



Environmental Activities: Supplementary Data

★ : Assured by an independent assurance provider

2 Environmental Protection

Environmental Performance

Sumitomo Chemical collates and totals environmental data for the Company and Group companies in Japan and overseas, including data on energy and resource consumption, production quantities, and environmental impact (e.g., release of pollutants into the air and water).

FY2018–2020 Environmental Performance (Sumitomo Chemical and Group Companies in Japan)

INPUT Energy and Resources



Water

	(Million tons)		
	FY2018	FY2019	FY2020★
Industrial water*1	63.1	63.7	63.4
Drinking water	0.8	0.8	0.8
Seawater	848	918	878
Groundwater*1	28.3	25.3	26.8
Other water	2.4	2.2	2.6
Total*1	943	1,010	972



Energy

Calculated as kl of crude oil

	(Thousand kl)		
	FY2018	FY2019	FY2020★
Fuel, heat, and electricity*2	1,690	1,720	1,767



Exhaustible Resources

	(Thousand tons)		
	FY2018	FY2019	FY2020
Hydrocarbon compounds	1,676	1,829	1,704
Metals (excluding minor metals)*3	121	109	90.2
Minor metals*4	13.5	11.2	12.5

PCB/CFCs under Secure Storage

	FY2018	FY2019	FY2020
No. of electrical devices containing high concentrations of PCBs*5	10	13	11
PCB volume (pure equivalent) (kl)*5	0.1	0.1	0.1
No. of refrigeration units using specified CFCs as a coolant	32	32	37
No. of refrigeration units using HCFs as a coolant	272	260	255

Note: The number of companies included in the boundary of calculation for the environmental performance data on page 128 is as follows for each year.

FY2018: Sumitomo Chemical and Group companies in Japan: 21 companies

FY2019: Sumitomo Chemical and Group companies in Japan: 21 companies

FY2020: Sumitomo Chemical and Group companies in Japan: 22 companies

*1 At Sumitomo Chemical's Works, it became apparent that some of the industrial water and groundwater withdrawal had not been included in the calculations, so industrial water in fiscal 2019 has been retrospectively revised by 0.2 million tons while groundwater in fiscal 2018 has been revised by 5.6 million tons and in fiscal 2019 by 3.5 million tons. Totals have also been revised accordingly.

*2 From fiscal 2017, the energy (calculated as kl of crude oil) indices were calculated in accordance with the GHG Protocol (refer to page 225 "Calculation Standards for Environmental and Social Data Indicators").

• Having adopted the GHG Protocol standards for our GHG emission disclosures, we now include the following data previously excluded from calculations: amount of energy used to produce power and steam sold to external parties by Sumitomo Chemical and Group companies in Japan (the portion attributable to energy provider subsidiaries was included in years prior to fiscal 2016). In addition, the amount of energy used by Sumitomo Chemical's non-production sites is included from fiscal 2017, and the amount of energy used by the Group companies in Japan non-production sites is included from fiscal 2018. From fiscal 2018, the boundary of calculation has been expanded to include principal consolidated Group companies in Japan, which account for up to 99.8% of consolidated net sales.

*3 Calculations include the following 12 metals: iron, gold, silver, copper, zinc, aluminum, lead, platinum, titanium, palladium, gallium, and lithium.

*4 Calculations include the following seven minor metals: nickel, chromium, tungsten, cobalt, molybdenum, manganese, and vanadium. The supply structure for each of these minor metals is extremely fragile. These minor metals are subject to national stockpiling.

*5 Fluorescent lamps and mercury lamp ballast as well as contaminated substances (wastepaper, etc.), including PCB waste, are not included in unit and volume data.



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OUTPUT Product Manufacturing and Environmental Impact



Products

	(Thousand tons)		
	FY2018	FY2019	FY2020★
(Calculated on the basis of ethylene production)*1	2,490	2,521	2,526



Water
Pollutant
Emissions

		(Tons)		
		FY2018	FY2019	FY2020★
COD	Coastal waters/waterways	998	887	874
	Sewer systems	216	197	168
Phosphorus	Coastal waters/waterways	35	30.5	34.7
	Sewer systems	5	4.7	4.9
Nitrogen	Coastal waters/waterways	1,488	1,457	1,281
	Sewer systems	96	53.3	48.1
Substances subject to the PRTR Act		13	8.0	11.7



Water
Discharge

	(Million tons)		
	FY2018	FY2019	FY2020
Total amount of water discharge	911	980	947

Note: Includes seawater emissions of Sumitomo Joint Electric Power Co., Ltd.



Waste
Materials

	(Thousand tons)		
	FY2018	FY2019	FY2020★
Waste emissions*2	244	232	248
Landfill*2	23	22	25.1
(Breakdown)			
On-site landfill	0	0	0
External landfill	23	22	25.1

Note: The number of companies included in the boundary of calculation for the environmental performance data on page 129 is as follows for each year.

FY2018: Sumitomo Chemical and Group companies in Japan: 21 companies

FY2019: Sumitomo Chemical and Group companies in Japan: 21 companies

FY2020: Sumitomo Chemical and Group companies in Japan: 22 companies

*1 Certain assumptions were made in calculations due to the difficulty of obtaining weight-based figures for some products.

*2 The amount of coal ash generated at Sumitomo Joint Electric Power, which is included in "Waste emissions" and "Landfill" (Sumitomo Chemical and Group companies in Japan) is calculated on a dry-weight basis.



Environmental Activities: Supplementary Data

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	(Thousand tons of CO ₂ e)		
	FY2018	FY2019	FY2020★
Greenhouse gases (seven gases)* ¹	5,957	5,962	6,072
Emissions from energy use (CO ₂)	5,172	5,209	5,312
CO ₂ emissions from other than energy use	684	659	661
N ₂ O	101	89	94
HFC* ²	—	4	4
PFC* ²	—	—	—
CH ₄ * ²	—	—	—
SF ₆ * ²	—	—	—
NF ₃ * ²	—	—	—

	(Tons)		
	FY2018	FY2019	FY2020★
Others			
NO _x	4,326	4,208	4,359
SO _x	5,152	4,621	4,584
Soot and dust	222	192	211
Substances subject to the PRTR Act* ³	458	438	419

Note: The number of companies included in the boundary of calculation for the environmental performance data on page 130 is as follows for each year.

FY2018: Sumitomo Chemical and Group companies in Japan: 21 companies

FY2019: Sumitomo Chemical and Group companies in Japan: 21 companies

FY2020: Sumitomo Chemical and Group companies in Japan: 22 companies

*1 From fiscal 2017, the greenhouse gas (all seven gases) indices were calculated using the GHG Protocol for greenhouse gas emissions (refer to page 226 "Calculation Standards for Environmental and Social Data Indicators") for principal consolidated Group companies in Japan, which account for up to 99.8% of consolidated net sales.

• Having adopted the GHG Protocol standards for our GHG emission disclosures, we now include the following data that was previously excluded from calculations: CO₂ emissions from energy sold to external parties by Sumitomo Chemical and Group companies in Japan (the portion attributable to energy provider subsidiaries was included in years prior to fiscal 2016); CO₂ emissions from energy use attributable to Sumitomo Chemical's non-production sites; and CO₂ emissions from non-energy sources not included in the scope of the Act on Promotion of Global Warming Countermeasures. In addition, from fiscal 2018, we include energy use attributable to the Group companies in Japan non-production sites.

*2 Outside the scope of reporting under the Act on Promotion of Global Warming Countermeasures.

*3 Calculated based on the amount released into water/the air of each substance subject to the PRTR Act.

Compliance with Environmental Laws and Regulations

(Yen)

	FY2018	FY2019	FY2020
Total fines	0	0	0

Note: Sumitomo Chemical and Group companies in Japan are included in the boundary of calculation.

[The production sites of the 22 Group companies in the boundary are listed below]

Sumika-Kakoushi Co., Ltd.; Sumika Color Co., Ltd.; Sumika Plastech Co., Ltd.; Nippon A&L Inc.; Asahi Chemical Co., Ltd.; Ceratec Co., Ltd.; Sumika Assembly Techno Co., Ltd.; SanTerra Co., Ltd.; Sumika Agro Manufacturing Co., Ltd.; SC Environmental Science Co., Ltd.; Sumika Agrotech Co., Ltd.; Sumika Polycarbonate Limited; Nihon Medi-Physics Co., Ltd.; Sumitomo Joint Electric Power Co., Ltd.; Koei Chemical Co., Ltd.; Taoka Chemical Co., Ltd.; Tanaka Chemical Corporation; SCIOCS COMPANY LIMITED; Sumitomo Dainippon Pharma Co., Ltd.; SN Kasei Co., Ltd.; SANRITZ CO.,LTD.; and Sumika High-Purity Gas Co., Ltd.



