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A Strategic Case Analysis of Cameco and the Uranium Mining Industry

by

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Abstract

The growing world demand for energy requires new supplies including nuclear power the future of which is questioned by governments and the public after each major accident. While some countries have chosen to exclude nuclear energy from their energy mix, others will continue with existing construction and plan to expand the number of nuclear reactors and therefore increase demand for uranium. Many countries consider uranium to be of strategic importance and maintain state controlled mining companies. Cameco is the largest non-government controlled company obtaining a majority of its revenue from uranium mining and services..

Keywords: atomic power, Cameco, nuclear energy, uranium supply and demand, nuclear reactors active-planned

JEL codes: L10, L72, O13, Q31, Q43

1. Introduction

The last century has witnessed a growing world population, and increasing industrialization and standard of living. Coal, oil, natural gas, and wood have been the major fuels powering this development. While fossil fuels are still the major energy source for transportation, heating, and generation of electricity, there is a growing environmental consciousness and understanding that these sources are finite and will need to be replaced. The rise in the price of crude oil, including the historic peak of US $147 in 2008, due to depletion of reserves, speculation, and an increasing demand for oil particularly in developing countries, coupled with a growing concern over CO2 emissions from fossil fuels has encouraged the diversification of energy supplies towards cleaner sources such as solar, wind, hydro, geothermal, and nuclear energy. The planning and construction of nuclear reactors in countries with existing nuclear generated power in addition to those countries considering their initial nuclear reactors as seen in Section 2.9 will increase demand for uranium (Wald 2008). Cameco is expected to play an important role supplying uranium and services to the nuclear industry. The purpose of this study was to provide an overview of the uranium market and nuclear energy, with an emphasis on Cameco's strengths, competitive advantages, and future strategy and options.

1.1 Background

Uranium is a relatively common element in the Earth's crust, being more than 500 times more abundant than gold. As with other mineral resources it is the grade or concentration of the desired mineral within the host rock or water that determines its economic viability. The oceans contain vast quantities of minerals, including uranium.

The name "Cameco" is the acronym for - **Ca**nadian **M**ining and **E**nergy **Co**rporation which was created by the merger and privatization of 2 state owned companies in 1988: the federally owned Eldorado Nuclear Limited *and Saskatchewan-based Saskatchewan Mining Development Corporation. Cameco - About – History (2011).*

Cameco became one of the world's largest publicly traded uranium mining companies with the remaining government ownership ending in February 2002. It is also a leader in refining, conversion, fuel rod assembly services, and generation of electricity from its 31.6% stake in Bruce Power nuclear facility in Ontario. Is headquartered in Saskatoon, Saskatchewan, Canada with approximately 3,300 *employees in North America of which 900 are unionized (*Cameco Annual Report, 2010) with stock trading on the Toronto (TSX-CCO) and New York stock exchanges (NYSE-CCJ). Listing of stock in more than one market increases the visibility of a company and the likelihood of overseas diversification (Hasan, Kobeissi, and Wang 2011). As of July 1st, 2011 Cameco's CEO and president is Tim S. Gitzel, who was president from May 14th, 2010, and is vice-chairman of the World Nuclear Association since March, 2011. Gitzel was senior vice-president and COO from January 9, 2007 at Cameco, and previously worked for Areva.

"Cameco will be a dominant nuclear energy company producing uranium fuel and generating clean electricity. Our goal is to be the supplier, partner, investment and employer of choice." Cameco Annual Report (2010).

2 General Environment Analysis

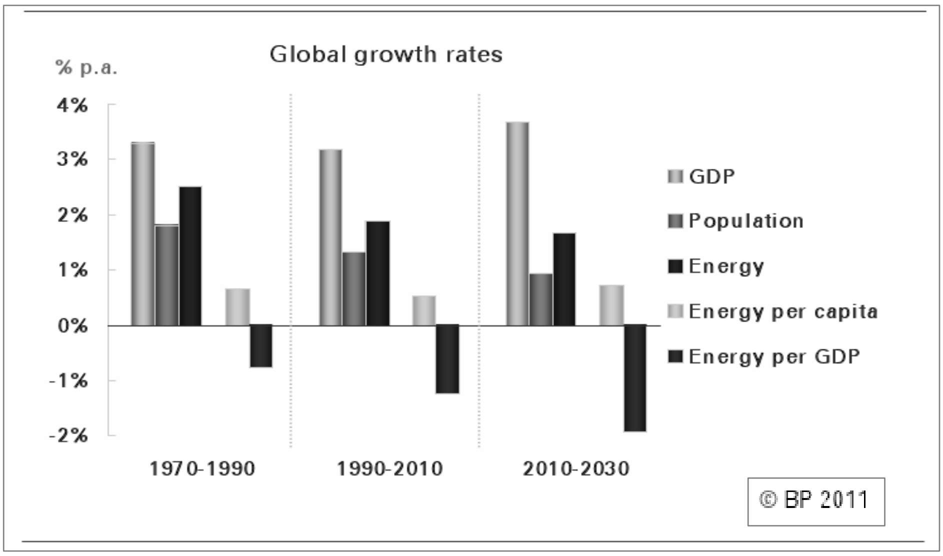
The general environment consists of many factors: regional, national, and international, each with their own sub-factors of: demography, economics, legal-political, social and cultural, technological, and infrastructure that significantly influence industries and companies. The operating environment of a company or industry may significantly change suddenly. It is important for companies and the industries they belong to to understand their operating environment and adjust appropriately while trying to influence it with good public relations, lobbying, and responsible corporate citizenship (environmental/social/legal) (Hamann and Acutt 2003; González and Martinez 2004). High environmental and social standards creates and maintains good community relations which is a competitive advantage for a mining company (David 2000).

2.1 Demography

The 19th century French philosopher Auguste Comte is credited with coining the phrase "Demographics is Destiny" (Chang et al. 2006). This not only applies to the sphere of culture, religion, ethnicity, or nationality but is also an important element in companies strategies. It applies to energy demand and resulting pollution, food demand, raw materials and waste products, real estate, and economics including labour supply and costs. The population size, lifestyle, affluence, and consequently consumption directly affects energy demand as seen in Figure 1; even with a slowing growth in population and more efficient use of energy as seen with decreasing energy per GDP, there is a growing demand for energy. The urbanization of the world reached 50% for the first time in 2008, and by 2030 5 billion people will be living in cities. (Urbanization 2012). The ageing of the population is occurring in many countries and regions, seen most acutely in Japan, Taiwan, South Korea, Europe, Russia and most former Soviet republics, is also occurring in China due to a combination of the government one child policy and industrialization (Chang et al. 2006).

