

Uranium

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OVERVIEW

In 2000, the liquidation of uranium inventories by a limited number of companies continued, placing downward pressure on the uranium market. Activity in the spot market was minimal and spot prices drifted continuously lower during the year. It was not until the Bush administration took office in January 2001, brightening prospects for further nuclear power development in the United States, that spot prices slowly began to rise.

In addition to inventory disposition and the marketing of uranium derived from dismantling Russian nuclear weapons, primary producers faced continued competition from uranium produced by the re-enrichment of depleted uranium tailings. However, Canadian uranium producers remain well positioned to capitalize on any market upturn as the transition to new production centres tapping high-grade, low-cost deposits in northern Saskatchewan is well under way.

Canadian uranium production in 2000 amounted to 10 683 tU, up some 30% from the 1999 total, mainly due to contributions from the new McClean Lake and McArthur River mines. As Figure 1 shows, the world's two largest uranium-producing companies have operations in Canada. As of January 1, 2001, Canada's total "known" recoverable uranium resources were 437 000 tU, compared with 417 000 tU as of January 1, 2000. This upward adjustment of some 5% is primarily the result of increased McArthur River resources.

Despite low prices, Canadian uranium production capability continues to expand in the province of Saskatchewan. The McClean Lake mill, which entered into production in June 1999, reached its

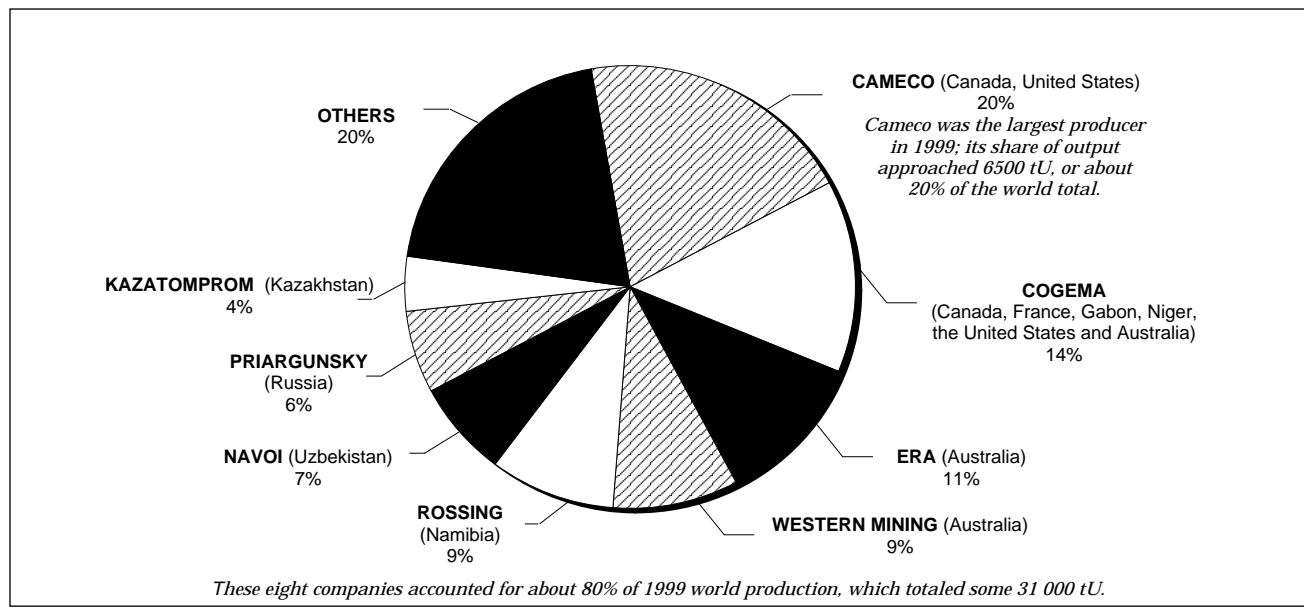
annual licensed production capacity of 2300 tU in November 2000. The McArthur River mine, which entered into production in December 1999, continued to ramp up towards its annual licensed production capacity of 6900 tU, producing about 3740 tU in 2000. Test mining and development continued at Cigar Lake in 2000 with the mine currently expected to begin production in 2005.

DOMESTIC PRODUCTION AND DEVELOPMENTS

In 1999, the most recent year with complete data available, production amounted to 8214 tU, a sharp drop from 1998 and 1997, mainly due to planned production cutbacks. Nonetheless, overall employment at Canada's uranium production centres remained above 1000 (Table 1). Shipments from mining centres increased slightly in 1999, compared to 1998, although the value of these mine shipments remained about the same (Table 2). These variations primarily reflect planned production cutbacks, the transition to new high-grade uranium mines, and the low market price. Despite these conditions, however, uranium continues to rank among Canada's top 10 metal commodities in terms of output value. Table 3 documents the main operational characteristics of the existing uranium production centres in Canada in 1999, and Table 4 updates the status of new projects that represent Canada's future production capability. Although current production and new projects are centred in the Athabasca basin of northern Saskatchewan, one prospective property, Kiggavik, is located in Nunavut (Figure 2). Uranium production in Canada in 1999 (Figure 3) was dominated by two companies: Cameco Corporation and COGEMA Resources Inc. (CRI).

On August 25, 2000, Billiton Plc and Rio Algom Limited announced that they had reached an agreement whereby Billiton would offer \$27.00 per share to acquire the entire issued share capital of Rio Algom (a total of some \$1.7 billion). Rio Algom recommended that shareholders accept this offer on September 15, 2000, and by November 29, 2000, Billiton had completed the acquisition of the balance of the common shares, finalizing the Rio Algom purchase. Headquartered in London, Billiton is one of

Figure 1
World's Top Uranium Mining Companies in 1999



Sources: Natural Resources Canada; trade press.

Note: Ranking reflects equity interest in production facilities, not market share.

the world's largest mining and metals companies with major operations and development projects concentrated in three main mining areas of Australia, Latin America and southern Africa.

In March 2001, Redstone Resources Inc. purchased a 20.7% share in the Midwest Uranium Project as both Denison Mines Limited and CRI reduced their interests by 5.04% and 15.66%, respectively. The new Midwest ownership structure is documented in Table 4.

Elliot Lake, Ontario

All significant reclamation work at Denison Mines' Elliot Lake properties was completed in 1998. Denison continues to be in full compliance with all of its licence requirements for the tailings management areas, and all systems at the former mine sites are operating better than anticipated. Monitoring the tailings management areas at the Denison and Stanrock sites and the treatment of water discharged from these areas are ongoing. In 2000, additional activities at the two sites included treatment of runoff, surface drainage alteration, and the use of bio-solids to improve the vegetation cover on the Stanrock tailings basin.