Environmental Activities: Supplementary Data

Evaluation of Environmental Protection Costs and Economic Effects through Environmental Accounting

Sumitomo Chemical continuously gathers and evaluates data on environmental protection-related expenses, investments, and economic results in line with the Company's environmental accounting system introduced in fiscal 2000.

◆ Items Pertaining to Environmental Accounting

(1) Period: April 1, 2020 to March 31, 2021

(2) Boundary: Sumitomo Chemical and 21 major consolidated subsidiaries (16 in Japan and 5 overseas)*

(3) Composition (Classification): Based on Ministry of the Environment (Japan) guidelines

(4) Outline of the results (investment and expenses): Consolidated investment increased year on year by 1.3 billion yen, and consolidated expenses decreased by 0.6 billion yen.

* Sumitomo Dainippon Pharma Co., Ltd.; Koei Chemical Co., Ltd.; Taoka Chemical Co., Ltd.; Asahi Chemical Co., Ltd.; Sumitomo Joint Electric Power Co., Ltd.; Sumika Color Co., Ltd.; Nihon Medi-Physics Co., Ltd.; Nippon A&L Inc.; SanTerra Co., Ltd.; Sumika-Kakoushi Co., Ltd.; Sumika Agrotech Co., Ltd.; Ceratec Co., Ltd.; SC Environmental Science Co., Ltd.; SN Kasei Co., Ltd.; Sumika Agro Manufacturing Co., Ltd.; Sumika Plastech Co., Ltd.; Dongwoo Fine-Chem Co., Ltd.; Sumitomo Chemical Asia Pte Ltd; The Polyolefin Company (Singapore) Pte. Ltd.; Sumika Technology Co., Ltd.; and Sumika Electronic Materials (Wuxi) Co., Ltd.

■ Environmental Protection Cost

(Billion yen)

Classification	Details of Major Initiatives	FY2019				FY2020			
		Non-Consolidated		Consolidated		Non-Consolidated		Consolidated	
		Investment	Expenses	Investment	Expenses	Investment	Expenses	Investment	Expenses
Facility Area Costs		0.7	20.4	1.9	32.7	1.0	19.2	3.2	31.2
Breakdown	Pollution Prevention Costs	(0.5)	(15.2)	(1.3)	(19.6)	(0.6)	(13.8)	(2.3)	(18.1)
	Global Environmental Protection Costs	(0)	(0.2)	(0.4)	(4.3)	(0)	(0.2)	(0.4)	(4.1)
	Resource Recycling Costs	(0.2)	(5.0)	(0.2)	(8.8)	(0.4)	(5.2)	(0.5)	(9.0)
Upstream/Downstream Costs		0	0	0	0.3	0	0	0	0.4
Administrative Costs		0	0.8	0	1.4	0	0.8	0	1.5
R&D Costs		0.1	7.4	0.1	7.5	0.1	8.1	0.1	8.2
Social Activities Costs		0	0.5	0	0.8	0	0.6	0	0.8
Environmental Remediation Costs		0	0	0	0	0	0	0	0
Total		0.8	29.1	2.0	42.7	1.1	28.7	3.3	42.1



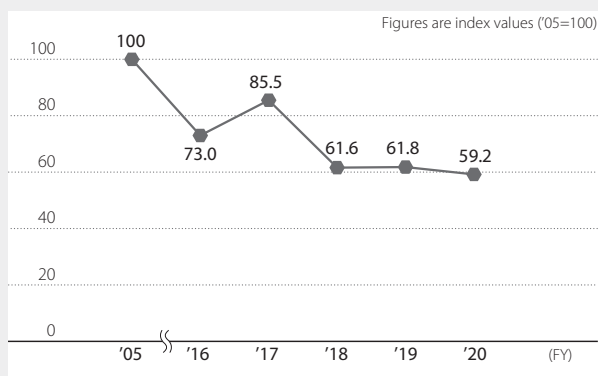
Environmental Activities: Supplementary Data

Economic Effects

(Billion yen)

Results	FY2019		FY2020	
	Non-Consolidated	Consolidated	Non-Consolidated	Consolidated
Reduced costs through energy saving	0.2	0.3	0.2	0.3
Reduced costs through resource saving	0.3	0.4	0.4	0.6
Reduced costs through recycling activities	2.8	3.0	2.4	2.6
Total	3.3	3.7	3.0	3.5

Cost Efficiency of Environmental Protection Measures (Sumitomo Chemical (All Worksites))



In fiscal 2005, we began implementing measures to improve the cost efficiency of our environmental protection measures by making sure that all activities were as cost effective as possible. We will implement more effective measures by analyzing and studying the breakdown of our environmental protection costs and reviewing each item to determine its importance. We calculate the cost efficiency of our environmental protection as the ratio of annual total production value to total environmental protection costs, in order to better reflect actual production activities in the calculation.



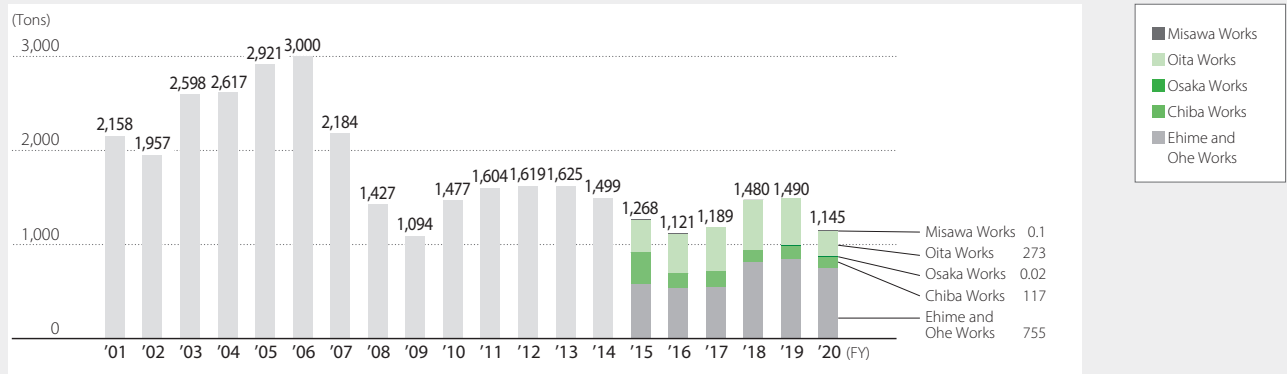
Environmental Activities: Supplementary Data

Preventing Pollution: Atmospheric Emissions of SOx, NOx, Soot, and Dust

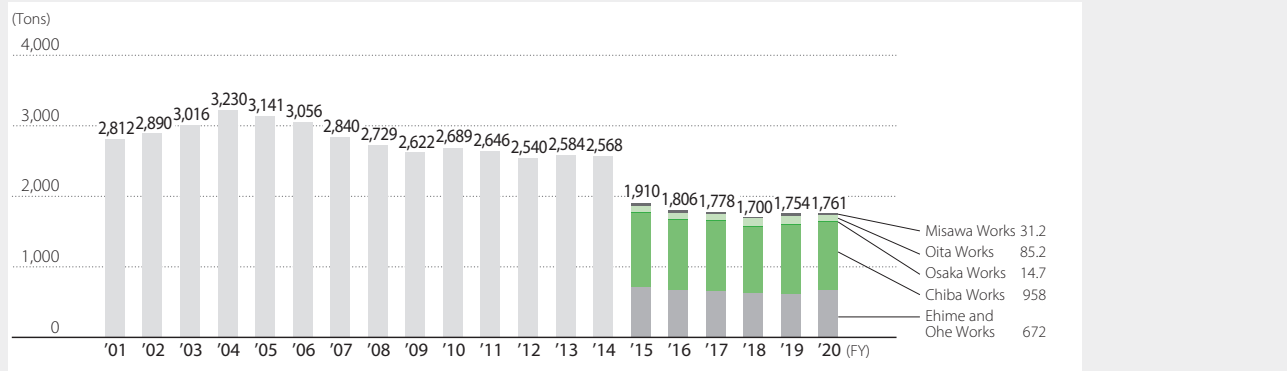
In 1970, Sumitomo Chemical achieved a marked reduction in the release of SOx, NOx, soot, and dust into the atmosphere, and continued to maintain low levels of emissions from 1980 to the present. Furthermore, the Company has concluded cooperative agreements with local municipal governments at each of its Works, establishing voluntary control levels that are stricter than the standards given under applicable laws and regulations.

