

Sophisticated Environmental Accounting Systems for Better Management Decision-making and Disclosure

Environmental Accounting System of Cosmo Oil Group

The environmental accounting system of the Cosmo Oil Group has entered its second year since the Group introduced the system in 2001. The Cosmo Oil Group is using the system as a tool for management decision-making and for promoting accountability to the public.

In gathering environmental accounting data, we measure the costs associated with our environmental protection activities and also the benefits resulting from those activities, taking into account several unique characteristics of the petroleum industry, such as: 1) That since petroleum products are burned when used by consumers, environmental pollutants are generated at the consumption stage; and 2) That because Japan's petroleum products are largely produced from high-sulfur Middle East oil, massive investment has been necessary over many years to build an advanced purification infrastructure (see the graph 'Changes in Year-end Acquisition Costs', which is shown below).

In the previous year, we undertook environmental accounting in accordance with the guidelines of the Petroleum Energy Center (PEC), drawing upon the guidelines of the Ministry of the Environment (2000 version). This year, however, we referred to the 'Guideline for Introducing an Environmental Accounting System (2002 Version)' of the Ministry of the Environment, which was made public in March 2002, to make our environmental accounting more comprehensible.

As in the previous year, environmental costs are calculated to cover the costs stated in financial accounting.

This year, the Cosmo Oil Group, for the first time, calculated environmental indicators*. Although this effort is still in its pilot phase, we hope the indicators will be of use to the reader.

Period and Scope of the Environmental Accounting Report

Report Period

Fiscal year 2001 (April 1, 2001 to March 31, 2002)

Report Scope

The report covers Cosmo Oil's four oil refineries and its Research and Development Center, and Cosmo Matsuyama Oil. With regard to the environmental costs and benefits of the affiliated companies, only those that are closely related to Cosmo Oil's four oil refineries are identified and measured.

Cosmo Oil Co., Ltd.

Chiba Oil Refinery, Yokkaichi Oil Refinery, Sakai Oil Refinery, Sakaide Oil Refinery, Research and Development Center (only the costs and benefits of research and development in the area of environmental protection are included)

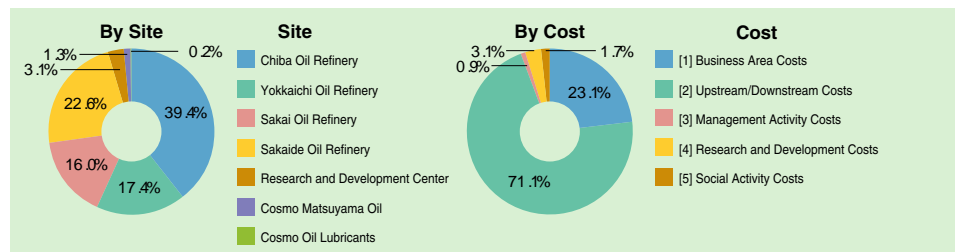
Cosmo Matsuyama Oil Co., Ltd.

Cosmo Oil Lubricants, Co., Ltd.

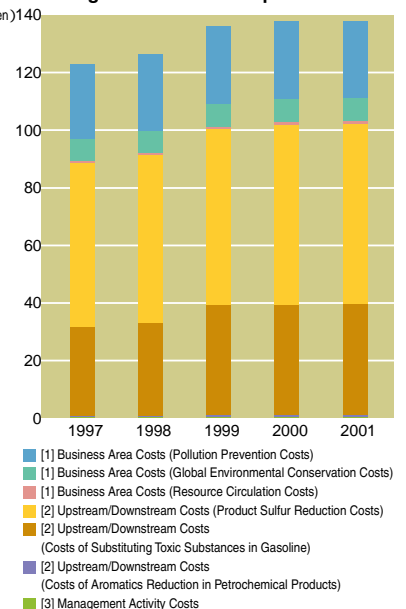
Chiba Factory, Yokkaichi Factory (the environmental costs and benefits of these two factories are included in those of Cosmo Oil's Chiba Oil Refinery and Yokkaichi Oil Refinery), green procurement costs for raw materials of lubricating oils

* See pages 22, 25, 27 and 28.