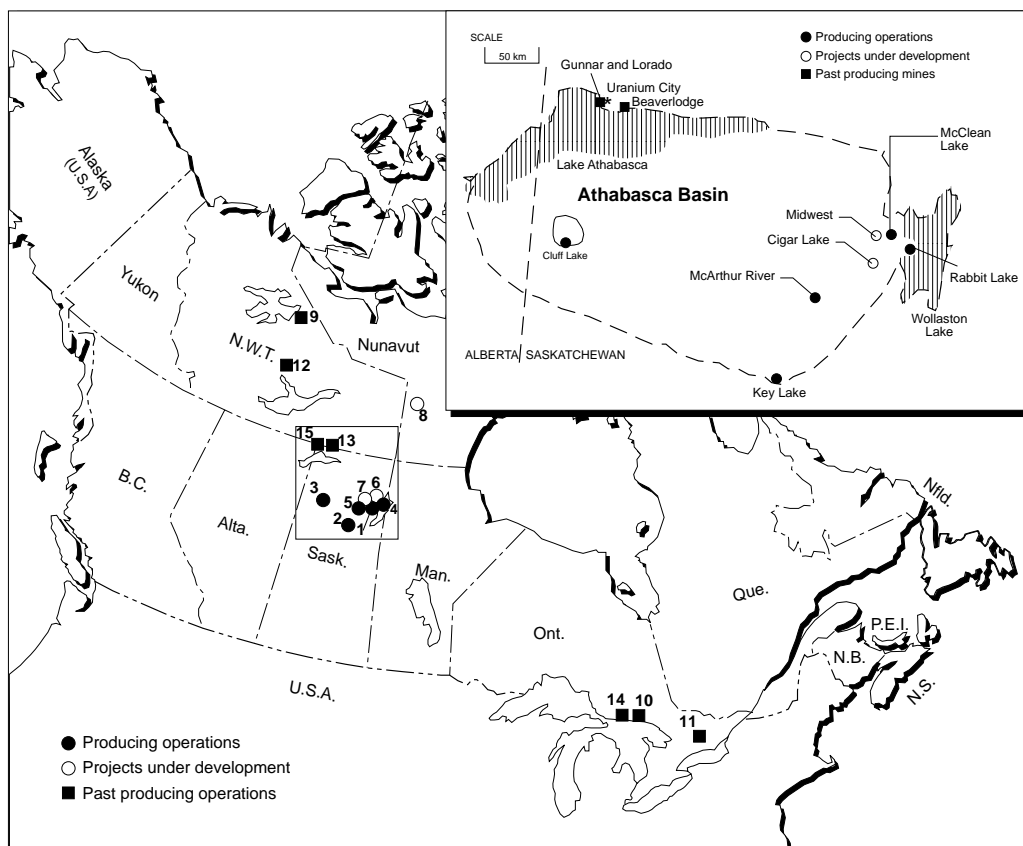
Denison, in cooperation with Rio Algom, began reporting water quality data in January 2000 for the Serpent River Watershed Monitoring Program (SRWMP), a comprehensive effort to provide data to

assess the recovery of the watershed, which hosted uranium mining for over 40 years. Initial results indicate that water quality in the Serpent River, which drains the Elliot Lake watershed into Lake Huron, continues to improve, confirming that water in the river meets drinking water guidelines and provides a healthy habitat for fish.

Prior to Billiton's acquisition, Rio Algom and its predecessor companies operated nine uranium mines in Elliot Lake, which was Canada's major uranium-producing area for over four decades. Since 1985, Rio Algom has dismantled and remediated uranium mine sites in the region. In reclaiming the Quirke and Panel tailing areas, the primary environmental issues were preventing or controlling the long-term production of acid rock drainage and the contamination of water by radioactive materials. Rio Algom's proposal to cover these tailings with water was accepted and supported by a public review panel and approved by governments and regulators.

Dams and dikes were built to create ponds to submerge the tailings. Since the material is no longer exposed to air, the formation of acid generated in the waste rock is limited. The water also acts as a barrier to radiation releases. Water flowing from the site is being treated and will continue to be treated until water quality meets discharge criteria without treatment. At that time, the sites will enter into a phase of long-term monitoring with care and maintenance.

Figure 2
Uranium Mining in Canada, 2000



Numbers refer to locations on map above

PRODUCING OPERATIONS

- 1. Rabbit Lake
- 2. Key Lake
- 3. Cluff Lake
- 4. McClean Lake
- 5. McArthur River

PROJECTS UNDER DEVELOPMENT

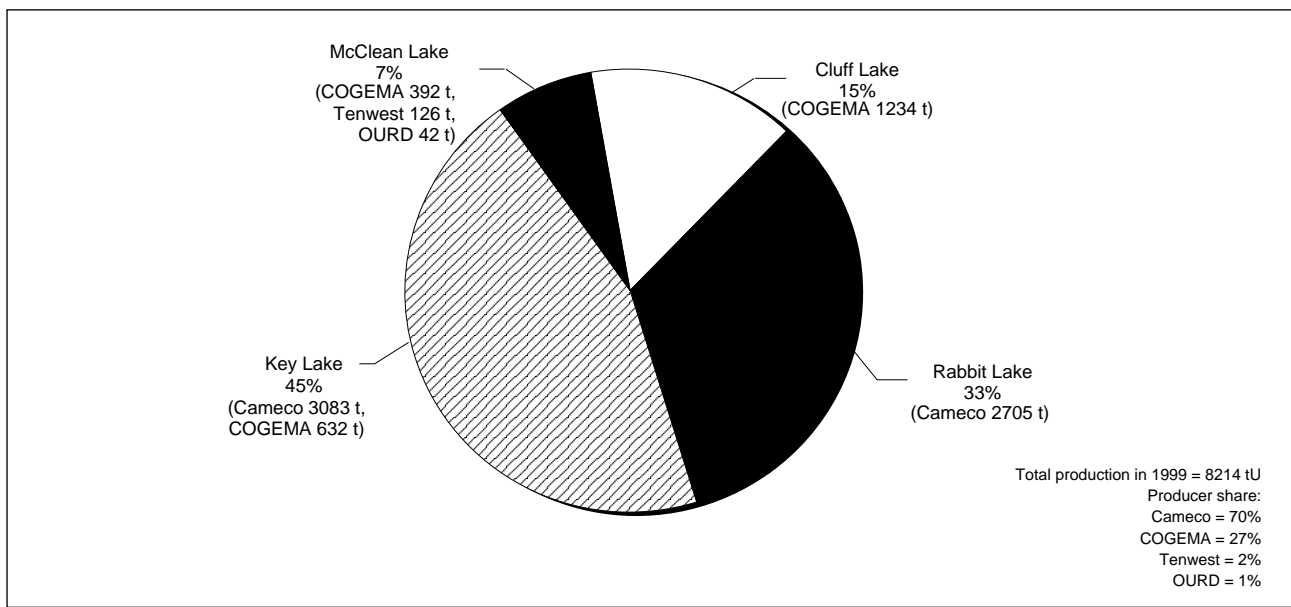
- 6. Midwest
- 7. Cigar Lake
- 8. Kiggavik