The global growth rates in Figure 1 show a slight decline in GDP growth from approximately 3.2% to 3.0% in the period 1970-1980 to 1990-2010, but estimated to be 3.5% during 2010-2030. The population growth rate has declined from approximately 1.8% 1970-1980 to 1.1% 1990-2010 and projected at 0.7% 2010-2030. The energy growth rate has been declining from 2.4% 1970-1980 to 1.9% 1990-2010, and expected at around 1.5% for 2010-2030. While energy per capita has declined from 1970-1980 from 0.4% to 0.3% 1990-2010 and expected to increase to 0.5% 2010-2030, but the efficiency/productivity has been increasing with energy per GDP declining approximately 0.5% 1970-1980, declining around 1.1% 1990-2010, and expected to decline around 1.8% 2010-2030.

Figure 1. Growth rates of population, GDP, and energy consumption



Source:http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/2030_energy_outlook_booklet.pdf

Many newly industrialized and developing countries are constructing, planning, or considering the use of nuclear power as seen in Section 2.8 as part of their energy mix to increase energy independence and reduce imports of oil, gas, and coal; simultaneously reducing pollution as part of the Kyoto protocol. Some oil rich countries in the Persian/Arab gulf: Dubai, Iran, Algeria, and Saudi Arabia are developing nuclear energy to permit greater export of their oil and gas, and also for desalination (Jha 2011; Nuclear Power UAE 2011; Quake prone Algeria 2011). Fresh water scarcity is considered by some to be a future cause of conflicts in many parts of the world (Nuclear Desalination 2011).

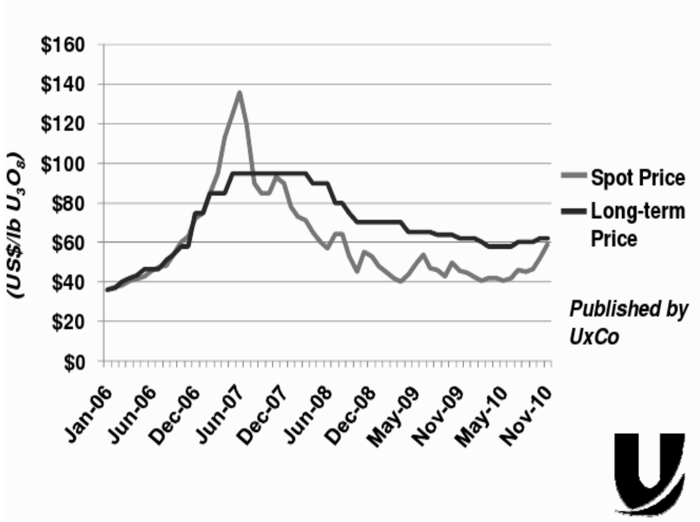
2.2 Economics

The growth in population, urbanization, industrialization, GDP, and standard of living has lead to increasing demand and prices for energy. Nuclear reactors provide base load (continuous and reliable) electricity supply as are hydroelectric, geothermal, and coal, with temporary increases in demand supplied by natural gas or other fossil fuels. Infrastructure spending by many governments is an economic stimulus that prepares their countries for future growth (Martin 2011). The demand for energy is growing fastest in countries developing from low per capita GDP levels. Incentives for nuclear energy are economic, diversifying sources of energy, developing scientific/technological expertise, national prestige, and increasingly to reduce air pollution and greenhouses gases such as CO2.

The price or uranium as shown in Figures 2, was at $10 US for many years, rose to $40 US early in 2006, and peaking at $136 US in June 2007. Uranium has risen like other commodities for many years, including after the floods at Cameco's Cigar Lake in 2006 and in 2008, and has declined with other commodities after the 2008 financial crisis, to around $40 US per pound by late 2009, rising early in 2011 to a peak of approximately $70 before declining after the Fukushima Daiichi accident starting March 11, 2011. Uranium long term contract price is less volatile, and maybe higher than the spot price as seen in Figure 3. Many utilities sign long term contracts (see Section 3.10(c)) with suppliers so that prices are set in advance for most uranium with only some allowance for fluctuation within a price range depending on factors such as inflation and spot prices of uranium. The major expenses that miners need to control are price or energy, mostly oil, and labour.

Figure 2. Uranium price chart

Figure 3. Uranium oxide prices



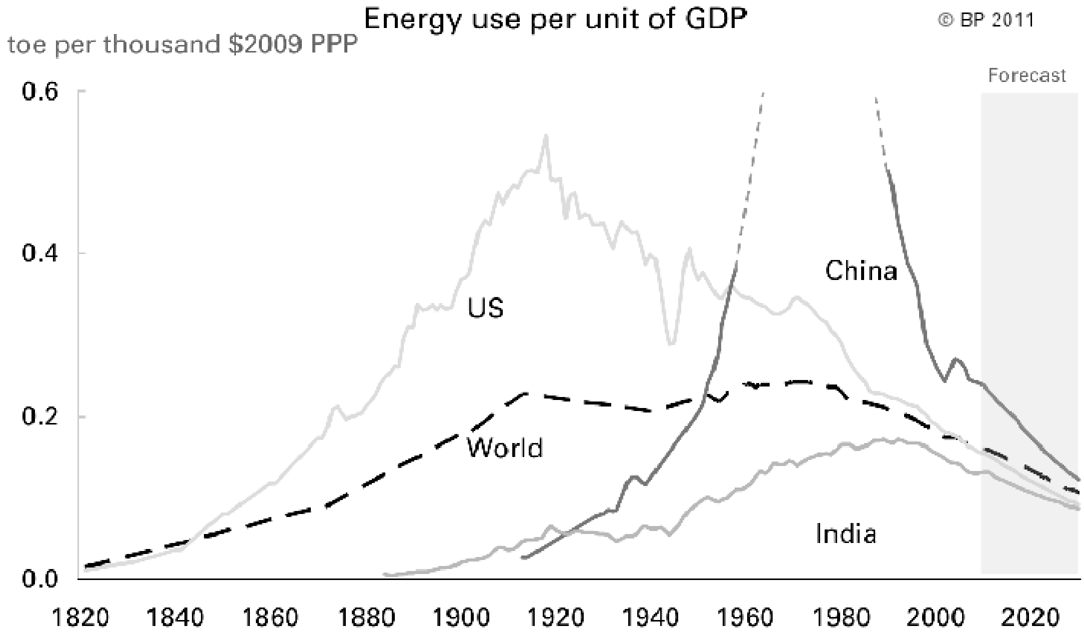
Source: www.infomine.com
Source: http://www.uraniumparticipation.com/SiteR
esources/data/MediaArchive/pdfs/investor_presentations/upc_geneva_nov_25_2010_vweb.pdf

