

Sulphur

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WORLD OVERVIEW

In 1996, world sulphur markets were relatively stable. In the first half of the year, sulphur producers faced a cost-price squeeze, resulting in a drastic reduction in Frasch output from both the United States and Poland, an important reduction in sulphur exports from the Commonwealth of Independent States (C.I.S.), and higher inventory additions in Canada and Russia. As demand weakened due to lower requirements in Asia, international prices fell drastically to equal the low levels of 1993. In the second half of 1996, world demand recovered and trade requirements increased. The resurgence of imports into China during the second half of the year had a positive effect for Canadian exporters; higher sulphur imports came from some substitution over pyrites and the need for make-up sulphur for enrichment in pyrite-based acid plants. Accrued sulphur exports to the Middle East, Latin America and Africa generated a tighter market and resulted in upward pressure on prices by year-end.

In 1996, global consumption of elemental sulphur rose by 2% to about 36.3 Mt. About 90% of the total elemental sulphur consumed was transformed into sulphuric acid; world consumption of sulphuric acid in 1996 was estimated at 150 Mt, of which two thirds was in the fertilizer sector. The relatively strong demand for phosphate-based fertilizers in major consuming countries resulted in a fairly balanced market for sulphur. World demand for phosphate fertilizers showed a 3% increase over 1995, leading to a small increase in the production of phosphate products. Phosphate processing facilities sustained high operating rates in 1996, as was the case in 1995; high rates prevailed in the United States (99% of capacity) and Morocco (92%). Accrued trade of finished fertilizers led to higher demand for sulphur in phosphate-producing and exporting countries such as Tunisia, while lower requirements for phosphoric acid in India

dampened sulphur imports in acid-producing countries such as Morocco, South Africa and the United States. Global sulphur trade was generally flat in 1996 at 16 Mt. Exports increased to Africa (mostly Tunisia), the Middle East (Israel and Jordan) and China, while decreases were reported in several Asian countries (India, Indonesia and Korea) and in the United States.

In 1996, world elemental sulphur production rose by 2% to 37.7 Mt. Increases were registered for recovered sulphur, while a 13% decrease was reported for Frasch sulphur. The production of recovered sulphur continued to grow, totalling 32.7 Mt, with significant increases occurring in the United Arab Emirates (U.A.E.), Canada, Venezuela, Korea and Kazakstan. Recovered sulphur accounted for 87% of total elemental sulphur production; gas processing was in turn the source of 57% of recovered sulphur, while oil and heavy oil refining contributed 43%. In 1996, Frasch sulphur production totalled 5.0 Mt accounting for 13% of world elemental sulphur production.

CANADIAN DEVELOPMENTS

Elemental Sulphur

In 1996, Canada was the world's second largest producer of elemental sulphur with a 22% share. It also remained the leading exporter with a 39% share of world trade. In Canada, sulphur is recovered from the processing of sour natural gas with a high hydrogen sulphide content, and from the refining of high-sulphur crude oil and heavy oil; there is no production derived from Frasch mining. Canadian sulphur production from natural gas processing accounted for 87% of total production, while the remainder was from oil sands plants (8%) and oil refineries (5%). Most sulphur production occurs in Alberta and, to a lesser degree, in British Columbia and Saskatchewan. In eastern Canada, all sulphur production is derived from oil refining.

The production of elemental sulphur in Canada in 1996 was estimated at 8.3 Mt, a 4% increase over the previous year. Gas-related sulphur production rose 5% to reach 7.2 Mt. The high levels of sulphur recovery in 1996 were related to strong performance by the natural gas sector in Canada; sulphur recovery

increased in both Alberta and British Columbia. Sulphur production from oil sands operations remained stable at 0.67 Mt. Oil-related sulphur production was estimated at 0.4 Mt, a 5% increase over 1995, with higher sulphur output from refineries in Newfoundland, Ontario and Alberta.

In 1996, Canadian shipments of elemental sulphur were static at 7.1 Mt as gains achieved in offshore exports were offset by lower sales to the United States. In 1996, exports to the United States, which was the dominant export destination for Canadian sulphur, decreased significantly by 35%, accounting for 17% of Canada's total exports. Canadian exports to the United States decreased to 1.1 Mt due to a combination of increasing sulphur recovery from American oil and gas plants, weakened prices in most markets, higher levels of sulphur imports from foreign suppliers, and a slightly lower operating rate at phosphate fertilizer plants.

During 1996, the U.S. Department of Commerce (DOC) finalized its 1991/92 anti-dumping review on sulphur sales to the United States against 15 Canadian exporters. The DOC determined dumping margins of 7.17% for three active sulphur exporters, a 28.9% rate for non-respondents, and a 5.56% rate for all other exporters who were not listed in any petitions or who have not received revocation. In August 1996, the DOC released its preliminary dumping determinations for the administrative reviews covering exports for the 1992/93 and 1993/94 periods: preliminary margins were determined at 11.79% and 28.90% respectively for the three active exporters. In December 1996, the DOC completed the preliminary determination for 1994/95 with margins determined at 0.33% for Husky and 7.17% for Mobil Oil. Final determinations for the last three reviews are expected in the early spring of 1997.

Offshore exports registered an increase for the third consecutive year to reach 5.1 Mt. This 9% growth resulted from a combination of strong demand in China and Tunisia, weaker delivered prices, and reduced output from some traditional competing suppliers such as Poland and France. Canadian sulphur was exported to more than 30 countries. Higher sales were reported in most markets in 1996, with the exception of Oceania. In Latin America, major increases were reported in Mexico, Argentina and Chile; sales to this region accounted for 32% of Canada's offshore exports. Exports to Africa, accounting for about 38% of Canadian offshore exports, rose by 20% as Tunisia increased its purchases from Canada fourfold. Morocco remained the largest single offshore destination for Canadian sulphur with a 19% share of Canada's total offshore exports. Canadian exports to Asia, which accounted for 22%, registered a 15% increase; strong sales levels were reported to China where Canadian exports increased from 30 000 t to 520 000 t due to strong demand in the industrial and fertilizer sectors as more sulphuric acid plants shifted feedstock from

pyrites to elemental sulphur. No Canadian sulphur shipments were made to India in 1996 (compared to close to 300 000 t in 1995) due to low international prices and high sulphur inventories that prevailed in Indian ports during the year. Lower exports were registered in Korea and Indonesia, while shipments to the Philippines increased slightly.