PAST PRODUCING DEVELOPMENT

- 9. Port Radium
- 10. Agnew Lake
- 11. Madawaska et al (Bancroft)
- 12. Rayrock (Marian River)
- 13. Beaverlodge et al
- 14. Quirke/Panel/Denison and Stanleigh et al (Elliot Lake)
- 15. Gunnar and Lorado et al

Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

Figure 3
Canadian Uranium Production and Ownership, 1999



Sources: Uranium and Radioactive Waste Division, Natural Resources Canada.

Cameco: Cameco Corporation; COGEMA: COGEMA Resources Inc.; OURD: OURD (Canada) Co. Ltd.; Tenwest: Tenwest Uranium Ltd.

Note: Tenwest is a wholly owned subsidiary of Denison Mines Limited.

Since the local topography around some of the older sites does not allow for the safe flooding of tailings, these areas have been vegetated to control dust and surface run-off. Run-off and seepage from the sites are collected for treatment. Of these older sites, Rio Algom's Spanish American, Milliken, Lacnor, Nordic, Buckles and Pronto uranium mining sites are not presently licensed by the Canadian Nuclear Safety Commission (CNSC). Although uranium mining and milling ceased at these facilities over 30 years ago, Rio Algom is currently in the process of obtaining CNSC licences for these sites.

Athabasca Basin, Saskatchewan

Rabbit Lake

The Rabbit Lake uranium production facility is wholly owned and operated by Cameco. Mill output in 2000 was similar to 1999 production (about 2790 tU), equivalent to about 50% of the facility's licensed production capacity. The decision to run the mill at reduced capacity was one part of Cameco's 1998 planned production cutbacks.

Cameco's planned production cutbacks also included the suspension of mining operations at the Rabbit Lake Eagle Point underground mine on March 31, 1999. In August 2000, Cameco decided to extend the temporary suspension of mining activities at Rabbit Lake. As a result, when the existing ore

stockpile is depleted (expected in June 2001), the mill will be placed on standby for approximately one year, depending on market conditions. Cameco has re-evaluated the Eagle Point mining plan to achieve further efficiencies and will seek regulatory approval in 2001 to re-open the facility based on the revised mining plan.

Key Lake

The Key Lake mill is a joint venture between Cameco and CRI that is operated by Cameco. In 2000, Key Lake production amounted to 4142 tU, up from the 1999 total of 3715 tU. All but 402 tU of the Key Lake production in 2000 is derived from McArthur River ore. The small contribution from Key Lake ore is derived from stockpiled low-grade mineralized waste rock; it is used to lower the McArthur River ore grade to about 3.4% U before being run through the mill circuit.

McArthur River

The McArthur River mine, the site of the world's largest high-grade uranium deposit discovered to date, is a joint venture between Cameco and CRI that is operated by Cameco. Mining began at McArthur River in December 1999 and, by November 2000, commercial production was achieved. The McArthur River mine is expected to achieve its monthly design capacity of 577 tU consistently through 2001.

In January 2001 it was announced that, as a result of an extensive underground drilling program, McArthur River's total reserves and resources had been increased by more than 50%. The McArthur River mine now has total reserves and resources amounting to some 152 000 tU with an average grade of 18% U (from the previous total of 98 000 tU at an average grade of 15% U).

Cluff Lake

The Cluff Lake uranium production facility is fully owned and operated by CRI. The mill operated throughout 2000 on a one-week-on/one-week-off schedule (excluding a three-week shut-down in July). Overall production amounted to 1443 tU in 2000, up from the 1234 tU produced in 1999, mainly due to mining higher ore grades. Mining is ongoing at the Dominique-Janine underground mine and is expected to continue throughout 2001. It is anticipated that the mill will continue operating in 2002 until all stockpiled ore is processed.

CRI had announced in 1998 its intention to suspend operations indefinitely at Cluff Lake on December 31, 2000. However, allowable capacity remaining in the tailings management area (TMA), higher ore grades, lower production costs and improved productivity have enabled operations to continue. Although higher-than-expected ore grades have resulted in fewer tailings, production remains limited by the capacity of the TMA. Because of the significant capital expense required to build a new TMA, CRI's decision to suspend operations at Cluff Lake has not changed.

In anticipation of the suspension of operations, CRI has begun site clean-up and reclamation activities, including removal of ore storage bins, the gold plant, buildings at the Claude pit, the mine water holding pond, and the remaining reusable equipment from the Dominique-Peter underground mine. CRI has also implemented an outplacement program to assist employees affected by the upcoming suspension of operations.

McClellan Lake

The McClellan Lake uranium production facility is majority-owned and operated by CRI. In 2000, production reached its licensed capacity (2308 tU) by the end of October. In its 2001 licence renewal application to the CNSC, CRI has requested that McClellan Lake's annual production capacity be increased by an additional 769 tU. A decision on the McClellan Lake licence renewal is expected in August 2001.

During 2000, the McClellan Lake mill was fed by ore from the Sue C open pit and stockpiled ore from the JEB open pit. Ore from the Sue C mine is expected to provide mill feed for some 12-18 months.

Following two years of preparation, the McClellan Lake operation received ISO 14001 certification for its environmental management system – the first uranium mine in North America to do so.

Cigar Lake

The Cigar Lake mine is a joint venture being developed by the Cigar Lake Mining Corporation (Table 4). The Cigar Lake orebody is the world's second largest high-grade uranium deposit discovered to date. At present, the site consists of an underground development mine complete with two main levels and a 500-m mine shaft and head frame, water treatment ponds, standby generators, a freeze plant and support installations. Cigar Lake is not expected to enter into production until 2005.

