Reduction of Environmental Impacts from Product Production and from Product Use

Although the largest environmental impacts that occur within the life cycle of petroleum products are attributable to the CO_2 emissions from product use, considerable environmental impacts are caused during crude oil refinery processes as well. On this account, Cosmo Oil works hard to reduce energy use at refineries, prevent air and water pollution, reduce waste, and control chemical substances.

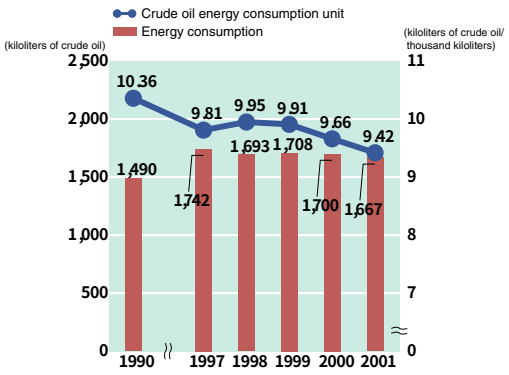
We also recognize that in order to promote effective environmental protection, it is important to provide information that confirms the actual effects of our activities on the reduction of impacts on the environment. This year, therefore, we did a trial calculation on the balance between the environmental impacts occurring from product production and from customer use of products*1.

Prevention of Global Warming

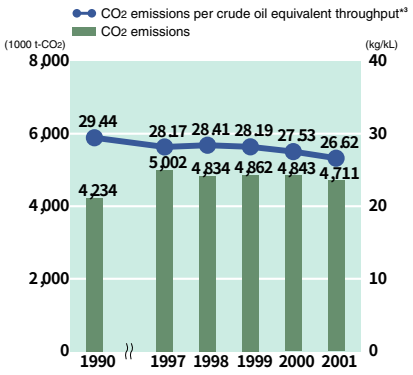
Oil refineries use a great deal of energy and emit large amounts of CO_2 in the process of refining crude oil; therefore, Cosmo Oil focuses on preventing global warming by reducing energy use. The oil industry sets its activity targets for reducing CO_2 emissions in terms of crude oil energy consumption units*2; we also set similar targets and promote the reduction of energy use for heating furnaces and boilers that are used during the refining processes.

In the 1990s, the increases in crude oil throughput, and the actions for the environment such as the reduction of sulfur content in kerosene and the reduction of benzene in gasoline increased energy consumption at oil refineries. However, through the promotion of energy conservation, FY 2001 levels of energy consumption units in total for the four refineries were already 9.1 percent below FY 1990 levels.

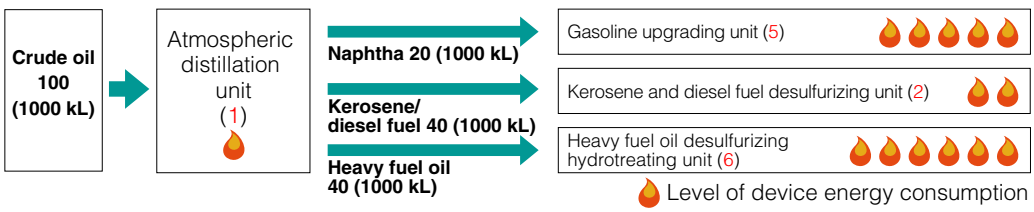
Changes in Energy Consumption



Changes in CO_2 Emissions



- **Calculation:** Total oil refinery energy use (5000 kL crude oil equivalent)



- **Crude oil equivalent throughput** (100x1) + (20x5) + (40X2) + (40x6) = 520
- **Crude oil energy consumption units** 5000/520 9.6 (kiloliters of crude oil/thousand kiloliters)

*1 See page 22.

***2 Crude oil energy consumption units**

The unit of crude oil energy consumption is the total amount of energy used at oil refineries divided by the amount of crude oil equivalent throughput. The unit is shown in "kiloliters of crude oil/thousand kiloliters". The total amount of energy used is converted to the crude oil equivalent and the unit is shown in "kiloliters of crude oil".

***3 Crude oil equivalent throughput**

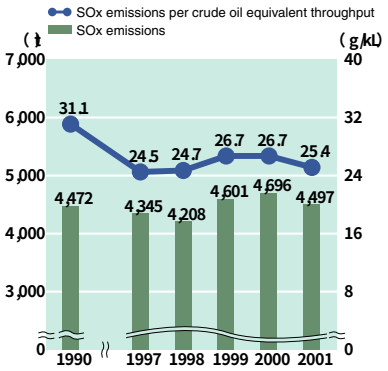
Crude oil equivalent throughput is derived by converting the throughput of each unit into the crude oil equivalent throughput at the atmospheric distillation column. Crude oil is first separated at the atmospheric distillation column into naphtha, kerosene, diesel fuel, heavy fuel oil, etc., and then processed for sulfur reduction. Because the composition of units differs among oil refineries, crude oil energy consumption units are calculated by using crude oil equivalent throughputs that reflect the operating conditions of each unit. The throughputs are converted based on the consumption of energy at each unit with the energy consumption at the atmospheric distillation column as the base. The sum of the throughputs for individual units is the total crude oil equivalent throughput for an oil refinery.