Total Canadian sulphur stocks rose by 1.3 Mt to reach 9.7 Mt by year-end. On a yearly basis, additions to inventories averaged 100 000 t/m, a similar level compared to 1995; however, close to 60% of that amount was added during the first half of 1996 as offshore sales remained strong in the second half. Canadian sulphur stocks in early January 1997 were distributed mainly amongst 20 sites in Alberta with the principal locations being Ram River, Syncrude, Waterton, Kaybob III, Rainbow, East Calgary, and East Crossfield.

Alberta

Fernz Corporation Ltd. of New Zealand announced plans to construct a 120 000-t/y plant for producing micronized sulphur at Irricana, northeast of Calgary. Completion is expected in the fall of 1997. Granulated high-value sulphur products are to be sold in the emerging plant nutrient sulphur market.

Amoco Canada Petroleum Company Ltd. shut down its Bigstone sour gas processing unit and rerouted sour gas to its Whitecourt plant; Bigstone's sulphur recovery capacity was rated at 385 t/d. Canadian 88 Energy Corp. debottlenecked the Olds gas plant and expects to double its sulphur recovery to 360 t/d. Chevron Canada Resources' sulphur recovery at Kaybob III is expected to increase by 350 t/d with the tie-in of sour gas from the important Berland River gas field. Conwest Exploration Company Ltd. commissioned a new gas plant at Grand Prairie for processing sour gas from the Sexsmith/Valhalla field (8-10% H₂S); the plant includes a 500-t/d sulphur recovery unit. Mobil Oil Canada upgraded its sulphur recovery capacity at Harmattan from 69 to 81 t/d. Morrison Petroleums Ltd. completed its expansion at Coleman/Savannah Creek where its sulphur recovery capacity increased from 450 t/d to about 700 t/d. Shell Canada Limited filed an application to the Alberta Energy and Utilities Board to expand by 15% the gas throughput rate at its Caroline gas plant; if approved, sulphur recovery at Caroline would increase by 20% to reach 5500 t/d.

Suncor Inc. installed a new sulphur dioxide (SO₂) recovery system at its oil sands operations at Fort McMurray. The operations will reduce their SO₂ emissions by 75% through a scrubber system that will produce inert synthetic gypsum.

During 1996, several other activities occurred in Alberta that affected the structure of the Canadian sulphur industry: Conwest Exploration merged with Alberta Energy Co. Ltd.; Morrison Petroleums Ltd.

purchased the Nevis sour gas plant from Canadian Gas Gathering Systems Inc.; Pan East Petroleum Corp. announced its intention to acquire a 10.4% interest in Chevron Canada Resources' Kaybob III plant; Mobil Oil Canada sold the operating rights of the Wimborne gas plant to Ulster Petroleum Ltd.; Petro-Canada Resources purchased the assets of Amerada Hess Canada Ltd.; and Procor Sulphur Services Inc. of Calgary sold its international sulphur marketing branch to Petrosul International Ltd. in a management buy-out (Procor acquired the sulphur assets of Petrosul from ConAgra Inc. in 1995).

British Columbia

In the spring of 1996, Westcoast Energy Inc. shelved two new major gas projects in northern British Columbia: a new plant at Aitken Creek, and the third expansion at Pine River (which replaced plans for a major new plant at Tumbler Ridge/Grizzly Valley). The company is expected to carry out two small upgrading projects at the existing Aitken Creek and McMahan sour gas plants.

Westcoast Gas Services Inc., a subsidiary of Westcoast Energy Inc., completed the construction of a new gas plant at Jedney near Fort St. John in north-eastern British Columbia. The plant is the first in the province that features a new acid-gas injection technology; therefore, no sulphur recovery is expected from this new-generation plant as hydrogen sulphide residual gas will be re-injected in deep subsurface formations for permanent disposal. In early 1997, Westcoast announced the construction of another plant at Highway in the same region that will process sweet natural gas. These recent developments are in line with Westcoast's new approach to smaller plants with no sulphur recovery and the development of longer transmission pipeline systems for accessing sour gas reserves.

Novagas Clearinghouse Ltd. announced the construction of a new sour gas processing plant at Jedney to be completed in 1997. Pembina Resources closed its Turner Valley/Diamond Valley sour gas plant, which had a sulphur recovery capacity of 16 t/d. Morrison Petroleum Ltd. announced plans for a new sour gas plant to be constructed in the Bulrush area, 100 km north of Fort St. John, where hydrogen sulphide will also be reinjected into a disposal well.

Pacific Coast Terminals Co. Ltd. pursued its \$18 million expansion work at the Port Moody sulphur terminal where a new 5000-t/h quadrant shiploader will be operating late in 1997, replacing the two existing smaller shiploaders at Berths No. 1 and No. 2.

Sulphuric Acid

According to Natural Resources Canada's annual survey on sulphuric acid, Canadian sulphuric acid production in 1995 totalled 4.28 Mt, of which smelter acid contributed 2.74 Mt and elemental sulphur

burners contributed 1.54 Mt. Domestic consumption was estimated at 2.56 Mt, a 6% increase over 1994. Sulphuric acid consumption in eastern Canada was static at 0.77 Mt in 1995 and accounted for 30% of total Canadian consumption. Agricultural chemicals accounted for one half of the sulphuric acid consumption, followed mainly by pulp and paper, inorganic chemicals, uranium ore leaching, and nonferrous smelting and refining.

In 1996, the production of sulphur products (sulphuric acid, sulphur dioxide, and elemental sulphur) from smelters was estimated at 1.09 Mt of sulphur, a 1% increase from 1995. Sulphuric acid production from smelters was estimated at close to 3.0 Mt H₂SO₄, representing 90% of total sulphur products output from smelters. Increases in sulphuric acid production were reported in all producing provinces except British Columbia. In 1996, shipments to the domestic market increased as higher sales were reported in the fertilizer, oil refinery, ore leaching and refining, and chemicals sectors. Declines in sales were registered in the pulp and paper sector due to lower pulp mill operating rates.

AlliedSignal Inc. re-opened its hydrofluoric acid plant at Amherstburg, Ontario, creating another market for sulphuric acid in eastern Canada. Until 1992, close to 150 000 t/y of acid were consumed for the manufacture of chlorofluorocarbons. The production of a new generation of fluorocarbons, bearing a lower ozone depletion potential, is expected to use a larger volume of fluorspar and sulphuric acid per tonne of finished product manufactured.

Cameco Corp. announced the construction of a new sulphuric acid plant at McLean Lake in northern Saskatchewan for leaching rich uranium ore; the 250-t/d acid plant is expected to be completed in 1997/98.