Note: Data for the Gifu Plant and Okayama Plant from fiscal 2004 to fiscal 2012 is included in Osaka Works.
Data for the Gifu Plant and Okayama Plant from fiscal 2013 is included in Oita Works.

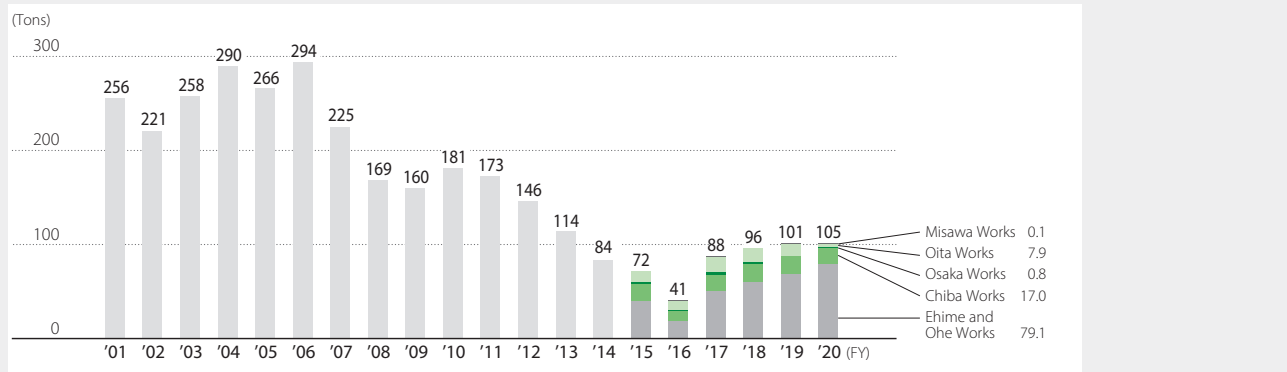
SOx Emissions (Sumitomo Chemical)



NOx Emissions (Sumitomo Chemical)



Soot and Dust Emissions (Sumitomo Chemical)



Target

Continue to sustain levels below voluntary control standard values.



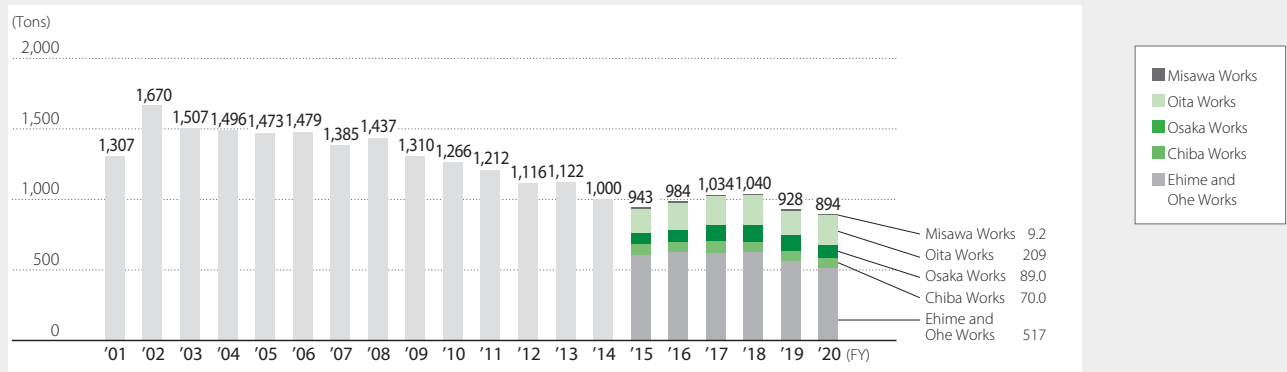
Environmental Activities: Supplementary Data

Water Emissions of COD, Nitrogen, and Phosphorus

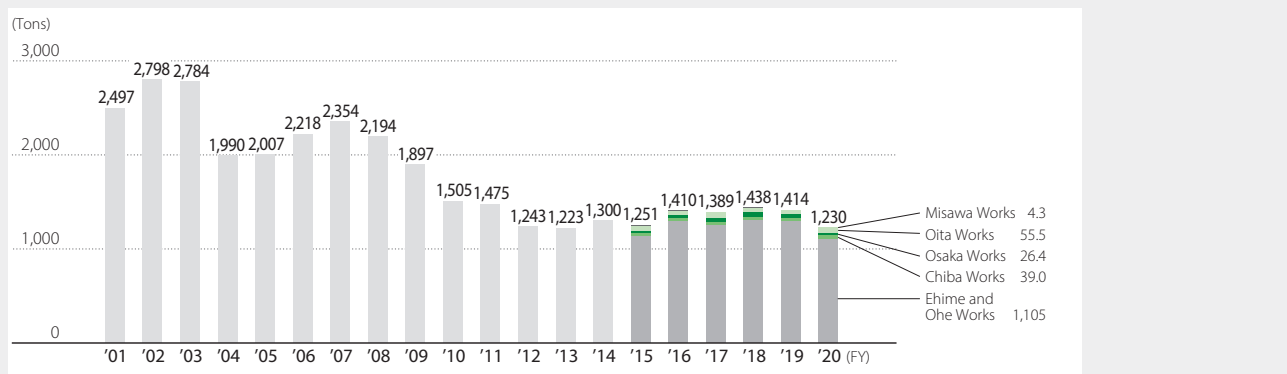
A number of measures have been implemented to cut emissions, in line with fifth-generation Water Quality Standards, and emissions of COD, nitrogen, and phosphorus into waterways have been significantly reduced since fiscal 2004. Sumitomo Chemical has also concluded cooperative agreements with local municipal governments to establish voluntary control levels for COD, nitrogen, and phosphorus released into waterways at each Works. These standards are also stricter than those established under applicable laws and regulations.

Note: Data for the Gifu Plant and Okayama Plant from fiscal 2004 to fiscal 2012 is included in Osaka Works.
Data for the Gifu Plant and Okayama Plant from fiscal 2013 is included in Oita Works.

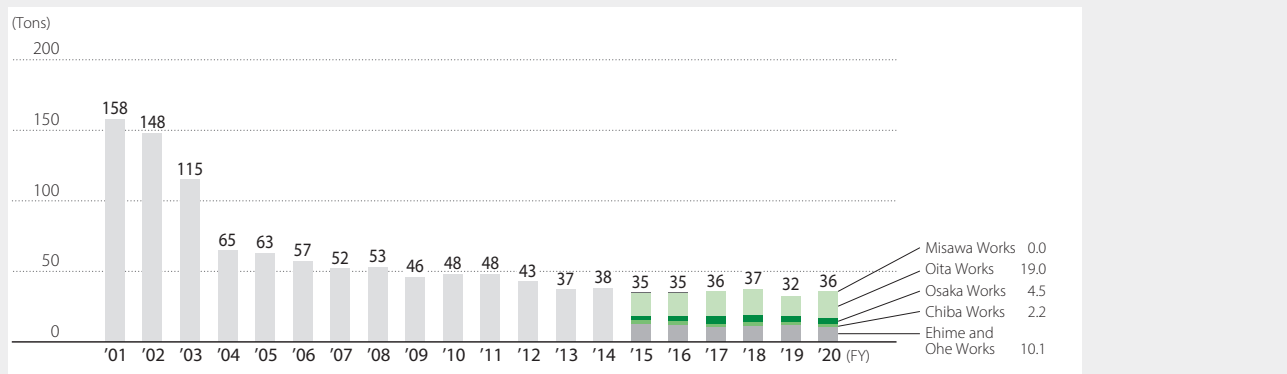
COD Emissions (water emissions include water discharge to sewage systems) (Sumitomo Chemical)



Nitrogen Emissions (Sumitomo Chemical)



Phosphorus Emissions (Sumitomo Chemical)



Target

Continue to sustain levels below voluntary control standard values.