Prevention of Air Pollution

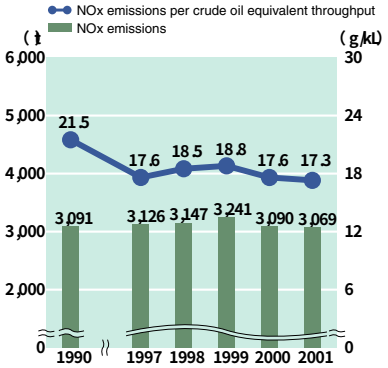
The heating furnaces, boilers and other facilities used for refining at the oil refineries emit both SOx (sulfur oxides) and NOx (nitrogen oxides) gases. We therefore work hard not only to comply with regulatory standards but also to further reduce emissions of these air pollutants through the use of low-sulfur fuels and countermeasures including the desulfurization of flue gases.

As for hydrocarbon vapors, a cause of photochemical smog, actions have been taken to reduce their leakage from tanks and distribution facilities at oil refineries and oil storage depots. These countermeasures also contribute to the reduction of emissions of benzene, toluene, xylene, etc. which are contained in petroleum products*1.

Changes in Sulfur Oxides (SOx) Emissions



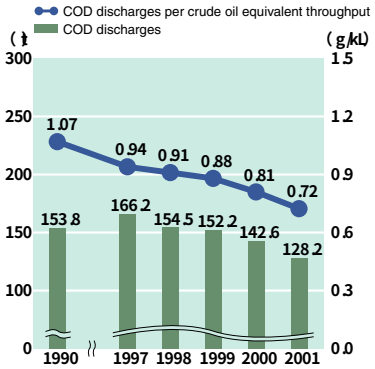
Changes in Nitrogen Oxides (NOx) Emissions



Prevention of Water Pollution

Because oil becomes mixed with wastewater at oil refineries, oil separation systems are installed to purify the wastewater before discharge in order to prevent water pollution.

Changes in Water Pollutant (COD*2) Discharges



Reduction of Emissions of Dioxins*3

Pollution caused by dioxins emitted from facilities such as waste incineration plants has attracted great attention in recent years. In 1999, the Law Concerning Special Measures against Dioxins, which sets environmental standards and emission standards, came into force. The levels of dioxins emitted from our oil refineries equipped with incinerators had been controlled well below the emission standards; however, we decided to suspend the use of some of the incinerators in consideration of future circumstances surrounding the issue. For the rest of the incinerators, we have tightened their control.

PCB Storage Management

The production of polychlorinated biphenyls (PCBs), which had been widely used in electric appliances such as transformers and condensers, was banned in 1972, since their toxicological properties caused controversy through incidents as the Kanemi Rice Oil Case in 1968. In 2001, the Law Concerning Special Measures against PCB Waste was enacted, under which organizations holding PCB waste are required to submit a report on the storage conditions and to properly dispose of the waste within a certain period of time. PCBs are stored under strict control at our sites.

***1** See page 21 “Control of Chemical Substances”.

***2 COD**
Chemical Oxygen Demand. A water pollution index that indicates the amount of oxygen consumed in the complete chemical oxidation of organic and inorganic oxidizable substances present in wastewater.

***3 Dioxins**
Polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and coplanar PCBs are classified as “dioxins” under the Law Concerning Special Measures against Dioxins. They are generated through, for example, the incinerating process of wastes, and have toxic and carcinogenic effects.

Soil Conservation

As public awareness of soil conservation and soil pollution prevention has increased in recent years, many laws have been passed by the government in order to improve the situation. The Cosmo Oil Group drew up a policy for its approach to soil conservation in June 2002, and will work to protect the soil environment based on this policy.

Policy on Soil Conservation

We check the soil condition at the offices of Cosmo Oil and its affiliated companies and sales facilities of Cosmo brand products according to the plans, and take measures where required.

- Voluntary soil investigations conducted at our service stations, where underground tanks were installed more than 20 years ago, revealed obvious soil pollution at some sites. We will therefore take the following additional measures.
  1. A risk assessment of the soil environment will be performed at all our service stations including special agents. A voluntary check of facilities will be conducted in accordance with the degree of risk and measures will be taken.
  2. A new standard for service station management will be established to strengthen day-to-day management and to prevent oil leakages.
- For other business establishments, specific soil investigation plans will be drawn up based on the type of business and use of each establishment, and the plans will be implemented accordingly.