Additional Production Possibilities

Beyond the existing and committed centres of uranium production mentioned above, there are two projects that could be brought on stream in the next few years if environmental and regulatory approvals are received and market conditions are favourable. Table 4 updates, as of June 1, 2001, recent developments at the mining projects that will contribute to Canada's uranium production capability in the future.

Environmental Assessments

As mentioned above, Rio Algom decided in 1995 to license historic mines in the Elliot Lake region (Spanish American, Milliken, Lacnor, Nordic, Buckles and Pronto) that are not presently licensed by the CNSC. In support of its licence application, Rio Algom has submitted an environmental assessment screening report to the CNSC. Review and revision of this report are ongoing with licensing anticipated in 2001.

CRI is currently preparing a comprehensive study (CS) environmental assessment under the *Canadian Environmental Assessment Act* of its plans to suspend operations at Cluff Lake. Early in 2001, the CS, which outlines, among other issues, the decommissioning plan, options and mitigation measures, was submitted to the CNSC for preliminary review. Development of this CS has already involved public consultation and additional public consultations on the CS and the decommissioning plan are scheduled to take place once the assessment is finalized.

In its 2001 operating licence application renewal to the CNSC, CRI has requested that the McClellan Lake annual production capacity be increased by some 769 tU (to 3077 tU). The requested amendment requires a screening report environmental assessment that is expected to be completed before the initial CNSC hearing on the McClellan Lake licence scheduled for June 28, 2001.

In late 2000, CRI and Cigar Lake Mining Corporation submitted a screening report environmental assessment of the preferred options to dispose of potentially acid-generating waste rock from the Cigar Lake mine. The proponents determined that the preferred option is disposal in the mined-out Sue C pit at McClean Lake. The report is now under review by regulatory agencies.

A CS environmental assessment of the proposal to mill approximately half of the Cigar Lake ore at the Rabbit Lake mill is expected to be submitted to regulators in 2001. Subject to regulatory approvals and mutually agreeable business arrangements among the joint-venture partners, ore from Cigar Lake could feed the Rabbit Lake mill for some 10-14 years.

Other Developments Affecting Canada's Uranium Industry

In October 2000, Cameco Corporation announced that it had signed an agreement with British Energy plc to acquire a 15% interest in the Bruce Power Partnership (Bruce Power). Under the terms of the agreement, Cameco will have full responsibility for managing all of Bruce Power's fuel procurement needs. The agreement came into effect on May 12, 2001, shortly after the Bruce Power Partnership received an operating licence from the CNSC. The Bruce nuclear power plants consist of four Bruce B reactors currently in operation and four Bruce A reactors that are not operating. Bruce Power plans to bring two of the Bruce A reactors back into operation by the summer of 2003, subject to regulatory approvals.

EXPLORATION

Natural Resources Canada (NRCan) completed its twenty-fifth annual assessment of Canada's uranium supply capabilities and uranium exploration, and reported² the results in September 2000. Uranium exploration activity remains concentrated in areas favourable for the occurrence of deposits associated with Proterozoic unconformities, notably in the Athabasca Basin of Saskatchewan and the Thelon Basin of Nunavut. In 1999, overall uranium exploration expenditures reached \$49 million while uranium exploration and surface development drilling amounted to over 89 000 m, down from about 95 000 m reported for 1998.

As in recent years, most of the overall exploration expenditures can be attributed to advanced underground exploration, deposit appraisal activities and care-and-maintenance expenditures associated with those Saskatchewan projects awaiting production approvals. In comparison, the Saskatchewan government estimates that "grass-roots" uranium explo-

ration in the province amounted to \$14 million in 1999, down some \$8 million from the 1998 total of \$22 million. Table 5 summarizes uranium exploration activity in Canada from 1986 to 1999.

In recent years, the number of companies with major exploration programs in Canada has declined. The top five operators,³ accounting for a major portion of the \$49 million expended in 1999, were: Cameco Corporation, Cigar Lake Mining Corporation, CRI, JNR Resources Ltd., and Argonaut Resources. Expenditures by CRI include those of Urangesellschaft Canada Limited.

RESOURCES

NRCan's annual assessment of domestic uranium supply capability provides a compilation of Canada's "known" uranium resources based on the results of an evaluation of company data. Uranium supply from Canada in the next decade will come from known resources, estimates of which are divided into three major categories, *measured*, *indicated* and *inferred*, that reflect different levels of confidence in the reported quantities. Most of these resources are associated with deposits identified in Figure 2.

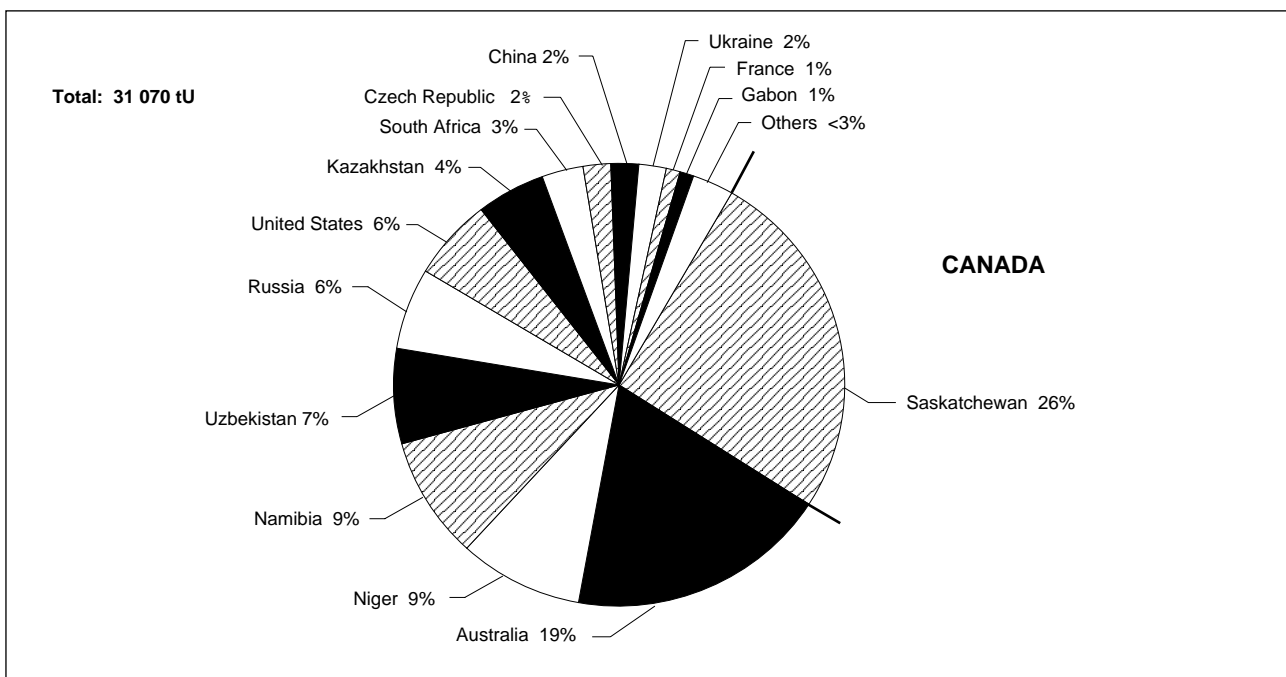
Recent NRCan assessments of Canada's uranium resources have been restricted to those recoverable from mineable ore at prices of \$100/kgU or less. Table 6 shows the breakdown of the latest resource estimates, compared with those of the previous year. As of January 1, 2000, total recoverable known uranium resources were estimated at 417 000 tU, compared with 433 000 tU as of January 1, 1999. This downward adjustment of some 4% is the result of ongoing deposit appraisal.

