Silicon

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SUMMARY

For the purpose of this review, silicon metal and ferrosilicon are considered together since they are both produced from the same raw material, silica, using similar smelting processes.

In 1995, Canada's production of ferrosilicon was similar to that of 1994, while the country's only silicon metal producer operated at capacity. The value of Canadian exports of silicon-based products increased by 18.6% to $83.9 million, while the value of imports increased by 31.8% to $50.9 million. A decrease in net exports indicates that domestic demand increased during the year, led by increased steel and aluminum alloy production at plants across Canada.

The world's 1995 production of silicon metal increased by about 6.1% over 1994, while consumption was estimated to have increased by 8.0%, outstripping production for a second consecutive year and forcing a further drawdown in stocks. Similarly, the production of ferrosilicon in the Western World in 1995 was estimated to have increased by 8.5% over 1994, while consumption increased by about 1.7% on the continued strength of the steel industry. Drawdowns from consumer and producer stocks, and increased exports by C.I.S. and Chinese producers, made up for the supply shortage.

Prices for silicon-based products increased during the year as the result of a tightening market caused by a significant hike in demand (as a result of growth in the main consuming industries), while supplies remained limited in part because of anti-dumping duties. The average U.S. 1995 price for 75% Si imported ferrosilicon was US58.10¢/lb compared to US40.77¢/lb in 1994, while the average U.S. 1995 price for dealer import silicon metal was US69.49¢/lb compared to US64.13¢/lb in 1994.

The outlook for 1996 suggests a small increase in demand for ferrosilicon over 1995 as world economies expand, and a corresponding hike in supplies with increases in production capacity utilization rates. Demand for silicon metal in 1996 is expected to increase at a higher rate than for ferrosilicon, pushed by strong growth in both the aluminum and chemical sectors. Increased supplies due to greater production capacity utilization, increased exports from Eastern Bloc countries, and new production from Saudi Arabia are expected to keep the market tightly balanced. Prices for ferrosilicon are expected to stabilize at current levels in 1996 and to even fall slightly early in the year, while those for silicon are expected to increase further in the first quarter of 1996 and to stabilize at a slightly lower level afterwards. Prices should remain at these historically high levels for some time.

USES

Elemental silicon (Si) is a bluish grey-coloured, brittle, metallic lustre material that exhibits both metallic and nonmetallic characteristics. Its properties include a low density, a low melting point at 1410°C, and a low coefficient of thermal expansion. It is considered to be a semi-conductor since its conductivity increases with temperature. Combined with oxygen and other elements to form silicates, silicon constitutes about 25% of the earth's crust, making it the crust's most abundant element after oxygen.

Silica (SiO_2), the highest grading silicon compound found stable in nature, is used in the form of quartz or quartzite as the main source of silicon to produce silicon-based products mostly for the aluminum, chemical, and iron and steel industries.

Silicon metal and ferrosilicon are referred to according to the silicon content of the material, or the maximum amount and nature of trace impurities contained in the material.

The two generally used standard grades of ferrosilicon respectively contain about 50% and 75% silicon by weight. Almost all ferrosilicon products are consumed by the iron and steel industry. The main uses of ferrosilicon are as a deoxidizer of molten steel, and as a reducing and alloying agent in the production of iron and steels. As an additive it is used as a

graphite promoter in the production of cast iron to soften the iron and improve its machinability, and in the production of carbon steels to improve the electric properties and tensile strength. On average, 5.4 kg of ferrosilicon are used per tonne of stainless steel produced, and 17.0 kg are used per tonne of cast iron produced.

Ferrosilicon applications other than in the iron and steel industry include its use as a heavy-medium ore separation material and as a reduction agent in the manufacture of alloys such as ferrovanadium.

In the Western World, silicon metal is used 56% by the aluminum and magnesium industries, 37% by the chemicals industry, and 7% by the electronics and other industries. As an alloying agent for aluminum and magnesium, silicon increases fluidity and corrosion resistance, as well as thermal and electrical conductivity. It also reduces the specific gravity and thermal expansion of aluminum and magnesium alloys, which contain, on average, 6% silicon. These alloys are used principally to make aluminum castings that are utilized in large part in the transportation industry.

In the chemicals industry, silicon metal is the basic material for the manufacture of silanes, silicones, fumed silica, and semi-conductor-grade silicon. These are used in a variety of products which include: sealants and lubricants, fabric softeners, medical devices and pharmaceuticals, silicon chips and wafers, cosmetics, and polishes.

CANADIAN DEVELOPMENTS

Canada's ferrosilicon production in 1995 was estimated at 68 561 t, about equal to the level in 1994, while its silicon metal production was estimated at 29 000 t, similar to the 1994 production level.

The Canadian ferrosilicon and silicon metal industries are concentrated in Quebec where large supplies of cheap hydro-electric power and raw materials are available and markets are easily accessible. In 1995 there were two producers of ferrosilicon, one of which also produced silicon metal. By-product ferrosilicon grading 9-16% Si was also produced at a few locations in Ontario in the manufacture of fused aluminum oxide abrasives and silicon carbides.

Elkem Metal Canada Inc. operates a 30-MW electric arc furnace at its Chicoutimi, Quebec, plant alternately producing 50%- and 75%-grade ferrosilicon. The furnace's capacity is rated at 40 000 t when its operating time is split equally between the production of the two grades. In 1995, the plant operated at capacity, producing 39 561 t, similar to 1994's production. This production is destined 65% for domestic consumers and 35% for exports. During the year, Elkem initiated the dismantlement of the remaining installations at its Beauharnois plant. These facilities produced ferrosilicon up to 1982 and ferromanganese and silicomanganese up to 1991, but remained closed afterwards. In 1996, Elkem's production is expected to reach only 32 500 t of ferrosilicon due to an increase in the production of 75%-grade material.