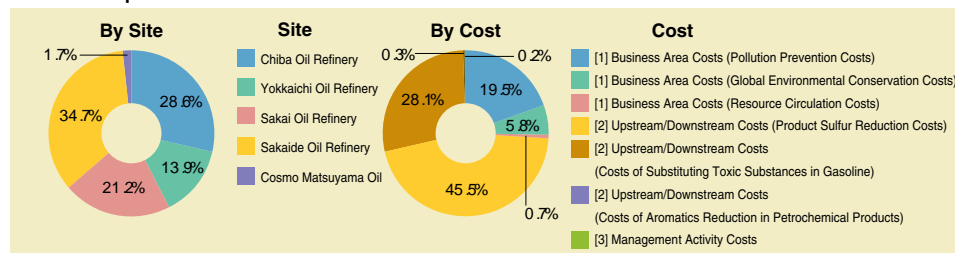
Environmental Cost



Changes in Year-end Acquisition Costs



Year-end Acquisition Costs



Environmental Accounting by Site

Environmental accounting is prepared separately for Cosmo Oil's four refineries, Cosmo Matsuyama Oil and others. Separate data on each site is provided on pages 45 to 50.

Changes from the Previous Year

Changes from the previous year's environmental accounting are shown below.

Expansion of Scope

In the previous year, at Cosmo Matsuyama Oil, only the after-treatment facilities used for the reduction of benzene in gasoline, which is directly related to Cosmo Oil's products, were included in the scope. This year, however, the scope was expanded to include all environmental protection activities.

Cosmo Matsuyama Oil, which mainly deals with petrochemicals production, differs in its objectives, equipment, and processes from oil refineries, which are principally concerned with the production of fuels such as gasoline. The process in which aromatics are removed from Cosmo Matsuyama Oil's products is regarded as the process of producing environment-friendly products, and the costs associated with the process are accounted for as upstream/downstream costs.

Data Compilation

In the previous year, we compiled environmental accounting data in accordance with the guidelines of the Petroleum Energy Center (PEC). This year, however, we turned to the guidelines of the Ministry of the Environment, and counted 'product environmental impact reduction costs' and 'product environmental impact reduction benefits' as 'upstream/downstream costs' and 'upstream/downstream benefits', respectively.

The costs and benefits of product sulfur reduction did not cover all the products of the Cosmo Oil Group and therefore were not fully comprehensible. This year, sulfur reduction in the Cosmo Oil Group's major products, which range from LPG to heavy fuel oil C, is subject to environmental accounting. The costs of product sulfur reduction are allocated to each product according to the sulfur reduction rate of the product.

The costs of the environmental impact reduction of gasoline, which were shown as 'costs of removal of

lead from gasoline' and 'costs of benzene reduction in gasoline' in the previous year, are shown as 'costs of substituting toxic substances in gasoline'.

The benefits of environmental impact reduction, which were in the previous year measured as the differences between the levels set by the Japanese Industrial Standards (JIS) and the actual levels, are measured as the differences between the concentrations or the basic units of the previous year and those of the current year.

Results of Environmental Accounting

For the fiscal year 2001, the investment amount was 1,062 million yen and the expenditure amount was 47,191 million yen. Compared with the previous year, the investment amount decreased by 1,371 million yen, while the expenditure amount decreased by 1,773 million yen. On the other hand, the year-end acquisition costs were 137,804 million yen, an increase of 140 million yen from the previous year.

With regard to the benefits of environmental protection, we performed better than the previous year in almost all items of the 'business area benefits'. Among the 'upstream/downstream benefits', although the sulfur content of four oil products increased, the average of all oil products scored better than that of the previous year.

The sulfur content of kerosene increased from the previous year, but it is still far below the level of 0.008 volume percent, which is set by the JIS.

Tasks for the Future

This year, which is the second year of our environmental accounting, we focused on issues remaining from the previous year.

Public demand for the disclosure of environmental information will surely continue to grow in the future.

In response, the Cosmo Oil Group will conduct research on how environmental accounting can be used to assist management decision-making while fulfilling our obligations to stakeholders.

Furthermore, we will consider developing computer systems for environmental accounting to improve the accuracy and speed of compiling environmental accounting data.

Methods of Compiling Environmental Accounting Data

Measurement of Environmental Costs

Investment amount: Capital investment for depreciable assets which were acquired for the purpose of environmental protection

Expenditure amount: Current expense amount associated with environmental protection activities (including depreciation expense)

Changes: Changes from fiscal year 2000

[1] Business area costs

Global environmental conservation costs:

Costs associated with energy saving facilities and equipment such as co-generation facilities

Pollution prevention costs:

Costs to prevent air pollution (sulfur recovery facilities, nitrogen oxide control facilities, etc.)

Costs to prevent water pollution (wastewater treatment facilities, sour water treatment facilities, etc.)