SUPPLY CAPABILITY

In 2000, Canada's uranium supply capability increased as producers successfully brought the McClean Lake and McArthur River projects into commercial production, completing the first steps in the transition to the new high-grade mines in northern Saskatchewan. A continued smooth transition to other new mines, combined with timely licensing approvals and higher uranium prices, will be required to allow Canada's production capability to expand to its full potential of some 15 000 tU annually in the next 10 years.

Developments in the international uranium market, the rate at which projects clear environmental reviews, and uncertainty regarding the costs associated with certain of the planned new projects preclude projecting future production capability levels with much certainty. Table 7 ranks Canada among

Figure 4
World Uranium Production, 1999



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

the world's major producers, showing actual uranium production from 1995 through 1999. Figure 4 illustrates Canada's share of world output in 1990, compared with other major producers.

ownership from 5% to 15% and the aggregate share ownership voting right from 20% to 25%. These changes will allow Cameco to attract new investment capital and forge new strategic alliances.

GOVERNMENT INITIATIVES

The *Nuclear Safety and Control Act* (NSCA) and associated regulations were brought into force on May 31, 2000. On that date, the Canadian Nuclear Safety Commission (CNSC) replaced the Atomic Energy Control Board (AECB). The revamped law and regulations, the first major overhaul of Canada's nuclear regulatory regime since 1946, reflect the increased focus on health, safety, security and environmental protection in recent years. Although the CNSC regulatory regime includes new requirements, such as lower radiation dose limits and strengthened security requirements, as well as increased penalties for non-compliance, in general the NSCA codified existing practices of the AECB.

On June 7, 2001, the Canadian government passed legislative amendments to ease, but not eliminate, the current foreign share ownership restrictions specified in the *Eldorado Nuclear Limited Reorganization and Divestiture Act*, Cameco's governing legislation. The changes raise the limits on non-resident share

URANIUM MARKET

Overview

There were no major developments directly affecting the uranium market in 2000. Activity in the spot market was minimal, and spot prices drifted continuously lower during the year. It was not until the Bush administration took office in January and prospects for further nuclear power development in the United States began to brighten that spot prices slowly began to rise again.

On July 26, 2000, the U.S. International Trade Commission (ITC) lifted restrictions on imports into the United States of uranium produced in Uzbekistan and Ukraine. At the same time, the ITC ruled that the existing suspension agreement limiting imports of Russian uranium into the United States should continue until 2004. By year-end, the Euratom Supply Agency was also contemplating amending its policy on diversification of sources of supply to allow further purchases by European Union utilities of

uranium produced in Kazakhstan and Uzbekistan. These developments would leave uranium produced or held by the Russian Federation as the only uranium still subject to trade restrictions in the Western markets following the collapse of the former Soviet Union.

Uranium Prices

The decline in uranium spot market prices that began in the second quarter of 1999 continued throughout 2000 before finally beginning to recover during January 2001. The "restricted" spot market price, as reported by *TradeTech*,⁴ fell steadily from US\$9.60/lb U₃O₈ at the beginning of the year to \$7.10/lb at year-end. The "unrestricted" spot price, attributable to uranium from the former Soviet Union, began the year at US\$7.60/lb U₃O₈ and declined to US\$6.40/lb at the end of 2000.

The average price of Canadian export deliveries decreased from \$49.10/kgU (US\$12.70/lb U₃O₈) in 1999 to \$47.70/kgU (US\$12.40/lb U₃O₈) in 2000. In large measure, this reflected the growing dominance of long-term contracts with prices tied to published spot market prices. Table 8 shows the export price trend from 1977 to 2000 while Table 9 indicates actual exports of Canadian-origin uranium to principal customers from 1994 to 1999. The destination of Canada's exports of uranium on a cumulative basis (1995-99 inclusive) is illustrated in Figure 6, which highlights the growing importance of the United States as a customer.