In 1995, as in the previous year, SKW Canada Inc. produced at capacity. The company operates three electric arc furnaces at its Bécancour, Quebec, plant. Two 20-MW furnaces with a total capacity of 29 000 t/y produce silicon metal, while a 30-MW furnace with a 30 000-t/y capacity produces 75% ferrosilicon. Only about 20% of both products are earmarked for the domestic market, while the remaining 80% is exported to the United States, Japan, and Germany. In 1996, SKW expects to continue operating at capacity.

Near the end of 1994, Dow Corning Corp. reported the completion of tests at its Selkirk, Manitoba, pilot plant where it had been conducting a program to develop a technology for direct current closed-furnace silicon metal manufacture. This US$32 million program, funded 62.5% by Dow Corning, 15.6% by Western Economic Diversification Canada, 15.6% by the Province of Manitoba, and 6.3% by the U.S. Department of Energy, confirmed this new technology to be more energy efficient, safer to use, and less polluting than current open-furnace processes. In a bid to commercialize the technology, Dow Corning concentrated on finding partners for the project in 1995.

Canada's consumption of ferrosilicon in 1994, the latest year for which data are available, increased 4.9% to 57 728 t gross weight compared to 1993. This increase was due to a 13.8% hike in the use of high-grade (>70%) ferrosilicon, while the use of lower-grade ferrosilicon actually decreased by 6.7%. An improved demand for high-grade ferrosilicon followed improved demand for steel products. (Consumption data for silicon metal were not available.)

TRADE

Canada's trade in silicon-based products is relatively small. However, it is vital to the country since silicon is essential to the activities of the steel, aluminum and chemical industries.

In 1995, total imports of silicon-based products (excluding silicomanganese, which only contains about 16% Si) were valued at $50.9 million, up 31.8% compared to 1994, while exports amounted to about $83.9 million, up 18.6%.

Overall 1995 imports of ferrosilicon increased by 1.0% to 26 014 t compared to 1994. Broken down by grade, 1995 imports of 75% ferrosilicon increased to 10 477 t from 7532 t in 1994, while imports of 50% ferrosilicon decreased to 15 537 t from 18 217 t.

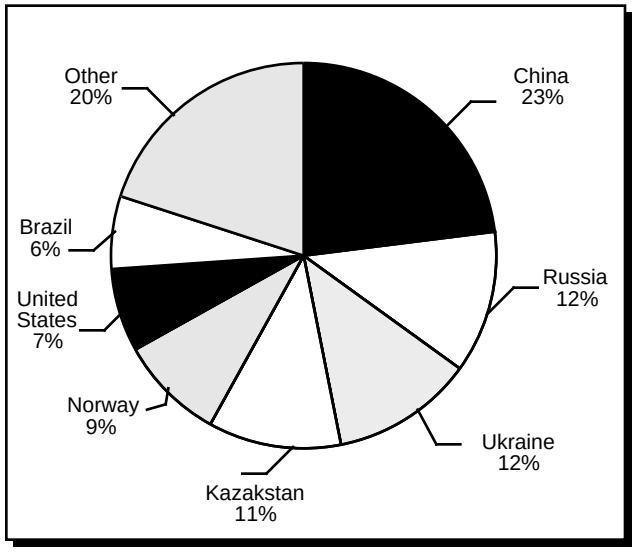
Similarly for exports, overall 1995 shipments decreased by 8.6% to 30 027 t compared to 1994. Again, broken down by grade, 1995 exports of 75% ferrosilicon fell to 12 200 t from 14 193 t, while those of 50% ferrosilicon fell to 17 827 t from 18 666 t. Imports of silicon metal increased by 59.7% to 15 582 t in 1995 compared to the previous year, while silicon metal exports increased 2.9% to 25 222 t. Canada's 1995 production of silicon metal and ferrosilicon being at about the same level as in 1994, coupled with 1995 trade data that show a decrease in net exports compared to 1994, indicate that domestic demand increased during the year led by increased steel and aluminum alloy production.

WORLD DEVELOPMENTS

A country's competitiveness (hence, the size of its industry) in the production of ferrosilicon and silicon metal depends on its availability of large supplies of relatively cheap power, low-cost labour, and raw materials, as well as its proximity to markets. A typical breakdown of costs at Western World silicon smelters is as follows: electricity, 26.1%; reductants, 18.1%; labour, 17.4%; electrodes, 17.3%; quartz, 8.3%; and others, 12.8%. China, Russia, Ukraine, Kazakstan, Norway, the United States, and Brazil are the leading world producers of ferrosilicon, while silicon metal is mostly produced in the United States, China, Brazil, Russia, Norway and France (Figures 1 and 2).

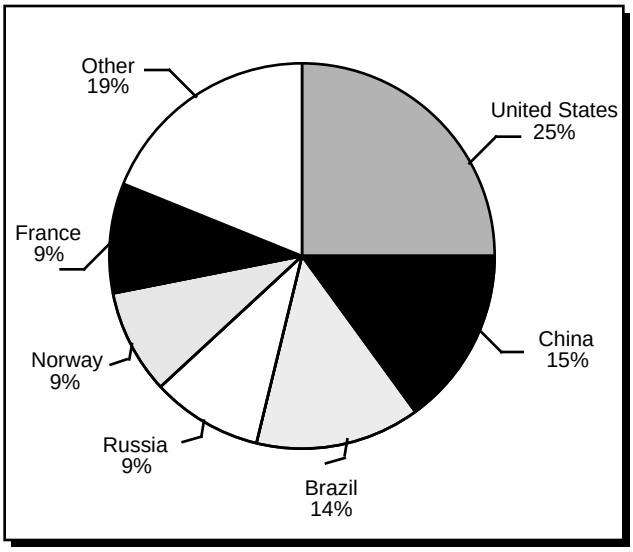
The world's 1995 production of silicon metal was estimated to have increased to 780 000 t from 732 420 t in 1994, mostly due to greater capacity utilization.