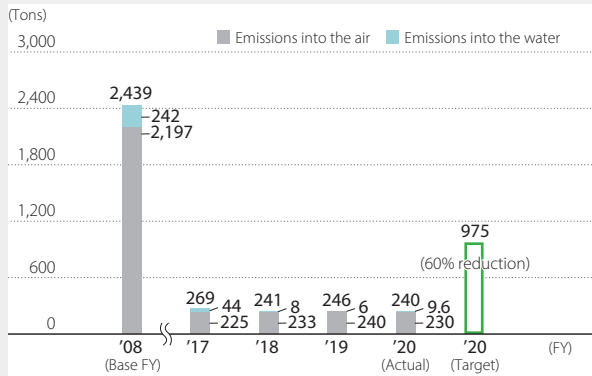


Environmental Activities: Supplementary Data

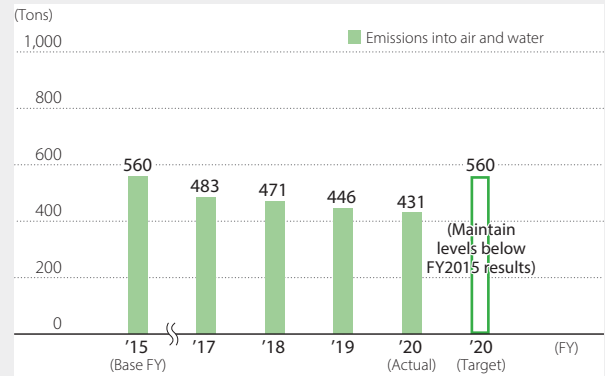
Addressing PRTR and VOCs

Trends in Emissions of Substances Subject to the PRTR Act

Sumitomo Chemical



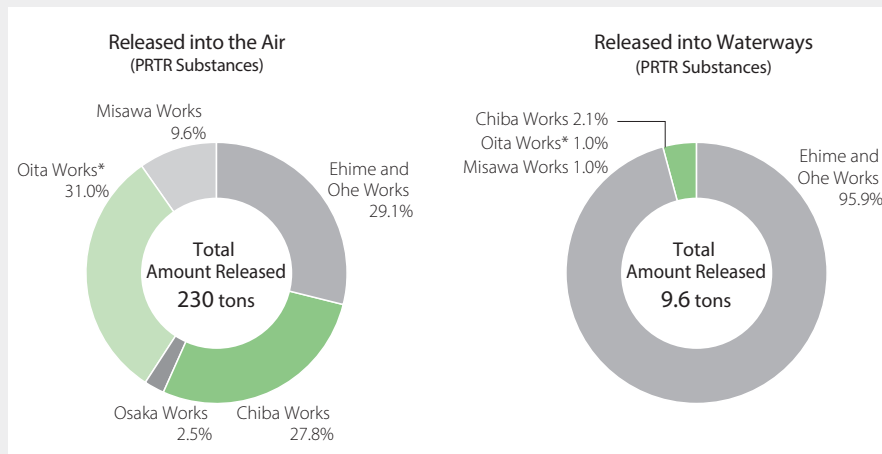
Sumitomo Chemical and Group Companies in Japan



FY2020 Release and Transfer of PRTR Substances (Sumitomo Chemical and Group Companies in Japan)

	Released			Transferred		
	Air	Water	Subtotal	Sewage	Waste	Subtotal
PRTR substances						
Sumitomo Chemical (123 substances)	230	9.6	240	4.0	4,956	4,960
Sumitomo Chemical and Group companies in Japan	419	11.7	431	7.3	7,764	7,771

FY2020 PRTR Substances Released by Works (Sumitomo Chemical)



* Data for the Oita Works includes data for the Gifu and Okayama plants.

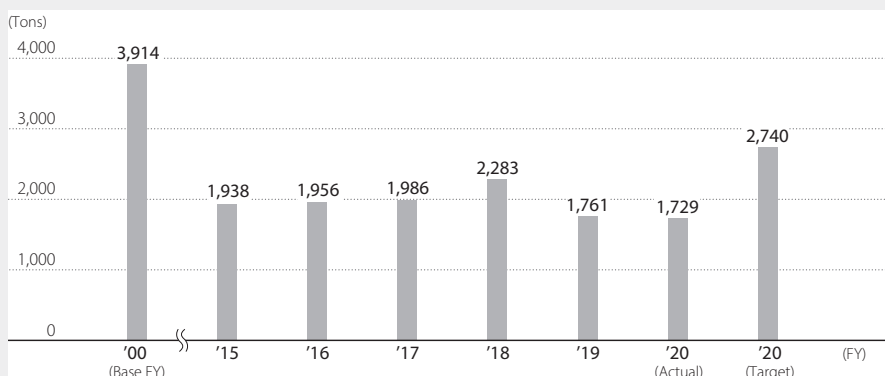
Target Reduce the total release of PRTR substances by 60% compared with fiscal 2008 by fiscal 2020

Results Reduced the total release of PRTR substances to 240 tons, by 90.2%, compared with fiscal 2008 by fiscal 2020, achieving the target.



Environmental Activities: Supplementary Data

Initiatives to Reduce Emissions of Volatile Organic Compounds (VOCs) (Sumitomo Chemical)



Target Maintain a 30% reduction in VOC emissions compared with fiscal 2000.

Results Reduced emissions by 1,729 tons, or 55.8%, compared with fiscal 2000 by fiscal 2020, achieving the target.

Prevention of Ozone Layer Depletion

Number of Refrigeration Units That Use Specified CFCs and HCFCs as Coolants (Sumitomo Chemical and Group Companies in Japan) as of the End of Fiscal 2020

(Number of units)

	Sumitomo Chemical	Sumitomo Chemical and Group Companies in Japan
CFC11	8	8
CFC12	6	26
CFC13	0	1
CFC115	2	2
HCFC22	71	222
HCFC123	26	33

Target

- Eliminate the use of refrigeration units that use specified CFCs as coolants by fiscal 2025.
- Eliminate the use of refrigeration units that use HCFCs as coolants by fiscal 2045.



Environmental Activities: Supplementary Data

Response to the Pollutant Release and Transfer Register Ordinance(Issued on November 21, 2008)

(Tons, Dioxins: mg-TEQ)

No.	Name of Chemical Compound	Amount Released					Amount Transferred		
		Air	Water	Soil	Landfill	Total	Sewage	Waste	Total
1	Zinc compounds (water-soluble)	0.0	3.1	0.0	0.0	3.1	<0.1	81.6	81.7
2	Acrylic acid and its water-soluble salts	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
3	Methyl acrylate	0.6	0.0	0.0	0.0	0.6	0.0	0.0	0.0
4	Acrylonitrile	3.9	0.0	0.0	0.0	3.9	0.0	0.0	0.0
5	Acrolein	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1
6	Sodium azide	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4
7	Acetaldehyde	<0.1	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0
8	Acetonitrile	1.1	0.0	0.0	0.0	1.1	0.0	39.4	39.4
9	o-Anisidine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Aniline	0.7	0.0	0.0	0.0	0.7	0.0	6.9	6.9
11	2-Aminoethanol	<0.1	0.2	0.0	0.0	0.2	0.0	28.2	28.2
12	5-amino-1-[2,6-dichloro-4-(trifluoromethyl) phenyl]-3-cyano-4-[[trifluoromethyl]sulfinyl]pyrazole (also known as fipronil)	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1
13	m-Aminophenol	0.0	<0.1	0.0	0.0	<0.1	0.0	11.7	11.7
14	Allyl alcohol	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
15	Antimony and its compounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Isobutyraldehyde	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.0
17	O-ethylO-6-nitro-meta-tolyl-sec-butylphosphoramidothioate (also known as Butamifos)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	O-ethylO-4-nitrophenyl phenylphosphonothioate (also known as EPN)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	Ethylbenzene	3.4	<0.1	0.0	0.0	3.4	0.1	17.0	17.1
20	Epichlorohydrin	0.6	0.0	0.0	0.0	0.6	0.0	0.0	0.0
21	1,2-Epoxypropane (also known as propylene oxide)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	Cadmium and its compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
23	ε-Caprolactam	0.2	1.5	0.0	0.0	1.7	0.0	0.0	0.0
24	Xylene	3.0	<0.1	0.0	0.0	3.0	0.1	20.0	20.1
25	Quinoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	Cumene	9.1	<0.1	0.0	0.0	9.1	0.0	0.0	0.0
27	Cresol	0.2	0.0	0.0	0.0	0.2	0.0	<0.1	<0.1
28	Chromium and chromium(III) compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
29	Chromium(VI) compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
30	Chloroacetic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	Chlorodifluoromethane (also known as HCFC-22)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	2-chloro-4,6-bis (ethylamino)-1,3,5-triazine (also known as simazine or CAT)	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
33	3-Chloropropene (also known as allyl chloride)	1.6	0.0	0.0	0.0	1.6	0.0	17.8	17.8
34	Chlorobenzene	4.6	<0.1	0.0	0.0	4.6	0.0	158.5	158.5
35	Chloroform	<0.1	0.0	0.0	0.0	<0.1	0.0	266.4	266.4
36	Cobalt and its compounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	Vinyl acetate	37.2	<0.1	0.0	0.0	37.2	0.0	0.0	0.0
38	Salicyl aldehyde	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	(RS)-α-Cyano-3-phenoxybenzyl 2,2,3,3-tetramethylcyclopropanecarboxylate (also known as fenprothrin)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	Inorganic cyanide compounds (excluding complex salts and cyanates)	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1