The projected new nuclear reactors in China alone will be equivalent to 5 times what Germany plans to phase out by 2022, if current construction plans are achieved (Growth remains nuclear's future 2011). Even with the phase out of nuclear power in Germany, Switzerland, and Belgium, no new construction in Italy, Austria, Mexico, and Venezuela, and opposition to nuclear energy in Japan the demand for uranium will not be affected negatively due to increasing number of reactors in China, India, and Russia. (Black 2011; Italy says no 2011; Japan scraps 50% nuclear-power target 2011; Last decade of German nuclear power 2011; Sieg and Kubota 2011; Swiss council votes for phase out 2011; Vogel 2011). There is discussion in Japan to completely eliminate nuclear power by 2030 (Iwata and Mochizuki 2012), and a moratorium on new nuclear reactors has been put in place in the USA until a permanent repository for spent nuclear fuel is built (NRC Freezes All Nuclear Reactor Construction & Operating Licenses In U.S. 2012)(see Section 2.9). The energy supplied and expected to be supplied by nuclear will largely be replaced with new coal powered plants of which Germany has 19 under construction, and Italy, China, and India will also generate most of their new electricity from coal fired generating plants producing more CO_2. (Nuclear retreat to add 30 percent to CO_2 growth 2011).

As with previous countries industrializing the energy intensity (energy consumed per GDP) is highest in the early stage of development during expansion of heavy industry as seen in Figure 4. The peak energy per GDP in the USA was around 1910 and subsequently declined, China and India have shown similar patterns, but with a more rapid decrease in energy per GDP, especially in the case of China. Figure

4 does not show Japan, Europe, South America, or Africa, but the world figure for energy per GDP was at a plateau from 1900 to 1980 and has since been decreasing and projected to continue declining. Even with a declining growth rate in global energy use per GDP there is an increasing growth rate of energy per capita as seen in Figure 1.

Figure 4. Energy intensity during the last 200 years



toe=tonne of oil equivalent; PPP=purchasing power parity
Source:http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/2030_energy_outlook_booklet.pdf

2.3 Energy Prices

The economic crisis of 2008 reduced the demand and prices for commodities, including natural gas and oil, yet the world continues to build more cars, and expands demographically and economically increasing the demand for energy regardless of temporary economic or political setbacks. Even with the current price of oil which is still cheaper than the peak of $147 US per barrel for crude oil at its peak in July 2008, there is less oil in the world each year, more difficult to recover, with fewer and smaller new oil fields discovered with predictions of peak oil production between 2009 and 2021 and decline thereafter (Maggio and Cacciola 2009). Countries most affected by high oil prices are those without major reserves of oil or those requiring oil and gas imports to supplement inadequate domestic production.

Some governments have introduced financial incentives such as feed-in tariffs to encourages the adoption of renewable and alternative energy: geothermal, wind, solar, and bio-fuels. The feed-in tariff allowing renewable electricity to compete with conventionally generated electricity by setting higher prices utilities pay for the renewable energy to cover costs of generation are to decline with time. Currently in most countries renewable energy makes up a small part of the total energy mix, and with the exception of wind power are not economical without government incentives, but each is approaching cost parity (Table 1). There is also controversy over using land to grow fuel for motor vehicles, and thereby increasing the price of food which is felt most acutely by the poor of the world (Dunmore 2010; Rosenthal 2011).

A comparison of estimated costs of electricity generation in the US for 2016 is shown in Table 1. The electric generation capacity has a wide span from 92% for geothermal to only 18% for solar thermal. The levelized capital costs for nuclear is similar to coal with carbon capture technology to reduce CO2 emissions, while the costs of solar and offshore wind are over twice as much. Even onshore wind, geothermal, and hydroelectric levelized costs approach that of nuclear. The fixed operating and maintenance costs for nuclear is similar to geothermal, wind, coal with carbon capture, solar photovoltaic, and biomass; but is less than half that for offshore wind, and a quarter of the cost of solar thermal. The variable operating and maintenance costs for nuclear are similar to geothermal, twice that of hydroelectric, but a fraction of that for coal, natural gas, or biomass; with wind and solar generated electricity having zero variable operating and maintenance costs. Transmission costs are small compared to other costs in building and operating electricity generating plants, with solar and wind having 3.5 to over 5 times the costs for nuclear due to the locations, distances, and variability of electricity. The total levelized system costs show nuclear to be similar to coal plants, onshore wind, geothermal, biomass, and half to a third the cost of offshore wind, and solar.

Table 1. Estimated US costs of generating electricity in 2016

Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2009 $/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	65.3	3.9	24.3	1.2	94.8
Advanced Coal	85	74.6	7.9	25.7	1.2	109.4
Advanced Coal with CCS	85	92.7	9.2	33.1	1.2	136.2
Natural Gas-fired						
Conventional Combined Cycle	87	17.5	1.9	45.6	1.2	66.1
Advanced Combined Cycle	87	17.9	1.9	42.1	1.2	63.1
Advanced CC with CCS	87	34.6	3.9	49.6	1.2	89.3
Conventional Combustion Turbine	30	45.8	3.7	71.5	3.5	124.5
Advanced Combustion Turbine	30	31.6	5.5	62.9	3.5	103.5
Advanced Nuclear	90	90.1	11.1	11.7	1.0	113.9
Wind	34	83.9	9.6	0.0	3.5	97.0
Wind – Offshore	34	209.3	28.1	0.0	5.9	243.2
Solar PV[1]	25	194.6	12.1	0.0	4.0	210.7
Solar Thermal	18	259.4	46.6	0.0	5.8	311.8
Geothermal	92	79.3	11.9	9.5	1.0	101.7
Biomass	83	55.3	13.7	42.3	1.3	112.5
Hydro	52	74.5	3.8	6.3	1.9	86.4

[1] Costs are expressed in terms of net AC power available to the grid for the installed capacity.