Figure 1
World Ferrosilicon Production, 1995



Source: Natural Resources Canada.

Figure 2
World Silicon Metal Production, 1995



Source: Natural Resources Canada.

Meanwhile, consumption was estimated to have increased to 796 000 t from 732 320 t, outstripping production for a second consecutive year and forcing a further drawdown in stocks. The increased demand for silicon was led by growth in the aluminum and chemical industry sectors of the North American and Western European economies.

The production of ferrosilicon in the Western World in 1995 was estimated to have increased to 1 865 000 t from 1 706 475 t in 1994. The production of ferrosilicon increased due to greater capacity utilization and recently developed plants achieving their designed capacity. Western World consumption in 1995 was estimated to have increased from 2 206 835 t in 1994 to 2 245 000 t on the strength of increased demand from the steel industry. The supply deficit is estimated to have been filled by drawing on stocks at all levels of the industry chain, and by increased C.I.S. and Chinese exports which effectively satisfied excess demand.

Historically high commodity prices and robust demand from the major consumer industries encouraged the re-opening of closed capacity and the development of new silicon and ferrosilicon production capacity in some areas of the world. Some of the 1995 developments are described below by country.

Brazil

In 1995, Brazil's production of silicon products, which is concentrated in Minas Gerais State, was made difficult by the reduced availability of surplus energy generated by the Minas Gerais State Energy Authority (Cemig) because of low rainfalls. However, because of the current high commodity prices,

producers elected to pay higher electricity rates to keep production at capacity when Cemig announced in early September that it was cutting the supply of surplus energy. The country's ferroalloy producers have been dependent on these cheaper surplus energy supplies since 1990 when a drastic increase in electricity charges was introduced, raising basic rates to about four times that in Canada.

To remedy the problem of restricted power supplies, Cemig and a consortium of companies in energy-intensive industries announced the investment of US$430 million to develop additional power capacity.

The production of ferrosilicon in Brazil is distributed between a large number of producers with a total capacity of about 320 000 t/y. However, the main producers are: Cia Brasileiro Carbureto de Calcio (64 000 t/y), Minasligas - Cia Ferroligas Minas Gerais (50 000 t/y), and Italmagnesio SA and Eletrovale SA (44 000 t/y each). In recent years the Brazilian industry has been operating, on average, at about 75% of its capacity, resulting in production in the range of 240 000 t/y.

Libra Ligas do Brazil SA (12 000 t/y) and Nova Era Silicon (45 000 t/y) were exempted in May from anti-dumping duties into the European Union (EU), but will be subject to a minimum price setting. Recently, Nova Era was shipping 85% of its production to Japan.

Brazilian production of silicon metal was split between eight producers for a total production capacity of 156 000 t/y, with the main ones being Ligas de Aluminio SA (48 000 t/y), Camargo Correa Metais SA (32 000 t/y), and Eletrosilex SA (22 000 t/y). Brazil's 1995 silicon production was estimated at 89 757 t, up 29% over 1994's level.

In early July, Rima Eletrometallurgia SA announced the conversion of its No. 4 furnace at the Varzea da Palma plant in Minas Gerais State to the production of ferrosilicon, leaving only one of its six furnaces for the production of silicon.

China

China, with current production estimated at 750 000 t, is the world's largest producer of ferrosilicon. It is also the world's second largest producer of silicon metal after the United States with a production capacity of over 150 000 t/y. China exported 300 000 t of ferrosilicon and 116 000 t of silicon in 1994, mostly directed to Japan and other Asian countries. However, due to increased domestic consumption and lower production, 1995 exports are estimated to have not exceeded 250 000 t of ferrosilicon, while silicon exports stayed at 1994 levels.

Reduced ferrosilicon production in 1995 was reportedly caused by rising domestic inflation, cash shortages, higher power costs brought about by a drought period, and capacity conversions to the production of ferrochromium. Although some of the capacity was re-converted in June, ferrosilicon exports are not expected to increase in the short term since anti-dumping duties in the European Union and the United States restrict China's markets, while the Chinese government's revision of the value-added tax rebate on exports from 13-14% to 8-9% increases export costs.

The Xibei Ferro-Alloy Works suspended its production of ferrosilicon in June because of cash-flow problems, reducing China's capacity by 80 000 t/y. The Zunyi Ferro-Alloy Works in Guizhou Province started producing with one of its three furnaces at a rate of 50 000 t/y in mid-July. The company had been idle since its construction a few years ago, waiting for the market to improve.

Commonwealth of Independent States (C.I.S.)

Ferrosilicon products inside the C.I.S. were produced by operations in Russia, Kazakstan, and Ukraine, while silicon was only produced in Russia. C.I.S. production of ferrosilicon was reported at 846 000 t in 1994 and was estimated at about 745 000 t in 1995. Similarly, the production of silicon in 1995 was estimated at just under 50 000 t, down about 12% from 1994. Silicon exports in 1994, estimated at 56 260 t, were directed mostly to the United States where Russian material is not subject to anti-dumping duties, unlike exports to EU countries.