Environmental Activities: Supplementary Data

(Tons, Dioxins: mg-TEQ)

No.	Name of Chemical Compound	Amount Released					Amount Transferred		
		Air	Water	Soil	Landfill	Total	Sewage	Waste	Total
41	S-4-chlorobenzyl N,N-diethylthiocarbamate (also known as thiobencarb or benthocarb)	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
42	Tetrachloromethane	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
43	1,4-Dioxane	<0.1	0.0	0.0	0.0	<0.1	<0.1	129.0	129.0
44	Cyclohexylamine	0.0	<0.1	0.0	0.0	<0.1	0.0	1.1	1.1
45	1,2-dichloroethane	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1	<0.1
46	1,1-Dichloroethylene (also known as vinylidene chloride)	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
47	Cis-1,2-dichloroethylene	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
48	2,2-Dichloro-1,1,1-trifluoroethane (also known as HCFC-123)	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0
49	1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	426.0	426.0
50	1,3-Dichloropropene (also known as D-D)	0.4	0.0	0.0	0.0	0.4	<0.1	71.0	71.0
51	Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	82.0	82.0
52	Dichloromethane (also known as methylene chloride)	2.4	0.0	0.0	0.0	2.4	0.0	47.7	47.7
53	Dicyclopentadiene	<0.1	0.0	0.0	0.0	<0.1	0.0	5.9	5.9
54	O,O-dimethyl S-(N-methylcarbamoyl)methyl phosphorodithioate (also known as dimethoate)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	2,4-Dinitrophenol	0.0	0.0	0.0	0.0	0.0	0.0	27.5	27.5
56	1,3-Diphenylguanidine	0.0	0.3	0.0	0.0	0.3	0.0	7.5	7.5
57	2,6-Di-tert-butyl-4-cresol (also known as BHT)	0.0	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0
58	2,4-Di-tert-butylphenol	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
59	N,N-Dimethylacetamide	0.0	0.0	0.0	0.0	0.0	0.0	9.5	9.5
60	2,4-dimethylaniline	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
61	N,N-Dimethylaniline	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9
62	Dimethylamine	0.0	<0.1	0.0	0.0	<0.1	0.0	2.2	2.2
63	N,N-Dimethylformamide	0.2	<0.1	0.0	0.0	0.2	0.0	230.8	230.8
64	Mercury and its compounds	<0.1	0.0	0.0	0.0	<0.1	<0.1	0.0	<0.1
65	Styrene	2.0	0.0	0.0	0.0	2.0	0.0	0.4	0.4
66	Selenium and its compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
67	Dioxins	<0.1	<0.1	0.0	0.0	<0.1	<0.1	<0.1	<0.1
68	O,O-dimethyl O-3-methyl-4-nitrophenyl phosphorothioate (also known as fenitrothion or MEP)	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1
69	Tetrachloroethylene	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
70	Tetramethylthiuram disulfide (also known as thiuram or thiram)	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
71	Terephthalic acid	0.0	0.0	0.0	0.0	0.0	0.0	415.8	415.8
72	Water-soluble copper salts (excluding complex salts)	0.0	<0.1	0.0	0.0	<0.1	<0.1	0.0	<0.1
73	Triethylamine	0.6	0.4	0.0	0.0	1.0	0.5	57.6	58.1
74	1,1,1-trichloroethane	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
75	1,1,2-trichloroethane	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
76	Trichloroethylene	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
77	2,4,6-Trichloro-1,3,5-triazine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78	Trichlorofluoromethane (also known as CFC-11)	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
79	1,2,3-Trichloropropane	<0.1	0.0	0.0	0.0	<0.1	0.0	2.2	2.2
80	1,2,4-Trimethylbenzene	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0
81	Toluidine	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.8
82	Toluene	119.3	0.1	0.0	0.0	119.4	0.3	2,445.3	2,445.6
83	Naphthalene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Environmental Activities: Supplementary Data

(Tons, Dioxins: mg-TEQ)

No.	Name of Chemical Compound	Amount Released					Amount Transferred		
		Air	Water	Soil	Landfill	Total	Sewage	Waste	Total
84	Lead compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
85	Nickel compounds	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8
86	Nitrobenzene	0.5	3.5	0.0	0.0	4.1	0.0	32.1	32.1
87	Vanadium compounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
88	Arsenic and its inorganic compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
89	Hydrazine	<0.1	<0.1	0.0	0.0	<0.1	0.0	12.5	12.5
90	Hydroquinone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
91	4-Vinyl-1-cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
92	Biphenyl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
93	Pyridine	0.0	<0.1	0.0	0.0	<0.1	0.0	0.5	0.5
94	Phenylenediamine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95	1,3-Butadiene	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
96	Bis(2-ethylhexyl)phthalate	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.2
97	tert-Butyl hydroperoxide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
98	2-tert-Butyl-5-methylphenol	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
99	Hydrogen fluoride and its water-soluble salts	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
100	2-Propyn-1-ol	<0.1	0.0	0.0	0.0	<0.1	0.0	94.8	94.8
101	Hexadecyltrimethylammonium chloride	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
102	n-Hexane	21.8	<0.1	0.0	0.0	21.9	0.0	145.1	145.1
103	Water-soluble salts of peroxydisulfuric acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	Benzyl chloride	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
105	Benzaldehyde	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
106	Benzene	0.3	0.1	0.0	0.0	0.4	<0.1	0.0	<0.1
107	Boron compounds	0.0	0.0	0.0	0.0	0.0	<0.1	1.2	1.2
108	Polychlorinated biphenyls (also known as PCBs)	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
109	Poly (oxyethylene) alkyl ether (alkyl C=12-15) and its mixture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
110	Formaldehyde	<0.1	<0.1	0.0	0.0	<0.1	2.4	14.5	16.9
111	Manganese and its compounds	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
112	Phthalic anhydride	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
113	Maleic anhydride	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
114	Methacrylic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
115	2,3-Epoxypropyl methacrylate	1.8	0.0	0.0	0.0	1.8	0.0	0.0	0.0
116	Methyl methacrylate	8.7	0.0	0.0	0.0	8.7	0.0	33.4	33.4
117	(Z)-2'-Methylacetophenone= 4,6-dimethyl-2-pyrimidinyl hydrazone (also known as Ferimzone)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
118	Methylamine	0.3	0.0	0.0	0.0	0.3	0.0	0.0	0.0
119	3-Methylthiopropional	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
120	Methylnaphthalene	2.5	0.0	0.0	0.0	2.5	0.0	0.0	0.0
121	Molybdenum and its compounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
122	Morpholine	0.0	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0
123	Triphenyl phosphate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		230	9.6	0.0	0.0	240	4.0	4,956	4,960



Environmental Activities: Supplementary Data

Industrial Waste Reduction

PCB Waste (Sumitomo Chemical and Group Companies in Japan)

Storage and Control of High Concentrations of PCB Waste as of the End of Fiscal 2020

	Number of units of PCB waste			Volume of PCBs (kl)
	Total	Storage	Usage	
Sumitomo Chemical	0	0	0	0
Sumitomo Chemical and Group Companies in Japan	11	0	11	0.1

Note: The volume of PCBs does not include minute amounts of PCB waste in the PCB net conversion amount. High concentrations of PCBs in such classes of materials as fluorescent lamps, mercury lamp ballast, and contaminated substances (wastepaper, etc.) fall outside the scope of collation.

Target

Properly collect and store high-concentration PCB-containing waste and complete treatment of this waste at an early date.

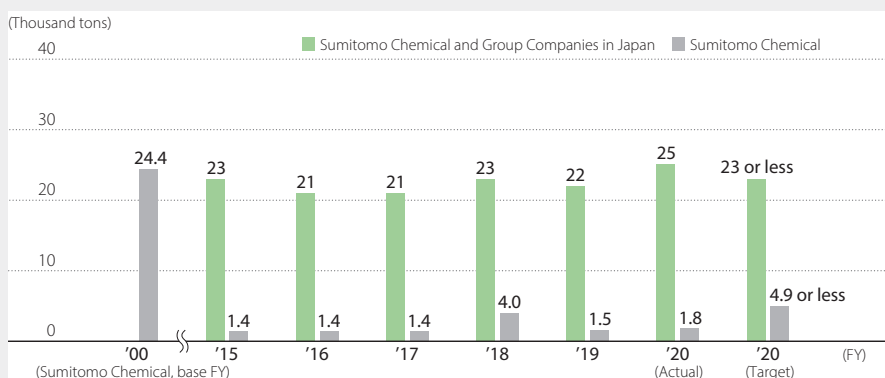
Results

Sumitomo Chemical: As of March 31, 2021, the treatment of all high-concentration PCB-containing waste that had been stored and used has been completed.
 Group companies in Japan: Untreated high-concentration PCB-containing waste is still being collected and stored.

