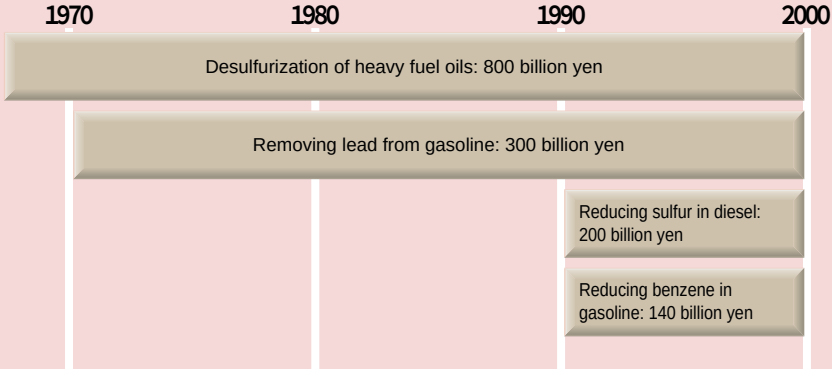
Enhancing the quality of petroleum products—to reduce environmental impacts during use

In the life cycle of petroleum products*1 the greatest environmental impacts occur during the usage phase. Because sulfur oxides (SOx) emitted into the atmosphere become a major cause of air pollution, the oil industry in Japan is working hard to reduce the sulfur content in products.

Japan relies heavily on the Middle East for its supply of oil. Because the sulfur content of Middle East crude is higher than African and North Sea crude, a considerable amount of secondary treatment equipment is needed during refining. Petroleum products used in Japan today have some of the lowest environmental impacts in the world, thanks to strict laws and regulations requiring low sulfur content, as well as investments by industry in desulfurization equipment. In addition, the Petroleum Energy Center is working with the automobile industry to improve air quality, and is working to consider the best improvement strategies for Japan (JCAP*2).

Meanwhile, Cosmo Oil is working to reduce the environmental impacts of the refining process and pouring resources into technological development, with the top priority given to areas such as reducing the sulfur content of fuels and improving fuel combustion. We will continue to put our effort into developing catalysts to reduce sulfur content, and to provide customers with products that have low environmental impacts during use.

Environmental measures and capital investment (by Japan's petroleum industry)



• Gasoline

To reduce the environmental impacts of gasoline, Japan's petroleum industry has worked to make gasoline lead-free, and to reduce benzene and sulfur content.

In 1975 regular gasoline became lead-free, followed by premium gasoline in 1986. Meanwhile, the government reduced the permitted benzene*3 content to less than 1 volume % in January 2000, paving the way for sales of low-benzene gasoline.

Sulfur content is regulated by JIS standards at 100 ppm (0.1 mass %) today, and this will be further reduced to less than 50 ppm in 2005. Cosmo Oil is already selling gasoline with sulfur content far better than the regulated standards, at 30 ppm for regular gasoline and 5 ppm for premium (both levels achieved during fiscal 2002).

In order to reduce emissions of hydrocarbon vapors, one cause of photochemical smog, as a part of voluntary efforts by the oil industry, starting in 2005 we will be reducing the Reid vapor pressure (RVP) of gasoline in summer from the current 72 kPa down to 65.

Improvements in gasoline quality by the Japanese petroleum industry

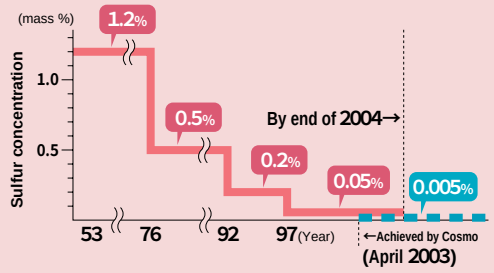
1950 Gasoline production begins
1970 Lead pollution (in air) incident in Shinjuku, Tokyo
1975 Regular gasoline becomes completely lead-free
1986 Premium gasoline becomes completely lead-free
1987 Sales of 100-octane premium gasoline begin
1991 Sales of methyl tertiary butyl ether (MTBE) blended premium gasoline begin*4
1996 Revision of JIS standards (benzene to less than 5 volume %, sulfur to less than 100 ppm, and MTBE to less than 7 volume %)
2000 Regulation of benzene content to 1 volume %

• Diesel

To reduce the amount of sulfur in diesel fuel, the Japanese petroleum industry began the installation of hydro-desulfurization equipment during the late 1950s. Sulfur levels in diesel fuel were reduced to 0.2 mass % in 1992, and then to less than 0.05 in 1997. In order to make emissions gases even cleaner, the government has decided to reduce sulfur in diesel to 0.005 mass % (50 ppm) by the end of 2004.

Using newly developed catalysts, Cosmo Oil was able to start supplying 50 ppm diesel in April

Regulated sulfur levels in diesel (Japan)



***1.** See page 31.

***2. JCAP**
Abbreviation for Japan Clean Air Program. This is an air quality improvement program promoted by the Petroleum Energy Center, with cooperation from the automobile and petroleum industries. Its focus is on promoting advanced automobile and fuel technologies. Japan's vehicle exhaust regulations are among the toughest in the world, but to improve air quality it is necessary to reduce emission gases even further. For this purpose, Cosmo Oil is considering air quality improvement strategies that would be the most appropriate for Japan, considering the specific conditions of the country's society, industrial structure, geography and climate, etc.

***3. Benzene**
Benzene has attracted concern for its adverse effects on human health. Japan's Ministry of the Environment has classified it as a priority substance and hazardous air pollutant, although the effects on living organisms of benzene at the levels found in gasoline are not yet fully known.

***4. MTBE**
Cosmo Oil applied the precautionary principle when considering the environmental impacts of MTBE, and stopped using it as a gasoline additive in fiscal 2001.