Russia's production of ferrosilicon comes from two plants with a combined capacity of over 635 000 t/y: the Chelyabinsk Electro-Metallurgical Works, and the Kuznetsk Ferro-Alloy Works. Output of silicon metal also comes from two plants for a total capacity of 76 000 t/y. In 1995, Russia's ferrosilicon plants were reportedly operating at about 55% of capacity and were gradually being switched to the production of higher-grade material to expand their output of 70-75% Si. In addition, the construction of a 300 000-kW gas-turbine power plant was being planned near the Chelyabinsk Works, which will significantly reduce its production costs.

Kazakstan's ferrosilicon output was mostly produced at the Yermavosky Ferro-Alloy Works in the Pavlodar region, where the plant's 1.1-Mt/y capacity was split to produce chromium and silicon alloys. In 1994 the plant produced 207 700 t of ferrosilicon, and was estimated to have produced just over 175 000 t in 1995. As with Russian production, furnace capacity was being redirected from the production of 45% Si ferrosilicon to the 75% grade. Moreover, Yermavosky plans to convert idled ferrosilicon furnaces to boost the production of ferrochromium, which it can produce more competitively because of its vast chromium reserves. Once these changes are completed, Kazakstan's ferrosilicon capacity should be reduced to 370 000 t/y.

Ukraine's ferrosilicon production capacity utilization in 1994 was reported at about 45% with an output of 277 400 t, while production in 1995 was estimated at under 245 000 t because of energy shortages. Ukraine's production comes mostly from the Zaporozhye Ferro-Alloy Works, with some production also reportedly coming from the Stakhanov plant.

C.I.S. ferrosilicon exports in 1995 were still subject to anti-dumping duties of 104.18% in the United States and 74% in EU countries.

European Union (EU)

By the end of the year, the European Commission had still not confirmed the continuation of anti-dumping duties on imports of silicon metal from China following a review request by EU producers. The anti-dumping action brought in 1989 with final determination in 1990 was valid for a five-year period ending July 29, 1995. Duties on the import of silicon metal, coupled with anti-dumping duties ranging between a low of 9.2% for some Brazilian material and a high of 74% for C.I.S. countries on imports of ferrosilicon, have been largely successful in leaving EU and Norwegian producers in control of the European market. However, these measures have resulted in a tightening of supplies of both materials with a corresponding pressure on prices. Consumer requests to drop duties were countered by the EU producers' reply that the whole point of the anti-dumping duties was to ensure fair prices, and not to stop material from coming into the market.

Norway

Norway is the world's fourth leading producer of silicon metal and its fifth largest ferrosilicon producer. Fesil A/S and Elkem A/S produce both ferrosilicon and silicon metal, while Bjølvefossen A/S and Finnfjord Smelteverk A/S only produce ferrosilicon.

Norway's 1995 production of ferrosilicon was estimated at 455 000 t, a 12.8% increase compared to 1994, while estimates put silicon metal production at 81 500 t, up 10.9%. Norway's higher ferrosilicon production in 1995 stems from capacity resumption of furnaces shut down in 1994. Because of improved markets and lower power costs, Fesil re-opened its smallest furnace at the Hafslund plant in April, while Bjølvefossen re-opened its closed capacity in late May.

Fesil A/S, the new name of Ila og Lilleby Smelteverker as of March 31, 1995, was expected to have produced about 209 000 t of ferrosilicon and 26 000 t of silicon metal in 1995 at its four domestic plants: Hafslund, Rana Metall, Lilleby Metall, and Holla Metall. The company mentioned that it plans to put more emphasis on the production of specialized products like ferrosilicon granules and powders, and foundry alloys. Because of increased demand from steel-makers, Fesil plans to double its production of granulated ferrosilicon to 70 000 t by the first quarter of 1996. Also in the fourth quarter of 1996, the company plans to convert one of its two furnaces at its Lilleby Metall plant to the production of silicon metal from that of high-purity ferrosilicon because of declining demand for the latter. This will result in a small silicon production increase in 1996 and a hike of 8000 t in 1997.

Elkem A/S was estimated to have produced at slightly less than capacity in 1995. The company's ferrosilicon production comes from the Salten, Tamshaun and Bremanger plants with a total capacity of 225 000 t/y, while its silicon production comes from the Bremanger, Fiskaa and Meraker plants with a total capacity of 70 000 t/y. Finally, Bjølvefossen A/S, owned 70% by Elkem, produced about 52 000 t of ferrosilicon in 1995.

United States

The United States is the world's largest producer of silicon metal and its sixth largest producer of ferrosilicon. However, it is a net importer of both commodities.

Ferrosilicon was produced by five companies: American Alloys Inc., Applied Industrial Minerals Corp., Globe Metallurgical Inc., Keokuk Ferro-Sil Inc., and SKW Metals and Alloys Inc., for a total nominal production capacity of about 370 000 t/y. Silicon metal was also produced by five companies: American Silicon Technologies, American Alloys Inc., Elkem Metals Co., Globe Metallurgical Inc., and Simetco Inc., for a total nominal production capacity of about 160 000 t/y. The overall gross production of silicon-based products in 1994 was reported at 390 000 t, while it was estimated to have increased to about 400 000 t in 1995. The 39-day strike at Elkem's Alloy, West Virginia, silicon plant in the first quarter was reported as not having resulted in a significant production loss.