Cominco Ltd. completed the construction of its new zinc smelter late in 1996 at Trail, British Columbia. Its sulphuric acid recovery is expected to increase by 10% in 1997.

Inco Limited announced plans for a new nickel smelter to develop its Voisey's Bay nickel deposit in Labrador. Inco expects to complete the construction of its new smelter and an adjacent acid plant at Argentia on the eastern coast of Newfoundland in 2000/01.

Marsulex Inc. of Toronto, a subsidiary of Harrowston Inc., acquired Coulton Chemical Company, an important U.S.-based sulphuric acid producer that operates a 175 000-t/y acid regeneration plant in Toledo, Ohio.

Noranda Metallurgy Inc. announced important investment plans at the Gaspé copper smelter in Murdochville and at the CEZinc refinery in Valleyfield; these projects will result in a 10-15% increase in sulphuric acid recovery at both locations

in 1998. Another project is slated for Noranda's Horne copper smelter in Rouyn-Noranda where sulphuric acid recovery is expected to increase by the end of the 1990s. In mid-1996, Noranda Metallurgy Inc. closed its phosphate fertilizer plant at Belledune, New Brunswick; acid recovered from Noranda's nearby smelter will be sold on the merchant market.

Solv-Ex Corp. continued its development work on a new oil sands extraction operation near Fort McMurray. The company will use sulphuric acid as a solvent for leaching minerals from the oil sands. Solv-Ex purchased an idle 365 000-t/y sulphuric acid plant in Calgary from Western Co-operative Fertilizers Limited and relocated it near Fort McMurray. The acid plant will be using elemental sulphur as feedstock.

Viridian Inc., the largest Canadian sulphuric acid consumer, previously known as Sherritt Inc., merged with Agrium Inc. late in 1996. Viridian had been using sulphuric acid for the manufacture of phosphate fertilizers at Redwater, Alberta.

In its 1995 Annual Report on the Federal-Provincial Agreements for the Eastern Canada Acid Rain Control Program, Environment Canada reported that the seven eastern provinces emitted around 1.8 Mt of SO₂, which was 22% below the regulatory cap of 2.3 Mt. Emissions from all smelters were below their mandatory 1994 limits, and overall, smelters accounted for 51% of SO₂ emissions in eastern Canada.

WORLD DEVELOPMENTS

In 1996, world production of sulphur-in-all-forms rose 2% to 57 Mt. Of this amount, elemental sulphur accounted for 66%; sulphuric acid from smelters, 19%; and pyrites, 15%. World production of elemental sulphur was estimated at 37.7 Mt, of which recovered sulphur accounted for 87%. Frasch sulphur output, accounting for 13%, declined by 15% as production was curtailed in both Poland and the United States. The production of recovered sulphur rose 6% to 32.8 Mt with higher recovery registered from both oil refining and gas processing.

The United States remained the world's largest producer of elemental sulphur with production estimated at 10.4 Mt, or 28% of world output. Canada was the second largest producer (8.3 Mt, 22%), followed by the C.I.S. (3.9 Mt, 10%), Japan (1.7 Mt, 5%) and Saudi Arabia (1.6 Mt, 4%).

On the supply side, the major international events in 1996 were: the curtailment of Frasch output from established producers (Ciech of Poland reduced its annual output by 25%, and Freeport Sulphur of the United States by 10%); the installation of a new 1000-t/d sulphur burner at Lacq, France, for reclaiming Elf Aquitaine Production's 1.6-Mt stockpile over a

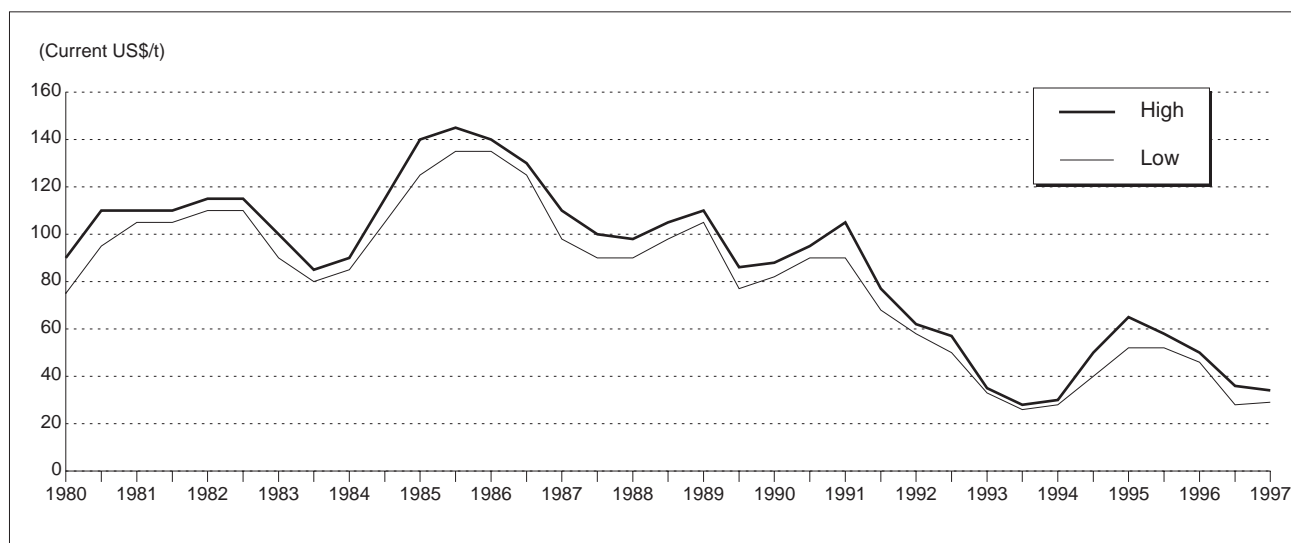
10-year program; a 10% increase in sulphur recovery from the Middle East where several oil and gas operations were expanded or commissioned (the U.A.E., Kuwait and Iran); the ongoing debottlenecking and expansion programs at three major gas processing plants and one oil refinery in Saudi Arabia (with anticipated incremental sulphur recovery totalling 0.5 Mt/y by 2000); a 10% increase in sulphur recovery from oil refineries in Asia where several projects have been completed or are being carried out (Thailand, Korea, Malaysia and Taiwan); and finally, an important reduction in sulphur exports from the C.I.S. due to a combination of inventory depletion at Astrakhan 1 and high logistic costs. In addition, the commissioning of the Astrakhan 2 sour gas plant in Russia has been further postponed by another year, and there have been ongoing discussions for the installation of sulphur forming units at Astrakhan 1 by two separate joint ventures with Astrakhan-gazprom for completion in late 1997 (International Commodities Export Corp., a 1.2-Mt/y unit; and Fedcominvest, a 0.75-Mt/y unit).

