mean Energy Budget, Bull. Am. Met. Soc. 78, pp197-208

2.3 NATURAL VARIABILITY OF THE CLIMATE[6]

Climate variability occurs both externally and internally. When variability occurs as the result of an external force, the responses by the five components of the climate system are quite different. For instance, while the atmosphere responds relatively quickly, the oceans require longer time to respond. Therefore, the climate system may respond to external variations across a wide range of time and space. On the other hand, the climate system varies naturally even without external forces. The five components in the climate system are never in equilibrium and vary constantly. The so-called *El Nino* Southern Oscillation is an example of internal climate variation. The *El Nino* is the result of interactions between the atmosphere and ocean in the tropical Pacific.

In addition to external and internal variability, response to the changes is another important but more complicated factor. These responses are categorized as positive feedback, which intensifies the original change, and negative feedback, which reduces the impact of the change. Water vapor feedback is an important example of positive feedback. When heat comes into the climate, water vapor increases in the atmosphere as a result of vaporization, which makes the earth warmer due to the strong greenhouse effect of water vapor.

2.4 HUMAN-INDUCED CLIMATE VARIATIONS[7]

Humans, like every other living organism, constantly affect the environment. However, since the mid-19th century, the impact of human activities on the environment has risen exponentially due to the effects of the Industrial Revolution. In particular, combustion of fossil fuels and biomass burning have produced greenhouse gases and aerosols. Land-use changes caused by urbanization has had major effects on the physical and biological properties of the earth's surface. These changes affect climate and are accelerating.

Before the Industrial Revolution, the level of greenhouse gases was almost constant for a thousand years. But after the Industrial Revolution, carbon dioxide increased by more than 30% (see Fig. 2-3 A,B,C) and is still increasing an average 0.4% per year. This is caused primarily by combustion of fossil fuels and deforestation and can be seen in an analysis of the isotopic composition of carbon dioxide in the atmosphere. Other greenhouse gases, such as methane and nitrous oxide, are increasing as well. In addition, water vapor feedback also accelerates the greenhouse effect. Water vapor feedback is caused by an increase of water vapor in the atmosphere due to temperature increases, and the feedback amplifies the temperature increase.

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[6] Intergovernmental Panel on Climate Change, 2001, "The Climate System" pp.91-92
[7] Intergovernmental Panel on Climate Change, 2001, "The Climate System" pp.92-94

Fig.2-3A: The increase of atmospheric carbon dioxide since 1700[8]

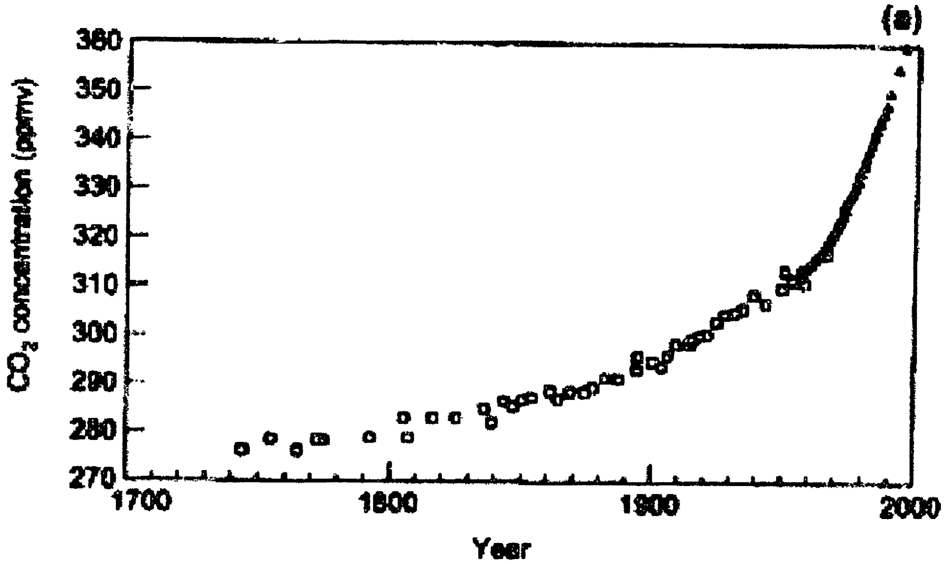
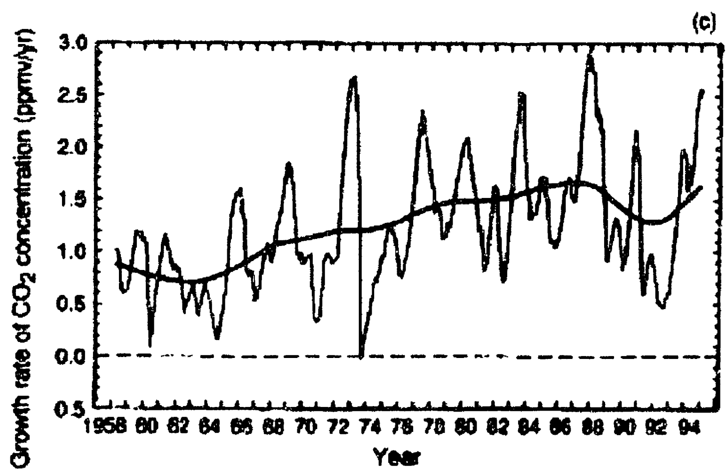


Fig.2-3B: Growth rate of carbon dioxide concentration since 1958[9]



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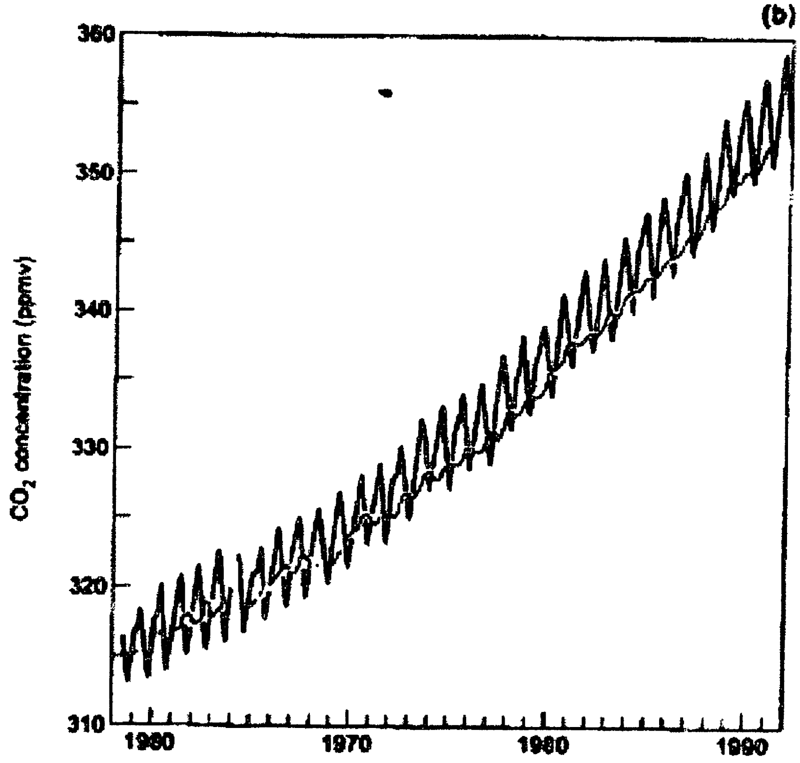
[8] John Houghton, 1997, The Greenhouse Gases, Global warming, pp25
[9] John Houghton, 1997, The Greenhouse Gases, Global warming, pp.25

Fig.2-3C :Detailed measurements of the increase of carbon dioxide since 1959[10]



Land-use changes are also initiated by humans, often resulting from changes in agriculture, irrigation, deforestation, reforestation, and urbanization. Land-use changes contribute to the local and global climate and have significant impacts on the carbon cycle. Land-use changes affect the exchange of water vapor and greenhouse gases between land and the atmosphere. It also affects the climate system through biological processes involving terrestrial vegetation.

Urbanization is also an important land-use change. Urbanization makes a local climate substantially warmer than the surrounding countryside because of heat released in a densely populated area. The so-called "urban heat island" is a well-known phenomenon caused by urbanization.

2.5 CARBON DIOXIDE AND CARBON CYCLE[11]

Carbon dioxide is the most important greenhouse gas, and its presence is growing in the atmosphere as the result of activities by humans. If we ignore the effect of the chlorofluorocarbons (CFCs), carbon dioxide contributes about 70% of the increased

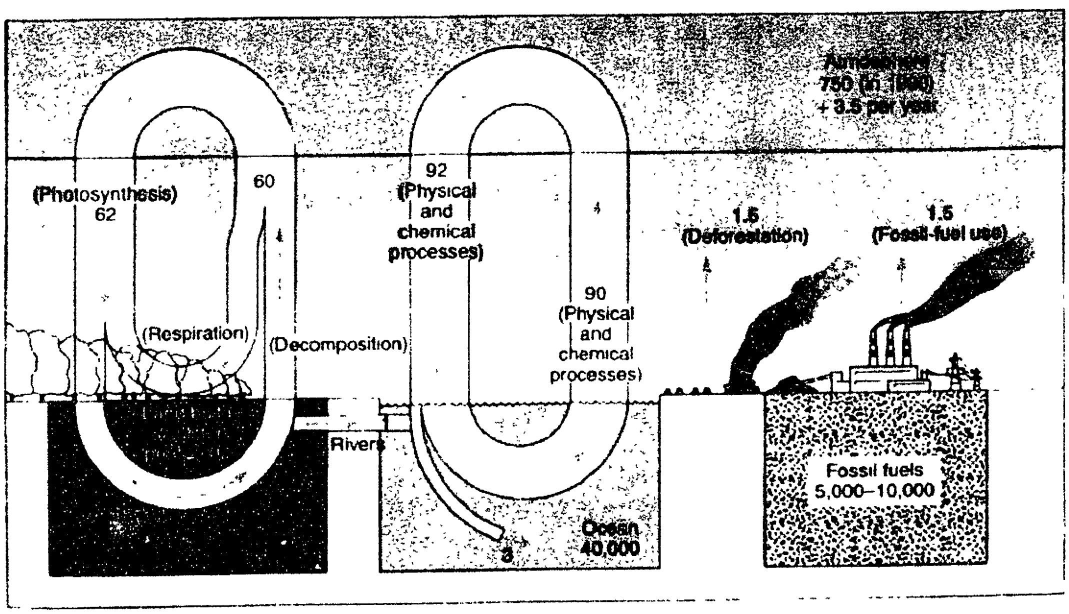
[10] John Houghton, 1997, The Greenhouse Gases, Global warming, pp25

[11] John Houghton, 1997, The Greenhouse Gases, Global warming, pp22-45

greenhouse effect, with contributions of methane and nitrous oxide at 24% and 6%, respectively. That is why reduction or at least control of carbon dioxide is the main topic of any consideration of effective measures to deal with global warming.

Carbon is transferred in nature between several natural carbon reservoirs in a process called "carbon cycle". Figure 2-4 is a simple diagram of the carbon cycle between various reservoirs, such as the atmosphere, the oceans, the soil and the land biota (*biota*: all living thing). As the figure shows, one-quarter of the total amount of carbon in the atmosphere is circulating—about 40% between the atmosphere and the land biota, and about 60% between the atmosphere and the oceans. The land and ocean reservoirs are much larger than the atmosphere reservoir. Therefore, even a small change in the land and/or ocean reservoirs has a significant affect on the carbon dioxide content in the atmosphere.

Fig.2-4: The reservoirs of carbon in the Earth[12]



As mentioned earlier, before the Industrial Revolution, exchanges between the reservoirs were remarkably constant and a steady balance was maintained. Today, although there are large variations from year to year, carbon dioxide is currently increasing by about 1.5 ppm per year. Although it is difficult to estimate its contribution to the generation of carbon dioxide, about 80% is contributed by fossil fuel combustion and 20% is the contribution of changes in land use. One-half of the generated carbon dioxide stays in the atmosphere.[13]

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[12] John Houghton, 1997, The Greenhouse Gases, Global warming, pp23

[13] J.T. Houghton et.al., 1995, The science of climate change, Technical Summary

In terms of the absorption of carbon dioxide, the oceans and the land biosphere are key players. As carbon dioxide dissolves in water, carbon dioxide is in equilibrium between the oceans and the atmosphere at the surface of the oceans. The equilibrium is set up between the concentration of carbon dioxide dissolved in the surface waters and the concentration in the air above the surface. This equilibrium is governed by chemical laws.

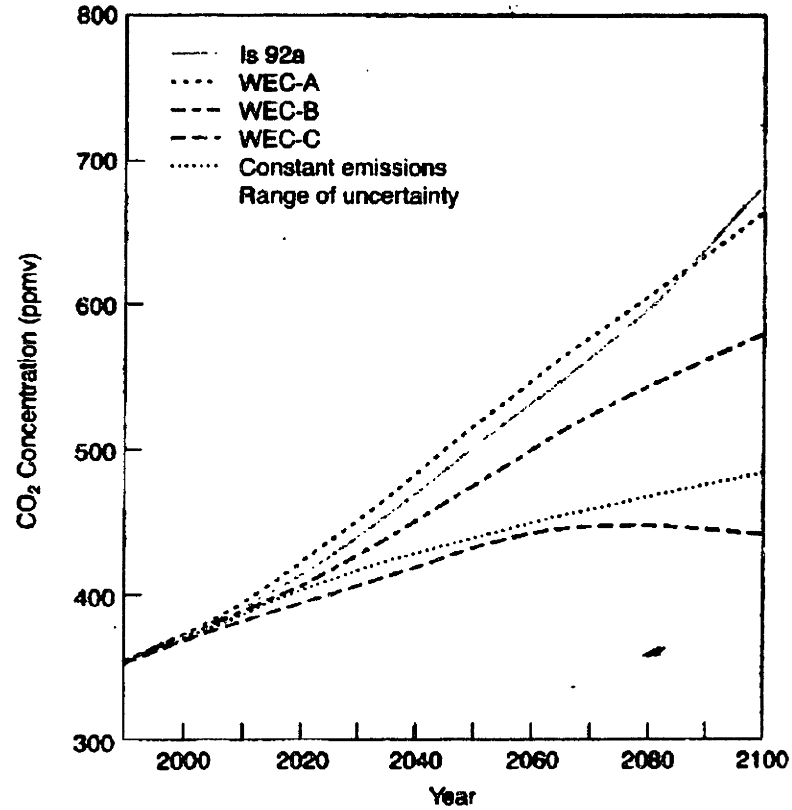
Another key is biological activity in the oceans. There are many plants and animal planktons in the oceans. When they die and decay, some of the carbon of which they are constituted are carried down to the lower levels of the ocean. Some are carried so deep they are out of circulation for more than a hundred years.

Another key in the oceans is biological activity in the oceans. There are many plants and animal planktons in the oceans. When they die and decay, some of the carbon, which consist of them, are carried down to the lower level of the oceans. Some are carried to the very deep level and are out of the circulation for more than hundreds years.

The last key player is the land biosphere. It reduces carbon dioxide through the photosynthetic process. Although the effect of the land biosphere is unclear, it is said that one-quarter of generated carbon dioxide is consumed by the land biosphere. It is assumed that increased carbon dioxide enhances the growth of the land biosphere and consumption of the carbon dioxide. It is called the "fertilization effect".

Although it is difficult to predict future the amount of carbon dioxide content in the atmosphere, a number of scientists in different counties have developed carbon cycle models and from them make attempts to predict the future. Figure 2-5 shows several estimations. The wide variations among models shows the difficulty of such predictions. In spite of these diverse predictions, it is clear that carbon dioxide will continue to increase during the 21st century.