As a result of increased market competition, and to defend its industry against unfairly priced imports, the U.S. Department of Commerce, in early 1994, announced the imposition of definitive anti-dumping duties of up to 137.73%, as in the case for China, on imports of ferrosilicon from China, Brazil, C.I.S. countries, Poland and Venezuela. Anti-dumping duties of up to 91.06% (as for some Brazilian material) on imports of silicon metal from China, Brazil and Argentina had already been assigned since 1991. However, strong demand from the steel, aluminum alloy and chemical sectors in both 1995 and the previous year caused a supply tightness to develop with resulting pressure on prices. This was brought about because of limited production by domestic producers while anti-dumping duties kept out imported material. Duty orders on silicon and ferrosilicon imports were revisited during the year with preliminary reviews being applied, some increasing and others

decreasing. However, the full results of the reviews had not been announced by year-end.

SKW Metals and Alloys Inc. sold its Niagara Falls, New York, ferrosilicon-silicon plant to Globe Metallurgical Inc. at the close of 1994, while it brought 12 000 t/y of extra 75% ferrosilicon capacity on line at Calvert City, Kentucky, at the end of August.

Simetco Inc., under bankruptcy protection since September 1993, was acquired by two investment groups. Simcala Inc., as the company is now known, began an $8 million upgrading program at its Montgomery, Alabama, silicon metal plant to increase its production capacity by 43% to 40 000 t/y by restoring the plant's third furnace, which has been dormant since 1989.

In addition, in a decision that could affect all domestic silicon producers, Dow Corning Corp., the country's largest consumer of chemical-grade silicon metal, entered Chapter 11 bankruptcy protection on May 15, 1995, after being faced with multi-million-dollar claims for its silicon gel breast implants.

On September 22, Elkem Metals Co. pleaded guilty to conspiring to fix ferrosilicon prices in the United States during the period between late 1989 and mid-1991. The company and the U.S. Justice Department agreed to recommend to the courts that Elkem pay a fine of US$1 million in punitive damages. Other co-conspirators are still being investigated in this case.

Other Developments

Argentina's Stein Ferroaleaciones investigated financing possibilities to proceed with the construction of a fourth furnace at its Luján de Cuyo plant in Mendoza Province. This addition would increase the company's ferrosilicon production by 12 000 t/y. Electrometallúrgica Andina announced that it would resume production of silicon in the first quarter of 1996 at its Chimbas plant in San Juan Province at an initial rate of 8000 t/y. About 60-70% of the production is slated for the U.S. and European markets.

France's sole silicon metal producer, Pechiney Electrométallurgie, estimates that its 1995 production was 10% above that of 1994, at 70 000 t, because of improved efficiency at its plants.

In June, Indsil Electrosmelt Ltd. of India started its Palakkad plant's second ferrosilicon furnace to bring its production capacity to 17 600 t/y. This new production, like the rest of the country's output, is aimed mostly at domestic users. In addition, in order to put itself in a better position to compete with production from abroad, and in light of the ongoing liberalization of trade, the company is planning to set up a captive 21-MW power plant.

In South Africa, Silicon Smelters (Pty), the country's only silicon producer with a capacity of about 40 000 t/y, was reported in June to be working at just below capacity. Rumours about a switch to produce ferrochromium were denied during the year. Also, Silicon Technology (Pty) Ltd. resumed the operation of one of its two ferrosilicon furnaces on March 1 at its Ballengei plant in Natal. Closed since June 1994, the plant will bring on stream a production capacity of 27 000 t/y, adding to production from South Africa's other producer, Rand Carbide.

Venezuela's CVG Fesilven CA-Venezolana de Ferroaleaciones estimated that its 1995 ferrosilicon production jumped 52% to 62 500 t compared to 1994. However, renovations need to be completed before the company can produce at its design capacity of 80 000 t/y. An appeal by the U.S. industry to increase countervailing duties on imports of ferrosilicon from Venezuela, which now stand at 22.08%, may affect Fesilven's production plans by reducing its export market.

PRICES

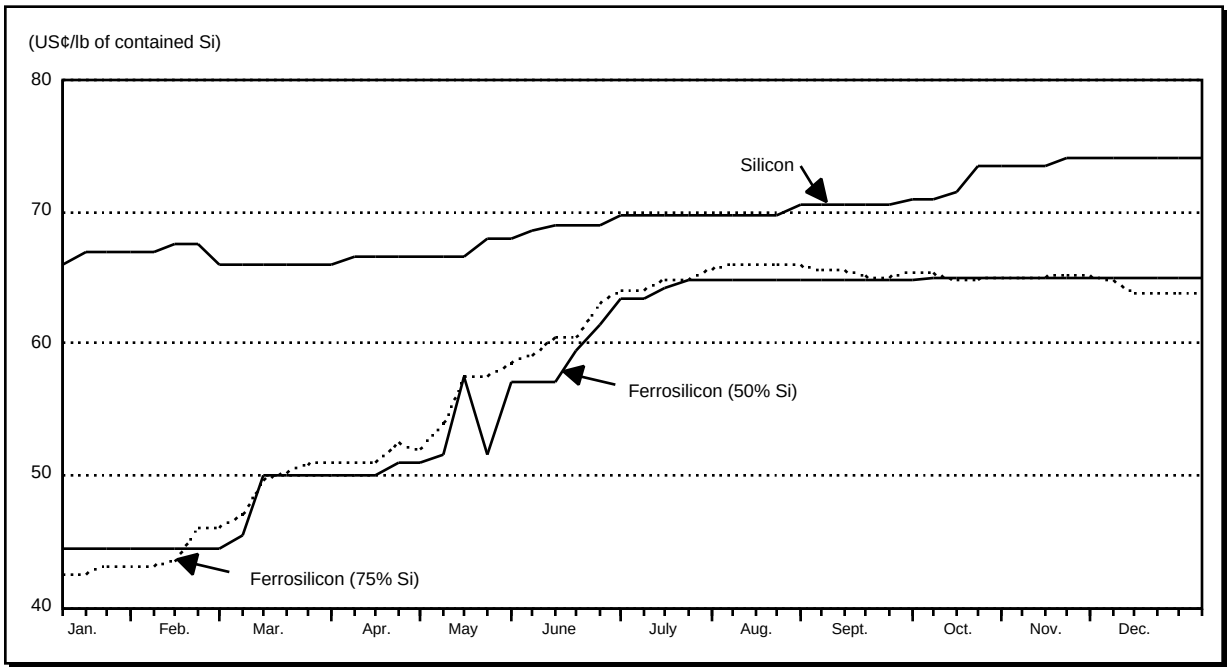
In 1995, the silicon market was somewhat unstable in response to a perceived tightness in supply. After a decrease in consumption in recent years due to recessions in North America, Europe and Japan, demand started to improve in 1994 and continued to increase in 1995. This rise in demand, coupled with production cutbacks in recent years, resulted in price increases throughout 1995 (Figure 3).