PRICES

Entering 1996, sulphur price quotations on a free on board (f.o.b.) Vancouver basis were between US\$51 and \$48/t. In the first quarter of the year, offshore prices were relatively stable until the end of March when lower demand in India and North Africa triggered price reductions from Middle Eastern exporters. Subsequent downward pressure on prices and harsh competition between suppliers led to a virtual collapse in international prices, including Vancouver quotations which bottomed out at US\$25-\$28/t in August, a 40% decline from quotations in late December 1995. During the summer, several major suppliers initiated inventory additions and production cut-backs for balancing the global marketplace. In the fall, demand rebounded in Asia and Africa, which led to some recovery in international prices from suppliers in the Middle East and North America. During the fourth quarter of 1996, Vancouver quotations rose slowly and reached US\$29-\$34/t by year-end. Overall, the net decrease in prices during 1996 was about US\$18/t, or 36%. The gap between high and low quotations peaked in June at US\$9/t and declined to US\$5/t in December, signalling a more balanced marketplace and higher prices for early 1997.

For the first five months of the year, prices in North American markets were relatively stable with pressure from important buyers on suppliers to obtain pricing concessions to coincide with softening international prices. At the beginning of 1996, prices for liquid sulphur (free on rail (f.o.r.) Alberta) varied between US\$8 and \$15/t. In the early spring, the U.S. Frasch sulphur producer and several Canadian exporters reduced their shipment levels to match weak market conditions and alleviate further price declines. However, in early summer, quotations

Figure 1
Canada, Offshore Sulphur Price Quotations, 1980-97
 f.o.b. Vancouver Contract



Source: Compiled by Natural Resources Canada from trade magazines and specialized subscriptions.

started to erode significantly as U.S. refineries initiated an aggressive pricing approach to move their non-discretionary sulphur volumes in a long market. In July, f.o.r. Alberta prices decreased by US\$5/t to reach US\$5-\$10/t, a level that remained unchanged for the rest of the year despite some improvement in sulphur demand in the United States during the second half of 1996. A tight spot market by year-end was also generating upward pressure on prices for the first quarter of 1997.

USES

The principal use of all sulphur consumed in the world is as a process agent in the manufacture of fertilizers such as superphosphate, ammonium phosphate, and ammonium sulphate (60% of world demand). The second largest consuming sector is the chemicals industry where sulphur is used as sulphuric acid in products ranging from pharmaceuticals to synthetic fibres. Other consumers of sulphur include manufacturers of pulp and paper, iron and steel, nonferrous metals, and titanium dioxide pigments. These consuming industries use sulphur in the form of sulphuric acid, which accounts for almost 90% of total sulphur consumption. (Some 60% of sulphuric acid consumption is in fertilizers.) Manufactured products that require sulphur in non-acid form in their production include insecticides and fungicides, pulp and paper, photography, leather products, rayon and rubber.

OUTLOOK

The world sulphur market is expected to be tight in 1997, led by sustained demand in the fertilizer and industrial sectors. The consumption of phosphate fertilizers is forecast to grow in most regions, especially in China, India and the United States. The renewed commitment by Chinese authorities to meet the pressing needs of the agricultural sector has already generated a series of investments in phosphate-based fertilizers (more than five phosphoric acid projects are slated for completion in 1996/97 that will bring more than 0.6 Mt of capacity on stream in 1997, and a total of seven projects will add 1.1 Mt in phosphoric acid capacity before 1999). In India, the newly elected government announced positive measures in mid-1996 for increasing access to fertilizers by readjusting its subsidies and pricing mechanisms for phosphate fertilizers. In the United States, phosphate application is forecast to increase by 2% due to favourable farm income levels and higher crop acreages anticipated for corn and soybeans in 1997. Increased consumption, production and trade in finished and semi-finished phosphate fertilizers will translate into additional demand for elemental sulphur, particularly in Morocco, Tunisia, South Africa, Senegal, Jordan, India and China. In 1997, sulphur consumption in the fertilizer sector is forecast to increase by 4%, while a 2% growth rate is projected in the industrial sector. World consumption of elemental sulphur is expected to increase by 3.3% to 37.5 Mt in 1997.

Between 1996 and 2000, world sulphur consumption is expected to continue to recover and grow at an annual rate of 2%. Most of the growth will come from the fertilizer sector, with strong demand for sulphur being forecast in the United States, China, the C.I.S., Africa and the Middle East. In the industrial sector, sulphur consumption is projected to increase at an annual rate of 2%, led by strong demand in ore leaching, caprolactam manufacturing, and petroleum refining. Declining industrial markets for sulphur products include sulphate-based titanium dioxide pigments, hydrofluoric acid, and carbon disulphide. Demand in pulp and paper is expected to remain flat.

On the supply side, world elemental sulphur production in 1997 is forecast to grow by 4% to reach 39.3 Mt. Frasch sulphur production is expected to decrease further as Poland continues to gradually reduce its production to reach a stable level of 1.2 Mt/y before the end of the decade, compared to an average level of 4.9 Mt/y during the 1980s. Recovered sulphur production will continue to grow as more oil- and gas-related projects are developed worldwide with the addition of sulphur recovery systems to meet stricter environmental regulations on atmospheric SO₂ emissions and lower sulphur content in gasoline and diesel fuel. In 1997, recovered sulphur production is expected to reach 34.4 Mt, with additional tonnage coming from both gas processing (+0.5 Mt) and oil refining (+1.2 Mt). Higher sulphur production is anticipated from Canada, Russia, the U.A.E., South Korea and Venezuela.