2003 nationwide (except in Okinawa and the outer islands), a year and nine months ahead of the government regulations. We are now participating in a New Energy and Industrial Technology Development Organization (NEDO) project to develop even more efficient catalysts.

●Kerosene

Current JIS standards for sulfur content in kerosene are at 80 ppm (0.008 mass %). Cosmo Oil started supplying kerosene at even cleaner levels (28 ppm) in fiscal 2002.

●Heavy fuel oil

The government ordered temporary shutdowns of nuclear power plants in Japan for inspections during fiscal 2002, which led to an increase in demand for heavy fuel oil C for electricity generation. Cosmo Oil adjusted production to meet these changing circumstances, but a decline in demand for this grade of oil is predicted in the future. We will increase production of higher value-added diesel and gasoline products by refining heavy oil further. Cosmo Oil is also entering into independent power production, generating electricity using heavy oil and asphalt fractions.

Progress toward sulfur-free automotive fuel

●Developing automotive fuels

The European Union is preparing for the complete phase-in of "sulfur-free" gasoline and diesel (sulfur content 10 ppm or less) by 2009. Oil refineries will have to make capital investments in order to produce sulfur-free automotive fuels, and more intensive processing will increase CO_2 emissions during the refining process. The new legislation will only succeed through the introduction and popular use of vehicles built with new technologies that can run on sulfur-free fuels.

Cosmo Oil and other members of the Petroleum Association of Japan believe that with the utmost effort, it will be possible to have all gasoline and diesel products sulfur-free by 2008. We are studying the possibility of having all diesel fuels sulfur-free by 2007, provided vehicles are on the market that can use it. Although conditions differ with each oil company, Cosmo Oil will be able to offer a partial supply of sulfur-free diesel in about 2005, and we are working hard to make it available at the earliest possible date.

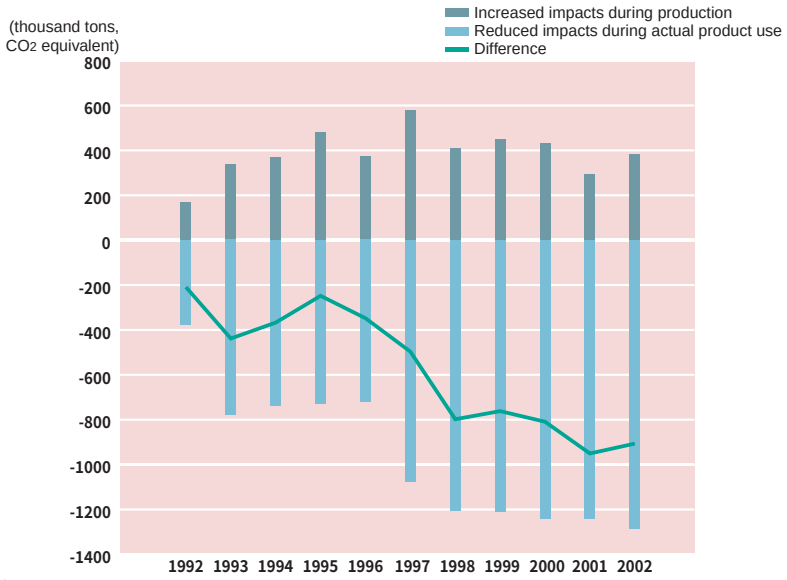
■Integrated assessment: Reduced diesel sulfur content and environmental impacts at refineries

It is impossible to reduce environmental impacts during the use phase of fuels by boosting the quality of petroleum products without more intensive refining—and this requires the use of more energy at refineries. To reduce the environmental impacts of petroleum over the entire life cycle, the decrease in impacts during use must be greater than the increase in impacts during refining. We used diesel as a case study of an integrated assessment to compare the net change in environmental impacts.

Sulfur content of diesel was reduced from 0.5% to 0.2% in October 1992, and then to 0.05% in July 1997. Cosmo Oil reduced it further to 50 ppm (0.005%) in September 2002.

The graph below shows the environmental impacts at the oil refinery and during use, with 1991 as the base year. Clearly the impacts at the refinery increased, but impacts during the use of diesel fuel declined an even greater amount. One can conclude that the environmental impacts over the entire life cycle have declined.

Reference "Environmental Priority Strategies in Product Design (2000)", Centre for Environmental Assessment of Products and Material Systems, Sweden.



Notes:

1. EPS weighting factors (CO_2=1): SOx=30.3, NOx=19.7, COD=0.00935.
2. This study uses CO_2, SOx, NOx and COD to assess environmental impacts.
3. The environmental impact of diesel fuel use was assessed in terms of SOx, calculated by multiplying production volume by sulfur content (using the JIS standard for diesel sulfur content until fiscal 1999, and our actual sulfur content thereafter), and then converting it to SO_2.

Status of ISO 9001 certification

Site	Prefecture	Certification body	Certification date
Cosmo Oil Co.			
Chiba Oil Refinery	Chiba	JQA	December 25, 1996
Yokkaichi Oil Refinery	Mie	JQA	February 18, 1997
Sakai Oil Refinery	Osaka	JQA	March 14, 1997
Sakaide Oil Refinery	Kagawa	JQA	May 10, 1996
Cosmo Matsuyama Oil Co.	Ehime	JQA	November 14, 1997
Cosmo Oil Lubricants Co.			
Osaka Plant	Osaka	JQA	March 31, 1997
Shimotsu Plant	Wakayama	JQA	May 9, 1997

ISO 9001 is a set of globally accepted standards created in 1987 by the International Organization for Standardization (ISO), to ensure the quality of products and services. An independent certification body verifies and judges if quality management systems established by companies meet international requirements set in ISO 9001.