REFINING AND CONVERSION

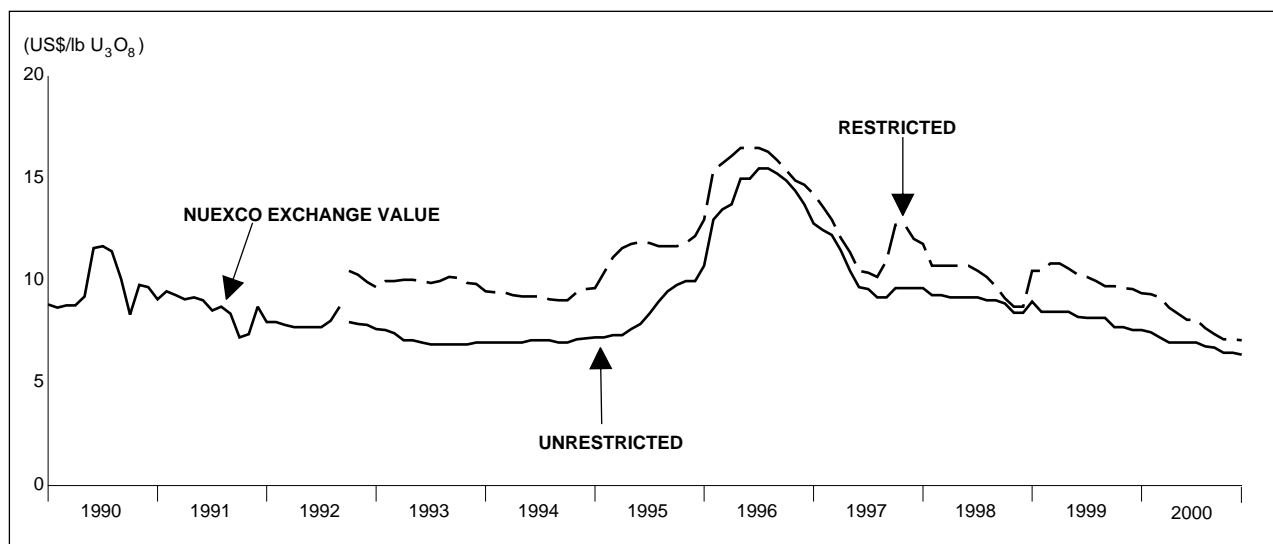
Cameco operates Canada's only uranium refining and conversion facilities, located at Blind River and Port Hope, Ontario, respectively. At the Blind River refinery – the world's largest – uranium mine concentrates from Canada and abroad are refined to uranium trioxide (UO₃), an intermediate product. The UO₃ is then trucked to the Port Hope facilities, which have about one quarter of the Western World's annual uranium hexafluoride (UF₆) conversion capacity and currently provide the only commercial supply of fuel-grade natural uranium dioxide (UO₂). UF₆ is enriched outside Canada for use in foreign light-water reactors while natural UO₂ is used to fabricate fuel bundles for CANDU reactors in Canada and abroad. About 80% of the UO₃ from Blind River is converted to UF₆ while the remaining 20% is converted to UO₂. Table 10 tabulates Canada's production of refined and converted uranium, and notes the associated work force, from 1996 to 1999, inclusive.

Early in 2000, the Port Hope conversion facility received certification under ISO 14001, the most widely recognized international standard for environmental management systems.

OUTLOOK

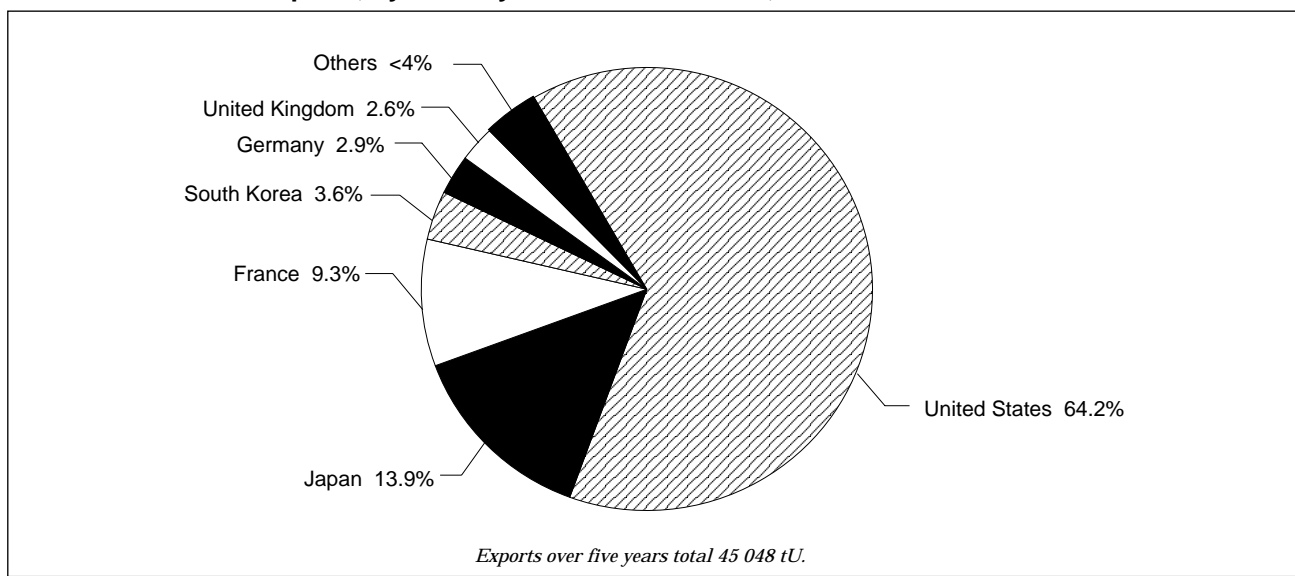
The continued liquidation of uranium inventories coupled with no significant changes in demand have led to poor market conditions for uranium producers. The depletion of inventories and improving prospects

Figure 5
Trend in Uranium Spot Prices, 1990-2000



Source: *TradeTech*.

Figure 6
Canadian Uranium Exports, by Country of Final Destination, 1995-99



Source: Canadian Nuclear Safety Commission.

for growth in the nuclear power generation sector should translate into improved market conditions in the near future. This, in turn, will allow Canada to remain a stable and competitive supplier of uranium to world markets for the foreseeable future.

Improved market conditions will be welcomed by Canadian producers as they continue an important period of transition in 2001. As mineable reserves at Key Lake, Rabbit Lake and Cluff Lake are depleted, new high-grade mines are being brought into production beginning with McClean Lake and McArthur River. Given favourable market conditions and timely regulatory approvals, the Cigar Lake mine is expected to enter into production in 2005. Continued success in bringing operations on stream will ensure that Canada remains the world's premier uranium producer well into the 21st century.

ENDNOTES

¹ John French, Advisor, Uranium Markets (tel. 613-995-7474) has contributed to the text in those sections dealing with international uranium market developments and uranium prices.

² *Canada's Uranium Industry in 2001 - Production Rebounds with New Mines on Stream*, NRCAN mailing, October 2001.

³ In certain cases, the identified operator has reported the total expenditures of a joint-venture effort. Therefore, contributions by other parties not responding to the

NRCAN survey are accounted for in the \$49 million total expenditure for 1999.

⁴ NUEXCO, an international uranium brokerage firm, was originally called the Nuclear Exchange Corporation. Several companies in the NUEXCO organization that were associated with uranium trading declared bankruptcy in early 1995. Certain of these have been reorganized and continue to provide brokerage services. NUEXCO's publication activities are carried on by *TradeTech*.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to chapter 65. (2) Information in this review was current as of June 1, 2001. (3) This paper on uranium and other information on developments in Canadian nuclear policy can be accessed on the Internet at nuclear.nrcan.gc.ca. (4) This and other reviews, including previous editions, are available on the Internet at http://www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. URANIUM PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1997-99

Province and Producer	Company Work Force ¹ (Dec. 31)			Annual Output ² (tU)		
	1997	1998	1999	1997	1998	1999
ATHABASCA BASIN, SASKATCHEWAN						
Cluff Mining (COGEMA Resources Inc., 100%)	222	158	151	1 964	1 039	1 234
Key Lake JV (Cameco operator)	316	285	277	5 434	5 392	3 715
Rabbit Lake JV (Cameco, 100%)	285	287	155	4 633	4 491	2 705
McClellan Lake JV	225	265	283	—	—	560
McArthur River JV (pre-production)	57	89	157	—	—	—
Cigar Lake JV (pre-production)	..	50	53	—	—	—
Total	1 105	1 134	1 076	12 031	10 922	8 214

Sources: Company annual reports; Canadian Nuclear Safety Commission open files.