Fig.2-5 : Concentrations of carbon dioxide in the atmosphere resulting from several scenarios[14]



2.6 KYOTO PROTOCOL

2.6.1 Outline[15]

The Kyoto Protocol (so named because the agreement was undertaken in principle in Kyoto, Japan in 1997) is a global commitment by several countries to reduce greenhouse gases. In the early 1990s, consideration of global climate change became an important issue for many countries and it was first taken up at The Conference of the Parties (COP-1), held in Berlin in 1995. The COPs were subsequently held every year thereafter, with the Kyoto Protocol agreed to at the COP-3.

Because the interests of the different countries are quite different, reaching an agreement was very difficult. Most European countries indicated a willingness to

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[14] John Houghton, 1997, The Greenhouse Gases, Global warming, pp.33

[15] Michael Grubb, Cristiaan Vrolijik and Duncan Brack, 1999, The Kyoto Protocol

reduce national greenhouse gases to levels as they were in 1990. But because Japan had already made considerable investment to improve fuel efficiency even before 1990, using 1990 as the base year was uncomfortable for Japan. Therefore, until COP-7, Japan had been negotiating with other countries to include reduction by sinks.

The United States took a negative position against the Kyoto Protocol. It was afraid that adjustments needed to accomplish carbon dioxide reductions would ultimately slow national economic growth. Although most industrialized countries agreed with the content of the Kyoto Protocol, there was no mandatory obligation on any country to reduce carbon dioxide levels until the target year.

In November 2001, some of industrialized countries agreed to ratify the Kyoto Protocol in 2002 at the COP-7. Therefore, after 2002, the Kyoto Protocol will likely go into effect in those countries and relevant regulations, such as a carbon tax, will be introduced. It requires countries to reduce greenhouse gases by approximately 5% from 1990 levels. Required reduction levels vary from country to country. A number of countries, including the U.S., refuse to ratify the Kyoto Protocol and appear not to care about carbon dioxide emissions.

2.6.2 Complying with the Kyoto Protocol

There are four ways to comply with the Kyoto Protocol. ***Direct reduction*** is the simplest method for reducing greenhouse gases. By improving fuel efficiency and switching energy sources from high carbon intensity fuel (i.e., coal and oil) to low carbon intensity fuel (i.e., LNG and solar energy), the generation of greenhouse gases can be directly reduced.

The second option is ***emissions trading***. This enables any two parties to the Protocol to exchange parts of their emissions commitment, thereby providing a cost-effective way to meet their commitments. For instance, some countries have already reduced the emission of greenhouse gases by more than 5% from the 1990 level due to reduced economic growth. Eastern European countries and the former Soviet Union are in this group. These countries can sell their allowance to other high-emission countries. However, at the same time, the market should be competitive and transparent so as to prevent a few countries from taking advantage of this system. The trade price should be consistent with the cost of direct reduction and the joint implementation option. Otherwise, the Kyoto Protocol will be meaningless.

The third option is ***joint implementation***. When highly efficient countries do not have any effective measures to reduce emissions, they can invest in less-efficient countries that are emitting greater volumes of greenhouse gases, and share the reduction of emissions in the countries to which they have invested.

The last option is ***sinks*** of greenhouse gases through forestry. Forests absorb carbon dioxide through the photosynthesis process. Therefore, investing in greater forestry will contribute to reducing greenhouse gases.

2.6.3 "Post Kyoto"

Although the Kyoto Protocol is a clear target for many countries, I also wish to consider post-Kyoto. As agreed in the Kyoto Protocol, some industrialized countries need to reduce their greenhouse gas emissions to the target during the time range, which is from 2008 to 2012. But this will not be sufficient to stabilize the climate. While the target was set at a 5% reduction, many researchers agree that temperatures will continue to increase even if carbon dioxide emissions are reduced by 5% from 1990 levels. For example, based on an analysis using the RICE model (a major model used to predict future climate), even if carbon dioxide emissions are reduced to Protocol targets, earth temperatures will increase by 1.5°C from 1990.[16]

The Protocol targets were established as the result of negotiations among countries and were not based on technical targets that would actually resolve global warming problems. Therefore, setting a strategy based on the perspective of "post-Kyoto" has important ramifications for oil companies.

The basic trend of "post-Kyoto" is to diminish coal and oil demand. Car engines will still have room for improvement in 2010 and further installation of co-generation will decrease demands for heating oil. Sterman [17] states that even if the world completely stopped emitting carbon dioxide in 2000, temperatures would continue to increase for many decades. Therefore, it is obvious that we need to reduce fossil fuel consumption as much as possible. To accomplish this target, new technologies are needed that will create cleaner energy, such as solar cells and other renewable energy resources.

"Post-Kyoto" will be an interesting world for oil companies. Demand will likely be diminished and supply capacities will result in huge excesses. If we estimate a declining demand rate "post-Kyoto", it would perhaps be 1% or 2 % every year. However, this is too slow to stabilize the earth's temperature. But this rate may be the most reasonable because it will take some time to change energy sources and rebuild infrastructure.

As to the day when energy sources are switched to renewable sources, what will become of oil companies? I cannot imagine such a world now. But I believe that change creates opportunity and the bigger the change, the bigger the opportunity.

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[16] William D. Nordhaus, Joseph Boyer, 2000, "Economic analysis of the Kyoto Protocol", Warming the World, pp.149-153

[17] John Sterman, 2000, "System Dynamics in Action: Global Warming", Business Dynamics, pp.241-249

3. The Japanese Oil Industry

3.1 HISTORICAL OVERVIEW

The history of the Japanese oil industry can be divided into two parts. Before 1987, the industry was protected by regulations designed to secure a stable energy supply. Since Japan does not have enough natural resources, securing a stable source of energy was a high priority for the Japanese government and its economy. In fact, more than 80% of Japan's energy comes from imported energy resources. Complicating matters, most of Japan's oil sources are located in the Middle East, a region which has been and continues to be politically unstable. Therefore, developing and maintaining a stable oil industry was very important at that time. Under regulation, a specific production volume was allocated to each oil company which meant there was no competition. During those days, oil companies enjoyed high margins and earn a satisfactory income.

However, all that changed completely with the advent of deregulation. Japan's economy grew rapidly in the 1960s and 1970s, and consumers began to travel abroad frequently. They enjoyed shopping in other countries because the price of goods was lower than in Japan. Soon they became aware that everything was more expensive in Japan compared with prices in other countries—and they soon deduced that regulations in many of Japan's industries were at least part of the reason for the high price of goods. Therefore, the public demanded deregulation, and the government began to comply by gradually deregulating industries beginning in the 1980s.

For the Japanese oil industry, deregulation began in 1987, gradually but steadily. The year 1996 marked a major turning point in the industry. Before 1996, companies that did not have refining facilities (such as trading companies) could not import products. Therefore product importing was used by the oil companies as a measure for fulfilling supply shortages, and oil companies did not have to compete with foreign oil companies. However, after 1996 any companies that were permitted to import oil products could import any oil products at any time they chose. This means that the Japanese oil industry faced competition with foreign oil companies as well as domestic competitors.

In addition to the competition with foreign oil companies, Japanese oil companies also had to compete with domestic trading companies which represent another major player in the retail area for gasoline, kerosene, and diesel. Before 1996, the trading companies bought oil products from oil companies and sold them through their own retail channels. After 1996, the trading companies could import their own oil products, which created competition between the oil companies and the trading companies.

Deregulation introduced new competition into the Japanese oil industry. Because oil products are commodities, price is the basis for competition in the oil market. Oil products sellers reduced their prices to keep plenty of shares in the market. As a result, margins diminished and oil companies became eager to find ways to reduce costs, one of which was seeking good partners to ensure survival.

As competition grew more severe, some refineries stopped their operations; others merged to create stronger companies. In 2000, Nippon Oil and Mitsubishi Oil merged and created Nippon Mitsubishi Oil. Tonen and General Sekiyu merged and created TonenGeneral Sekiyu in the same year. Tonen and General Sekiyu were subsidiaries of Exxon and/or Mobil. In addition to TonenGeneral, other related companies, Esso Japan and Mobil Japan, created a Japanese group known as ExxonMobil group.

Today the Japanese oil industry is divided into four groups: Nippon Mitsubishi Oil & Cosmo group, ExxonMobil group, Showa-Shell & Japan Energy group, and Idemitsu group. These four players are the major competitors in the Japanese oil market.

3.2 INDUSTRY ANALYSIS

The Japanese oil industry is focused on refining and retailing, which are generally referred to as "downstream" components. The Japanese government is presently engaged in trying to further expand the Japanese oil business into exploration, which is called an "upstream" component. However, this expansion has not yet been successful.

An analysis of competition in the Japanese oil industry can be developed using Porter's "Five Forces Model".[18] Using the model I analyzed competition in the Japanese oil industry along the lines of five elements: suppliers, buyers, new entrants, substitutes and industry competitors. I discuss my analysis and findings for each of these, below.

3.2.1 Suppliers

The world's supply of oil comes from crude oil exporting countries, all of whom are either OPEC or non-OPEC members. These countries also supply LPG and naphtha to the Japanese market. Southeast Asian countries, such Singapore and Thailand, also supply oil products such as naphtha, gasoline, kerosene, and jet fuel.

There are numerous technology providers and equipment suppliers also related to the oil industry, but as they provide their services to all Japanese oil companies equally, they have no significant competitive role in the Japanese oil industry.

In addition, because Japan has few natural resources, especially crude oil, the crude oil exporting countries are not competitors of the oil companies. But they play an important role in the Japanese oil industry. If an oil company cannot buy crude oil from an exporting country, the company would be in trouble. Therefore, as an industry, the Japanese oil industry must always maintain good relationships with the exporting countries.

Product exporters are competitors of the oil companies and Southeast Asian countries are in this group. Because they need to transfer their products in tankers that are smaller than crude oil tankers, and because the amount of freight carried by small tankers is greater than that of crude oil tankers because of economies of scale, the exporters have a major weakness. On the other hand, however, because of their low fixed costs, including labor costs, utility costs, land costs, and regulation-related costs, their refining costs are less than those of Japanese oil companies which make the

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[18] Michael E. Porter, 1980, Competitive Strategy: Techniques for Analyzing Industries and Competitors

exporters competitive with the products refined by the Japanese oil companies.

Also, as I mentioned earlier, product exporters compete with the Japanese oil companies by selling their products to the Japanese trading companies who then sell it through their retail channels. In addition, as the area facing Japanese Sea is close to Korea, many Korean oil companies represent a threat to Japanese oil companies in that area.

Japan has imposed a tariff on imported oil products, which is the last barrier for the Japanese oil industry in its competition with outside competitors. Although the Japanese oil industry is supported by the tariff, imported oil products are competitive in the Japanese market. Product exporters who understand the Japanese market can produce oil products that meet Japanese oil specifications. For the exporters, the Japanese market is very attractive because of its size and its unique weakness in refining costs due to expensive fixed costs.

3.2.2 Buyers

There are major three buyers in the business: end users, industry users, and importers, with a common characteristic among all three—price sensitivity. One characteristic of oil products is that they do not differ much from company to company. Because oil is a commodity, maintaining the same quality from every oil company is highly important; therefore a minimum required quality is specified by law. And because the hardware is designed based on this minimum required quality, buyers do not require any higher quality. Meanwhile, the oil companies try to minimize higher quality over and above the required quality because higher quality means higher cost. Thus, to buyers, higher quality means nothing; they only care about stable quality that meets specifications and a low price.

This characteristic of buyers makes the entire oil industry price sensitive. Buyers do not see any value in products that have unnecessary, higher quality. Therefore the most severe competition among oil companies is on price; the oil business is one that has thin margins and mass sales.

3.2.3 New Entrants

For new entrants, oil business is difficult to enter because it is a capital-intensive business. Initial investment is huge and the margin is thin. In addition, the Japanese oil industry has excess supply capacity. This excess capacity creates intense price competition.

For example, British Petroleum (BP) entered the Japanese oil retail business with no refining capacity in Japan. The company started its retail business through self-service gas stations. In Japan, self-service gas stations were prohibited until 1998, when the regulation changed and retailers could sell products through self-service gas stations. Prior to that time, staff at the gas stations filled customers' cars. Customers wanted lower-priced gasoline, but it was said that the high cost of manpower was one cause for expensive gasoline.

BP was interested in the oil business in Japan after deregulation, and decided that it could create some sales advantage by introducing self-service gas stations which were nonexistent before then. BP's gas station were very efficient, but in the highly competitive market, selling products without doing your own refining was a big disadvantage. Oil companies tried to integrate their refining and marketing functions vertically to gain a cost reduction. This meant BP needed to compete with vertically integrated Japanese oil companies. Ultimately, in 2001 BP decided to leave the Japanese retail oil market. This case highlights the barriers of new entrants into the Japanese oil business and therefore its unattractiveness to new entrants. (Note: BP still sells its lubricants in Japan.)

3.2.4 Substitutes

There are many substitutes for oil, but substitution takes a long time. Oil is used everywhere and is easy to use. The infrastructure is reliable and everyday life heavily depends on oil products. Any substitutes that have been developed have historically encountered technical difficulties. For instance nuclear energy is a potential substitute but it comes with many problems concerning safety and waste disposal. The problem with using renewable power, such as solar, wind, or geothermal, is with the low density of energy. They are clean and sufficient for people's lives, but low energy density makes it difficult to use them. Fuel cells are another possibility, but in addition to technological difficulties, they have difficulty supplying hydrogen. If hydrogen is produced from oil, coal or natural gas, hydrogen cannot be a substitute. In other words, fuel cells can be a substitute for conventional power generators or internal combustion engines, but not a substitute for oil.

Oil is a key component of the infrastructure of economy and life. Making a major change to infrastructure is time-consuming. Therefore, even if substitutes or other new technologies became feasible, switching from oil to those substitutes would take a long time. If we consider 2050 or 2100, perhaps by then oil could be replaced with another substitute—maybe—but many years are needed.

3.2.5 Industry Competitors

Industry rivals are the most influential players in the market. They compete very intensively, and the competition is based on price. Two factors impact this competition: (1) the Japanese oil companies have excess refining capacity; and (2) oil companies and trading companies in the oil business can now import oil products freely. However, the volume of imported products is not growing. Because Japanese oil companies compete intensively, the price of their products is lower than the cost of imported products, even though fixed costs, such as manpower, land, and so on, is much higher than those of exporters. This illustrates the intensiveness of price competition in the Japanese oil business.