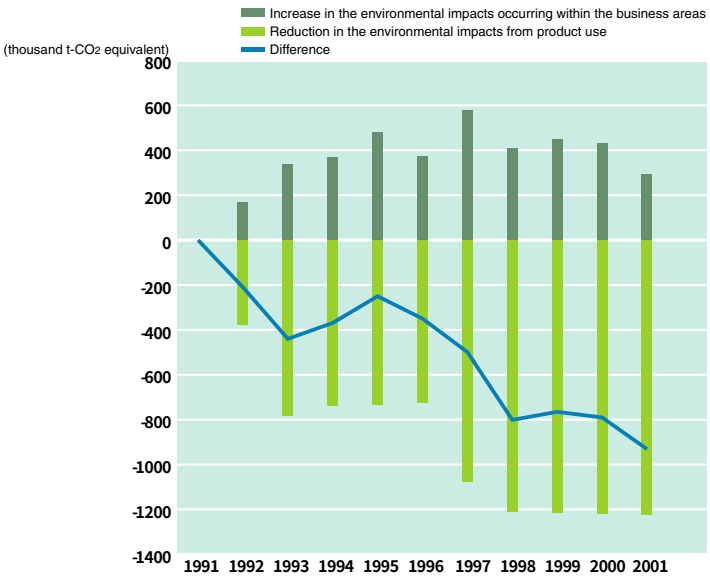
Diesel Fuel Sulfur Reduction and Integrated Evaluation of Environmental Impacts

In order to reduce environmental impacts occurring at the time of product use by increasing the quality of petroleum products, a large amount of energy is required during the refining process at oil refineries thereby increasing the environmental impacts generated. Environmental impacts must be evaluated comprehensively in order to reduce the impacts throughout the life cycle of oil. We performed an integrated evaluation of sulfur reduction and environmental impacts caused by oil refineries on a trial basis, focusing on sulfur reduction of diesel fuel as a typical example of quality improvement of petroleum products. We used EPS*, a common method for integrated evaluation developed in Sweden.

The sulfur level in diesel fuel was reduced from the previous level of 0.5% to 0.2% by October 1992, and it was further reduced to less than 0.05% by July 1997. During this period, improvements were made to facilities and their operation, including the installation of a deep desulfurization unit, and although crude oil energy consumption units and environmental impacts per crude oil equivalent throughput were reduced as a result of our efforts to conserve energy and reduce environmental impacts, the absolute amount of environmental impacts occurring at oil refineries inevitably increased.

The figure below shows changes in environmental impacts from oil refineries and from use of diesel fuel, compared with FY 1991 levels. The environmental impacts from oil refineries increased; however, a greater reduction was achieved in the impacts caused by use of diesel fuel. This means that the environmental impacts from the whole life cycle of products was reduced.

*EPS: Environmental Priority Strategies in Product Design Version 2000
(Centre for Environmental Assessment of Products and Material Systems, Sweden)



* Weighting factor in EPS (CO_2 = 1): SOx = 30.3, NOx = 19.7 and COD = 0.00935
* The environmental impacts from oil refineries that have been evaluated include CO_2, SOx, NOx, and COD.
* The environmental impacts from the use of diesel fuel was calculated as SOx emissions. The total amount of sulfur content in diesel fuel is firstly calculated by multiplying the sulfur content in diesel fuel according to the JIS and the production volume. The total amount of sulfur is then converted to SO_2 emissions.

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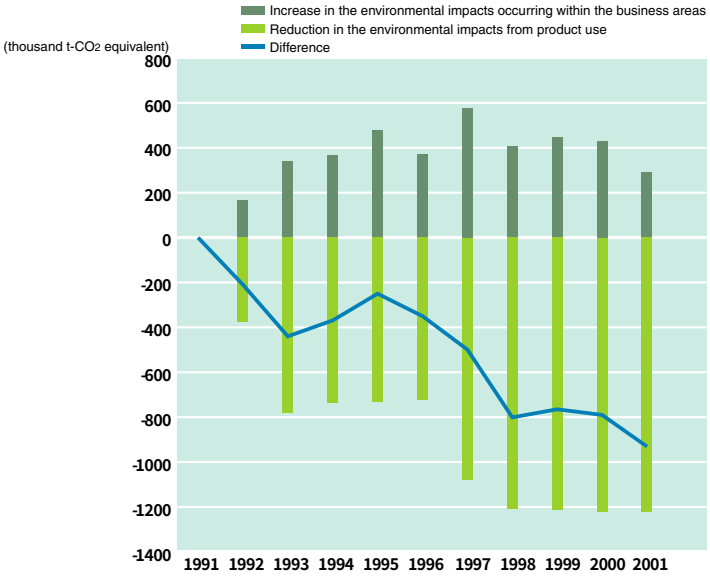

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