In accordance with the Act on Special Measures against PCB Waste, Sumitomo Chemical properly collects high-concentration polychlorinated biphenyl (PCB)-containing waste.* The Company then stores this industrial waste, which is subject to special controls, in specified areas within the Company's waste storage facilities, subsequently ensuring strict control of this waste. Sumitomo Chemical completed treatment of all of its PCB-containing waste ahead of the legally prescribed deadline.

* Transformers, capacitors, and other electronic devices that contain PCB insulating oil.

Landfill Disposal Amount (Sumitomo Chemical and Group Companies in Japan)



Target

Maintain landfill disposal amount of no more than 4.9 thousand tons, 80% less than the fiscal 2000 levels.

Results

The total amount in fiscal 2020 was reduced by 93% compared with fiscal 2000 to 1.8 thousand tons, achieving the target.



Environmental Activities: Supplementary Data

Digitization of Manifests to Be Prepared Pursuant to the Waste Management and Public Cleansing Act (Sumitomo Chemical)

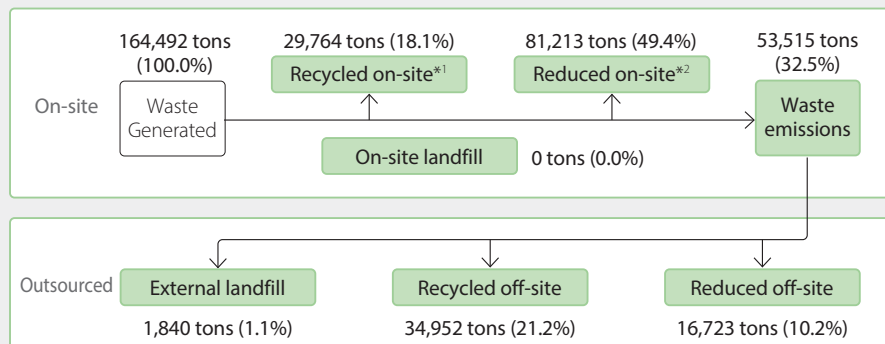
	Number of manifests issued	Number of manifests digitized	Digitization rate (%)
FY2014	18,662	14,930	80
FY2015	18,973	16,337	86
FY2016	19,868	19,594	99
FY2017	19,858	19,585	99
FY2018	20,598	20,355	99
FY2019	19,835	19,726	99
FY2020	20,735	20,675	99

Sumitomo Chemical has been fostering the digitization of manifests to improve operational efficiency and ensure compliance with the law and transparency of data.

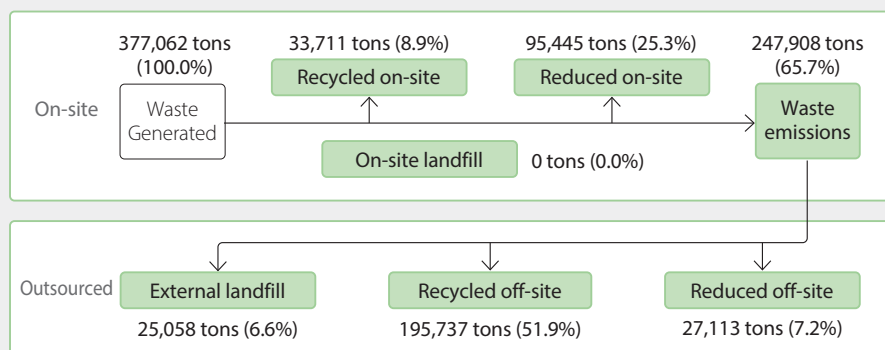


Environmental Activities: Supplementary Data

Waste Disposal Flow Chart and FY2020 Results (Sumitomo Chemical)



(Sumitomo Chemical and Group Companies in Japan)



Note: The waste amount for Sumitomo Chemical and Group companies in Japan accounts for around 80% of the entire Group total, which includes overseas Group companies.

*1 Recycled waste: Total amount of waste that was reused, recycled, or thermally recycled

*2 Reduced waste: Total amount of waste reduced through incineration, etc.

List of FY2020 Results by Item in connection with the Disposal of Waste (Sumitomo Chemical)

(Tons)

Type	Waste Generated	Recycled on-site		Reduced on-site		Waste emissions	On-site landfill	Reduced off-site	Recycled off-site		External landfill
		Reused, recycled	Thermally recycled	Incineration	Other				Reused, recycled	Thermally recycled	
Burnt residue	5,284.5					5,284.5			4,885.8		398.7
Sludge	48,671.4		10,468.1	21,348.7	2,835.7	14,018.9		3,495.1	10,315.8	1.9	206.2
Oil waste	42,811.0	3,791.7	12,567.3	12,553.4		13,898.6		5,505.0	6,382.7	1,935.5	75.6
Waste acid	8,458.8		0.9	6,311.4	582.7	1,563.8		1,430.8	120.4		12.6
Waste alkali	49,902.0	2,590.9	22.4	35,810.9		11,477.8		4,939.2	5,131.5	1,235.3	171.9
Waste plastic	5,294.7		273.4	837.0		4,184.3		421.6	2,923.2	46.9	636.4
Waste paper	975.3		47.0	834.0		94.3		25.8	68.4		0.1
Wood waste	1,020.7			93.0		927.7		48.1	462.0	397.9	19.7
Textile waste	13.7					13.7		11.7	2.1		
Animal and plant residues	12.8					12.8		12.8			
Metal waste	701.6			6.5		695.1		155.3	681.1		14.9
Glass and pottery waste	507.6					507.6		84.2	361.3	0.0	62.1
Slag											
Debris	799.6					799.6		581.4			218.2
Soot and dust	38.6		2.7			35.9		12.0			23.9
Total	164,492.3	6,382.6	23,381.8	77,794.9	3,418.4	53,514.6	0.0	16,723.0	31,334.3	3,617.5	1,840.3



Environmental Activities: Supplementary Data

Categories of Hazardous* and Non-Hazardous Waste (Sumitomo Chemical)

(Tons)

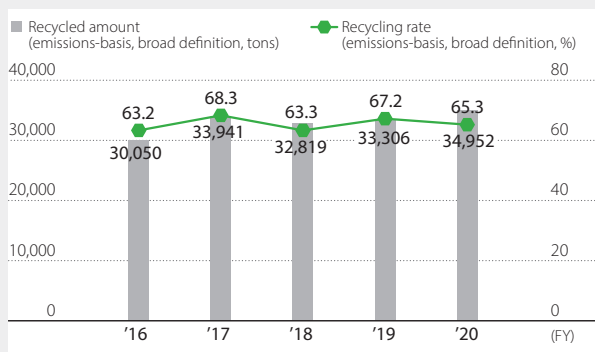
Type	Waste Generated	Recycled on-site		Reduced on-site		Waste emissions	On-site landfill	Reduced off-site	Recycled off-site		External landfill
		Reused, recycled	Thermally recycled	Incineration	Other				Reused, recycled	Thermally recycled	
Non-Hazardous Waste	63,320	0	10,791	23,119	2,836	26,574	0	4,848	19,700	447	1,580
Hazardous Waste	101,172	6,383	12,591	54,676	583	26,940	0	11,875	11,635	3,171	260

* Waste oil (including waste organic solvents), alkaline waste, acidic waste

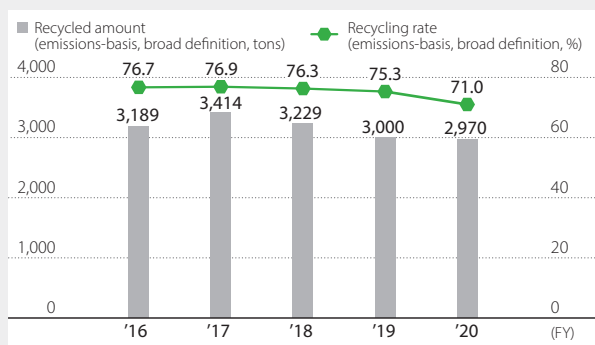
Initiatives to Recycle and Reuse Plastic and Other Waste

Sumitomo Chemical is proactively working to recycle and reuse plastic and other waste.

Results of Recycling and Reusing Waste (including heat recovery)*1



Results of Recycling and Reusing Plastic Waste (including heat recovery)*1,2



*1 Recycling and reuse of plastic and other waste is calculated based on waste emissions.