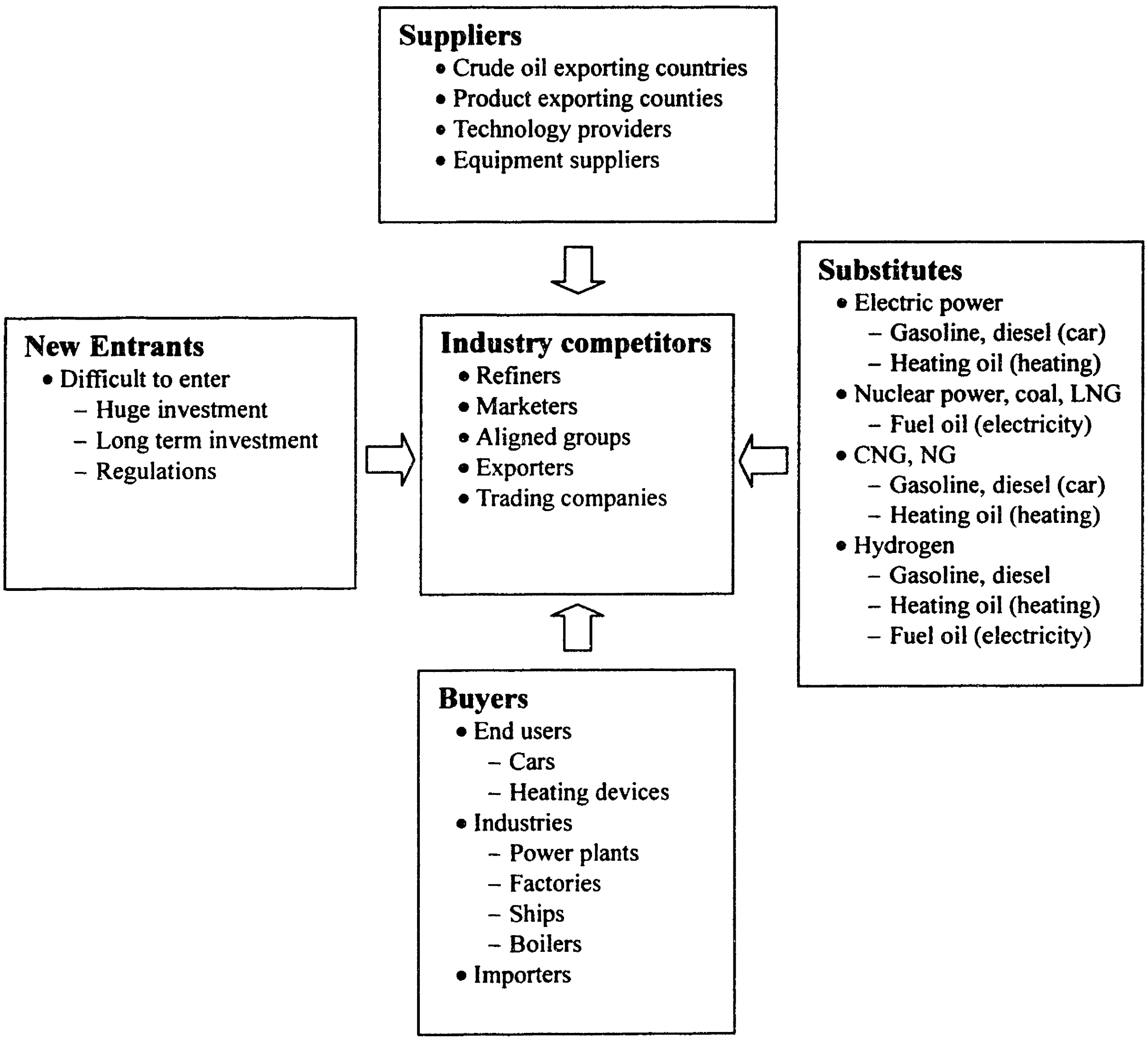
Another key factor is the exit barrier. As the oil business is capital-intensive, once a company starts into the oil business, it is difficult to exit. Exit prevents huge future losses, but it also means sacrificing enormous amounts of money invested prior to exit. In BP's case, the company decided to exit because it had invested only in retailing, but not in refining.

In addition, prior to deregulation, spending huge amounts of money was viewed as a good strategy for new entrants into the Japanese oil business because the regulations would serve as a buffer. Thus, for existing players who now might wish to exit, it is quite difficult to do so. They have already invested heavily and a significant barrier to exit has been created.

The size of the oil companies is also a key factor. There are many small companies in the Japanese oil business, and they never stop operating. Recently, it was determined that the average utilization factor of Japanese refining facilities is less than 80%. Eighty percent utilization is not so bad, but there is major fluctuation among refineries. The stronger the refinery is, the higher it is utilized. Therefore, weak oil companies face challenges to continuing in business. However, they too face difficulties exiting the oil business. One reason is the previous huge investments made by the companies, and the other reason is a strong connection with the local community. Oil refineries are generally located in rural areas and they have strong connections to the local communities. All of this means that the refineries are struggling hard to survive, and they reduce costs and export their products instead of closing the refineries, even though product exporting is not so profitable.

In summary, Figure 3.1 illustrates how the Japanese oil industry is situated today on Porter's model.

Fig.3-1: Forces from outside: Porter's Five Forces Model[19]



[19] Michael E. Porter, 1980, Competitive Strategy: Techniques for Analyzing Industries and Competitors

3.3 COMPETITIVE ANALYSIS OF EXXONMOBIL JAPAN

In 1999, Exxon and Mobil merged to create ExxonMobil. At that time, there were four group companies in Japan: Tonen, General Sekiyu, Esso Japan, and Mobil Japan. Before the ExxonMobil merger, these four companies operated separately in competition in the Japanese oil market.

I have analyzed the competitiveness of ExxonMobil Japan using the framework developed by Gary Hamel.[20] In this framework, companies are analyzed from the standpoints of *customer interface, core strategy, strategic resources*, and *value network*. In addition, customer interface and core strategy create *customer benefit*, and core strategy and strategic resources create *company configuration*. In the same way, strategic resources and value network contribute *company boundaries*.

3.3.1 Customer Interface

The customer interface for gasoline, diesel and kerosene is gas stations. The staff at gas stations communicates with customers, but there is little or no difference in service among oil companies. The service provided by each gas station is stereotypical, even though the stations are operated by different companies. It is likely that severe competition among the stations actually created the same kind of service among gas stations.

As mentioned before, the oil business is divided into two segments, upstream and downstream. Between the upstream and downstream, there is an efficient crude oil market. Crude oils are traded in the crude oil market, and the market decides the price. Therefore, even in the same company, the downstream and upstream functions operate separately (see Fig.3-2). In the U.S., there is a products market and it separates refining and marketing. Gas stations buy gasoline from the market freely, and the market decides the price of the products. Similarly, in Japan, there is also a products market between refining and marketing, but it is very small and does not work well. Oil companies supply gasoline to gas stations, which use their brand name.

Although some gas stations try to differentiate their services from others by adding coffee shops and convenience stores, their attempts are not particularly successful.

Information about the gas stations' customers is obtained through a membership card system. Only minimal information for payment is obtained via the membership card—name, address, phone number and bank account number—but the information is not used effectively for marketing or other customer services.

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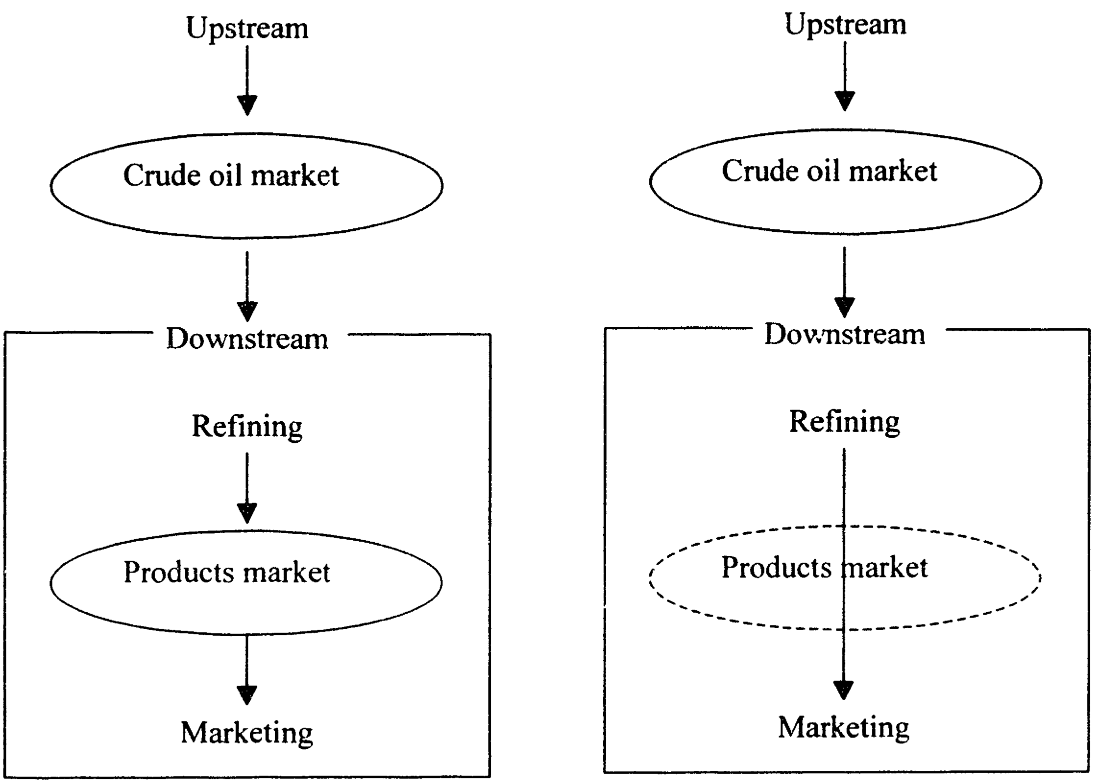
[20] Gary Hamel, 2000, "Business Concept Innovation", Leading the Revolution, pp.61-113

Fig.3-2: Business Structures of Oil Business



U.S. Style Business Structure

Japan Style Business Structure

At the gas station, communication between the staff and customers and the quality of service are very important factors for retaining customers. Although high-quality service does not in itself create an advantage, if the quality of service is lower than expected (or required), customers will leave. Oil companies train their staff at the gas station in order to prevent any disadvantage caused by poor service, not to create an advantage as a result of the services.

Retail prices of gasoline, diesel, and kerosene are set by competition in the local area. As there is no effective open market for these products in Japan, prices are set competitively in small local area. If one gas station reduces its price, other surrounding gas stations will reduce their prices accordingly. If supply exceeds demand in the local area, price goes down—sometimes below the break-even point. This situation happens often and in this case, oil companies help their gas stations by giving rebates to keep the station alive. However, this rebate usually accelerates price competition because gas stations tend to reduce prices to even lower levels. Consequently, even though the real problem is oversupply, the oil companies and gas stations overlook this root cause and struggle with severe price competition at prices lower than the break-even point.

3.3.2 Core Strategy

The mission of ExxonMobil Japan (EMJ) is to supply energy stably at a reasonable price. Oil is a kind of infrastructure of the daily life of a population. If the oil supply suddenly declines sharply or stops, people cannot function as they are accustomed. In addition to stability of supply, stability of product quality is also important. Just as the performance of hardware changes with the quality of the fuel, instability creates trouble. If the fuel quality fluctuates frequently, car performance declines; kerosene stoves exhaust high-SOx flue gas; water temperature in boilers fluctuates from too low to too high; diesel cars exhaust far too many particulates. Therefore, stability of oil, in both supply and quality, is very important and the first priority of EMJ.

The scope of EMJ is basically restricted in the Japanese domestic market. As product imports and exports affect the global oil market, these activities are managed by the global function of ExxonMobil. Of course, EMJ imports and exports products, but these transaction need to be profitable for global ExxonMobil. Even if EMJ creates money through international transactions, if other affiliates lose more money, the Japanese transaction is not an optimal solution for global ExxonMobil. As global optimization is not always equal to local optimization, sometimes EMJ encounters disadvantages as it competes in the Japanese market due to ExxonMobil's global optimization policies.

At the same time, ExxonMobil's global network contributes to improving EMJ's profitability. For example, ExxonMobil affiliates in Asia sell their kerosene to EMJ in the winter to help EMJ meet strong kerosene demand. With this strong connection, ExxonMobil's Asian affiliates can invest in facilities to meet expected demand for kerosene in Japan. But without that stable demand in Japan, the affiliates would lose an opportunity to make money. From EMJ's viewpoint, the availability of kerosene from ExxonMobil's affiliates is favorable since it does not have to buy more expensive, market-priced kerosene.

Although the ExxonMobil's global optimization has both advantages and disadvantages for EMJ, the advantages merit are supposed to be greater than the disadvantages. EMJ makes money in the Japanese oil market and at the same time it is supported by the global network of ExxonMobil.

3.3.3 Strategic Resources

ExxonMobil Japan has two major competencies. One is high-gasoline-yield and low-cost refineries, and the other is highly efficient gas stations.

EMJ's refineries have a huge bottom conversion capacity and are operated efficiently. Gasoline yield is the highest in Japan and its bunker fuel yield is the lowest. As gasoline is one of the highest margin products, high gasoline yield contributes higher profitability to the company. In addition, the monthly sales volume at each EMJ gas station is the highest in Japan—evidence of the efficiency of EMJ gas stations. Because manpower and land costs are very expensive in Japan, efficient gas stations are a key factor in reducing costs and remaining competitive.

Table 3-1 compares manpower costs in different countries. The table shows that manpower costs in Japan are more than three times higher than in Singapore and Korea.

Even though oil companies in Japan compete under the same conditions, lower fixed costs, including manpower and land, could be an advantage in a highly price-sensitive market. Thus the competencies in refining and marketing sustain the competitiveness of EMJ.

Table 3-1: Comparison of average wage[21]

Japan	19.20
Korea	5.37
Singaporé	5.38
Australia	12.25
U.S.	16.79

Locations of refineries and gas stations are also important. EMJ's refineries are located close to metropolitan areas where demand is huge. Good locations contribute to lower costs. Gas stations are located mainly in big cities where there are large populations and demand is high, which means every gas station can sell a high volume of oil products. In rural areas, where population density is much lower, gas stations sell a significantly smaller volume of oil products.

3.3.4 Value Network

ExxonMobil group developed a global value network that runs from upstream to downstream. Crude oil is supplied from ExxonMobil to EMJ and each local affiliate complements the other to adjust any imbalance of supply and demand in local markets.

Petrochemicals is another key partner. ExxonMobil has a business function, ExxonMobil Chemical, that is responsible for petrochemical production and marketing. It has a business unit in Japan and strong connections between the oil and petrochemical businesses has created an advantage against the competitors.

Petrochemical is another key partner. ExxonMobil has a business function that is responsible for petrochemical production and marketing and its name is ExxonMobil chemical. They have a business unit in Japan and strong connection between oil and petrochemical creates an advantage against the competitors.

However, the value network outside of ExxonMobil is very weak. For example, EMJ has no strong relationship with the auto industry, even though motor fuel is a major EMJ product. EMJ does have a relationship with the auto industry to supply lubricants and test fuels, but the relationship is not strong. Instead, ExxonMobil has developed a good relationship with General Motors and Toyota to develop a fuel cell car. There is some relationship between the ExxonMobil group and the auto industry, but there is no strong connection between EMJ and Japanese auto industry.

The value network inside the group or inside the industry is strong and has resulted in a strong and effective network. Because real competition began in the

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21 Roudou Anzen Joho Center, http://www.campus.ne.jp/~labor/sonota/kaigai01.html

mid-1990s, oil companies tried to develop a strong value network inside the group, but this took about five years. As the oil industry is in the early stage of real competition, its value network outside the oil industry is weak.

3.3.5 Customer Benefit

Benefits to EMJ's customers are created by the company's customer interface and its core strategy. EMJ's business mission is to supply energy stably, so customers can buy oil products stably through EMJ. In other words, the only customer benefits are reliable quality and low price. Therefore, if the quality of other companies' oil is sufficient, EMJ customers have no incentive to remain loyal to the company and will easily switch to other companies. Customer needs can be obtained through gas stations and the only information about the customer needs is that customers are very price sensitive. All Japanese oil companies supply reliable quality products. Therefore, for the customers, low price is the only driver for selecting an oil company. Thus, the relationship between customers and oil companies is very weak.

3.3.6 Configuration

Based on my above analysis of the core strategy and strategic resources, EMJ has been configured to compete on the basis of price. Refineries and gas stations are very efficient and they contribute to reduce cost and survive despite keen competition. Although these are competitive advantages of EMJ against other competitors, efficient refineries and gas stations are already at the mature level. EMJ began improving the efficiency of its resources earlier than other oil companies and it created competitive advantage early. Therefore, EMJ's configuration—to survive severe price competition through low cost—works well. However, other companies are now trying to rapidly improve their efficiencies, and EMJ's competitive advantage is beginning to diminish.