Source: Energy Information Administration, Annual Energy Outlook 2011, December 2010, DOE/EIA-0383(2010)

2.4 Governments Role in the Economy

The economy depends on producers, consumers, and the government to various degrees. Which is most important depends on the style of government (ranging from centrally planned to laissez-faire), type of industry in question (essential, luxury, heavy, or service), and the consumer (affluent with discretionary spending or subsistence) (Porter 1998).

Type of government intervention: 1. Regulations, 2. Direct Aid, 3. Government Services, 4. Guided Development

1. Government regulations benefit the safety of its citizens, protect the environment, and ensure a fair and orderly functioning economy.
2. Direct aid to develop desired sectors or maintain strategic industries.
3. Government services like libraries, parks, education, safety (fire, police, ambulance), health care, transportation (road, rail, shipping, and including public transportation).
4. Guiding development with direct plans and goals, or monetary policies targeted to

achieve a desired effect in a country or specific regions. (Porter 2000).

2.5 Political and Legal

The growing public concern about air pollution and global warming has lead to a limiting CO2 policy and tax, in the form of carbon credits and their trading. The Kyoto protocol aimed to reduce four greenhouse gases: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, and two groups of gases created by them: hydrofluorocarbons and perfluorocarbons (Kyoto Protocol 1997). Obama had promised during his 2008 presidential election campaign to be more green (environmentally friendly) than his predecessor, invest in renewable and alternative sources of energy including nuclear, and even to sign the Kyoto protocol, but the Nobel peace prize winner forgot along with his promise to close the Guantanamo Bay detention camp (Rafalowicz 2010). The Kyoto protocol has been ratified by other advanced industrial countries like those of the European Union (EU) and Japan, with varying success adhering to reduction plans. The EU has ambitious aims for Greenhouse Gas (GHG) reduction of 50% by 2030, and 80% by 2050 (World Energy Council 2007).

Life Cycle Analysis for carbon dioxide (CO2) emissions in grams per kilowatt hour (kWh) seen in Table 2 shows that the lowest emissions of CO2 per kWh come from hydro generated electric power, while nuclear generated electricity was found to produce less CO2 than wind generated electricity in a Japanese study, but slightly more than wind in a Swedish study.

Table 2. Life cycle analysis for carbon dioxide emissions per kWh

g/kWh CO2	**Japan**	**Sweden**	**Finland**	**UK: SDC**	**EU ExternE**
Coal	990	980	894	891	851
Gas Thermal	653	1170*			
Gas Combined Cycle		450	472	356	362
Solar Photovoltaic	59	50	95		53
Wind	37	5.5	14		6.5
Nuclear	22	6	10-26	16	19.7
Hydro	18	3			

* peak-load, reserve

Source: *Japan: Central Research Institute of the Electric Power Industry, March 1995.*
Sweden: Vattenfall, 1999, popular account of its own LCA studies in Sweden.
Finland: Kivisto, 2000.
UK: Sustainable Development Commission report, March 2006.
EU: Krewitt et al 1998, ExternE data for Germany.

The wide ranging values for CO_2 emissions from nuclear power in a Finnish study in Table 2 make comparison with wind generated electricity difficult, while German data found nuclear generated electricity emitted 3 fold more CO_2 than wind generated electricity. The CO_2 emissions from solar photovoltaic generated electricity were greater than hydro, nuclear, or wind, but lower than natural gas generated electricity, with coal generated electricity producing the most CO_2, except for Swedish values for peak load gas thermal which exceeded even coal. While the CO_2 values from coal generated electricity and combined natural gas generated electricity was similar across the studies, the other sources of electricity showed much greater variation between studies.

Nuclear energy is often portrayed as producing no greenhouse gas emissions, which is not entirely true as seen in Table 2. Greenhouse gases are emitted during the construction of the reactors, the materials used, the mining, processing, enrichment of the uranium, transportation of nuclear fuel, and the final decommissioning of the rectors after use (Kunakemakorn et al. 2011).

2.6 Social and Cultural

The easiest way to reduce energy demand is by promoting conservation, reduce waste, and increase efficiency. Environmental policies have promoted saving energy with changes in consumers behaviour, mandating energy efficient light bulbs, appliances, encouraging use of public transportation, increasing fuel efficiency of automobiles, and insulating buildings. In the USA the major use of household electricity is for space cooling (air conditioning) comprising 17.9% of US residential electricity consumption in 2009, with lighting 15%, and water heating 9.3%.

Initially, environmentalism was detrimental to the nuclear industry, especially after the Chernobyl nuclear power accident in April 26, 1986. With increasing concerns about CO_2 and global warming public opinion was changing for nuclear energy, and some foresaw a nuclear power renaissance, until March 11, 2011. On that day the reactor complex at Fukushima Daiichi survived a 9.0 Richter scale earthquake off the East coast of Japan, but the resulting tsunami flooded the emergency backup power generators that were to cool the reactors. The resulting melt down of 3 nuclear cores, mass evacuation, and radiation warnings revived concerns about nuclear power worldwide (Wakatsuki and Lah 2011). China, Japan, the EU, and other countries quickly ordered safety reviews, while some announced the end of the nuclear renaissance. After safety reviews China will continue with its nuclear plans. The Environmental Protection Minister of China, Tian Jiashu, is pragmatic about nuclear risks "We're not going to stop eating for fear of choking", but a reduction in China's plans may come from a lack of skilled labour to build so many nuclear reactors in such a short time, (China lowering nuclear plants target (2011). Many countries withdrew from building new nuclear reactors: Mexico, Venezuela, Italy (94% voted against in a referendum), Greece, Ireland, Denmark, Portugal, and Austria, (Section 2.8) and the phase outs of existing reactors: Germany (phase out by 2022), Belgium, and Switzerland (Hooper 2011; Pidd 2011).