Resource circulation costs:

Costs related to waste processing and recycling

[2] Upstream/downstream costs

Product environmental impact reduction costs:

Costs associated with producing products that are less damaging to the environment

Product sulfur reduction costs:

Costs associated with reducing the emissions of SOx that are generated during product use by lowering the sulfur content in products

Costs of substituting toxic substances in gasoline (benzene, etc.):

Costs associated with the reduction and substitution of toxic substances in gasoline such as benzene and lead

Costs of aromatics reduction in petrochemical products:

Costs associated with the reduction of aromatics and olefins in raw materials of petrochemical products

[3] Management activity costs:

Costs incurred for employee environmental education, operation, and maintenance related to the environmental management system, maintenance of green spaces in business establishments, and the monitoring and measurement of environmental impacts

[4] Research and development costs:

Costs incurred for research and development related to environmental protection

[5] Social activity costs:

Costs incurred for compensation levied by the Pollution-related Health Damage Compensation Law

Measurement of Benefits of Environmental Protection

"Reduction benefit" and "Reduction": The 2000 value minus the 2001 value

[1] Business area benefits

Concentrations/unit values: Environmental impacts per crude oil equivalent throughput

Environmental impacts: Environmental impacts generated at business establishments

* Concentrations/unit values of Business area benefits do not include figures of Cosmo Matsuyama Oil, since no crude oil is processed at Cosmo Matsuyama Oil and therefore crude oil equivalent throughput cannot be calculated.

[2] Upstream/downstream benefits

Benefits of product environmental impact reduction through the sophistication of refining processes at refineries

Concentrations/unit values:

Product sulfur reduction: Sulfur content in products

Benefits of substituting toxic substances in gasoline (benzene reduction in gasoline): Benzene concentration in gasoline

CO₂ emissions from product use: CO₂ Emissions divided by the production volume of petroleum products

Environmental impacts: Potential environmental impact expected when the product is used, after the reduction of product environmental impacts at the oil refinery level

Product sulfur reduction: SO_x emissions, calculated by multiplying the average sulfur content in products by their production volume

Benefits of substituting toxic substances in gasoline (benzene reduction in gasoline): Potential benzene emissions, calculated by multiplying the average benzene concentration in gasoline by its production volume

Benefits of aromatics reduction in petrochemical products: Aromatics in raw materials of petrochemical products reduced at business establishments

CO₂ emissions during product use: CO₂ Emissions, calculated by multiplying the CO₂ emission factor for the product, which is set by the Petroleum Association of Japan, by its production volume

* The actual SO_x emissions are smaller than the potential SO_x emissions, as the reduction of SO_x emissions by the desulfurization unit at the time of customer use is not taken into consideration.

* Most suitable production methods are employed to strike a balance between costs and environmental protection, and thus the sulfur content of each product is well below the level set by the JIS.

* The figures include those of naphtha, although naphtha is used as a raw material for petrochemicals and fertilizers and thus SO_x and CO₂ are not directly generated.

Environmental Accounting

Item	Environmental cost (million yen)			
	Investment amount		Expenditure amount	
	FY 2001	Changes	FY 2001	Changes
1 Business area costs	203	- 390	10,911	- 232
Global environmental conservation costs	1	- 29	6,494	14
Pollution prevention costs	185	- 220	3,794	- 157
Resource circulation costs	17	- 141	623	- 89
2 Upstream/downstream costs	859	- 981	33,546	- 1,726
Product environmental impact reduction costs	859	- 980	33,446	- 1,744
Product sulfur reduction costs	469	- 1,044	23,817	- 1,236
Gasoline	133	- 297	6,497	- 332
Naphtha	29	- 60	1,597	183
Jet fuel oil	16	- 35	1,296	77
Kerosene	82	- 180	4,116	- 600
Diesel fuel	116	- 255	5,935	- 586
Heavy fuel oil A	66	- 157	2,705	152
Heavy fuel oil C	8	- 30	780	- 159
LPG	19	- 30	891	29
Costs of substituting toxic substances in gasoline (benzene, etc.)	389	63	9,514	- 506
Costs of aromatics reduction in petrochemical products	1	1	115	- 2
Green procurement costs	0	- 1	100	18
3 Management activity costs	0	0	452	22
4 Research and development costs	0	0	1,462	131
5 Social activity costs	0	0	820	32
Total	1,062	- 1,371	47,191	- 1,773

Integrated Environmental Indicators and Environmental Productivity

As part of environmental accounting, we calculated integrated environmental indicators and environmental productivity on a trial basis.

Integrated environmental indicators are derived by using EPS, which is a commonly used method for integrating environmental impacts. The emissions from business establishments of SO_x, NO_x, benzene, COD, CO₂, and the emissions of SO_x and CO₂, which are assumed to be generated at the time of customer use, are evaluated from a comprehensive standpoint.