3.3.7 Company Boundaries

Company boundaries can intermediate between strategic resources and a value network. EMJ focuses on the oil business in Japan, and its partners in the value network complement its strategic resources. Its main partners are retailers, including gas stations, distributors, and the petrochemical industry.

Many gas stations are owned by individuals even if they use the ExxonMobil brand name. These individually owned gas stations are one of the key players in the value chain in terms of customer interface.

Distributors are also key players. Distribution is operated by individual distributors and good relations between EMJ and its distributors are absolutely requisite for efficient operation. In the value chain from refineries to consumers, gas stations and distributors play the role of connecting oil companies with consumers and they are crucial.

Petrochemical industry is also a partner of the oil industry. ExxonMobil has a petrochemical affiliate in Japan, ExxonMobil Chemical Japan (EMCJ), and EMJ and EMCJ cooperate in many ways, such as exchanging feedstocks, sharing utility facilities, and so on. This close relationship enhances the competitiveness of EMJ and EMCJ with the market. EMJ's core resource is to create cost competitiveness, and its partners' is to support EMJ's cost competitiveness. Focusing on a specific area and having good partners enables EMJ to remain an efficient oil company.

3.3.8 Wealth Potential

Hamel found that there are four key elements for wealth potential: *efficient*, *unique*, *fit*, and *profit boosters*.[22] These four elements are key factors that enable the company to succeed.

Under keen price competition, EMJ uses its "efficient" to create wealth. From the earliest stages of deregulation, EMJ has continued to improve its efficiency, even though the company began as four separate companies. EMJ focused on improving efficiencies of refineries, gas stations and a whole supply chain.

"Fit" means how well elements of the company fit its business strategy. Key elements of EMJ fit its strategy, which is capturing value through high efficiency of operation. Refineries are highly efficient and competitive, selling volume of each gas station is the highest in Japan and number of layers in its organization is fewer than the average of Japanese companies. All EMJ's key elements fit its strategy.

"Unique" is one of EMJ's weakest factors. Because the quality of oil products is regulated by law, the products of all oil companies are virtually the same. Oil is a commodity with a social infrastructure that depends on it, and these characteristics make differentiation among companies difficult. It is convenient for customers that oil quality remains the same, regardless of which company produces it. It means that customers do not have to care about quality, only about price. EMJ is not successful to differentiate its products from other companies' products.

EMJ has no strong "profit booster". Efficiencies created in the early stage of deregulation could be a profit booster, but this is not strong and the advantage of efficiency continues to diminish. ExxonMobil's global network boost EMJ's profitability, but it is also weak. ExxonMobil also competes other global companies, such as BP and Shell, and giving too much wealth to EMJ would weaken ExxonMobil. EMJ has no clear and strong profit booster.

Figure 3-3 shows the analysis of EMJ based on Hamel's framework.

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[22] Gary Hamel, 2000, "Business Concept Innovation", Leading the Revolution, pp.94

Fig.3-3: Competitive Analysis (ExxonMobil Japan) : Hamel's Framework[23]

Customer Benefit | Configuration | Company Boundaries

Customer interface
- Fulfillment & support
  - convenience store, coffee shop, Gasoline, diesel and kerosene are supplied through gas stations
  - Fuels for industries are supplied directly
  - Additional services at gas stations: car goods store, etc.
- Information & insight
  - Customers' info through membership cards
  - Not effectively used
- Relationship Dynamics
  - Direct contact with customers
- Pricing Structure
  - Cost + margin
  - No strategic pricing

Core strategy
- Business Mission
  - Energy supplier (stable supply & stable quality)
- Product/Market Scope
  - Oil products
  - Japanese market
- Basis for Differentiation
  - Product quality
  - Low cost (refinery, depot, gas station)
  - Efficient gas stations
  - Same or similar service

Strategic resources
- Core Competencies
  - Low production cost
  - High white oil yield
  - Efficient gas stations
- Strategic Assets
  - EM's global network
  - Efficient refining process
- Core Processes
  - Best practice

Value network
- Suppliers
  - ExxonMobil
  - Crude oil exporters
  - Product exporters
  - Tech. Providers
  - Equipment suppliers
  - EM affiliates
- Partners
  - Retailers
  - Distributors
  - Petrochemical
- Coalitions
  - ?

Efficient / Unique / Fit / Profit booster

23 Gary Hamel, 2000, "Business Concept Innovation", Leading the Revolution, pp.61-113

4. Possible Scenario for Oil Industry in Japan

4.1 JAPAN'S CURRENT SITUATION

4.1.1 Current Emissions and Required Reductions[24]

Meeting the requirements of the Kyoto Protocol will be difficult for Japan. Greenhouse gas emissions as a result of energy use contribute approximately 90% of total emissions in Japan. Therefore, some form of reduction in emissions for energy use and/or greenhouse gases intensity is requisite in order to comply with the Kyoto Protocol.

By 1998 emissions had increased by 2.3% from 1990, which is the base year for the Kyoto Protocol, and forecasted emissions for 2010 are expected to be 21% greater than emissions for 1990. The Japanese government is committed to reducing emissions by 6% from the base year of 1990. Therefore, this will require a reduction rate of 27% by 2010. This forecast is predicated on the installation of seven new nuclear power plants; however, at present only four new nuclear power plants are under construction, and it is expected to take even longer to install the remaining three plants. Therefore Japan needs to reduce emissions by about 30% from current emissions forecasts for 2010 if no measures are undertaken. Greenhouse gases emissions in Japan (see Table 4-1) are very high and meeting the requirements of the Kyoto Protocol seems a far away prospect and one that will be difficult to attain.

Table 4-1: Greenhouse gases emission in Japan (Unit: MTon-CO2)[25]

	1990	1998	2010(est.)	Growth Rate (1990-2010)
Energy origin, MTon-CO2				
Energy	76	82	95	26%
Industry	495	469	510	3%
Transportation	210	265	281	34%
Consumer	262	295	376	44%
S. Total	1,043	1,111	1,263	21%
Non-energy origin	68	76	70	4%
CH4	27	24	25	-9%
N2O	20	21	18	-10%
HFC etc.	51	46	84	65%
G. Total	1,210	1,279	1,461	21%

*: Emission for the electric power required for each segment, such as industry, transportation and consumer, is distributed into the numbers in each segment. Energy segment includes energy consumptions for electric power generation, oil refining and gas distribution.

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[24] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.56-89

[25] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.59

4.1.2 Proposed plan of Japanese government[26]

To meet the requirements of the Kyoto Protocol, the Japanese government has developed an outline of measures that it proposes to take (Ministry of the Environment, March 2001b). The government announced that Japan would reduce emissions by 6% from 1990 levels as required in the Kyoto Protocol agreed at COP3. At COP7, Japan received permission to include a 3.7% reduction from 1990 levels by sinks. Sinks involve a carbon dioxide reduction through forestry. Therefore, the net reduction target is 2.3% from the 1990 levels.

The Japanese government assumes that technology improvements can reduce greenhouse gas emissions by 2.5% from 1990 but changes in hydrofluorocarbons, perfluorocarbons, and sulfur hexafluorides will increase emissions by 2.0%. Therefore, another reduction of 1.8% from the 1990 level is required, but no clear measures have been proposed for this. Perhaps some emissions trading will be required.

Even though the government has developed an official implementation plan, the plan contains some infeasibilities. For example, the effects of technology improvement are doubtful. Given that the target should be met by 2012, and that investment is likely to require at least five years, it will be virtually impossible to develop new technology and then implement it by 2012.

In addition, emissions in Japan have already increased by about 15% from 1990 levels. This means that Japan needs to reduce emission by about 20% from the current level—a reduction that is simply too large, realistically, to implement. The current plan is too optimistic, and many changes will be required within a couple of years.

4.2 EFFECT ON MARKETING

4.2.1 Demand forecast

Based on information about greenhouse gas emissions, I have developed a forecasted demand for 2010, shown in Table 4-2. This forecast is based on assumptions and data about greenhouse gas emissions which were developed by the Japanese Ministry of the Environment (MOE).[27,28,29]

The economic growth rate is set at 2.0%. The MOE assumed that seven new nuclear power plants would be installed by 2010, but I have revised the number of installed nuclear power plants to four, because four nuclear power plants are now under construction[30] and they should be operational by 2010. The remaining three nuclear

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[26] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.8-9

[27] Petroleum Association of Japan, Apr. 2001, "Historical data of domestic oil demand", Konnichino Sekiyu Sangyou, pp.10

[28] Sekiyu Tsushinsha,Sep. 2001, "Historical data of products import", Sekiyu Shiryo, pp.130

[29] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.17-18, 61-75, 85

[30] http://mext-atm.jst.go.jp/atmurl11.htm

power plants are currently only in the planning phase and any realization of their operation by 2010 is questionable under the current severe circumstances for the safety of nuclear power plants.

Naphtha

Naphtha is used by the petrochemical industry and naphtha demand is based on the demand for petrochemical products.

I set the growth for naphtha demand at 26.8% from 1998 to 2010. This growth rate corresponds to a 2.0% of annual growth rate, the same as the economic growth rate in the greenhouse gases emissions forecast in the previous section. More than half of Japanese domestic demand for naphtha is met by imports, and increased naphtha demand will undoubtedly be satisfied by increasing the amount of imports.

Gasoline

The growth of demand for gasoline from 1998 to 2010 is set at 8.5%, based on estimations by the MOE[31] and forecasted improvements in engine efficiency.[32] The potential for further reductions is expected through governmental regulations, as well as further improvements in car efficiency, increased use of public transportation, a reduction of average car size, a modal shift from cars to ships, efficiency improvements in town areas, increased use of teleconferencing, and enhancement of freight efficiency. By taking into account the effects of these measures, I believe gasoline demand should decrease by about 30% from 1998 levels. And because gasoline can be switched to naphtha and more than half of the naphtha demand is imported, reduced demand for gasoline will be balanced with naphtha demand.

Kerosene

I have used 27.5% as the expected growth from 1998 to 2010 to estimate kerosene demand in 2010. This is the same growth number as greenhouse gases emissions in the consumer segment as estimated by MOE.[33] In addition, the MOE estimates a potential reduction of 18.1%[34], caused primarily by efficiency improvements in heating devices for both home and office use. Therefore, the net increase from 1998 to 2010 is about 10%.

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[31] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.61-69, 75

[32] Malcolm A. Weiss et. al., Oct. 2000, "Overview", On the Road in 2020, pp.1-17

[33] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.68

[34] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho Gaiyo", pp.9

Table 4-2: Oil Product Demand Forecast in Japan (Unit: KKL)

	1998			'98->'10	2010						
	Demand	Import	Domestic production	Demand growth	Demand w/o measure	Demand adjustment Base	Demand adjustment Potential	Demand adjustment Total	Demand w/ measure	Domestic Production	Import
Naphtha	44,976	27,100	17,876	26.8%*1	57,040	0.0%	0.0%	0.0%	57,040	31,445	25,595
Gasoline	**55,782**	936	54,846	8.5%*2	60,523	-21.6%	-10.2%	-31.8%	**41,277**	41,277	0
Kerosene	28,484	2,539	25,945	27.5%*2	36,317	-11.2%	-6.9%	-18.1%	29,744	25,945	3,799
Jet	4,846	286	4,560	38.7%*3	6,721	-7.5%	0.0%	-7.5%	6,217	6,217	0
Diesel	**43,911**	538	43,373	4.2%*2	45,755	-21.6%	-10.2%	-31.8%	**31,205**	31,205	0
Heating oil	**27,983**	0	27,983	27.5%*3	35,678	-11.2%	-6.9%	-18.1%	**29,221**	29,221	0
Bunker fuel (Elec.)	**24,598**	2,014	22,584	13.1%*4	27,810	-4.4%	-43.3%	-47.7%	**14,545**	14,545	0
Bunker fuel (Ship)	9,584	3,651	5,933	-16.2%*3	8,031	1.1%	0.0%	1.1%	8,120	8,120	0
Total	240,164	37,064	203,100						217,368	187,974	29,394
									90.5%	92.6%	
									222,568@FY90		
									-2.3%v.s.FY90		

*1: 2.0% P.A.
*2: Japanese Environmental Agency's estimation + estimation based on "On The Road in 2003"
*3: Japanese Environmental Agency's estimation
*4: Japanese Environmental Agency's estimation + adjustment of 3 less nuclear plants

In Japan, kerosene demand fluctuates considerably depending on the season, and the peak demand season is winter. In winter, Japanese oil companies must import kerosene to meet domestic demand because of shortages. Therefore, demand growth causes an increase in kerosene imports, but the impact of demand growth on domestic production is negligible. Therefore, domestic kerosene production will remain stable while kerosene demand will increase by 10%.

Jet fuel

Demand for jet fuel will increase by 38.7%, along with an expected increase in the number of air travelers. Quality of jet fuel is virtually the same as that of kerosene, and demand for jet fuel does not fluctuate seasonally. As larger airplanes are introduced, fuel consumption demand should decrease. But the impact of larger airplanes is not significant. Jet fuel demand is expected to increase by about 30% from 1998 to 2010.[35]

Diesel

The diesel demand forecast is almost the same as that of gasoline. However, the basic growth rate of demand is different from that of gasoline because of differences in demand forecasts for gasoline and diesel cars. The potential reduction will be same as that of gasoline.

Heating oil

Demand for heating oil will increase by about 10% from 1998 to 2010. The growth rate from 1998 to 2010 and potential reductions are set based on estimations of greenhouse gas emissions by the MOE.[36,37] The forecast for heating oil demand is the same as that of kerosene.

Bunker fuel (ship)

The demand for bunker fuel for ships will decrease mainly because of a modal shift from ships to trucks. To improve customer satisfaction, logistics companies have shifted transportation size from large to smaller size loads, which means the transportation mode can shift from ships to trucks. Therefore, the demand for bunker fuel for ships will decrease. Measures to reduce gasoline and diesel consumption will increase demand for bunker fuel for ships, but the effect of the measures will be small. The net growth for bunker fuel for ships will be about –15%.[38,39]

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35 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.66

36 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.68

37 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho Gaiyo", pp.9

38 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission

Bunker fuel (others)

Demand for bunker fuel for other uses than ships will decrease dramatically.

Other major users of bunker fuel are power generation plants and industrial factories. There are two key assumptions regarding power generation. One is the number of newly installed nuclear power plants prior to 2010. Four nuclear plants are under construction now[40], and three other nuclear plants are in the planning phase and will be completed by 2010, according to the original plans.[41] But because construction of the first four nuclear power plants will take more time originally planned, I am assuming that completion of the additional three nuclear plants prior to 2010 will be difficult and unlikely. Therefore, four new nuclear plants are reasonable for oil demand prediction.