The benefits of nuclear energy have been promoted by the industry to help allay fear and gain favour amongst the public that want to have a good standard of living and simultaneously reduce pollution (Singh 2011). Some maintain that the total cost of nuclear energy is not included in the market price of the electricity produced, because risks of accidents are socialized due to accident insurance being capped at different levels depending on the country with the rest of the accident costs the responsibility of the government, thereby providing a subsidy which would otherwise make nuclear reactors uninsurable and uneconomical (Kidd 2011). "The cost of a worst-case nuclear accident at a plant in Germany, for example, has been estimated to total as much as €7.6 trillion ($11 trillion), while the mandatory reactor insurance is only €2.5 billion." (Baetz 2011)

2.7 Technological

The hope and promise of science and technological progress was often overly optimistic and went unfulfilled.

"It is not too much to expect that our children will enjoy in their homes electrical energy too cheap to meter; will know of great periodic regional famines in the world only as matters of history; will travel effortlessly over the seas and under them and through the air with a minimum of danger and at great speeds, and will experience a lifespan far longer than ours, as disease yields and man comes to understand what causes him to age. This is the forecast of an age of peace." (Strauss 1955).

While air travel, hovercrafts, and an understanding of what causes ageing may have been fulfilled, unfortunately disease is still with us, energy is not too cheap to go unmetered, famines are not history, and world peace has not been achieved.

Many countries have made it a priority to be able to develop their own nuclear programs, both civilian and militarily. This requires a high level of education and technological skills which like space exploration programs of many nations aids national development, prestige, and exports. The nuclear industry produced numerous spin offs: sterilization of medical equipment, food irradiation to eliminate pathogens and increase storage life, smoke detectors, directed radiation at cancers, and use of isotopes in medical procedures for imaging and treatments of cancer and thyroid dysfunction (Clinton's cobalt campaign 2010). Research into using fusion energy for electricity is being conducted at the Joint European Torus (JET) in the UK, and in France from 2019 at the International Thermonuclear Experimental Reactor (ITER).

There is also interest in the potential of using a modular design in which several small reactors could be used together to provide the energy of large reactor (Mini nuclear reactors: Thinking small 2010). These small reactors could be used to provide power in remote locations and could be providing energy sooner than building a large reactor since it would be built in a factory instead of constructed on site. Similar designs have been used in nuclear powered submarines and ships for decades.

2.8 Global

Resource companies often diversify globally in order to increase reserves, and to reduce risks: political, environmental, currency, and economic. Cameco has not been an exception with its expansion into Australia, the USA, and Kazakhstan which have large uranium resources. Each country provides challenges (cultural, geological, environmental, legal, economic, and political) that must be overcome.

Table 3. World nuclear power reactors, uranium requirements, and future plans as of 2012

COUNTRY (Click name for Country Profile)	NUCLEAR ELECTRICITY GENERATION 2011		REACTORS OPERABLE Aug 2012		REACTORS UNDER CONSTRUCTION Aug 2012		REACTORS PLANNED Aug 2012		REACTORS PROPOSED Aug 2012		URANIUM REQUIRED 2012
	billion kWh	% e	No.	MWe net	No.	MWe gross	No.	MWe gross	No.	MWe gross	tonnes U
Argentina	5.9	5.0	2	935	1	745	1	33	2	1400	124
Armenia	2.4	33.2	1	376	0	0	1	1060			64
Bangladesh	0	0	0	0	0	0	2	2000	0	0	0
Belarus	0	0	0	0	0	0	2	2000	2	2000	0
Belgium	45.9	54.0	7	5943	0	0	0	0	0	0	995
Brazil	14.8	3.2	2	1901	1	1405	0	0	4	4000	321
Bulgaria	15.3	32.6	2	1906	0	0	1	950	0	0	313
Canada	88.3	15.3	17	12044	3	2190	2	1500	3	3800	1694
Chile	0	0	0	0	0	0	0	0	4	4400	0
China	82.6	1.8	15	11881	26	27640	51	57480	120	123000	6550
Czech Republic	26.7	33.0	6	3764	0	0	2	2400	1	1200	583
Egypt	0	0	0	0	0	0	1	1000	1	1000	0
Finland	22.3	31.6	4	2741	1	1700	0	0	2	3000	471
France	423.5	77.7	58	63130	1	1720	1	1720	1	1100	9254
Germany	102.3	17.8	9	12003	0	0	0	0	0	0	1934
Hungary	14.7	43.2	4	1880	0	0	0	0	2	2200	331
India	28.9	3.7	20	4385	7	5300	18	15100	39	45000	937
Indonesia	0	0	0	0	0	0	2	2000	4	4000	0
Iran	0	0	1	915	0	0	2	2000	1	300	170
Israel	0	0	0	0	0	0	0	0	1	1200	0
Italy	0	0	0	0	0	0	0	0	10	17000	0
Japan	156.2	18.1	50	44396	3	3036	10	13772	5	6760	4636
Jordan	0	0	0		0	0	1	1000			0
Kazakhstan	0	0	0	0	0	0	2	600	2	600	0
Korea DPR (North)	0	0	0	0	0	0	0	0	1	950	0
Korea RO (South)	147.8	34.6	23	20787	4	5205	5	7000	0	0	3967
Lithuania	0	0	0	0	0	0	1	1350	0	0	0
Malaysia	0	0	0	0	0	0	0	0	2	2000	0
Mexico	9.3	3.6	2	1600	0	0	0	0	2	2000	279
Netherlands	3.9	3.6	1	485	0	0	0	0	1	1000	102
Pakistan	3.8	3.8	3	725	2	680	0	0	2	2000	117
Poland	0	0	0	0	0	0	6	6000	0	0	0
Romania	10.8	19.0	2	1310	0	0	2	1310	1	655	177
Russia	162.0	17.6	33	24164	10	9160	17	20000	24	24000	5488
Saudi Arabia	0	0	0	0	0	0	0	0	16	17000	0
Slovakia	14.3	54.0	4	1816	2	880	0	0	1	1200	307
Slovenia	5.9	41.7	1	696	0	0	0	0	1	1000	137
South Africa	12.9	5.2	2	1800	0	0	0	0	6	960	304
Spain	55.1	19.5	8	7448	0	0	0	0	0	0	1355
Sweden	58.1	39.6	10	9399	0	0	0	0	0	0	1394
Switzerland	25.7	40.8	5	3252	0	0	0	0	3	4000	527
Thailand	0	0	0	0	0	0	0	0	5	5000	0
Turkey	0	0	0	0	0	0	4	4800	4	5600	0