— Nil; .. Not available.

¹ Figures are for company payroll employees only; on-site contractors (mining, construction, services, etc.) are not included. ² Primary output only. With the closure of Rio Algom's Stanleigh operation at Elliot Lake in mid-1996, by-products from Cameco's refinery/conversion facilities are no longer processed in Canada. Prior to 1997, by-product totals were NOT included in the Canadian totals of primary uranium production noted above, but were included in the shipments and value of shipments figures provided in Table 2. Cameco is currently seeking approval to process refinery/conversion by-products at the Key Lake mill.

TABLE 2. VALUE¹ OF URANIUM SHIPMENTS² BY PRODUCERS IN CANADA, 1996-2000

	Unit	1996	1997	1998	1999	2000 ^p
Total producer shipments	tU	11 396	11 127	9 984	10 157	9 921
Total value of shipments	\$ millions	624	554	500	500	485

Source: Natural Resources Canada.

^p Preliminary.

¹ Value of shipments is estimated from an average market price. ² Shipments in tonnes of uranium (tU), contained in concentrate, from ore-processing plants.

TABLE 3. OPERATIONAL CHARACTERISTICS OF EXISTING CANADIAN URANIUM PRODUCTION CENTRES, 1999

Operating Entity (Operator)/Location	Ore-Processing Plant ¹			
	Capacity Nameplate	Recovery Overall	Annual Throughput	
	(t/d)	(%)	Total Ore (t)	Ore Grade (%)
Cluff Mining (COGEMA Resources Inc.)/ Cluff Lake, Saskatchewan	800	97	258 180	0.50
McClellan Lake JV (COGEMA Resources Inc.)/ McClellan Lake, Saskatchewan	300	95	23 090	0.30
Rabbit Lake (Cameco Corporation)/ Rabbit Lake, Saskatchewan	2 000	97	204 590	1.30
Key Lake JV (Cameco Corporation)/ Key Lake, Saskatchewan	925	97	215 700	1.75

Sources: Corporate annual reports; Canadian Nuclear Safety Commission open files.

¹ Figures are rounded.

TABLE 4. CANADIAN URANIUM MINING PROJECTS PLANNED FOR PRODUCTION AS OF JUNE 1, 2001

Project, Province or Territory/Operator	Owners Share	Deposit Type/ Discoverer and Discovery Date	Resources (Company Estimates as of March 1, 2000)	Ore Grade and Notes on Deposits	Mining Method, Milling Rate and Capacity	Project Particulars and Status	Location of Project/ Notes of Interest
	(%)						
Cigar Lake, Sask./ Cigar Lake Mining Corporation	Cameco (50.025), COGEMA Resources Inc. (37.100), Idemitsu (7.875), TEPCO (5)	Unconformity-related/ COGEMA Resources Inc., 1981	Overall property 142 000 tU, <i>mineable</i>	Overall property grade of 14% U; grades vary from 5% to 70% U; orebody at depth of 450 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake and Rabbit Lake; contributing from 2300 to 6900 tU/y	\$555 million project; test mining completed in 1992; EIS submitted in October 1995; Joint Panel reports November 1997; government response April 1998; comprehensive study of Rabbit Lake milling option ongoing	670 km N of Saskatoon; 500-m-deep shaft sunk; brine freezing of ground is required to mine the ore; production to begin in 2005
Midwest, Sask./COGEMA Resources Inc.	COGEMA Resources Inc. (54.8), Redstone Resources Inc. (20.7), Tenwest Uranium Ltd. (20), OURD (4.5)	Unconformity-related/ Esso Minerals Canada, 1977 (interests of Bow Valley, Numac Oil & Gas, <i>et al</i> bought by partners)	Overall property 13 800 tU, <i>mineable</i>	Overall property grade of 4.5% U; grades vary from 2% to 30% U; orebody at depth of 200 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake; contributing 2300 tU/y	\$80 million co-venture with McClean; in 1993, Joint Panel rejects proposal; new EIS in 1995; final hearings August 1997; Joint Panel report November 1997; government response April 1998	710 km N of Saskatoon; 185-m-deep test-mine shaft; new operator, COGEMA Resources Inc., revised EIS; start-up subject to feasibility study
Kiggavik, Nunavut/ Urangesellschaft Canada Limited	Urangesellschaft (79), COGEMA Resources Inc. (20), Daewoo Corp. (1)	Unconformity-related/ Urangesellschaft, 1977	Overall property 15 000 tU, <i>mineable</i> (more incl. Andrew Lake <i>et al</i>)	0.41% U average overall; depth Centre pit 100 m, Main pit 200 m	Open-pit mining methods; 1200 t/d mill feed; output rate of 1200 tU/y originally expected	EIS submitted but project deemed deficient by Panel; COGEMA Resources Inc. expected to review project and submit new EIS	75 km W of Baker Lake; start-up not likely before 2005; >11-year mine life with tributary ore included

Notes: OURD (Canada) Co., Ltd. is a subsidiary of the Overseas Uranium Resources Development Corporation (OURD) of Japan. Urangesellschaft Canada Limited, operated by COGEMA Resources Inc., is a subsidiary of Compagnie générale des matières nucléaires (COGEMA) of France. Idemitsu Uranium Exploration Canada Ltd. is a wholly owned subsidiary of Idemitsu Kosan Co., Ltd. of Japan. TEPCO Resources Inc. is a subsidiary of Tokyo Electric Power Co., Inc. (TEPCO), Japan's largest nuclear power utility. Redstone Resources Inc. is a subsidiary of Franco-Nevada Mining Corporation Limited. Tenwest Uranium Ltd. is a wholly owned subsidiary of Denison Mines Limited.