The other assumption is that demand for power will be balanced with power generation by oil-burning power plants. Although coal-burning power plants emit more carbon dioxide than oil-burning power plants, the coal consumed for power generation does not balance with the decrease in demand because of the need to diversify energy sources. Japan has few naturally occurring energy sources, and therefore must import to meet much of its demand. The oil wells are located mainly in the Middle East, which is a politically unstable region. From the standpoint of energy security, Japan maintains a strategy of importing energy from as many countries as possible to reduce dependence on one source only. As coal is located in many countries, and those countries are not the same ones that have huge oil reserves, coal continues to be an important energy source for energy security. In addition, the cheap price of coal is another strong motivation to continue consuming coal instead of oil. Therefore, the Japanese government maintains a strategy of using coal because of its superiority in terms of security and price, compared with oil.[42]

Demand for electricity for the industry and consumer sectors will increase due to economic growth, if no plans are executed to reduce carbon dioxide emissions. As the Japanese government is planning to meet future demands for electricity by increasing the number of coal-burning power plants and nuclear power plants, oil demand should increase very little. The growth of oil demand for electric power generation will increase by about 10% from 1998 to 2010, while total electric power demand will increase by about 20%.[43]. The Japanese government assumes that it can decrease electric power consumption by efficiency improvement plans for the industry and

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reduction technology, Kentokai Houkokusho part-1", pp.66

39 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho Gaiyo", pp.9

40 http://mext-atm.jst.go.jp/atmurl11.htm

41 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.17

42 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-2, Reduction potential for energy transformation sector", pp.27

43 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.75

consumer sectors until 2010. As there is some room to improve efficiency in industries such as cement and steel, and in the consumer sector, it is expected that demand for electric power in both sectors will decrease. The decrease in electric power demand will be balanced mainly by oil-burning power plants.[44] Meanwhile, the electric power generation sector can improve its efficiency, which contributes to reduce fuel requirement.[45] Therefore, oil demand for power generation will decline.

Demand for bunker fuel in industrial factories will also decrease due to efficiency improvements. Fuel efficiency will be improved mainly in the cement, chemical, paper, and steel industries.[46] As a result of the two oil shocks suffered in 1973-1974 and 1978-1982, Japanese industries were eager to improve fuel efficiency throughout the 1980s, but in the 1990s efficiency improvements showed little progress due to the stable price of oil. Therefore, Japanese government needs to encourage industry sector to improve its energy efficiency in order to meet the requirements of the Kyoto Protocol.

4.2.2 Market condition

Based on the demand forecast, market conditions for oil products will change dramatically. Gasoline, diesel, and bunker fuel demand will decrease while naphtha, kerosene, jet fuel, and heating oil demand will increase. Total demand will be around 90% of 1998 levels, and supply from domestic refineries will be around 90% of supplies in 1998 as well. These figures show that the Japanese oil industry, which already faces a supply excess, will face even greater excesses in the future, which will become even worse for gasoline, diesel, and bunker fuel.

Gasoline and diesel are sold at gas stations and competition among gas stations will be fierce. More gasoline and diesel will be exported and the price of these products will be equal to export parity, which is much lower than the current price in the domestic market.

Conditions for bunker fuel will be worse than for gasoline and diesel. Some excess capacity of gasoline and diesel can be shifted to other products, such as naphtha, kerosene, and heating oil. However, there is little room to adjust bunker fuel production. Therefore, refinery operations will be restricted by limits on bunker fuel demand. As there are no oil companies that want to reduce their refinery utilization, they will compete severely over the price of bunker fuel in order to keep using their refineries. The bunker fuel market will find itself in fierce price competition.

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44 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.62-69

45 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.59

46 Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.65

4.3 EFFECT ON REFINING

4.3.1 Regulation

Regulation of refining operations to cope with global warming is unknown. The energy efficiency of refineries is improving steadily, but it is still very gradual. At the same time, energy consumption at Japanese refineries is increasing as new facilities are installed.

There are two types of new facilities. The first type converts bunker fuel to more profitable products such as gasoline and diesel. In the 1990s, many oil companies introduced conversion plants that consume huge quantities of energy. The second type of facility is a hydro-treating unit designed to meet quality regulations. The quality regulations for gasoline and diesel changed several times during the 1990s in an effort to make fuels cleaner. In response, oil companies introduced new facilities to meet those quality regulations. These facilities reduce toxic compounds to a certain level, but they also consume huge quantities of energy as well.

Thus, both types of new facilities increase fuel consumption at refineries. If future regulations force oil companies to reduce their carbon dioxide emissions, the oil companies will have to invest even more for emission reduction facilities. For example, the maximum sulfur content allowed in diesel will be reduced from 500ppm to 50ppm by the end of 2004, and further reductions will probably be introduced. There are other possible regulations, such as sulfur content in gasoline, aromatics content in diesel, and so on. While the energy efficiency of refineries is improving, total energy consumption is growing due to improvements in product yield and quality regulation changes. Therefore, the reduction of carbon dioxide from refineries is very difficult and will be expensive.

4.3.2 Required product quality

Quality regulation is another key issue. The auto industry is taking steps to improve fuel efficiency in cars and to reduce the emission of toxic compounds. In addition, if fuel cells are introduced for cars, requirements for motor fuel quality will change completely. These changes will force oil companies to spend money. Clearly, quality regulation has a huge impact on the oil industry.

4.3.3 Refinery operations

Regarding refinery operations, there will be three phenomena in the oil industry. These are (1) low refinery utilization but no refineries closed, (2) a surplus of bunker fuel and (3) an increase in kerosene imports.

Refinery utilization will be lowered due to declining demand. Based on demand forecasts in the previous chapter, oil demand will decrease by about 10% from 1998 to 2010, and demands for gasoline, diesel, and bunker fuel will decrease by more than 30% from 1998 levels. Utilization in 1998 was about 80% and by 2010 it will drop to around 70%.

Despite lowered refinery utilization, most oil companies will hesitate to close their less competitive refineries due to the high exit barrier in the oil industry. There are two reasons for this exit barrier. Refineries are strongly connected with the local community, and land previously used for refineries has little value for other industries, even if for no other reason than the land parcel is too large for other industries. Therefore, excess capacity among refineries will increase and price competition will become worse.

There are two types of refineries. One type is a hydro-skimming refinery and the other is a conversion refinery. A hydro-skimming refinery has only crude oil distillation units and product yield is decided by each kind of crude oil. Bunker fuel oil yield in a hydro-skimming refinery is around 40% on processed crude oil. A conversion refinery can reduce bunker fuel production by converting bunker fuel oil to gasoline and diesel. Bunker fuel oil yield in a conversion refinery is less than 20%, depending on the configuration of each refinery. Hydro-skimming refineries produce more bunker fuel oil than conversion refineries do; indeed, they need to reduce bunker fuel oil production to meet lowered demand by reducing refinery utilization. Although conversion plants can reduce bunker fuel production, hydro-skimming refineries cannot introduce conversion plants because they are very expensive; also hydro-skimming refineries do not have sufficient budget due to low profitability of oil business.

A decrease in the demand of bunker fuel will become a bottleneck for refinery operations. As a refinery cannot operate without producing bunker fuel, declining demand for bunker fuel will force refinery utilization to decline as well.

In addition, decreased demands for bunker fuel will cause fierce price competition in the bunker fuel market and this will make bunker fuel less profitable than it is today. Less profitability for bunker fuel will deteriorate the margin of hydro-skimming refineries more than conversion refineries, which have conversion facilities to convert bunker fuel to higher margin product, such as gasoline, diesel and so on. As a result, only conversion refineries can survive in the future oil business.

The story will different for kerosene. As noted earlier, demand for kerosene fluctuates seasonally with peak demand in the winter, when kerosene demand becomes greater than domestic production. Although Japanese oil companies build up their inventories of kerosene to reduce the need to import kerosene, built-up inventory still does not cover the supply shortfall.

As total demand for oil is expected to decrease by 10% from 1998 to 2010, kerosene production will also decrease. My demand forecast assumes that kerosene production will be kept constant at 1998 levels until 2010. But as refineries cannot produce just kerosene, the declining demand for gasoline, diesel, and bunker fuel means that the production of kerosene will also decrease. Therefore, oil companies will need to increase kerosene imports to compensate for decreased kerosene production, as well as to meet growing kerosene demand.

Increased kerosene import by the Japanese oil companies will affect the Asian kerosene market. In winter, kerosene prices increase to meet demands in northern hemisphere countries where it is winter. A parallel demand increase in Japan will accelerate kerosene price increases. In spite of the already high price of imported kerosene, Japanese oil companies will need to import more in order to meet domestic demand.

Refinery operations in 2010 will be different from those in 1998. As a whole, refinery utilization will be less, but there will be different circumstances for each product. Gasoline and diesel production will be surplus, but they can be shifted to other products and does not pose a problem for refinery operations.

Instead, bunker fuel will become the problem. Lowered bunker fuel demand will restrict refinery operations in order to adjust bunker fuel production downward. Kerosene will be another problem. Domestic kerosene production will be short and oil companies will need to import expensive kerosene.

5. Strategic Measures

5.1 POSITIONING

Positioning is an important factor when developing company strategy. According to Hax and Wilde[47], there are three distinct strategic options: Best Product, Total Customer Solutions, and System Lock-in.

Best Product positioning is a strategy to provide either price advantage or unique features—a classic form of competition. In this competition, products tend to be standardized.

The Total Customer Solutions positioning is a strategy to develop value propositions bonded to each individual customer. This strategy focuses more on customer need than on the product. It is aims at initiatives with key customers to jointly develop distinctive products.

The System Lock-in strategy consists of the firm, its customers, suppliers, and complementors. Complementors are the most important players in this strategy. The richness and depth of the complementors supporting a product or service lock the product into the system and lock out the competition. Microsoft is a well-known example. Microsoft's strong position is created by a self-reinforcing feedback loop: people choose Windows to gain access to the most applications, applications providers choose Windows to reach the most people.

Among oil companies, there is no difference in positioning. Because the quality of oil is regulated by law, competition in the oil market is based on price. The quality of oil does not differ among the companies, so customers choose an oil company based on price, and oil companies focus on cost reduction to keep their product price competitive.

All Japanese oil companies follow the Best Product strategy which causes severe price competition, thus creating a market with very thin margin. If demand continued to increase steadily, price competition would not be bad. However, based on the demand forecast in the previous chapter, oil demand will decrease and it is doubtful that all oil companies will be able to survive under a scenario of diminishing demand.

The strategy followed by of ExxonMobil Japan (EMJ) is also Best Product. In the commodity market, the Best Product positioning is a typical strategy. The analysis offered in Sections 3.2 and in Figure 3.3 highlight the fact that EMJ's core resources are all developed in accordance with the Best Product strategy. EMJ's refineries and gas stations are highly efficient. The refining side focuses on reliable quality and low cost. Conversion plants were installed to increase the yield of high-margin products. Price is set competitively, i.e., cost plus a thin margin, not at a value which is determined from the customers' viewpoint. Customer information is not used effectively and membership is used only for price discount. Overhead costs are diminished by reducing the number of employees. All of these functions are in line with the Best Product strategy. In fact, EMJ's strength is that it is strictly focused on this strategy. Therefore,

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[47] Arnoldo C. Hax, Dean L. Wilde II, 2001, "The Delta Model: The End of Conventional Wisdom", the delta project, pp.10-13

EMJ has been one of the best performers among Japanese oil companies for many years. (see Table 5-1)

Table 5-1: Financial Data of Japanese Oil Companies

	TonenGeneral		Showa Shell	Nippon Oil
	'99 actual	'00 actual	'00 actual	'00 actual
ROE*), %	9.0	18.5	6.0	3.3
ROCE*), %	1.8	5.2	N.A.	N.A.

Data source: Yahoo Japan Finance, Toyo Keizai Inc.
*: Estimated based on available data

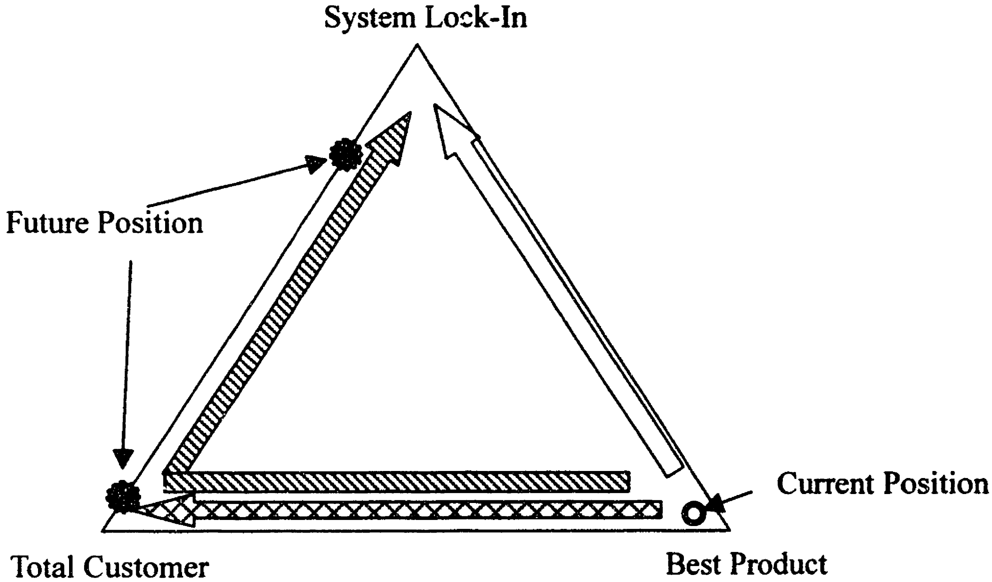
While all Japanese oil companies competing in today's market follow the Best Product strategy, business circumstances will soon change completely, forcing oil companies to change as a result of global warming. Until now, oil demand has fluctuated according to economic growth. The richer people became, the more energy they used. However, global warming will change the demand structure. Oil demand will not be affected by economic growth and will keep decreasing for a long time. Obviously, oil companies cannot remain successful if they insist on pursuing the same strategy they followed when demand was on the rise. Business condition will be different from what they are currently.

Until now EMJ has been successful because of its clear focus on the Best Product strategy. To remain competitive despite severe price competition, EMJ has improved its efficiency. Differentiating itself from other oil companies is not the strategy today; so, the questions are what strategy to pursue under these new conditions and how to implement that strategy.

In these new business circumstances of diminishing demand, I believe a differentiation strategy will be required. Diminishing demand creates excess refining capacity and excess capacity creates supply excess. Supply excess causes even more severe price competition. If EMJ remains with the Best Product strategy, it will need to cope with terrible price competition which ultimately will not be profitable. The race for survival will be long and difficult.

Therefore, EMJ should switch its strategy from Best Product positioning to Total Customer Solutions or System Lock-in. Figure 5-1 illustrates this shift of strategy from Best Product.

Figure 5-1: Strategic positioning (Delta model)[48]



To switch its positioning, EMJ should change its product from oil to services related to oil. Oil cannot be differentiated, but service related to oil can be differentiated. For example, a service that enriches car life can be provided at gas stations, including information about fuel refilling history, maintenance history, parts replacement, booking hotels, traffic information, and so on. Such services will increase the switching cost for customers who might think about moving EMJ's service to another oil company's products or service.

To provide good service, an understanding of customer needs is crucial. In addition, external resources are also important. This means enhancing customer benefit, enriching the configuration, and expanding company boundaries, as shown in Figure 3-3. This change will create a different kind of wealth potential.