Environmental productivity is the production volume divided by the integrated environmental impacts. Greater environmental productivity indicates that more is produced per given environmental impacts. Both types of indicators score better than those of the previous year.

Item	Benefits of environmental protection			
	Concentrations/unit value		Environmental impacts	
	Reduction benefit	FY 2001	Reduction	FY 2001
1 Business area benefits				
Benefits of reduction in resource input	(kL-crude oil/thousand kL)	(kL-crude oil/thousand kL)	(TJ)	(TJ)
• Energy input	0.24	9.42	1,350	66,724
	(kg/kL)	(kg/kL)	(thousand t)	(thousand t)
• Water input	-9	190	-1,854	37,010
Benefits of reduction in emissions and waste generation				
Release to atmosphere	(kg-CO ₂ /kL)	(kg-CO ₂ /kL)	(thousand t-CO ₂)	(thousand t-CO ₂)
• CO ₂	0.91	26.62	139	4,862
	(g/kL)	(g/kL)	(t)	(t)
• SO _x	1.3	25.4	223	5,478
• NO _x	0.3	17.3	35	3,256
• Benzene	0.00	0.03	0.57	13.54
Release to water	(g/kL)	(g/kL)	(t)	(t)
• COD	0.09	0.72	14.5	130.6
Wastes	(g/kL)	(g/kL)	(t)	(t)
• Industrial wastes generated	33	301	5,715	53,584
• Industrial wastes recycled	-1	63	-173	11,204
• Industrial wastes disposed of	3	10	522	1,881
2 Upstream/downstream benefits				
Benefits of product environmental impact reduction				
Product sulfur reduction	(sulfur: mass %)	(sulfur: mass %)	(potential SO _x emissions: t-SO ₂)	(potential SO _x emissions: t-SO ₂)
Total	0.0636	0.4083	29,631	178,022
Gasoline	0.0003	0.0025	26	235
Naphtha	-0.0010	0.0271	-143	757
Jet fuel oil	-0.0081	0.0255	-215	501
Kerosene	-0.0006	0.0039	-31	225
Diesel fuel	0.0003	0.0409	88	3,433
Heavy fuel oil A	0.0617	0.4665	2,060	27,057
Heavy fuel oil C	0.0593	1.7546	27,847	145,811
LPG	-0.0001	0.0003	-1	3
Benefits of substituting toxic substances in gasoline	(volume %)	(volume %)	(t)	(t)
	0.0743	0.5401	4,006	30,595
Benefits of aromatics reduction in petrochemical products			(kL)	(kL)
			-1,736	3,652
CO ₂ Emissions from Product Use	(t-CO ₂ /kL)	(t-CO ₂ /kL)	(thousand t-CO ₂)	(thousand t-CO ₂)
	0.018	2.5365	1,105	69,355

Economic Benefits

Item	(million yen)	
	Amount	
Savings through energy reductions (savings through cogeneration)	2,067	
Saving through catalyst recycling	22	
Benefits from research and development	104	
Total	2,193	

Measurement of Economic Benefits

Savings through energy reductions (savings through cogeneration):
 Savings through cogeneration = Savings from steam generation + Reduction of electricity costs - Costs of fuels (LPG, heavy fuel oil, etc.)
 Saving through catalyst recycling (reduction of waste management cost, etc.):
 The costs avoided of purchasing new catalysts and of disposing of waste catalysts, through catalyst recycling
 Benefits from research and development (income from royalties, etc.):
 Income from royalties is the actual amount received, and savings from research and development are the costs avoided through the achievement of research and development.

Integrated Environmental Indicators

(Unit: thousand t-CO₂ equivalent)

Item	CO ₂ equivalent using EPS	
	FY 2001	Reduction (compared with FY 2000)
Business Area SO _x	166	7
NO _x	64	1
Benzene	0	0
COD	0	0
CO ²	4,863	138
Business Area Total	5,093	146
Product Use Potential SO _x emissions	5,394	898
CO ₂ emissions from product use	69,355	1,105
Product Use Total	74,749	2,003
Business Area Total + Product Use Total	79,842	2,148

1. Weighting factor in EPS (CO₂ = 1); SO_x = 30.3, NO_x = 19.7 and COD = 0.00935

*EPS: Environmental Priority Strategies in Product Design Version 2000

(Centre for Environmental Assessment of Products and Material Systems, Sweden)

Environmental Productivity

(Unit: kL/t-CO₂ equivalent)

Item	Production Volume Per Unit of Integrated Environmental Impacts	
	FY 2001	Improvement (compared with FY 2000)
Business Area Total	5.457	0.124
Product Use Total	0.372	0.008
Business Area Total + Product Use Total	0.348	0.007