Canadian sulphur production in 1997 is projected to increase by 2% to 8.4 Mt. For the next eight years, Canadian sulphur production is forecast to continue to increase driven by sustained strong gas demand in the U.S. market, which accounted for 53% of Canadian gas sales in 1996. Current gas export constraints due to limitations in pipeline capacity to access the United States will be alleviated in the next few years as new pipeline projects are being approved in western Canada. While gas production in western Canada is expected to increase by 5% between 1996 and 2000, gas-related sulphur recovery is projected to reach 7.7 Mt/y in 2000, an overall growth of 7% from 1996, including 6.7 Mt in Alberta and 1.0 Mt in British Columbia. Sulphur recovery from oil sands is projected to increase marginally to about 0.7 Mt/y by 2000, while sulphur production from oil refining is projected to increase by an overall 13% to 0.45 Mt/y. In late 1996, the Canadian government introduced a new regulation that sets limits on the sulphur content in diesel fuel, which is expected to reduce key diesel emissions by 20%. Regulatory limits on low-sulphur gasoline are also being evaluated. Total Canadian sulphur production is forecast at 8.8 Mt in 2000 and is expected to maintain that level up to 2005. With a stable but relatively small domestic market, Canadian sulphur will continue to be destined primarily for U.S. and offshore markets. Several ventures are currently being investigated in Canada that would expand domestic consumption of

elemental sulphur and benefit from very accessible sulphur supply. Projects for value-added sulphur products in the fertilizer and construction areas are being examined.

The production of smelter acid in Canada is also anticipated to grow due to a combination of higher capture rates of SO₂ emissions and higher metal production in Canada over 1996 levels. Canadian sulphuric acid production from smelters is forecast to increase by a net 13% to 3.4 Mt H₂SO₄ in 2000. Several smelters in eastern Canada have announced plans to further increase their sulphur recovery efficiency, which in turn will generate higher smelter acid output by 1997/98. The Voisey's Bay/Argentia nickel projects by Inco in Labrador/Newfoundland will add substantial acid capacity and recovery by the turn of the century. Between 1996 and 2000, Canadian smelter acid capacity is projected to increase by an overall 4% to 3.9 Mt/y H₂SO₄. It is estimated that annual operating rates will rise from the high-70% to the high-80% levels.

In the medium term, the International Fertilizer Industry Association (IFA) based in Paris forecasts that world elemental sulphur production will continue to exceed demand. Of significance during 1996 was the IFA's reassessment of the level of future surpluses. In its May 1996 estimates, the IFA indicated a persisting supply surplus towards the year 2000, but at a much reduced level than previously forecast due to revisions in the timing of Iraq's re-entry into world sulphur trade, downward projections in Frasch output (mostly from Poland), and delays in commissioning the Astrakhan 2 sour gas project in Russia.

For the period 1996 to 2000, elemental sulphur demand is projected by the IFA to increase from 36.2 Mt to 39.2 Mt, while overall production is expected to grow from 37.7 Mt to 41.1 Mt. Growth in sulphur consumption will be offset by a sustained increase in the production of recovered sulphur; therefore, the world's sulphur imbalance will prevail, resulting in small annual surpluses ranging between 1.0 and 2.0 Mt/y until 2000, equating to only 5% of world demand (previous forecasts for annual surpluses were estimated at an average of 6.5 Mt/y for the rest of the decade). This imbalance, albeit reduced, will continue to require inventory additions by high-cost producers and swing suppliers and will maintain pressure on Frasch producers.

In the medium term, Canadian sales are expected to increase with prospective growth in demand in both China and Oceania. Between 1996 and 2000, Canadian offshore exports could grow by more than 20% as suppliers take advantage of their competitive position in Asia where major increases in phosphate fertilizer production are projected, and in Oceania and Latin America where strong demand for industrial uses is forecast. However, for the rest of the decade, Canadian producers and exporters will continue to face the complexity of maintaining a delicate

balance between positive returns and a sustained surplus. The resurgence of strong sales to China, the implementation of optimum export strategies, and the development of new markets for elemental sulphur in industrial and agricultural sectors would alleviate the mounting pressure on Canadian produc-

ers to dispose of their increasing production of recovered sulphur.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 70. (2) Information in this review was current as of February 10, 1997.

TARIFFS

Item No.	Description	MFN	Canada		United States
			GPT	USA	Canada
2503.00	Sulphur of all kinds, other than sublimed sulphur, precipitated sulphur and colloidal sulphur				
2503.00.00.10	Crude or unrefined sulphur	Free	Free	Free	Free
2503.00.00.90	Other	Free	Free	Free	Free
2802.00.00	Sulphur, sublimed or precipitated; colloidal sulphur	Free	Free	Free	Free
2807.00.00	Sulphuric acid; oleum	Free	Free	Free	Free
2811.23.00	Sulphur dioxide	Free	Free	Free	Free

Sources: Customs Tariff, effective January 1997, Revenue Canada; Harmonized Tariff Schedule of the United States, 1997.

TABLE 1. CANADA, SULPHUR SHIPMENTS AND TRADE, 1995 AND 1996

Item No.	1995		1996P		
	(tonnes)	(\$000)	(tonnes)	(\$000)	
PRODUCTION					
	Sulphur in smelter gases ²	1 083 046	..	1 090 694	..
	Elemental sulphur ³	7 934 945	..	8 235 873	..
	Total sulphur content	9 017 991	..	9 326 567	..
SHIPMENTS¹					
	Sulphur in smelter gases ²	1 074 206	75 837	1 087 746	82 509
	Elemental sulphur ³	7 089 297	171 705	7 078 156	84 423
	Total sulphur content ²	8 163 503	247 542	8 165 902	166 932
IMPORTS					
2503.00.00.10a	Sulphur, crude or unrefined				
	United States	8 992	579	262	29
	Total	8 992	579	262	29
2503.00.00.90b	Sulphur, n.e.s.				
	United States	16 565	3 421	21 719	3 493
	France	..	..	2 398	367
	Spain	12	4	7	1
	Germany	24	9	..	..
	Total	16 601	3 434	24 124	3 861
2802.00	Sulphur sublimed or precipitated; colloidal sulphur				
	United States	920	347	748	306
	France	831	621	282	212
	Japan	-	-	4	3
	Germany	6	5	3	2
	Netherlands	-	-	2	2
	United Kingdom	-	-	...	...
	Total	1 757	973	1 039	525
2807.00	Sulphuric acid; oleum				
	United States	70 657	6 316	75 738	6 833
	India	-	-	193	25
	United Kingdom	13	2	32	4
	Germany	11	1	28	4
	Japan	3	...	18	2
	Taiwan	124	16	7	1
	Singapore	3	...	-	-
	Canada	3	...	-	-
	Switzerland	1	...	-	-
	Total	70 815	6 335	76 016	6 869
2811.23	Sulphur dioxide				
	United States	1 432	508	1 636	422
	France	82	30	-	-
	United Kingdom	10	6	-	-
	Chile	3	2	-	-
	Germany	2	1	-	-
	Total	1 529	547	1 636	422
EXPORTS					
2503.00.00.10a	Sulphur, crude or unrefined				
	Morocco	930 036	66 783	854 706	72 564
	Brazil	795 337	68 997	836 438	55 955
	United States	1 627 508	112 934	934 131	47 471
	People's Republic of China	74 507	6 388	690 512	45 416
	South Africa	499 541r	34 942r	504 626	31 366
	Mexico	275 834	18 585	471 452	26 649
	Tunisia	116 012	8 508	273 787	20 530
	Indonesia	231 025r	16 904r	247 357	19 684
	New Zealand	228 537	16 034	162 846	11 884