The U.S. price for 50% Si imported ferrosilicon started the year in the range of US44.0¢-45.0¢/lb, where it remained until jumping to the US48.0¢-52.0¢/lb range in early March. It stabilized at that level until mid-May when a strong rally pushed the price to the US64.0¢-65.5¢/lb range in mid-July, where it stabilized for the rest of the year. Similarly, the U.S. price for 75% Si imported ferrosilicon started the year in the range of US42.0¢-43.0¢/lb, but started to increase in mid-February, earlier than the price for 50% Si ferrosilicon, and gradually climbed to peak in the US65.0¢-67.0¢/lb range. It stayed there until early in September when it gradually started falling back in a see-saw fashion to finish the year in the US63.0¢-64.5¢/lb range.

The U.S. price for dealer import silicon metal started the year in the US65.0¢-67.0¢/lb range, where it hovered until mid-May when the price started to increase gradually to close the year in the US73.0¢-75.0¢/lb range, at which time it was still rising.

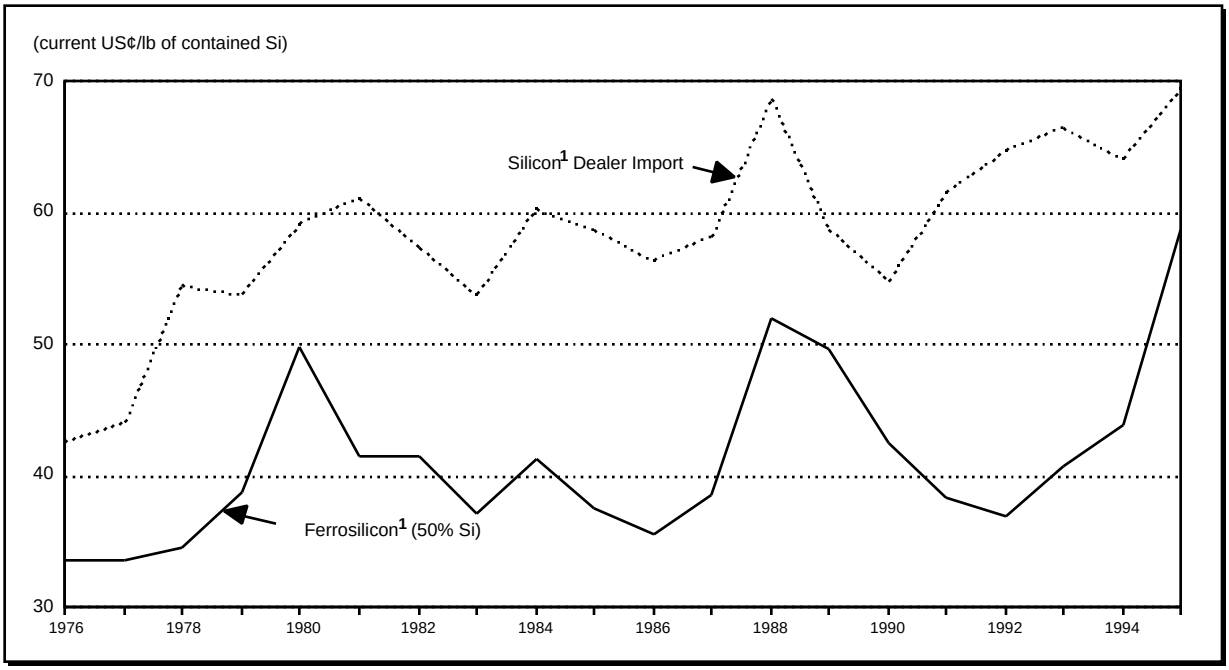
Weakening prices in December for 75% Si imported ferrosilicon were thought to be temporary, with prices regaining lost ground during the first quarter of 1996 before stabilizing. However, prices may fall slightly as additional supplies from market economy countries enter the market to counter an expected drop in exports from C.I.S. countries and China.

Figure 3
Silicon and Ferrosilicon Price Variations, 1995
Dealer Import Price



Source: *Metals Week*.

Figure 4
Silicon and Ferrosilicon Price Variations in the Past Twenty Years, Yearly Average, 1976-95



Source: U.S. Bureau of Mines' *Metal Prices in the United States Through 1991* for 1976-91; *Metals Week* for 1992-95.
[1] U.S. producer prices, 1976-79; U.S. dealer import prices, 1980-95.

Improved silicon metal output from existing producers, new capacity coming on stream, furnace re-activations, furnace conversions from the production of ferroalloys, and/or an increase in exports from Eastern Europe will help meet demand. However, the silicon metal market is expected to remain tight in the short-to-medium term, causing further price increases, particularly for chemical-grade material.