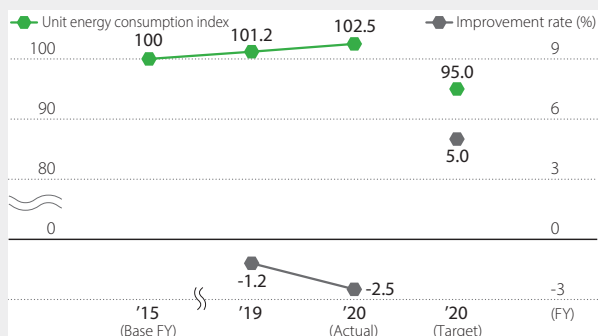
*2 Figures for the emission, recycling and reuse of plastic waste are also included in figures for the emission, recycling and reuse of general waste.



Environmental Activities: Supplementary Data

Sharing Environmental Protection and Management Targets (Japan)

Unit Energy Consumption Indices (2015 = 100)

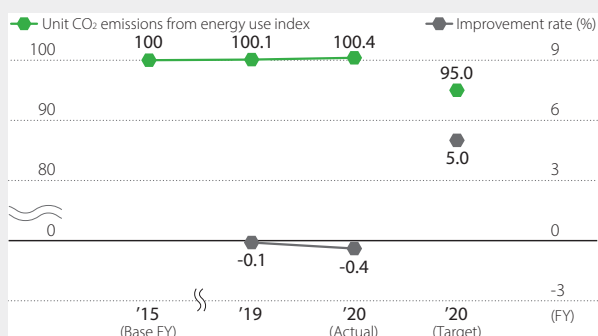


Improvement in Unit Energy Consumption Indices

Target Improve unit energy consumption Indices by at least 1% annually on average.

Results Unit energy consumption indices in fiscal 2020 worsened by 2.5% compared with fiscal 2015, failing to achieve the target.

Unit CO2 Emissions from Energy Use Indices (2015 = 100)

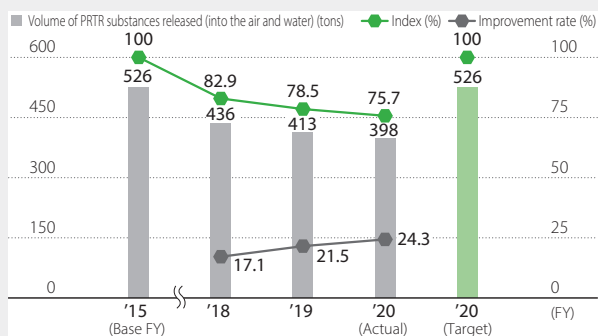


Improvement in Unit CO2 Emissions from Energy Use Indices

Target Improve unit CO2 emissions Indices by at least 1% annually on average.

Results Unit CO2 emission indices in fiscal 2020 worsened by 0.4% compared with fiscal 2015, failing to achieve the target.

Volume of PRTR Substances Released (into the Air and Water) and PRTR Substance Emissions Indices (2015 = 100)

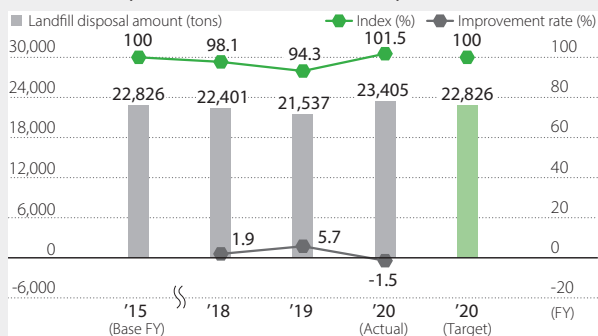


Reduction of Volume of PRTR Substances Released

Target Maintain the total volume of PRTR substances released (into the air and water) at or below fiscal 2015 levels.

Results The total volume in fiscal 2020 was reduced by 24.3% compared with fiscal 2015, achieving the target.

Landfill Disposal Amount and Landfill Disposal Indices (2015 = 100)



Reduction of landfill disposal amount

Target Maintain landfill disposal amount at or below fiscal 2015 levels.

Results The amount in fiscal 2020 was increased by 1.5% compared with fiscal 2015, failing to achieve the target.

Note: Sumitomo Chemical and the 13 Group companies in Japan listed below are included in the boundary of calculation.

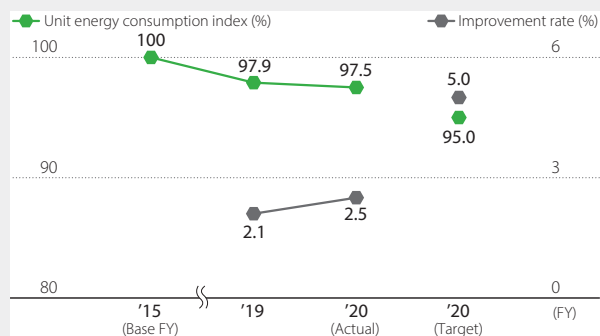
Sumika-Kakoushi Co., Ltd.; Sumika Color Co., Ltd.; Sumika Plastech Co., Ltd.; Nippon A&L Inc.; Asahi Chemical Co., Ltd.; Ceratec Co., Ltd.; Sumika Assembly Techno Co., Ltd.; SanTerra Co., Ltd.; Sumika Agro Manufacturing Co., Ltd.; SC Environmental Science Co., Ltd.; Sumika Agrotech Co., Ltd.; Nihon Medi-Physics Co., Ltd.; Sumitomo Joint Electric Power Co., Ltd.



Environmental Activities: Supplementary Data

Sharing Environmental Protection and Management Targets (Overseas)

Unit Energy Consumption Indices (2015 = 100)

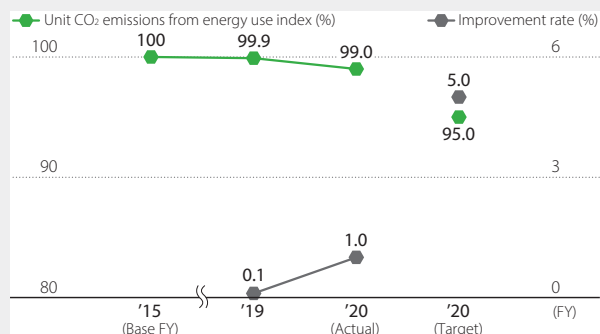


Improvement in Unit Energy Consumption Indices

Target Improve unit energy consumption Indices by at least 1% annually on average.

Results Unit energy consumption indices in fiscal 2020 improved by 2.5% compared with fiscal 2015, failing to achieve the target.

Unit CO₂ Emissions from Energy Use Indices (2015 = 100)

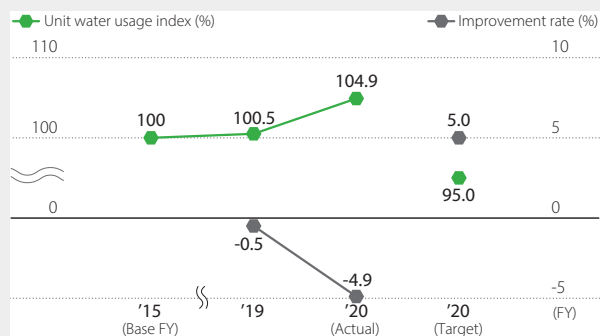


Improvement in Unit CO₂ Emissions from Energy Use Indices

Target Improve unit CO₂ emissions Indices by at least 1% annually on average.

Results Unit CO₂ emission indices in fiscal 2020 improved by 1.0% compared with fiscal 2015, failing to achieve the target.

Unit Water Usage Indices (2015 = 100)



Improvement in Unit Water Usage Indices

Target Improve unit water usage Indices by at least 1% annually on average.

Results Usage in fiscal 2020 worsened by 4.9% compared with fiscal 2015, failing to achieve the target.