TABLE 1 (cont'd)

Item No.	1995		1996 ^p		
	(tonnes)	(\$000)	(tonnes)	(\$000)	
EXPORTS (cont'd)					
	Philippines	108 502	8 985	150 003	10 456
	Chile	84 951	7 839	106 570	8 977
	Cuba	129 033	9 557	98 394	7 471
	Senegal	64 772	5 129	63 397	6 436
	South Korea	105 355	7 280	80 217	5 996
	Israel	194 897	11 645	85 165	4 846
	Australia	120 198	8 755	99 520	4 690
	India	229 495	17 803	39 065	4 203
	Argentina	43 769 ^r	2 625 ^r	56 616	4 097
	Thailand	53 933	4 222	38 032	3 109
	Vietnam	39 861	1 791	41 458	1 951
	Uruguay	15 550	1 021	14 115	1 139
	Egypt	..	..	33 000	990
	Taiwan	5 426	444	9 351	918
	Guatemala	..	..	4 096	123
	Saint Pierre and Miquelon	..	..	20	2
	Japan	43 909	2 977	..	..
	Italy	17 241	1 469	..	..
	Total	6 035 229 ^r	441 617 ^r	5 894 874	396 923
2503.00.00.90 ^b	Sulphur, n.e.s.				
	United States	37 175	3 710	127 794	7 291
	New Zealand	..	..	3 659	256
	Germany	3 307	300	..	..
	Netherlands	1 680	202	..	..
	South Korea	23	4	..	..
	Total	42 185	4 216	131 453	7 547
2802.00	Sulphur, sublimed or precipitated; colloidal sulphur				
	United States	–	–	7	7
	Total	–	–	7	7
2807.00	Sulphuric acid; oleum				
	United States	1 658 719	92 451	1 596 490	71 503
	Nicaragua	19	17	21	17
	Sierra Leone	–	–	3	4
	Libya	–	–	..	1
	People's Republic of China	83	63	–	–
	Grenada	2	2	–	–
	Thailand	7	1	–	–
	Bermuda	3	1	–	–
	India	..	1	–	–
	Dominica	5	..	–	–
	Netherlands Antilles	4	..	–	–
	Total	1 658 842	92 536	1 596 514	71 525
2811.23	Sulphur dioxide				
	United States	71 614 ^r	18 613	72 505	18 236
	Total	71 614 ^r	18 613	72 505	18 236

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; ^p Preliminary; ^r Revised.^a Data for previous years were included under code 2503.10. ^b Data for previous years were included under code 2503.90.¹ Data compiled regardless of origin (i.e., domestic and foreign source materials). ² Sulphur in liquefied SO₂ and H₂SO₄ recovered from the smelting of metallic sulphides and from the roasting of zinc-sulphide concentrates. ³ Producers' shipments of elemental sulphur produced from natural gas; also included are small quantities of sulphur produced in the refining of domestic crude oil and synthetic crude oil.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, SULPHUR SHIPMENTS AND TRADE, 1986-96

	Shipments ¹			Imports ²	Exports ²
	In Smelter Gases	Elemental Sulphur	Total	Elemental Sulphur	Elemental Sulphur
	(tonnes)				
1986	758 141	6 953 298	7 711 439	10 763	6 257 054
1987	783 115	7 322 791	8 105 906	24 711	6 571 800
1988	867 800	8 106 641	8 974 441	21 825	7 384 160
1989	831 503	6 868 930	7 700 433	18 311	5 514 059
1990	879 149	6 873 495	7 752 644	13 203	6 057 523
1991	883 565	6 937 884	7 821 449	9 026	5 845 372
1992	914 978	6 393 932	7 308 910	8 645	5 653 506
1993	856 236	5 220 304	6 076 540	7 532	4 193 877
1994	1 025 561	5 791 482	6 817 043	1 979	4 983 257
1995	1 074 206	7 089 297	8 163 503	25 593	6 077 414
1996 ^p	1 087 746	7 078 156	8 165 902	24 386	6 026 327

Sources: Natural Resources Canada; Statistics Canada.

^p Preliminary.

¹ Shipment data compiled regardless of origin (i.e., domestic and foreign source materials). ² Includes only elemental sulphur in a crude or refined form.

TABLE 3. CANADA, SULPHURIC ACID PRODUCTION, TRADE AND APPARENT CONSUMPTION, 1986-96

	Production	Imports	Exports	Apparent Consumption
	(tonnes, 100% acid)			
1986	3 536 062	29 127	755 606	2 809 583
1987	3 436 977	44 623	803 178	2 678 422
1988	3 804 856	40 078	851 622	2 993 312
1989	3 718 578	28 433	978 190	2 768 821
1990	3 829 570	71 319	1 280 502	2 620 387
1991	3 675 839	79 207	1 265 740	2 489 306
1992	3 776 086	86 284	1 340 213	2 522 157
1993	3 958 416	95 806	1 629 054	2 425 168
1994	4 055 165	68 261	1 645 406	2 478 020
1995	4 276 383	70 816	1 732 522	2 614 677
1996 ^p	..	76 016	1 596 514	..

Sources: Natural Resources Canada; Statistics Canada.

.. Not available; ^p Preliminary.

TABLE 4. CANADA, SULPHURIC ACID, REPORTED CONSUMPTION BY END USE, 1993-95

	1993a	1994a	1995p,a
	(tonnes)		
Agricultural chemicals and fertilizers	1 093 250r	1 164 032r	1 285 834
Pulp and paper	395 835	449 580	476 152
Industrial inorganic chemicals	367 936r	360 059r	369 770
Uranium mines	111 830	114 283	118 785
Nonferrous smelting and refining	129 923	110 530	116 421
Crude and refined petroleum products	38 290	60 478	64 631
Other mines, metal and nonmetal	30 722	40 399	34 149
Soap and cleaning compounds	x	x	x
Metal rolling and extruding	5 949	6 580	8 026
Food, brewery and distillery	3 261	x	x
Electrical products	3 298	x	x
Leather and textile	x	x	x
Plastics and synthetic resins	x	x	x
Other end uses	103 253	90 010	68 517
Total ¹	2 296 552	2 416 600	2 560 406

Source: Reports from producing companies, compiled by Natural Resources Canada, 1996.

p Preliminary; r Revised; x Confidential.

a Confidential numbers are included in the totals.