OUTLOOK

In Canada, the production of ferrosilicon is expected to decrease by 10.2% to 62 500 t in 1996, while the production of silicon metal is expected to remain at the 1995 level. The reduced ferrosilicon production is mostly attributed to Elkem's plan to produce a greater proportion of 75%-grade ferrosilicon instead of the 50%-grade because of market preference. In general, 75% ferrosilicon is preferred when distance to the client is great because of lower shipping costs per silicon unit and when steel scrap supplies are limited or increase in price.

Western World production of ferrosilicon is expected to increase by 4.2% to 1 944 000 t, with increases in production capacity utilization rates, furnace conversions from the production of ferrochromium, and the start-up of new production capacity in Iran. Meanwhile, Western World consumption, which is expected to increase by only 2.8% to 2 307 000 t following the steel industry's growth, will have to rely on supplies from Eastern Bloc countries to fill the gap. However, declining exports from China, the C.I.S. and Brazil, expected in the short-to-medium term because of energy shortages and higher production costs in each country, and because of increasing domestic demand in China, will exert a certain tightness on supplies until additional capacity comes on stream in 1997 in Saudi Arabia.

Likewise, world production of silicon metal is expected to increase by 3.7% to 819 600 t compared to 1995. Consumption may increase by 6.0% to 844 000 t, driven largely by the automotive industry's increased demand for silicones and aluminum castings. Increased supplies due to greater production capacity utilization, furnace conversions from the production of ferroalloys, increased exports from Eastern Bloc countries, and new production capacity in Saudi Arabia are expected to keep the market tightly balanced.

Prices for ferrosilicon in 1996 are expected to stabilize at the levels reached near the end of 1995, or to even fall slightly as more supplies gradually become available, while silicon metal prices are expected to peak in the first half of 1996 and to retreat slightly afterwards as more supplies enter the market. In the longer term, ferrosilicon demand is expected to follow the 1% growth of the world's steel industry, while silicon metal consumption is expected to grow at an average annual rate of 3.9% over the next five years, pushed mostly by stronger growth in the chemical and semi-conductor industries. Prices for both commodities should remain at historically high levels for some time.

Note: Information in this review was current as of January 31, 1996.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2804.61	Silicon containing by weight not less than 99.99% of silicon	2.1%	1%	Free	Free
2804.69	Silicon, other	5.3%	3%	1.8%	1-1.8%
2811.22	Silicon dioxide	Free	Free	Free	Free
2849.20	Silicon carbide	Free	Free	Free	Free
7202.21.10	Ferrosilicon containing by weight more than 55% but less than 60% of silicon	Free	Free	Free	Free
7202.21.20	Ferrosilicon containing by weight 60% or more of silicon but less than 90%	1.33¢/kg on the silicon content	Free	Free	Free
7202.21.30	Ferrosilicon containing by weight 90% or more of silicon	3.82¢/kg on the silicon content	Free	Free	Free
7202.29	Ferrosilicon, other	Free	Free	Free	Free
7202.30	Ferro-silico-manganese	1.33¢/kg or fraction thereof on the manganese content	Free	Free	Free
7202.50	Ferro-silico-chromium	8.8%	5%	Free	Free

Sources: Customs Tariff, effective January 1996, Revenue Canada, Customs and Excise; Harmonized Tariff Schedule of the United States, 1996.

TABLE 1. CANADA, SILICON TRADE, 1993-95

Item No.		1993		1994		1995p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS							
2804.61	Silicon containing by weight not less than 99.99% of silicon						
	Brazil	342	556	2 288	3 499	1 210	2 356
	People's Republic of China	–	–	–	–	567	894
	Japan	416	551	248	408	75	123
	United States	103	165	134	215	52	85
	Other countries	2	1	1	...	...	...
	Total	862	1 275	2 670	4 123	1 904	3 460
2804.69	Silicon, n.e.s.						
	Brazil	2 666	3 910	3 485	5 341	5 868	10 538
	United States	2 005r	2 666r	2 899	3 918	4 669	6 593
	People's Republic of China	2 521	3 223	3 283	3 979	3 196	5 446
	Australia	–	–	–	–	661	1 314
	Hong Kong	99	113	–	–	918	1 236
	Other countries	358	675	92	177	235	518
	Total	7 648r	10 590r	9 759	13 418	15 547	25 649
2811.22.00.90	Silicon dioxide, n.e.s.						
	United States	4 940	9 553	6 551	12 843	8 446	12 858
	France	1 496	2 011	2 202	3 396	2 214	4 164
	South Korea	1 533	1 300	2 218	1 047	3 677	1 937
	Germany	467	1 076	538	1 564	345	1 446
	Other countries	12	68	7	140	128	928
	Total	8 448	14 012	11 516	18 995	14 811	21 336
2849.20	Silicon carbide						
	United States	15 012	13 557	12 862r	12 900r	13 553	12 821
	People's Republic of China	10	7	46	50	849	509
	Cameroon	–	–	–	–	492	281
	Other countries	159	435	118	489	575	664
	Total	15 181	14 002	13 026r	13 443r	15 469	14 280
7202.21.10	Ferrosilicon, containing by weight more than 55% but less than 60% of silicon						
	United States	1 251	1 213	927	626	1 557	959
	Brazil	78	130	45	70	36	69
	Other countries	13	25	22	28	225	95
	Total	1 342	1 369	994	726	1 819	1 127
7202.21.20	Ferrosilicon, containing by weight 60% or more of silicon but less than 90%						
	United States	4 524	4 231	3 317r	3 658r	5 041	5 809
	Brazil	1 026	1 365	1 310	1 099	807	1 069
	Other countries	39	67	198	221	426	625
	Total	5 589	5 665	4 824r	4 979r	6 274	7 507
7202.21.30	Ferrosilicon, containing by weight 90% or more of silicon						
	United States	758	1 022	744r	825r	2 492	2 470
	Brazil	12	19	1 044	1 721	238	401
	Total	771	1 042	1 788r	2 546r	2 730	2 872
7202.29.00.10	Ferrosilicon, n.e.s., containing by weight more than 45% but not more than 55% of silicon						
	United States	15 781r	14 090r	13 810r	12 620r	11 793	9 503
	Norway	–	–	2 231	2 965	2 373	3 623
	Other countries	1 096	516	1 228	515	333	318
	Total	16 877r	14 607r	17 269r	16 101r	14 499	13 447
7202.29.00.20	Ferrosilicon, n.e.s., containing by weight not more than 45% of silicon						
	United States	624	503	1 018	949	1 301	1 260
	Other countries	–	–	8	8	76	124
	Total	624	503	1 026	957	1 377	1 385