Changes in business circumstances are often challenging. External change forces companies to change but this is not always easy. However, change can also be an opportunity for success. What is required on the part of the oil companies is a new perspective that regards change as a great opportunity for business

[48] Arnoldo C. Hax, Dean L. Wilde II, 2001, "The Delta Model: The End of Conventional Wisdom", the delta project, pp.10

5.2 STRATEGY TO TOTAL CUSTOMER POSITIONING AND SYSTEM LOCK-IN POSITIONING

5.2.1 Forces from Outside

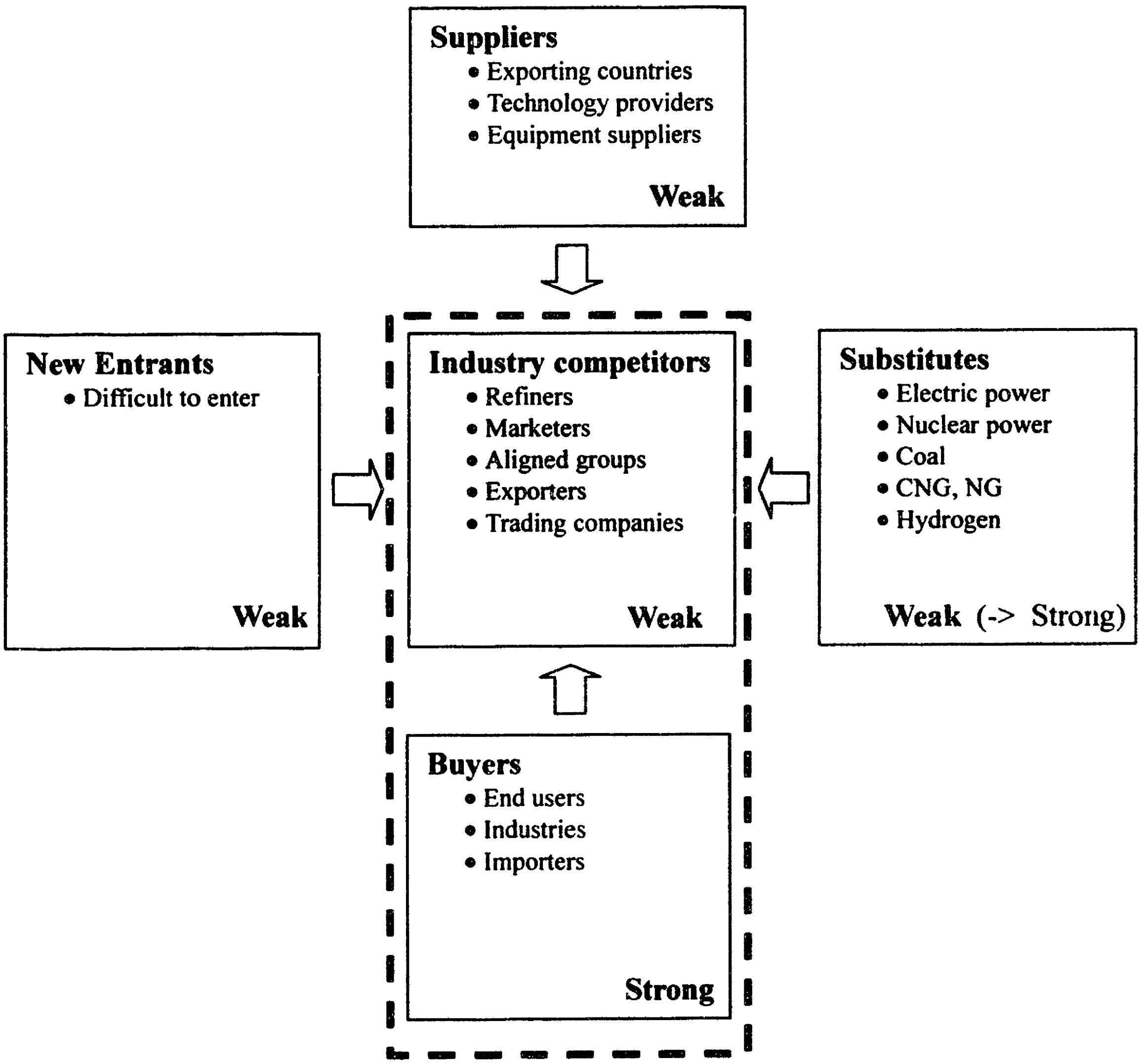
Figure 5-2 shows the balance of power between the five forces (Porter, 1985) in the oil industry. It is obvious that the focus should be on the relationship between "Buyers" and "Industry Competitors". Crude oil and oil product exporters are not strong because for both types of oil, there are several open markets in the world and trading volume is large enough to prevent intentional control by one person, company, or country. In terms of crude oil, OPEC has relatively strong power, but its power is not sufficient to completely control the market. Technology suppliers and equipment suppliers are not strong because there are many alternatives. As a result, the "Suppliers" is weak. The "New Entrants" has no power due to high entry barriers in the oil industry, which are created by huge, long-term investment in the oil industry and strict regulations.

The "Substitutes" is also weak. Electric power could be considered a substitute power source for cars, but the automotive industry has so far had difficulty developing a reliable battery. Nuclear power might be a substitute of oils for electric power generation, but there is a range of issues concerning safety and nuclear waste. Coal is widely used in electric power generation and coal deposits are huge. However, the carbon intensity of coal is the highest among fossil fuels, and its use is not likely to be increased because of pressures to reduce carbon dioxide to comply with the Kyoto Protocol. Although LNG is supposed to be the best substitute, there are difficulties with it as well. Because gas exploration requires a long-term commitment due to difficulties with storage, substituting oil with gas will proceed slowly. Hydrogen has major potential as a substitute for oil, but the technology required for hydrogen production is not mature, but in ferment. Therefore, the "Substitutes" is not yet strong. As a result, the company should focus on the power of "Buyers" and "Industry Competitors".

In terms of a relationship between "Buyers" and "Industry Competitors", it is apparent that "Buyers" has strong power. "Buyers" can switch oil companies from one to another easily, and switching oil companies to find the lowest price is beneficial for buyers because oil quality is standardized throughout the Japanese oil market.

Considering the five outside forces bearing on EMJ, the power of each force is quite different. As "Buyers" has the strongest power, EMJ needs to focus on the power balance between "Buyers" and "Industry Competitors"

Fig.5-2: Forces from outside: Porter's Five Forces Model[49]

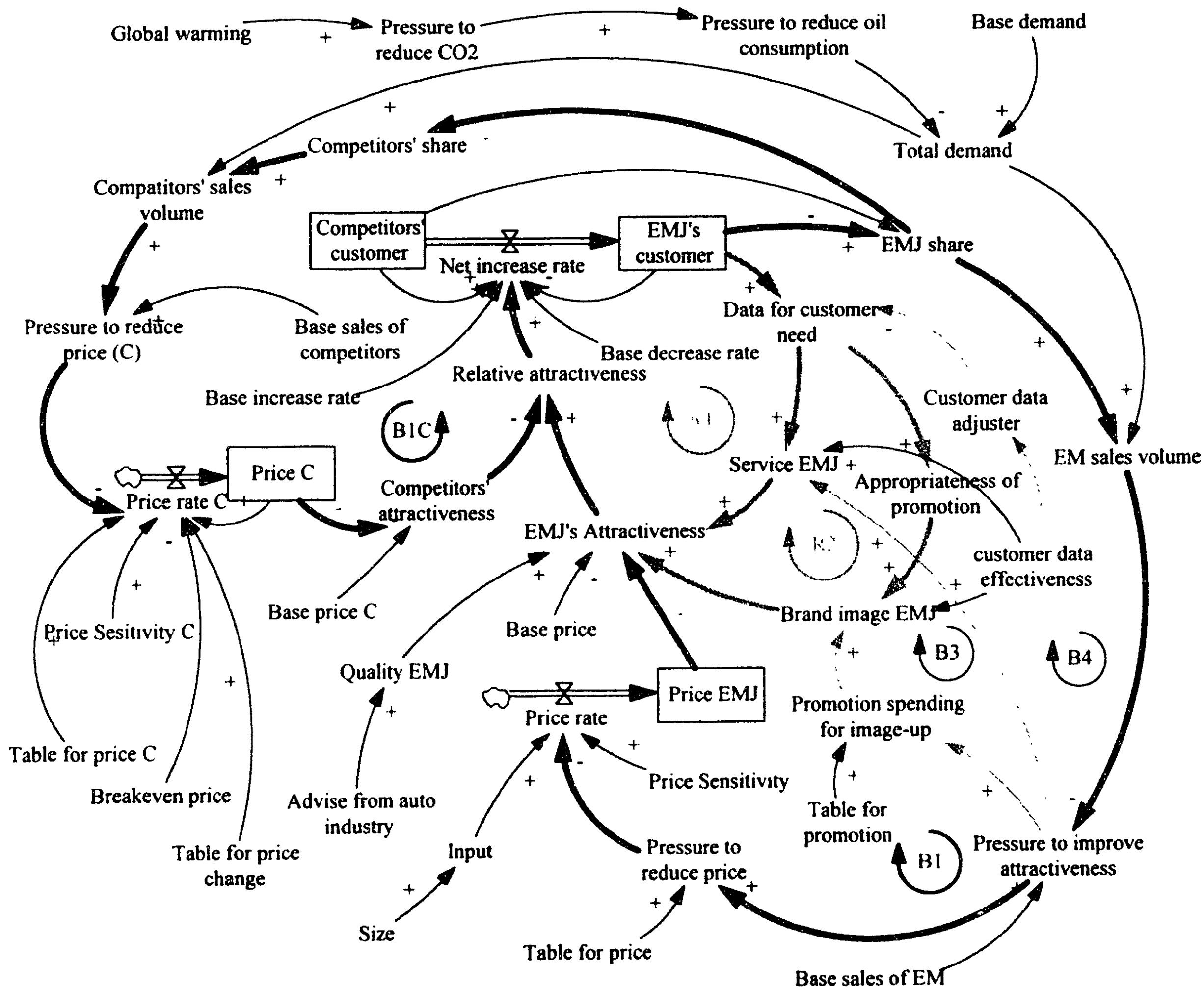


[49] Michael E. Porter, 1980, Competitive Strategy: Techniques for Analyzing Industries and Competitors

5.2.2 Business Dynamics

Figure 5-3 illustrates the business dynamics of the oil industry, based on the system dynamics methodology[50]. In this illustration, current market dynamics is

Figure 5-3: Business Dynamics of Oil Industry



dominated by two balancing loops, B1 and B1C. In the commodity market, price is one of the strongest variables for improving product attractiveness. If EMJ reduces its prices, a lower price will attract customers and more customers will buy EMJ's products.

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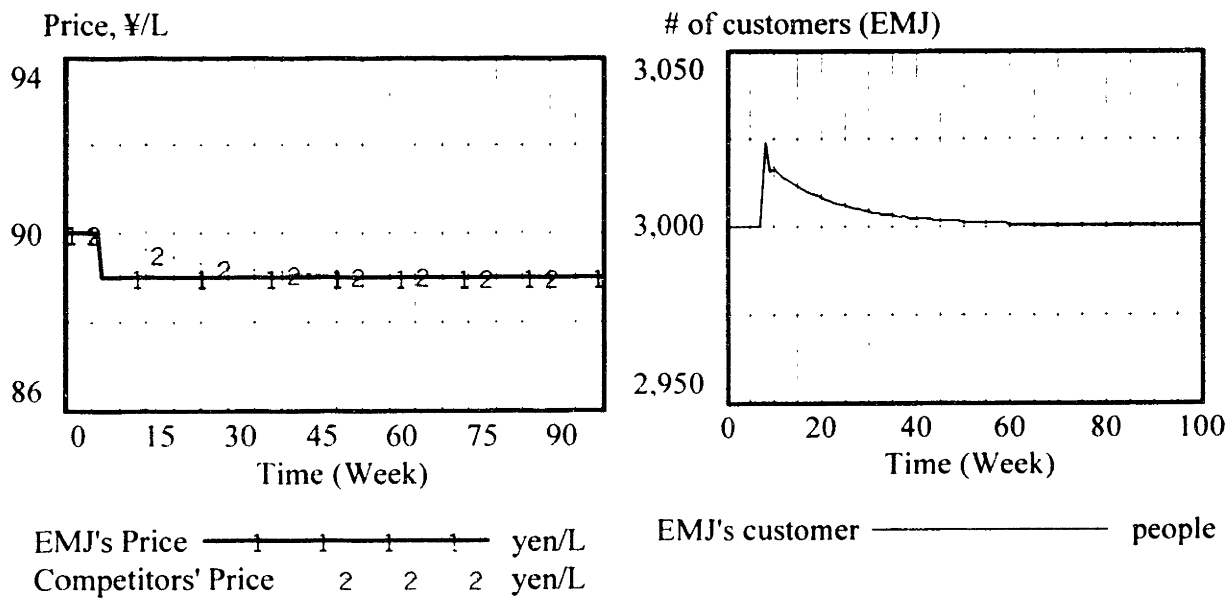
[50] John Sterman, 2000, Business Dynamics

Increased sale reduces the pressure to improve attractiveness and reduce price. This leads to higher prices, and the market behaves to stabilize price. On the other hand, if EMJ reduces its prices, competitors' attractiveness will be diminished and competitors' sale will decline. Lower sale motivates competitors to reduce their price to make their products more attractive, so they reduce their price. If this happens, EMJ will again reduce its price based on the same logic. This results in a loop in which EMJ's lower price drives competitors to lower their price, and competitors' lower price drives EMJ to lower its price. This is, in fact, the dominant dynamics of price competition in the oil industry.

Figure 5-4 shows a result of simulation of competitors' behavior activated by price reduction of EMJ. In the simulation, EMJ reduced the price by ¥1.0/L in week-6 and keep the price after then. Though the number of EMJ's customers increases soon after the price reduction, competitors follow EMJ and reduce their prices. As the result, prices of EMJ and competitors are settled down to the price, which is lower than initial price, by ¥1.0/L and number of EMJ's customers goes back to the initial number in around week-60. The response of the competitors depends on the price sensitivity of competitors and it is very high in the actual market. The Japanese market sometimes responds very quickly and competitors change their prices radically. Therefore, the advantage created by the low price cannot last more than one month. This shows that price reduction can increase number of competitors, but the competitors can catch up very easily and regain their customers as well. In other words, price reduction looks most efficient driver to attract customers, but it is not working well due to the behavior of the competitors. Lower price is a policy, which is very easy to be followed by the competitors, and this competitors' behavior destroy the attractiveness that was created by EMJ's low price. The price competition reduces price, but it keeps market shares of all players as well.

Figure 5-4: Behavior of competitors and customers through price competition

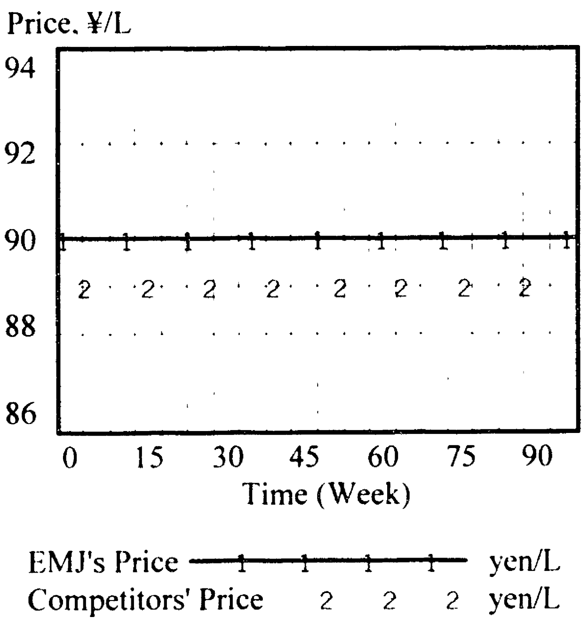


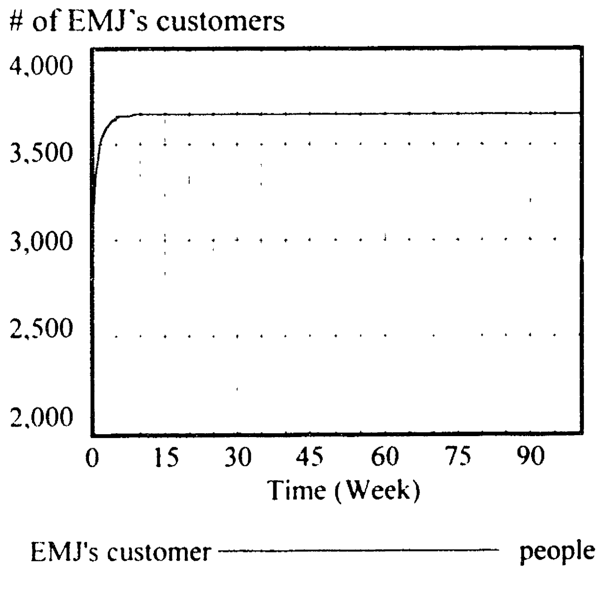
To prevent this price competition and to differentiate EMJ from its competitors, it is necessary to activate reinforcing loops. In the reinforcing loops, the attractiveness of EMJ's products should attract other customers, thereby increasing EMJ's customer base. These new EMJ's customers should improve the attractiveness of EMJ's product. But to activate the reinforcing loops, feedback from customers is necessary; the reinforcing loops cannot work without feedback. The reinforcing loop is very powerful, because once it starts to work, the loop keeps pushing growth to a certain level, and it is difficult for competitors to catch up. For example, Windows dominates the PC market because as the number of Windows users increases, more Windows-based applications are developed; increased application software attracts customers and increases number of Windows users.