¹ Reported consumption does not include imported acid.

TABLE 5. CANADA, CRUDE OIL AND OIL SANDS REFINERIES, SULPHUR CAPACITY, 1994-96

Operating Company	Location	Daily Sulphur Capacity		
		1994	1995	1996
(tonnes/day)				
CRUDE OIL REFINERIES				
Canadian Ultramar Limited	St. Romuald, Quebec	50	50	50
Chevron Canada Limited	Burnaby, British Columbia	10	10	10
Imperial Oil Limited	Dartmouth, Nova Scotia	76	76	76
	Edmonton, Alberta	40	40	40
	Nanticoke, Ontario	35	35	35
	loco, British Columbia	20	—	—
	Sarnia, Ontario	140	140	140
Irving Oil Limited	Saint John, New Brunswick	100	100	100
North Atlantic Refinery Limited	Come-By-Chance, Newfoundland	—	200	200
Petro-Canada Inc.	Edmonton, Alberta	56	56	56
	Lake Ontario-Mississauga, Ontario	44	44	44
	Lake Ontario-Oakville, Ontario	40	40	40
Shell Canada Limited	Sarnia, Ontario	35	35	35
	Scotford, Alberta	14	14	14
Sulconam Inc.	Montréal, Quebec	300	300	300
Suncor Inc.	Sarnia, Ontario	50	50	50
Total effective capacity		1 010	1 190	1 190
HEAVY OIL UPGRADERS				
Consumers' Co-operative Refineries Limited	Regina, Saskatchewan	220	220	220
Husky Oil Operations Ltd.	Lloydminster, Saskatchewan	250	250	250
Total effective capacity		470	470	470
OIL SANDS PLANTS				
Suncor Inc.	Mildred Lake, Alberta	850	850	850
Syncrude Canada Ltd.	Fort McMurray, Alberta	1 255	1 255	1 255
Total effective capacity		2 105	2 105	2 105

Sources: Natural Resources Canada; company interviews, 1996.

— Nil.

TABLE 6. CANADA, NATURAL SOUR GAS PROCESSING PLANTS, SULPHUR CAPACITY, 1994-96

Operating Company	Source Field or Plant Location	H ₂ S in Raw Sour Gas	Daily Sulphur Capacity ¹		
			1994	1995	1996
		(%)	(tonnes/day)		
SOUR GAS, ALBERTA					
Alberta Energy Company Ltd.	Sinclair-Hythe	3	256	256	256.7
Alberta Energy Company Ltd.	Valhalla-Sexsmith	10	–	475.4	475.4
Amoco Canada Petroleum Company Ltd.	Bigstone Creek	15	385	385	–
Amoco Canada Petroleum Company Ltd.	Caroline North-Garrington	0.3	10.4	10.4	10.4
Amoco Canada Petroleum Company Ltd.	Caroline South-Harmattan	0.4	8.6	8.6	8.6
Amoco Canada Petroleum Company Ltd.	East Crossfield-Lone Pine Creek	34	1 797	1797	1 797
Amoco Canada Petroleum Company Ltd.	Kaybob I/II-Fir	8	1 090	1090	1090
Amoco Canada Petroleum Company Ltd.	Windfall-Whitecourt	12	1 333	1 333	1 333
Anderson Exploration Limited	Carstairs	0.5	64.8	64.8	64.8
Canadian 88 Energy Corporation	Olds-Garrington	14	389	389	391
Canadian Occidental Petroleum Ltd.	East Calgary-Crossfield	16	1 696	1 696	1 696
Canadian Occidental Petroleum Ltd.	Okotoks-Medallion	25	577	577	577
Canadian Occidental Petroleum Ltd.	Paddle River	0.1	19.4	19.4	–
Chevron Canada Resources	Kaybob South III-Obed	8	3 557	3 557	3 557
Chevron Canada Resources	Medicine Lodge	7.5	55.9	55.9	55.9
Gulf Canada Limited	Brazeau River-Nordegg	1.7	46.5	46.5	46.5
Gulf Canada Limited	Brazeau River-Peco	1.3	110	110	110
Gulf Canada Limited	Homeglen-Rimbey	0.5	127.5	127.5	127.5
Gulf Canada Limited	Strachan	9	953	953	953
Husky Oil Ltd.	Rainbow Lake	2	142	142	142
Husky Oil Ltd.	Ram River (Ricinus)	16.5	4 572	4 572	4 572
Imperial Oil Resources Limited	Bonnie Glen	0.4	34.5	34.5	34.5
Imperial Oil Resources Limited	Quirk Creek	9	301.2	301.2	301.2
Imperial Oil Resources Limited	Redwater	3	11	11	11
Mobil Oil Canada, Ltd.	Harmattan-Elkton-Leduc	52	66.2	66.2	81
Mobil Oil Canada, Ltd.	Lone Pine Creek	13.5	162	162	162
Morrison Petroleum Limited	Nevis	4	245.8	245.8	300
Morrison Petroleum Limited	Savannah Creek (Coleman)	12	389	696.4	696.4
Norcen Energy Resources Limited	Progress	0.7	49.5	49.5	49.5
Pembina Corporation	Turner Valley	1.2	15.5	15.5	15.5
Penn West Petroleum Ltd.	Minnehik-Buck Lake	0.1	45	45	37.5
Pennzoil Petroleum Ltd.	Zama	4	74	74	74
Petro-Canada Inc.	Brazeau River-Peco	21	447.3	447.3	447.3
Petro-Canada Inc.	Gold Creek	2.4	43	43	97
Petro-Canada Inc.	Hanlan Robb	8	1 092	1 092	1 092
Petro-Canada Inc.	Wildcat Hills	7	280.3	280.3	280.3
Poco Petroleum Ltd.	Sturgeon Lake South	9.5	98	98	98
Shell Canada Limited	Burnt Timber Creek	13	489	560	560
Shell Canada Limited	Caroline	25	4 504	4 504	4 504
Shell Canada Limited	Jumping Pound	7.5	597	597	597
Shell Canada Limited	Waterton	15	3 107	3 107	3 107
Suncor Inc.	Rosevear North	8	111.3	111.3	111.3
Suncor Inc.	Rosevear South	6.5	171	171	171
Suncor Inc.	Simonette River	5.5	95	115.8	115.8
Talisman Energy Inc.	Edson-Pine Creek	1.4	292	292	292
Talisman Energy Inc.	Teepee Creek	0.4	23	23	23
Ulster Petroleum Ltd.	Wimborne	10.5	182	182	182
Wolcott Gas Processing Ltd.	W. Pembina-Brazeau	11	520	520	520
SOUR GAS, BRITISH COLUMBIA					
Westcoast Energy Inc.	Fort Nelson	2	674	674	674
Westcoast Energy Inc.	Taylor Flats-McMahon	1.6	558	558	558
Westcoast Energy Inc.	Pine River	12	2 000	2 000	2 000

Sources: Alberta Energy and Utilities Board publication, January 1997; companies' survey 1996-97.