TABLE 5. URANIUM EXPLORATION ACTIVITY IN CANADA, 1986-99

Year	Expenditures ¹	Drilling ²	Million-Dollar Projects ³
	(\$ millions)	(km)	(number)
1986	33	162	11
1987	37	164	12
1988	59	201	11
1989	58	158	11
1990	45	66	6
1991	44	67	4
1992	46	79	4
1993	40	62	5
1994	36	67	8
1995	44	75	10
1996	39	79	8
1997	58	104	6
1998	60	95	6
1999	49	89	3

Source: Natural Resources Canada.

¹ Direct exploration and drilling expenditures in current dollars; from the late 1980s, includes advanced underground exploration and deposit appraisal expenditures; from the mid-1990s, may also include care-and-maintenance costs associated with deposits awaiting production approvals.

² Exploration and surface development drilling; excludes development drilling on producing properties. ³ Number of projects where direct exploration and drilling expenditures exceeded \$1 million in current dollars.

TABLE 6. ESTIMATES OF CANADA'S URANIUM RESOURCES RECOVERABLE FROM MINEABLE ORE,¹ JANUARY 1, 1999, AND JANUARY 1, 2000

Price Ranges Within Which Mineable Ore is Assessed ²	Measured		Indicated		Inferred	
	1/1/99	1/1/00	1/1/99	1/1/00	1/1/99	1/1/00
	(000 tU)					
Up to C\$50/kgU	211	201	73	29	87	128
C\$50 to \$100/kgU	1	–	41	39	20	20
Total	212	201	114	68	107	148

Source: Natural Resources Canada.

– Nil; . . Not available.

¹ Actual or expected losses in mining recovery and ore processing have been accounted for; these factors were individually applied to resources tributary to existing or prospective production centres. In underground operations, mineable ore is generally 75-85% of the ore-in-place; higher mining recoveries are achievable in open-pit operations. Canada's weighted average ore processing recovery for existing conventional operations exceeded 97% over the 1999/2000 period.

² The Canadian dollar figures reflect the price of a quantity of uranium concentrate containing 1 kg of elemental uranium. The prices were used in determining the cut-off grade at each deposit assessed, taking into account the mining method used and the processing losses expected. The price of \$100/kgU was used by Natural Resources Canada to illustrate those resources that were of economic interest to Canada during the survey period.

Note: \$1/lb U₃O₈ = \$2.6/kgU.

TABLE 7. PRODUCTION OF URANIUM IN CONCENTRATES BY SELECTED MAJOR PRODUCING COUNTRIES, 1995-99

	1995	1996	1997	1998	1999
(tonnes U)					
Canada ¹	10 530	11 750	12 030	10 920	8 210
Russia	2 200	2 600	2 000	2 000	2 000
Kazakhstan	1 580	1 210	1 000	1 270	1 350
Uzbekistan	1 700	1 460	1 760	1 930	2 130
China	780	560	500	500	500
United States	2 324	2 430	2 170	1 810	1 810
South Africa	1 420	1 440	1 100	990	980
Namibia	2 010	2 450	2 900	2 760	2 690
Australia	3 710	4 970	5 520	4 910	5 980
Niger	2 980	3 320	3 500	3 730	2 920
France	1 020	930	750	510	440
Gabon	630	570	470	730	290
Other ²	2 730	2 540	1 990	1 730	1 770
Total ³	33 610	36 230	35 690	33 790	31 070

Sources: *Uranium: Resources, Production and Demand*, a biennial report published jointly by the Nuclear Energy Agency of the OECD and the International Atomic Energy Agency; miscellaneous corporate, national and international reports.

¹ Includes refinery/conversion facility by-product prior to 1997; differs from primary production figures shown elsewhere. ² Includes Argentina, Belgium, Brazil, Bulgaria, the Czech Republic, Germany, Hungary, India, Israel, Japan, Mongolia, Pakistan, Portugal, Romania, Spain, Ukraine and Yugoslavia. ³ Totals are of the listed figures only and represent global production.

Note: Country figures are rounded to the nearest 10 tU.

TABLE 8. CANADIAN URANIUM EXPORT PRICE,¹ 1977-2000

Year	Average Export Price		Spot Sale Portion of Deliveries
	Current Dollars	Constant 2000 Dollars	
	(\$/kgU) ²		(%)
1977	110	272	n.r.
1978	125	290	n.r.
1979	130	276	n.r.
1980	135	258	n.r.
1981	110	190	1
1982	113	179	1.5
1983	98	148	10
1984	90	131	26
1985	91	129	20
1986	89	123	21
1987	79	104	35
1988	79	100	13
1989	74	89	<1
1990	71	83	<1
1991	61	70	<2
1992	59	66	<1
1993	50	56	<1
1994	51	56	<1
1995	47	50	2
1996	53.60	56.61	1
1997	51.30	53.68	<1
1998	51.10	53.77	<2
1999	49.10	50.86	<1
2000	47.70	47.70	<1

Source: Natural Resources Canada.

n.r. Not reported.

¹ Derived annually based on the average price for all deliveries made by Canadian producers to export customers in the given year. ² \$/kgU x 0.38465 = \$/lb U₃O₈.

Notes: Pre-1996 prices are rounded to the nearest dollar. Constant dollar values are derived using the Implicit Price Index for Gross Domestic Product.

TABLE 9. EXPORTS OF URANIUM OF CANADIAN ORIGIN, 1994-99

Country of Final Destination	1994	1995	1996	1997	1998	1999
(tonnes of contained uranium ¹)						
Belgium	115	3	115	–	–	–
France	766	1 016	679	587	67	1 819
Germany	465	348	776	184	–	–
Japan	3 443	363	1 490	1 968	1 310	1 116
South Korea	455	290	261	315	444	309
Spain	274	186	103	160	–	121
Sweden	–	84	142	450	147	–
Taiwan	–	–	–	–	–	107
United Kingdom	50	188	250	374	345	–
United States	4 938	5 702	7 407	6 187	5 962	3 674
Total	10 506	8 180	11 223	10 225	8 274	7 146

Source: Canadian Nuclear Safety Commission.

– Nil.

¹ Some of this uranium was first exported to an intermediate country for conversion and/or enrichment prior to transfer to the country of final destination.

TABLE 10. URANIUM PROCESSING PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1996-99

Process and Location (Nameplate Capacity)	Production				Site Work Force			
	1996	1997	1998	1999	1996	1997	1998	1999
	(tU)				(number)			
Refining at Blind River (18 000 tU as UO ₃)	10 190	12 195	12 031	11 360	90	102	96	98
Conversion at Port Hope (12 500 tU as UF ₆ and 2800 tU as UO ₂)	10 127	12 594	11 169	11 231	257	277	271	272

Source: Cameco Corporation.