In the oil business, I believe no one has activated reinforcing loops before. In Figure 5-3, I assume two key reinforcing loops, R1 and R2. In loop R1, EMJ's service quality is improved by data for customers' needs. Customers are satisfied with the improved service and number of customers increases. In loop R2, the appropriateness of EMJ's promotion is also improved by data for customers' needs and the improved appropriateness improves EMJ's brand image. Good brand image contributes to obtaining more customers. These loops reinforce themselves.

Figure 5-5 shows a result of simulation of dynamics with activated reinforcing loops. In the simulation, EMJ starts to activate reinforcing loops at week-1 and it can get more customers by this. EMJ's customer increases by around 20%. In this simulation, EMJ's price sensitivity is set at very low level because EMJ has options to activate reinforcing loops. On the other hand, competitors try to regain customers by reducing price. Though competitors can regain customers by the low price, they cannot

Figure 5-5: Effect of reinforcing loops (minimum price: ¥89/L)





reduce their price to the price that is lower than breakeven price. In this simulation, the lowest price is set at ¥89/L. By setting the prices at ¥89/L, competitors try to recover a loss of a number of customers, but the number of customers cannot be recovered to the initial level. The number of EMJ's customers reaches to the level that is higher than initial number by around 20%, although EMJ keeps its price constant.

There are two issues related to these reinforcing loops. One is EMJ needs to create a mechanism to connect its service quality and brand image to a feedback from customers. At present, oil companies tend to be too sensitive to the price to improve their service quality. Therefore, it is requisite to develop a connection between service quality and feedback from customers. There are some movements in Japan. For example, EMJ started to develop gas stations with coffee shops to meet customers' needs. This movement is in the early stage and very slow, but EMJ has a chance to differentiate its service by accelerating this movement. The other is that EMJ needs to develop a system to get information on customers' needs. If EMJ can ascertain customers' real needs, these two reinforcing loops will work. Key is that EMJ needs to keep improving its service quality based on the feedback from its customers. Even if EMJ improves its service quality, competitors can follow EMJ. Copying service at gas station is not difficult and there is no way to protect copying good services. Reinforcing loops can work only if EMJ keeps receiving feedback from its customers and improving its service quality. If EMJ neglect to do this, the reinforcing loops will stop to work.

In addition to acceleration the reinforcing loops, being the first mover is also important. For example, if EMJ provides high quality coffee at gas stations, the brand name of the coffee is very important. Starbucks has a good brand image and customers would select EMJ's gas stations with Starbucks coffee, even if there is another gas stations with another coffee shop close to EMJ's gas station. The first mover has more chance to develop partnership with partners that have strong brand image than a second mover does. Though changing service will take more time than lowering price, competitors can follow EMJ's service within a certain delay. Even if the time lag is long, competitors can catch up the first mover and if the service quality of competitors becomes equivalent to EMJ's service quality, market share of EMJ will be settled down to the level that is before changing its service quality. It is obvious that if EMJ changes its services, competitors will follow EMJ. Therefore, developing partnerships with strong partners by being the first mover is another success factor.

Last thing important is <u>not</u> to activate the two balancing loops, B1 and B1C, shown in Figure 5-3. In the current market, both the competitors and EMJ are activating the two loops. Lowering price is an easy strategy for attracting customers, but it is also a driver for severe price competition. Therefore, activating the reinforcing loops but leaving the balancing loops inactive is a very important strategy.

5.2.3 Enhancing the Company's Power

To accelerate the reinforcing loops in Figure 5-3, EMJ needs to change some strategies inside the company. Figure 5-6 shows potential focusing points, based on

Hamel's framework.[51]

First, exploration of customer need is crucial. Oil companies use a membership system and therefore retain a database about their customers, but this is not sufficient. The data that can be mined via the membership cards are merely name, address and fuel refilling history, and these data do not tell anything about customer needs. Therefore, the oil companies must take other steps to explore customers' needs. One solution is to gather data through closer communications while customers are at gas stations. In Japan, gas stations provide full-service, which means the staff refills fuel and cleans windows. This gives the staff some opportunities to communicate directly with the customers, this offering many chances to learn about specific customer needs. Another solution is to gather data from the company's own employees. As oil company employees have cars and are customers of the oil companies as well, mining specific customers' needs from the ranks of their own employees is easier, cheaper, faster, and efficient. Clearly, exploring customer need is a key requirement.

Second, oil companies can change their pricing policy from a competitive market price basis to an evaluated value basis. Oil companies basically set price at cost plus margin, but they change their product price frequently to make the price competitive in the market. This is caused by the two balancing loops, B1 and B1C in Figure 5-3, and most oil companies use only price to attract customers. However, by activating reinforcing loops R1 and R2 in Figure 5-3, oil companies can imply a different pricing policy, i.e., evaluated value-based pricing, because other factors, such as service quality and brand image, can attract customers instead of price. Needless to say, in this situation, the existence of reinforcing loops is necessary.

Third, oil companies can add two visions to their business mission: enriching car life and environmental friendliness. If oil companies change their product from oil to services related to oil, enriching car life becomes a very important vision. Supplying oil is not sufficient to enrich car life, but developing and offering a vision of enriching car life enables high quality and differentiated services.

Environmental friendliness is another necessary vision. Oil companies should be positive about introducing new quality standards to reduce emissions of toxic compounds, such as sulfur dioxide, nitrogen oxide, and carbon particulate. Although this will require a major investment, it can create a good brand image. Therefore, these two added visions—enriching car life and environmental friendliness—can attract customers and differentiate EMJ from other oil companies.

Fourth, focusing on collaboration with the auto industry and information providers is another possible strategy. To enhance the attractiveness of service, service related to car dealers and parts retailers is essential. Providing information, such as traffic, weather, used/new car prices and so on is also important. A music download service is another potential service. Many drivers listen to music while driving, so receiving new music is another reason to choose EMJ. These are simple examples, but collaboration with other industries has huge potential for helping EMJ to dominate the market.

To enhance EMJ's position in the market, the company needs to change its

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[51] Gary Hamel, 2000, "Business Concept Innovation", Leading the Revolution, pp.61-113

strategies. Utilization of existing resources and expanding the company's boundary are important. And while I mentioned four potential options, there are many more potential options both inside and outside EMJ. No one knows what the best strategy is. Therefore, the most important measure is: "Listen to the customers' voice".

Fig.5-6: New Competitiveness (ExxonMobil Japan) : Hamel's Framework [52]

Customer Benefit — Configuration — Company Boundaries

Customer interface

- Fulfillment & support
  - Convenience store, coffee shop, Gasoline, diesel and kerosene are supplied through gas stations
  - Fuels for industries are supplied directly
  - Additional services at gas stations: car goods store, etc.
- Information & insight
  - Customers' info through membership cards
  - Not effectively used

⇩ ***Explore customer need***

- Relationship Dynamics
  - Direct contact with customers
- Pricing Structure
  - Cost + margin
  - No strategic pricing

⇩ ***Evaluated value basis***

Core strategy

- Business Mission
  - Energy supplier (stable supply & stable quality)

⇩ ***& Enrich car-life***
& Environment friendly

- Product/Market Scope
  - Oil products
  - Japanese market
- Basis for Differentiation
  - Product quality
  - Low cost (refinery, depot, gas station)
  - Efficient gas stations
  - Same or similar service

Strategic resources

- Core Competencies
  - Low production cost
  - High white oil yield
  - Efficient gas stations
- Strategic Assets
  - EM's global network
  - Efficient refining process
- Core Processes
  - Best practice

Value network

- Suppliers
  - ExxonMobil
  - Crude oil exporters
  - Product exporters
  - Tech. Providers
  - Equipment suppliers
  - EM affiliates
- Partners
  - Retailers
  - Distributors
  - Petrochemical
- Coalitions
  - ?

⇩ ***Auto industry***
Information
(Government)

Efficient / Unique / Fit / Profit booster

[52] Gary Hamel, 2000, "Business Concept Innovation", Leading the Revolution, pp.61-113

5.2.4 Strategy implementation

When EMJ implements new strategy based on customers' need, instead of low price strategy, how to implement strategy is another issue. One of the problem of low price strategy is that everyone can follow the same strategy easily. Though following new strategy is more difficult than following the low price strategy, competitors can follow EMJ's new strategy with a certain delay. The delay is sometimes enough for EMJ to develop new strategy, but sometimes it is not enough. Therefore, before starting implementing new strategy, EMJ should prepare some options that can be implemented quickly after being followed by the competitors. Even if the new strategy is nice, it will not create better position if it can be followed by competitors easily. Keeping EMJ differentiated from competitors is crucial.

5.3 MARKETING SIDE

Before developing a marketing strategy, EMJ needs to understand its product, which is oil. But EMJ must also re-think its product from scratch. Based on classical marketing theory, there four key elements for marketing: product, price, promotion and place.[53]

It is clear that oil companies focus on price as their major concern in marketing theory. Price includes list price, discounts, allowances, payment period, and credit terms. All Japanese oil companies use membership cards to raise the barrier to switching from one oil company to another by providing discounts and conveniences through the credit function of the membership cards. But while promotions may bring in more customers, it is not effective for the long term because ultimately customers—and oil companies too—care only about price. So while promotions are based on price discounts and customers enjoy the discount, if they find another oil company that sells oil at a cheaper price, they will move on to the new company without hesitation.

Current business practice is based on oil as a commodity with no differentiation in quality, so marketing activities focus on price. To avoid tough price competition, EMJ needs to develop another concept of product, one that is different from the current concept of same quality and low price. The new concepts could be different value and reasonable price.

Kotler found that product can be defined by product variety, quality, design, features, brand name, packaging, sizes, services, warranties and returns. [54] If EMJ thinks of its product only as oil, there are few variations in that product concept. However, if the company thinks of its product as service related to oil, then there can be many variations in that product. This is one solution for surviving in the commodity business.

As part of my research, I have developed two plans that EMJ could consider as methods for improving its future business circumstances.

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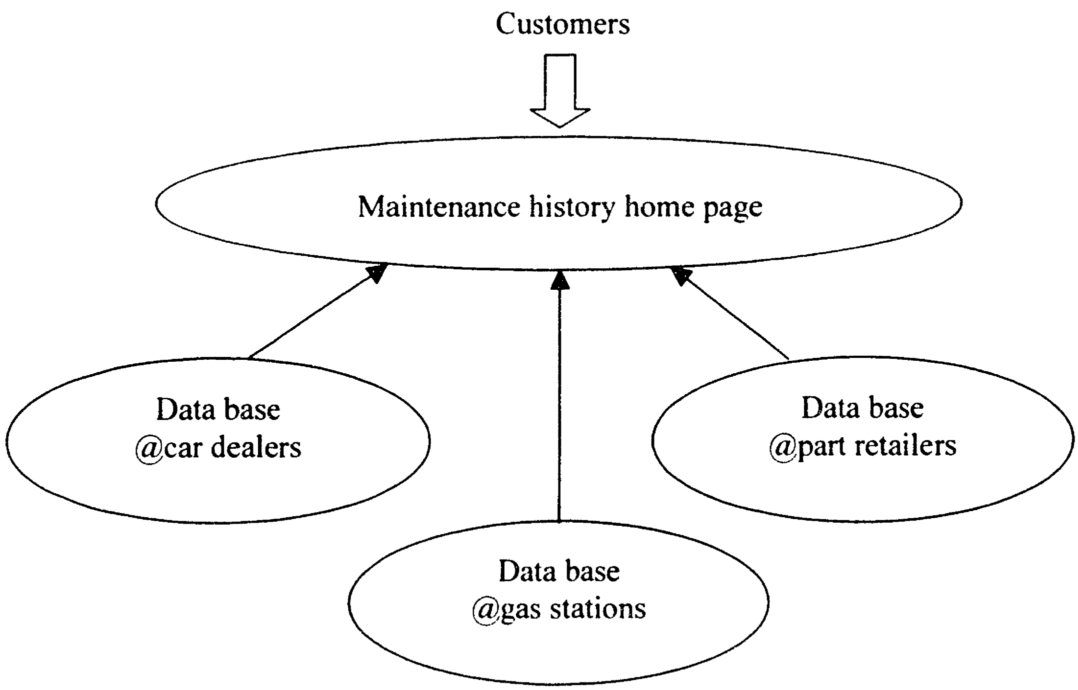
[53] Philip Katler, 2000, "Core Marketing Concepts", Marketing Management, pp.15-16
[54] Philip Katler, 2000, "Core Marketing Concepts", Marketing Management, pp.15-16

Plan-1: Cooperation with auto industry

As for gasoline and diesel, we can define our product as a service to improve car-life. The reason why customers buy gasoline is that they drive cars. Therefore, if customers can obtain major services related to cars, it could be very convenient for customers and a incentive to choose gas station. To provide car related services, oil companies should cooperate with auto industry, especially car dealers and part retailers. In the cooperation, the most important policy is not to invade partners' businesses. In other words, win-win situation for both EMJ and partners is requisite. EMJ's objective of the cooperation is not to earn money from additional services, but to gather more customers to EMJ's gas stations. Because the more customers go to EMJ's gas stations, the more EMJ can earn money. Partnership will be collapsed easily by the lowered incentives of partners due to an invasion of EMJ to their businesses. EMJ can be more profitable through the invasion in short-term basis, but long-term EMJ's profitability will be lowered by focusing on the short-term merit. As figures 5-5.6 show, better service can be a substitute of lower price and EMJ can improve its position in the market by attracting customers through better services. If EMJ can activate reinforcing loops in figure 5-3, it is not necessary to earn money by invading partners' business. The reinforcing loops can avoid price competition. The key for EMJ is to keep the reinforcing loops working and good relationship with partners. Cooperation with partners is necessary to activate reinforcing loops and to attract partners, EMJ should consider how to improve partners' profitability through the cooperation.

I have two ideas. The first one is a data aggregation service for car maintenance history. This service provide a data such as date of car purchase, date and volume of

Figure 5-7: Data aggregation for car-life



refill fuel and accumulated distance, date of part purchase, date of lubricant replacement, and so on. By aggregating these data, customer can recognize when they should replace lubricant, how the fuel efficiency of customers' cars, history of maintenance and so on. This service is beneficial for not only customers but also car dealers. Car dealers can recognize performance of customers' cars and provide customized promotion to each customer. They can mine customers' need through this service and mass-customized promotion can attract customers. They will participate in this service if the service contributes car sales increase. For example, car dealers can provide evaluation service of customers' car with new car information, based on the information on the web site of data aggregation. Through the evaluation service, car dealers can provide information about differences between new car and current car about fuel cost and maintenance cost. If the difference is sufficiently small, customers can be interested in buying new cars. In this partnership, EMJ's role is to activate EMJ's customers to go to partnered dealers. Good services related to car dealers could increase EMJ's customers and gathering more customers is the only objective for EMJ.