COUNTRY (Click name for Country Profile)	NUCLEAR ELECTRICITY GENERATION 2011		REACTORS OPERABLE Aug 2012		REACTORS UNDER CONSTRUCTION Aug 2012		REACTORS PLANNED Aug 2012		REACTORS PROPOSED Aug 2012		URANIUM REQUIRED 2012
	billion kWh	% e	No.	MWe net	No.	MWe gross	No.	MWe gross	No.	MWe gross	tonnes U
Ukraine	84.9	47.2	15	13168	0	0	2	1900	11	12000	2348
UAE	0	0	0	0	1	1400	3	4200	10	14400	0
United Kingdom	62.7	17.8	16	10038	0	0	4	6680	9	12000	2096
USA	790.4	19.2	104	101930	1	1218	11	13260	19	25500	19724
Vietnam	0	0	0	0	0	0	4	4000	6	6700	0
WORLD**	**2518**	c**13.5**	**433**	**371,745**	65	**64,979**	**158**	**175,115**	**329**	**369,915**	**67,990**
	billion kWh		**% e**		**No.**		**MWe**		**No.**		**MWe**

Sources:
Reactor data: WNA to 1/8/12 (excluding 8 shut-down German units)
IAEA- for nuclear electricity production & percentage of electricity (% e) 13/4/12.
WNA: Global Nuclear Fuel Market report Sept 2011 (reference scenario) - for U.

Operable = Connected to the grid;
Under Construction = first concrete for reactor poured, or major refurbishment under way;
Planned = Approvals, funding or major commitment in place, mostly expected in operation within 8-10 years;
Proposed = Specific program or site proposals, expected operation mostly within 15 years.

New plants coming on line are largely balanced by old plants being retired. Over 1996-2009, 43 reactors were retired as 49 started operation. There are no firm projections for retirements over the period covered by this Table, but WNA estimates that at least 60 of those now operating will close by 2030, most being small plants. The 2011 WNA Market Report reference case has 156 reactors closing by 2030, and 298 new ones coming on line.

TWh = Terawatt-hours (billion kilowatt-hours), MWe = Megawatt (electrical as distinct from thermal), kWh = kilowatt-hour.

67,990 tU = 80,181 t U_3O_8

** The world total includes 6 reactors operating on Taiwan with a combined capacity of 4927 MWe, which generated a total of 40.4 billion kWh in 2011 (accounting for 19.0% of Taiwan's total electricity generation). Taiwan has two reactors under construction with a combined capacity of 2700 MWe, and one proposed, 1350 MWe. It is expected to require 1291 tU in 2012.

The greatest growth in nuclear power is expected to be in the developing world, specifically China, India, and Russia as seen in Table 3. It can be seen that the most important country in growth of nuclear power and impact on the demand for uranium will be China with 26 nuclear reactors under construction, 51 planned, and 120 proposed. India has 7 under construction, 18 planned, and 39 proposed. Russia has 10 under construction, 17 planned, and 24 proposed. Those planned and proposed for, Italy, Mexico, and Switzerland have been abandoned, and what changes will occur in the remaining countries with significant plans of expansion such as the USA, Japan, or the Ukraine are uncertain. There is a moritorium on new reactor construction in the USA, and Japan is even considering Germany's direction of phasing out nuclear power. Even with this growth of nuclear energy in the developing world the main source of energy in the world will remain coal (Rosenthal 2008). China consumes approximately 50% of the worlds coal used each year. Percent of electricity in 2011 from nuclear reactors is 1.8% in China, and 3.7% in India as seen in Table 3, and even after the currently planned expansion will be less than 10%. This leaves much room for future expansion of nuclear energy and uranium demand.

2.9 Spent Fuel Management

A major long term concern for the nuclear industry is what to do with the high level, highly radioactive, waste. This spent fuel is stored "temporarily" for decades at the reactor sites in isolated water pools at the nuclear plants until a long term storage site is available. Many countries are planning and constructing permanent storage sites underground, but the construction of the permanent repository at Yucca mountain, Nevada in the USA has been suspended by the Obama administration.

An estimated 2% of nuclear fuel comes from reprocessing but it is not economical at this time, and controversial due to concerns of the possibility of plutonium being diverted for weapons, but can extend uranium up to 50 times. Uranium is reprocessed in a few countries (France, Russia, Japan, India and the UK) as seen in Table 4 (Fast Reactor Technology: A Path to Long-Term Energy Sustainability – Position Statement, 2005). Reprocessing spent nuclear fuel becomes economical if increasing safety concerns and costs of permanent storage are considered (Black 2006).

Table 4. World commercial reprocessing capacity (Tonnes per year)

<table>
<tr><td rowspan="5">LWR fuel</td><td>France, La Hague</td><td>1700</td><td></td></tr>
<tr><td>UK, Sellafield (THORP)</td><td>900</td><td></td></tr>
<tr><td>Russia, Ozersk (Mayak)</td><td>400</td><td></td></tr>
<tr><td>Japan (Rokkasho)</td><td>800*</td><td></td></tr>
<tr><td>Total LWR (approx)</td><td></td><td>3800</td></tr>
<tr><td rowspan="3">Other nuclear fuels</td><td>UK, Sellafield (Magnox)</td><td>1500</td><td></td></tr>
<tr><td>India (PHWR, 4 plants)</td><td>330</td><td></td></tr>
<tr><td>Total other (approx)</td><td></td><td>1830</td></tr>
<tr><td>Total civil capacity</td><td></td><td></td><td>5630</td></tr>
</table>