– Nil.

¹ Maximum design capacity.

TABLE 7. CANADA, PRINCIPAL SULPHUR DIOXIDE AND SULPHURIC ACID PRODUCTION CAPACITIES, 1996

Operating Company	Plant Location	Feedstock	Annual Capacity		
			Liquefied SO ₂	Sulphuric Acid ¹	Sulphur Equivalent ²
			(000 tonnes/year)		
EASTERN CANADA					
CE Zinc Falconbridge Limited	Valleyfield, Que.	SO ₂ zinc conc.		430	140
	Kidd Creek, Ont.	SO ₂ zinc conc.		220	72
	Kidd Creek, Ont.	SO ₂ copper conc.	30	470	168
	Sudbury, Ont.	SO ₂ nickel conc.		355	116
Gaspé Copper Mines, Limited	Murdochville, Que.	SO ₂ copper conc.		165	54
Inco Limited	Copper Cliff, Ont.	SO ₂ nickel conc.	100	1 000	377
Noranda Copper Smelting and Refining	Rouyn-Noranda, Que.	SO ₂ copper conc.		450	147
Noranda Mining and Exploration Inc.	Belledune, N.B.	SO ₂ lead and zinc conc.		176	57
Sulco Chemicals Ltd.	Elmira, Ont.	Elem. sulphur		33	11
Subtotal			130	3 299	1 142
WESTERN CANADA³					
Agrium Inc. ⁴	Redwater, Alta.	Elem. sulphur		910	297
Border Chemical Company Limited	Transcona, Man.	Elem. sulphur		150	49
Cameco Corporation-Rabbit Lake Operation	Rabbit Lake, Sask.	Elem. sulphur		72	24
Cameco Corporation-Key Lake Operation	Key Lake, Sask.	Elem. sulphur		72	24
Cominco Ltd. ⁵	Trail, B.C.	SO ₂ lead and zinc conc.	80	430	210
Hudson Bay Mining and Smelting Co. ⁶	Flin Flon, Man.	SO ₂ zinc conc.		n.a.	35
Sherritt Inc.	Fort Saskatchewan, Alta.	Elem. sulphur		233	76
Westcoast Energy Inc.	Prince George, B.C.	Elem. sulphur	30	75	39
Subtotal			110	1 942	754
Total Canada			240	5 241	1 896

Sources: Natural Resources Canada; Canadian company interviews, 1996.

n.a. Not applicable.

¹ 100% H₂SO₄. ² Elemental sulphur equivalent of sulphuric acid is 32.7% and sulphur equivalent of liquefied SO₂ is 50%. ³ Marsulex Inc. idled its 160 000-t/y acid plant in Fort Saskatchewan in 1993. ⁴ Agrium Inc. acquired the acid operations from Viridian Inc. (formerly Sherritt Inc.) in 1996. ⁵ Cominco operation at Trail also has a 30 000-t/y production capacity for elemental sulphur that has been added to the total sulphur equivalent production capacity of Cominco. ⁶ Hudson Bay recovers elemental sulphur from its zinc pressure leach smelter at Flin Flon; elemental sulphur is currently disposed of in tailings.

TABLE 8. WORLD PRODUCTION OF SULPHUR, 1993-95

	1993 ^r		1994 ^r		1995 ^p	
	All Forms ¹	Elemental	All Forms	Elemental	All Forms	Elemental
(000 tonnes)						
WESTERN EUROPE						
Finland	617	32	666	41	691	38
France	1 326	1 073	1 369	1 084	1 328	1 041
Germany	2 206	1 451	2 137	1 401	2 353	1 568
Italy	655	350	600	345	485	335
Netherlands	466	343	481	364	466	344
Spain	822	180	798	160	890	180
Others	1 139	617	1 044	577	1 088	621
Total, Western Europe	7 231	4 046	7 095	3 972	7 301	4 127
CENTRAL EUROPE						
Poland	2 097	1 893	2 341	2 141	2 559	2 349
Others	651	155	678	175	730	190
Total, Central Europe	2 748	2 048	3 019	2 316	3 289	2 539
COMMONWEALTH OF INDEPENDENT STATES						
	6 343	3 941	5 101	3 582	5 268	3 754
AFRICA						
South Africa	618	171	591	209	528	233
Others	183	3	187	3	180	3
Total, Africa	801	174	778	212	708	236
NORTH AMERICA						
Canada	8 483	7 576	8 963	8 018	8 939	7 973
United States	11 819	9 568	12 270	10 120	12 624	10 400
Total, North America	20 302	17 144	21 233	18 138	21 563	18 373
LATIN AMERICA						
Mexico	1 252	912	1 224	877	1 244	882
Others	1 104	425	1 284	480	1 410	515
Total, Latin America	2 355	1 337	2 508	1 357	2 654	1 397
MIDDLE EAST						
Iran	881	881	884	884	855	855
Iraq	375	375	375	375	375	375
Kuwait	246	246	490	490	559	559
Saudi Arabia	1 650	1 650	1 680	1 680	1 720	1 720
Others	537	430	789	634	753	590
Total, Middle East	3 689	3 582	4 218	4 063	4 262	4 099
ASIA						
China	6 323	262	7 014	285	7 562	403
Japan	3 114	1 560	3 081	1 667	3 131	1 682
South Korea	508	222	523	239	580	270
Others	1 055	425	1 067	442	1 214	529
Total, Asia	11 000	2 469	11 685	2 633	12 487	2 884
OCEANIA						
	379	57	393	77	317	89
Total, World	54 776	34 798	55 991	36 350	57 814	37 498

Source: The British Sulphur Corporation Limited, 1996.

^p Preliminary; ^r Revised.

¹ All forms includes elemental sulphur, sulphur contained in pyrites, and contained sulphur recovered from metallurgical waste gases, mostly in the form of sulphuric acid.