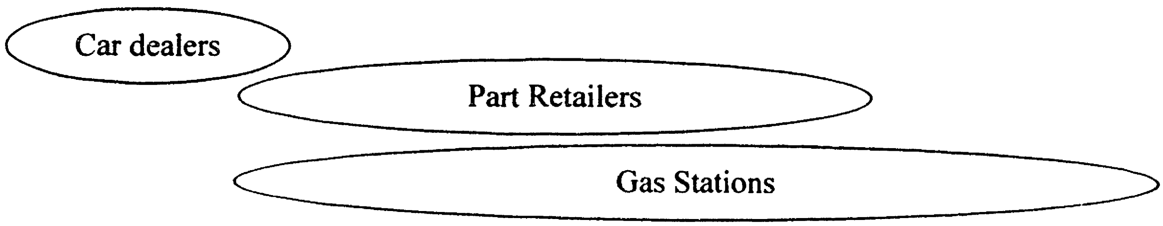
The second one is parts handling service, which might be attractive for customers. Customers can order parts through the web site of part retailers and get parts at gas station. This service can motivate customers to buy part because of convenience of this service. Typical behavior of customers is that they hesitate to go to parts retailers due to bother of going to shops even though they are interested in some parts. If they can get parts at gas station, they can buy parts without bother. Therefore, by this service, customers can get parts easily, part retailers could increase their sales and EMJ can get more customers.

In this service, partners, including EMJ, need to change their positions in the *car life support*. Figure 5-8 shows current and future possible position of each player in the market. Car dealers are doing major maintenance, such as inspection and periodical maintenance, and part retailers are doing minor and first-aid type maintenance, which includes replacement of tire, lubricant and battery, installation of stereo and navigation system, and small parts sales. On the other hand, gas stations are doing inspection, replacement of lubricant and tires and refueling. Therefore, gas stations are providing some services that are competing with car dealers and part retailers. For starting parts handling service at gas stations, partners should rearrange their positions. To avoid conflicts with partners, EMJ should give up inspection, tire replacement and so on. By doing this, partners can avoid competition among partners and be complementing each other. Part retailers need to change their way to sell small parts, but the change is the place where they sell small parts. Even if small parts are sold at gas stations, part retailers can earn money through the small parts sale. Because gas stations are just handling parts and are not getting money through the parts sale, but making more customers come to gas stations. Gas stations should focus on the first-aid maintenance, refueling and fulfilling temporary needs. By focusing on limited services, gas stations can enrich services to satisfy customers' needs. They can sell CD, camera, film, battery and so on. What they sell should be determined by the customers' need. At the same time, gas stations can play a role to support inspection service of car dealers. For example, gas stations can be a place to receive cars for inspection. In Japan, car owners basically need to bring their cars to car dealers for the inspection and owners bring their car in weekend. If gas station can hand over cars to dealers, car owners can bring their cars anytime they want because gas stations are usually open 24 hours. This can help effective utilization of spare maintenance capacity of car dealers in weekdays. It is a key for success of this service that partners are complementing each other's business. EMJ should consider not only how to attract customers but also how to motivate partners to participate in this cooperation.

Figure 5-8: Segmentation of car life support

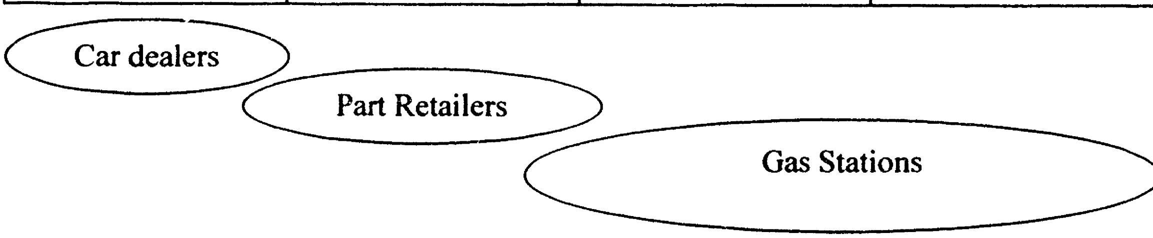
a) Current Segmentation

Major maintenance	**Minor maintenance**	**First-aid/Refueling**	**Temporary needs**
- Inspection - Periodical maintenance	- Tire, battery, lube - Stereo, navigation, etc.	- Tire pressure, Battery charge, quick check, etc. - Small parts	- Traffic info. - Beverage



b) Future Segmentation

Major maintenance	**Minor maintenance**	**First-aid/Refueling**	**Temporary needs**
- Inspection - Periodical maintenance	- Tire, battery, lube - Stereo, navigation, etc.	- Tire pressure, Battery charge, quick check, etc. - Small parts	- Traffic info. - Beverage - **Music** - **Camera, film, battery, etc.**



In addition, EMJ can contribute to the new car design of car manufacturers. As engine performance is affected by the fuel quality, EMJ can work with car manufacturers for new car design by providing special fuel. If car manufacturers can develop cars that can work well with normal fuel and work much better with specialized fuel in terms of fuel economy and pollution emission, EMJ can get better position. This is an ultimate case. It is obvious that making engine that is specialized with specialized fuel provided by one oil company is not realistic. But, it is also obvious that this is a great opportunity for EMJ to dominate the market if it will be real. In Japan, sulfur content in diesel will be reduced in 2004 from 500ppm to 50ppm. As Tokyo local government is eager to reduce air pollution in midtown Tokyo, Tokyo government offered oil companies to buy 50ppm sulfur diesel for public usage with premium price in 2001. Some oil companies promoted their sale of diesel by capturing this opportunity with high profitability. Though this is rare case, quality differentiation can be feasible in special conditions. Therefore, EMJ should have a strategy to create such kind of special conditions. Contribution to new car design could be one of the feasible strategies to create special conditions.

For this service, EMJ needs to keep space for warehousing parts. As gas stations give up some services, such as tire replacement, space would be available. Capital investment is also required and can be justified if more customers come to EMJ's gas station without price reduction.

Plan-2:Information providing

Information providing service is also important and there is much information that can be provided at gas stations. First, traffic condition and weather are very basic. Second, music download service has a potential to improve customer satisfaction. For the long drive, customers usually enjoy listening music. Therefore, if customers can use MP3 and download music at gas stations, customers may choose gas stations that have download service. Rental CD is a possible service. Gas stations do not need to provide full line-ups. Providing just top ten CDs is sufficient to motivate customers. Third, hotel reservation and route finding are possible service, too. By the route finding service, drivers can search the shortest route and print out. In the route map, locations of EMJ's gas stations are indicated. Forth, traffic congestion information is more usable through printing service.

Cost and profit

To implement these plans, EMJ needs to evaluate cost and profit. Total sales volume of gasoline and diesel in 2000 in Japan was about 100,000ML and EMJ's market share is about 20%. If EMJ could keep its price ¥1.0/L (¢ 3/Gallon) higher than its actual price by providing new service, it would create about ¥20B ($150M). If EMJ expects IRR at 12%, EMJ can spend ¥80B for these plans. These plans require new web site, warehouses for parts and CDs, terminals for providing information and additional workforce. I roughly estimate that web site can be developed within ¥10B and warehouses and terminals can be installed within ¥2M and ¥1M respectively, for each gas station. EMJ has about 7,000 gas stations in Japan, which means estimated total cost of warehouses and terminals is ¥21B. Additional workforce would be 8 hours a day and its cost would be ¥700 per hour, which means total additional workforce cost will be ¥14B. Therefore, total investment cost will be ¥45B and this shows these plans can be justified, even if the profit will be ¥0.6/L.

5.4 REFINING SIDE

Refining facilities are important complementary assets. In the commodity market, one way oil companies have captured value is through complementary assets. EMJ's refineries are top-ranked in terms of cost competitiveness, which is a strength. However, other oil companies are following EMJ and their competitiveness is improving rapidly. Therefore, EMJ needs to keep improving its refinery competitiveness and making continued investment in refineries will be required. For example, investment in a bunker fuel conversion plant to meet future demand is one candidate for strategic investment in order to capture opportunities to differentiate EMJ from other oil companies. There are also opportunities for differentiation along the lines of oil quality.

Regulation of emissions will require other changes for refineries, and a good relationship with the government is very important. As EMJ's refineries are already efficient, further efficiency improvements will be hard to find. If a regulation to restrict carbon dioxide emission via a carbon tax is introduced, it is not feasible to deal with such a regulation only by improvements in refineries. There is some room for improved efficiency or a reduction of carbon dioxide emissions by improving the entire whole value chain. For example, by making night-time gasoline deliveries to stations, the fuel efficiency of delivery by tank trucks can be improved because night deliveries would avoid inefficient use of gasoline and/or diesel caused by traffic congestion. Thus, coping with future regulations by improving the whole value chain is more efficient than just investing in refineries.

6. Conclusion

Looking at the world in 2010, the business circumstances surrounding the oil industry will be very different from today's circumstances. Demand will decrease and few refineries will be closed. The supply of gasoline, diesel, and bunker fuel will be in excess of forecasted demand. This means that future competition will be even keener than it is now. To survive in these circumstances, oil companies need to proceed cautiously and with clearly defined strategies.

Most important issue is the company's positioning strategy. A Best Product positioning is the typical strategy for commodities, but under the forecasted sharper business circumstances, oil companies need to change their positioning if they hope to see improved profitability. Oil is a difficult commodity to differentiate. There are specifications for every product that guarantee the same quality among all oil companies.

Thus, to differentiate their products, oil companies need to change their product from oil to services related to oil. This change will enables them to shift to Total Customer positioning or Lock-in positioning. These new positions will change the boundaries for all oil companies.

To pursue these changed positions, companies need to create relationships with other related industries, one being the auto industry, and make strong efforts to improve service. Such service should be considered from new viewpoints that are different from those currently held. In this strategy, customer information will be immensely useful to improving service, i.e., satisfying customers' needs, which will cause customers to return if they satisfied with the service. Designing service that is based on customers' needs is important.

In the commodity market, it is said that the customer chooses products only according to the price. Perhaps this is true, but I believe customers will be satisfied with a reasonable price. If EMJ can change its product from oil to service related to oil, the company will not have to remain with the cheapest price. A reasonable price, coupled with excellent service, would be acceptable to most customers.

The future is unpredictable, but there are only a few scenarios for the oil companies, so determining a strategy that is suitable for those scenarios is of paramount importance. For oil companies, the most important mindset is that product is a service and price is not the only factor that will attract customers.

7. Appendix

Appendix-1: Assumptions for estimation in Table 4-1[55]

	1990 actual	2010 estimation
GDP, Trillion Yen	430	593
Economic growth rate, % per yr (2001 to 2010)	---	2.0
Population, Thousands	123,611	127,623
New nuclear power plants, units	---	7
Industry production		
Steal, M Ton	111.7	96.5
Ethylene, M Ton	5.81	6.66
Cement, M Ton	89.43	82.79
Paper/pulp, M Ton	28.09	33.74
Agriculture		
Planted acreage, K ha	2,050	1,860
Consumers		
House holds, Thousands	40,670	49,142
Number of passengers, Billion people * Km		
Car	685	892
Train	387	400
Ship/plane	58	107
Waste, M Ton		
Consumer	50.44	50.00
Industry	395.00	480.00

[55] Ministry of the Environment, March 2001, "Scenario of Greenhouse gases emission reduction technology, Kentokai Houkokusho part-1", pp.10-18

Appendix-2: Cost comparison of future cars

Assumptions

- Gasoline price : ¢ 29.8/l (=$1.13/gal w/o tax)[56]
- Gasoline tax[57]
  - U.S. : ¢ 10.6/l(=$0.40/gal)
  - JPN : ¢ 53.6/l(=$2.03/gal)
- Energy consumption for 2020 baseline gasoline ICE : 2.34 MJ/km
- Gasoline LHV : 32.2 MJ/l
- Fuel efficiency[58]
  - 1996 reference gasoline ICE : 156
  - 2020 baseline gasoline ICE : 100
  - 2020 advanced gasoline ICE : 88
  - 2020 hybrid gasoline ICE : 61
- Fuel cost for 2020 baseline gasoline ICE : ¢ 2.9/l (=(29.8+10.6)/32.2*2.34)
- Other variable cost for 2020 baseline gasoline ICE59 : ¢ 2.7/l (=5.6-2.9)

Comparison

Unit: ¢ /l

	US Base			JPN Base		
	Fixed	Variable	Total	Fixed	Variable	Total
1996 gasoline ICE	23.9	7.1	31.0	47.8	12.1	59.9
2020 gasoline ICE	25.0	5.6	30.6	50.0	8.8	58.8
2020 advanced gasoline ICE	26.8	5.3	32.1	53.6	8.2	61.8
2020 hybrid gasoline ICE	29.2	4.9	34.1	58.4	6.9	65.3

Forecast

- As the costs of advanced gasoline ICE and hybrid gasoline ICE are higher than that of gasoline ICE, these cars will not be dominate the market.
- In Japan case, average cost of gasoline ICE and advance ICE is almost same as that of 1996 gasoline ICE. Therefore, I forecast that baseline gasoline ICE will dominate 50% in the market and advance gasoline ICE will dominate 50%.
- Fuel efficiency will be improved 40% in 2020 from 1996 and 20% in 2010. ((100+88)/2 vs. 156)

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56 On the road in 2020, p.2-4

57 On the road in 2020, p.2-14

58 On the road in 2020, p.1-17

59 On the road in 2020, p.1-20

Appendix-3: Assumption for Table 4-2

Gasoline (Appendix-2)

- High-efficiency ICE cars will be introduced, but cost competitive basis
- Fuel efficiency will be improved by 20% in 2010 compared with that in 1998
  Also, improved by 40% in 2020 compared with that in 1998
- 20% efficiency improvement contributes 20% demand decrease
- Demand change: -20%

Kerosene

- Heating efficiency of each house will be improved slightly
- Base demand will increase slightly
- Seasonal fluctuation will not change (long in summer, very short in winter)
- Demand change: 0%

Jet

- Demand will increase steadily and efficiency improvement will not be big
- Demand change: +30%

Diesel

- Same story as gasoline
- Demand change: -20%

Fuel-A (Heating oil))

- Demand increase by additional usage for cogeneration will compensate the demand decrease by efficiency improvement for existing facilities
- Demand change: 0%

Fuel-C (Bunker fuel)

- CO_2 emission by oil burning power plants: 0.7kg-CO_2/Whr
- Additional emission reduction in consumer sector will decrease electricity demand (6,586 ~ 15,390 Kton-CO_2 => 94 ~ 220 *10^8 KWhr)
- Additional emission reduction in industry sector will decrease fuel-C demand directory
  (17,831 ~ 52,102 Kton-CO_2 => 102 ~ 298 *10~8 KWhr as electricity (efficiency=40%))
- Base power generation by oil burning power plants is 918 *10^8 KWhr
- 3 planned nuclear power plants will not be installed by 2010. This will be compensated by oil burning power plants. This will be 225 *10^8 KWhr
- Fuel-C demand for power generation is one third of total fuel-A/C demand

- Power generation by oil burning plants in 1998 was 1057 *10^8 KWhr
- Balance

	Min.	Max.	
Base	918	918	
Nuclear plants	+ 225	+ 225	
Consumer	- 94	- 220	
Industry	- 102	- 298	
Total	947	625	=> 40% reduction from 1998 Around 25% reduction in fuel-C

Oil products total

	Base	% change	2010
LPG	12	0	12
Naphtha	17	0	17
Gasoline	20	-20	16
Kerosene	11	0	11
Jet	2	+30	3
Diesel	15	-20	12
Fuel-A	11	0	11
Fuel-C	11	-25	8
Lubricant	1	0	1
Total	100		91

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