* now expected to start operation in October 2012

Sources: Nuclear Engineering International Handbook 2007
Nuclear Energy Data 2007, OECD Nuclear Energy Agency (ISBN 9789264034532)

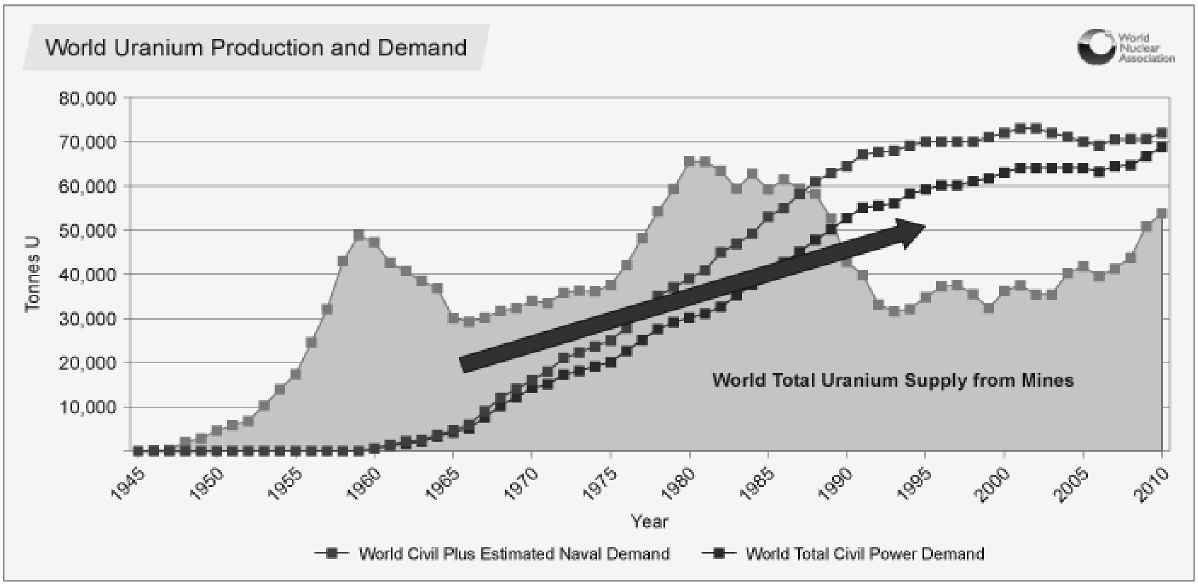
2.10 Uranium Supply and Demand

In the natural resource sector low prices reduce investments and exploration with uranium being used as an example in Section 3.11. With time leading to lower supply and higher prices that encourage exploration and development, often resulting in a boom-bust cycle.

The total civil plus naval demand for uranium has exceeded supply since approximately 1985 (Figure 5). The national reserves and decommissioning of nuclear weapons filled the shortfall in supply which is an important resource for companies in the West, like Cameco, while reducing concern that these materials might end up in the wrong hands.

The demand for electricity is relatively stable, while some heavy users of electricity in manufacturing and mining such as aluminium smelting may reduce their demand in major economic downturns, the long term trend is for more use of energy and electricity, and with increased use of electric and hydrogen motor vehicles there will be increased demand for electricity.

Figure 5. World uranium production and demand



Source: World Nuclear Association

Canada, Australia, and Kazakhstan accounted for 63.3% of total mined uranium in 2011 (Uranium Mining | World Uranium Mining 2011). Kazakhstan recently increased its capacity to become the worlds largest exporter of uranium, accounting for 35.6% of the worlds mined uranium in 2010 (table 6). Even with this increased supply of uranium only 85% of demand was met from mining in 2011. Current mines and those under development are not expected to avert a shortfall in uranium during 2010-2019 as shown in Section 3.11.

Table 5. Production from mines in (Tonnes U)

Country	2004	2005	2006	2007	2008	2009	2010	2011
Kazakhstan	3719	4357	5279	6637	8521	14020	17803	19451
Canada	11597	11628	9862	9476	9000	10173	9783	9145
Australia	8982	9516	7593	8611	8430	7982	5900	5983
Niger	3282	3093	3434	3153	3032	3243	4198	4351
Namibia	3038	3147	3067	2879	4366	4626	4496	3258
Russia	3200	3431	3262	3413	3521	3564	3562	2993
Uzbekistan	2016	2300	2260	2320	2283	2657	2874	3000
USA	878	1039	1672	1654	1430	1453	1660	1537
Ukraine (est)	800	800	800	846	800	840	850	890
China (est)	750	750	750	712	769	1200	1350	1500
Malawi						104	670	846
South Africa	755	674	534	539	655	563	583	582
India (est)	230	230	177	270	271	290	400	400
Brazil	300	110	190	299	330	345	148	265
Czech Republic	412	408	359	306	263	258	254	229
Romania (est)	90	90	90	77	77	75	77	77
Germany	77	94	65	41	0	0	0	52
Pakistan (est)	45	45	45	45	45	50	45	45
France	7	7	5	4	5	8	7	6
total world	**40 178**	**41 719**	**39 444**	**41 282**	**43798**	**51 450**	**54 660**	**54 610**
tonnes U_3O_8	47 382	49 199	46 516	48 683	51 651	60 675	64 461	64 402
percentage of world demand		65%	63%	64%	68%	78%	78%	85%

WNA Market Report data

Source: http://www.world-nuclear.org/info/inf23.html

2.11 Alternative and Renewable Energy

Electricity generated from wind and sun are intermittent unlike nuclear power, hydro, coal, and geothermal which is suitable for base load supply of electricity (a constant source of energy that is always required). Improvements to the electrical grids are required in developing countries to avoid large scale power outages, and in developed countries to balance out fluctuating power from renewable sources. The economic viability of renewable energy sources, wind, wave/tide, and geothermal energy, also varies geographically just like non-renewable sources as seen in Table 1 and Section 2.3. The costs of solar energy has been decreasing and is expected to reach grid parity (equal cost of electricity with competing non-renewable sources of electricity) within a matter of years (Solar Energy is Poised to Achieve Cost Parity 2010; Vaughan 2009). Solar power is most effective closer to the equator and on clear sunny days, having already reached grid parity in some high cost electricity regions such as: California, Hawaii, and Spain. Ideally a mix of energy sources most appropriate for an area should be used, with nuclear energy being an important part of that mix for many countries and regions.