Note: The following 20 Group companies overseas are included in the boundary of calculation:

- Singapore • The Polyolefin Company (Singapore) Pte. Ltd. • Sumitomo Chemical Asia Pte Ltd
- Thailand • Sumipex (Thailand) Co., Ltd. • Bara Chemical Co., Ltd. • Sumika Polymer Compounds (Thailand) Co., Ltd.
- China • Dalian Sumika Chemphy Chemical Co., Ltd. • Sumika Electronic Materials (Wuxi) Co., Ltd. • Sumika Electronic Materials (Hefei) Co., Ltd. • Sumika Huabei Electronic Materials (Beijing) Co., Ltd. • Sumika Electronic Materials (Shanghai) Co., Ltd. • Sumika Electronic Materials (Xi'an) Co., Ltd. • Sumika Polymer Compounds Dalian Co., Ltd. • Zhuhai Sumika Polymer Compounds Co., Ltd. • Dalian Sumika Jingang Chemicals Co., Ltd.
- Taiwan • Sumika Technology Co., Ltd. • Sumipex Techsheet Co., Ltd.
- India • Sumitomo Chemical India Private Limited
- South Korea • Dongwoo Fine-Chem Co., Ltd. • SSLM Co., Ltd.
- United States • Sumitomo Chemical Advanced Technologies LLC



Environmental Activities: Supplementary Data

Environmental Management System

Between 1997 and 2001, ISO 14001:1996 certification was obtained at all Works and continually maintained thereafter. Updated ISO 14001 certification was obtained later and all Works have been inspected on a continual basis to ensure the certification does not expire.

■ Acquisition of ISO 14001 Certification

1. Sumitomo Chemical (Acquisition Rate: 100%)

Works	Certificate Number	Certification Date
Ehime Works (including Ohe Works)	JCQA-E-0018	April 12, 2022
Chiba Works (including the SCIOCS Chiba Facility)	KHK-97ER, 004	December 25, 2021
Osaka Works	JQA-E-90072	November 27, 2021
Oita Works (Gifu Plant)	JCQA-E-0206	December 24, 2021
Oita Works (Okayama Plant)	JCQA-E-0218	January 21, 2022
Oita Works	JQA-E-90152	March 30, 2022
Misawa Works	JQA-EM0355	December 12, 2022

2. Group Companies In Japan

Companies	Certificate Number	Certification Date
Sumika-Kakoushi Co., Ltd.	JCQA-E-0532	January 12, 2022
Sumika Color Co., Ltd.	JUSE-EG-680	May 8, 2024
Nippon A&L Inc.	10157569	January 3, 2022
Asahi Chemical Co., Ltd.	JUSE-EG-717	February 26, 2024
Ceratec Co., Ltd.	JCQA-E-0018	April 12, 2022
Sumika Assembly Techno Co., Ltd	JCQA-E-0018	April 12, 2022
Sumika Agro Manufacturing Co., Ltd.	13ER, 925	August 5, 2021
Koei Chemical Co., Ltd.	JCQA-E-0969	March 11, 2023
Taoka Chemical Co., Ltd.	JQA-EM3938	November 27, 2021
Tanaka Chemical Corporation	4526844	July 25, 2023
SCIOCS COMPANY LIMITED	EC15J0024	March 24, 2024
Sumitomo Dainippon Pharma Co., Ltd. (Suzuka Works)	00ER-094	December 21, 2021
Sumitomo Dainippon Pharma Co., Ltd. (Oita Works)	JQA-E-90152	March 30, 2022

3. Overseas Group Companies

Companies	Certificate Number	Certification Date
BARA CHEMICAL CO., LTD.	24120907002	August 29, 2021
SSLM CO., LTD.	EAC-06178	May 7, 2021
SUMITOMO CHEMICAL INDIA PRIVATE LIMITED (ECC)	99 104 00704/02	December 26, 2021
SUMITOMO CHEMICAL INDIA PRIVATE LIMITED (SCIL)	IND.20.3082/IM/U	April 2, 2023
SUMITOMO CHEMICAL ADVANCED TECHNOLOGIES LLC	43631-2008-AE-USA-ANAB	June 2, 2023
SUMIKA TECHNOLOGY CO., LTD.	EMS 89814	December 26, 2021
Dongwoo Fine-Chem Co., Ltd. (Pyongtaek)	EAC-06003	July 9, 2021
Dongwoo Fine-Chem Co., Ltd. (Iksan)	KR15/02363	July 14, 2023
Dongwoo Fine-Chem Co., Ltd. (Samki)	KR20/81826429	August 22, 2022
SUMIKA ELECTRONIC MATERIALS (XI'AN) CO., LTD.	CN15/10718	November 21, 2021
SUMIKA HUABEI ELECTRONIC MATERIALS (BEIJING) CO., LTD.	19919E00003ROM	January 3, 2022
SUMIKA ELECTRONIC MATERIALS (HEFEI) CO., LTD.	268157-2018-AE-RGC-RvA	August 24, 2021
SUMIKA ELECTRONIC MATERIALS (SHANGHAI) CO., LTD.	11718EU0067-08 ROS	June 22, 2021
SUMIKA ELECTRONIC MATERIALS (WUXI) CO., LTD.	64188-2009-AE-RCG-RVA	October 30, 2021
SUMIKA POLYMER COMPOUND (THAILAND) CO., LTD.	66 104 130035	September 10, 2022
SUMIPEX (THAILAND) CO., LTD.	TH10/4097	November 30, 2023
Sumitomo Chemical Asia Pte Ltd (MMA plant)	10105637	June 30, 2021
Sumitomo Chemical Asia Pte Ltd (S-SBR plant)	ISO14001-0052710	June 30, 2021
THE POLYOLEFIN COMPANY (SINGAPORE) PTE. LTD.	N'CN/16164E	September 8, 2021
ZHUHAI SUMIKA POLYMER COMPOUNDS CO., LTD.	CN13/30779	August 19, 2022
SUMIKA POLYMER COMPOUNDS DALIAN CO., LTD.	CN14/10103	March 25, 2023

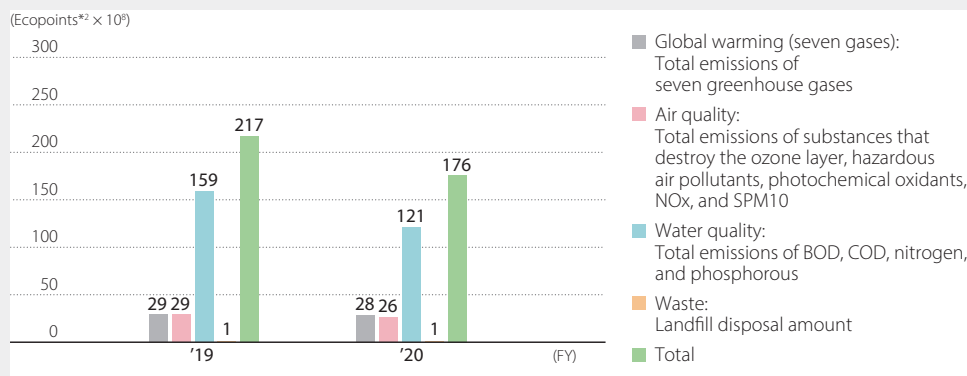
Note: Surveys are conducted once per year, and the above list is based on the survey results as of March 31, 2021



Environmental Activities: Supplementary Data

Examining the Practical Use of Environmental Efficiency Indicators and Environmental Management Accounting Methods

Breakdown of Aggregate Values for Environmental Impact (Sumitomo Chemical) by JEPIX*¹



Assessing the Environmental Impact of Each Group Company Using JEPIX

In fiscal 2020, as in the previous fiscal year, we undertook environmental impact assessments using JEPIX, in order to evaluate the effectiveness of this index as a strategic management indicator, and continued with relevant analyses.

Assessing the Environmental Impact of Each Product by LIME*³

For more practical use of LCA*⁴ data both internally and externally, we use LCA software (MilCA) from the Japan Environmental Management Association for Industry to undertake environmental impact assessments of our major products using the LIME method.

Trial Evaluation of Material Flow Cost Accounting (MFCA)*⁵

We are continuing to evaluate the effectiveness of this tool and also are performing examinations for the simplification and standardization of the method and procedures in order to foster their use. MFCA, which focuses on the loss of energy and resources, helps minimize loss and cost and reduces environmental impact.

*1 Environmental Policy Priorities Index for Japan (JEPIX):

This method, which employs a uniform single indicator called "Ecopoints" to evaluate environmental impact, is derived from the Swiss LCIA Eco Scarcity methodology. The current method evaluates the discrepancy between targets (e.g., laws and environmental policies) and actual conditions based on material flow data.

*2 Ecopoints:

An indicator for total environmental impact—the smaller the value, the lower the environmental impact.

*3 Life-cycle Impact assessment Method based on Endpoint modeling (LIME)

A life-cycle impact assessment method developed in Japan as a cornerstone for measuring Japan's environmental conditions.

*4 Life Cycle Assessment (LCA):

A method for evaluating the environmental impact of products and services throughout their life cycles.

*5 Material Flow Cost Accounting (MFCA):

An environmental cost accounting method that identifies input costs of materials, processing, electricity, fuel, and others, and compares them with the energy and resources lost in manufacturing processes.