TABLE 1 (cont'd)

Item No.		1993		1994		1995p	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
7202.30	Ferro-silico-manganese						
	Brazil	15 730	9 186	15 362	11 231	18 149	13 101
	South Africa	9 819	5 955	7 956r	6 165r	10 183	9 169
	United States	8 958	7 763	6 488	6 829	6 013	6 063
	Norway	517	653	2 156r	3 260r	1 491	2 202
	Other countries	3 971	3 596	3 044	2 566	5 659	4 441
	Total	38 996	27 156	35 006r	30 055r	41 494	34 982
7202.50	Ferro-silico-chromium						
	United States	723	853	469	668	644	1 041
	Turkey	20	27	224	344	127	197
	Russia	–	–	9	13	60	96
	Other countries	277	240	771	748	54	93
	Total	1 021	1 121	1 474	1 775	886	1 428
EXPORTS							
2804.61	Silicon containing by weight not less than 99.99% of silicon						
	United Kingdom	1	71	4	82	...	39
	United States	1	9	...	5	1	9
	Japan	1	82	...	6	–	–
	Other countries	–	–	4	7	–	–
	Total	3	162	8	102	1	49
2804.69	Silicon, n.e.s.						
	United States	14 248	25 555	17 219r	33 206r	14 816	29 975
	Germany	4 531	7 818	5 012	8 992	7 712	16 623
	France	607	1 213	822	1 659	1 205	4 559
	Belgium	80	56	367	611	723	1 322
	Japan	2 937	4 896	880	1 556	560	1 098
	Other countries	340	542	220	580	196	1 217
	Total	22 743	40 082	24 520r	46 611r	25 212	54 801
2811.22	Silcon dioxide						
	Hong Kong	–	–	60	176	563	1 068
	Taiwan	–	–	83	394	117	564
	United States	26	37	42	180	95	123
	Other countries	–	–	1	45	31	164
	Total	26	37	185	798	806	1 922
2849.20	Silicon carbide						
	United States	37 129	27 793	43 497	32 419	36 277	29 755
	Other countries	9	10	120r	77r	2 872	1 211
	Total	37 138	27 804	43 617r	32 498r	39 149	30 967
7202.21	Ferrosilicon containing by weight more than 55% of silicon						
	United States	13 919	13 225	9 869	9 825	6 363	6 864
	Germany	819	594	2 000	1 983	4 107	5 122
	Japan	2 763	2 865	1 765	2 156	985	1 391
	Austria	41	40	294	318	43	58
	Other countries	81	98	265	391	40	53
	Total	17 623	16 825	14 193	14 676	11 537	13 490
7202.29	Ferrosilicon, n.e.s.						
	United States	10 468	4 336	15 630	8 360	14 098	12 175
	Australia	1 228	568	2 940	1 579	2 900	1 703
	Other countries	75	50	96	64	272	95
	Total	11 772	4 955	18 666	10 005	17 270	13 975
7202.30	Ferro-silico-manganese						
	United States	167	77	385	142	89	58
	Total	167	77	385	142	89	58
7202.50	Ferro-silico-chromium						
	United States	–	–	–	–	20	23
	Australia	–	–	22	14	–	–
	Total	–	–	22	14	20	23

Source: Statistics Canada.
– Nil; ... Amount too small to be expressed; n.e.s. Not elsewhere specified; p Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, CONSUMPTION, EXPORTS, IMPORTS AND PRODUCTION OF SILICON FERROALLOYS, 1986-95

	Consumption [1]	Exports		Imports		Production [2]
	(tonnes)	(tonnes)	($000)	(tonnes)	($000)	(tonnes)
1986	51 276	45 605	31 386	13 552	13 798	83 329
1987	61 283	28 275	19 595	12 367	12 728	77 191
1988	62 172	30 248	28 755	20 502	20 012	71 918
1989	62 115	32 464	33 019	20 972	21 697	73 607
1990	53 886	52 965	33 768	20 534	21 115	86 316
1991	50 942	34 048	24 771	21 965	18 717	63 025
1992	56 214	30 146	19 991	30 372	24 516	55 988
1993	55 326	29 396	21 780	25 203	23 189	59 519
1994	57 745	32 859	24 681	25 901	25 311	64 703
1995 p	..	28 807	27 465	26 699	26 340	..

Sources: Natural Resources Canada; Statistics Canada.
.. Not available; p Preliminary.
1 Consumption as reported by consumers. 2 Consumption plus exports minus imports equals derived production.