3. Uranium Industry Background

External analysis can include: government regulations, taxes and royalties, industry background, public acceptance, infrastructure, market growth, standard of living and expectations of the community, competition, societal unrest (strikes, riots), and economic crisis or prosperity. The uranium industry is made up of a few large miners, more medium and small miners, and many explorers too small to develop a resource. The industry is becoming more concentrated as financially strong and state owned companies acquire smaller miners and explorers to build reserves and resources and take advantage of distressed companies. The sources and methods of uranium extraction are briefly discussed below.

3.1 Mining Methods

Mineral reserves are proven deposits of minerals that are legally, technically, and financially viable to mine. Resources are potentially viable deposits that need further exploration, higher mineral prices, or improved technology to extract . The method used to recover minerals depends on many factors, some of which are: accompanying minerals, depth of the minerals and the overlying strata, the economics of the resource, the local environment, and community acceptance. Conventional mining methods are listed in Table 6: in-situ leach (ISL) the most common, underground, and open pit.

Table 6. Common uranium mining methods 2011

Method	Tonnes U	%
Conventional underground	16,059	30%
Conventional open pit	9,268	17%
In situ leach (ISL)	25,296	46%
By-product	3,987	7%

(considering Olympic Dam as by-product rather than in underground category)

Source: http://www.world-nuclear.org/info/inf23.html

3.2 Conventional extraction methods

3.2(a) Open Pit Mining

Involves the excavation of mineral deposits close to the surface using quarrying in an open pit or strip mining after removal of overburden, the surface covering material. The Olympic Dam mine in Australia is one example. Once a mine resource is exhausted the area should be restored to conditions present before the mining operation.

3.2(b) Underground Mining

Is used when the depth of the deposits make them uneconomical for open pit mining, when an open pit mine as been exhausted but reserves continue deeper underground, or there is opposition to open pit mining.

3.2(c) In-situ Leaching

The in-situ method is a less invasive method than open pit or underground mining, and is the most common method used for uranium mining in the USA and Kazakhstan, and increasing in Australia. Currently it accounts for the most uranium mined annually as shown in Table 6, and is often considered more environmentally friendly than open pit or underground mining. In-situ leaching has a 60-80% recovery of total uranium, but requires new wells to be continually drilled due to a short production time of up to 3 years.

3.3 Unconventional deposits

3.3(a) Ocean/Seas

The search for minerals has expanded to new frontiers with recent attempts of large scale mining at sea of high grade mineral deposits proximal to geologically active areas that concentrated minerals, and even directly from the ocean water. Large deposits of uranium are present on the ocean bottom (Treasure on the ocean floor, 2006). Also direct absorption of uranium from seawater, which is estimated to contain over 1,000 times the uranium available on land, using various techniques has been examined in Japan (Heide et al. 1973; Sugo 1999).

3.3(b) Phosphate

As prices of minerals rise more diverse sources like uranium from phosphate deposits mined for fertilizer becomes economically viable. Morocco has the largest known uranium deposit contained in phosphates.

3.3(c) Biological

The use of biological organisms like bacteria or fungi have been used to leach out copper and gold. This method may make low grade deposits economically viable by recovering a larger percent of minerals. Bio-leaching was found to recover 80% of uranium in low grade black schists as apposed to 18% without bio-leaching (Choi et al. 2005)

3.3(d) Coal Ash

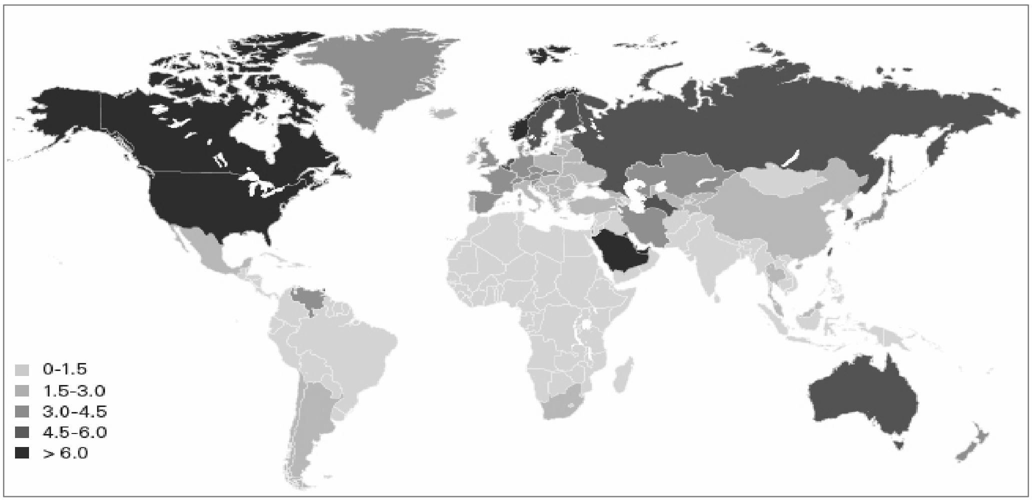
Uranium and thorium are often present in coal and may contaminate surrounding areas of a smoke stack. The level of radiation from a smoke stack are not considered dangerous and are low compared to natural background exposure (Hvistendahl 2007). The ash remaining after coal is burned for electricity is a potential source of uranium and other valuable minerals (Winning 2010).

3.4 Energy Consumers

Unlike the fluctuating resource industries the electricity market is relatively resistant to perturbances in the economy and continues to grow steadily as a function of population and GDP growth. The demand for electricity frequently outpaces GDP and primary energy demand and has increased every year since 1945 until its first decline in 2009, Mackenzie (2009). The International Energy Agency (IEA) predicted a decrease in electricity demand in 2009 for the first time since 1945 by 3.5%, 75% of that decline due to industrial reductions (IEA 2009), but the long term growth trend for electricity demand continues with the largest percent rise in 2010 since 1973, with nuclear-generated electricity rising by 2% (BP Statistical review: Electricity (2011).

Primary energy consumption per capita 2010 (Figure 6) showed developed countries with high standards of living using the most energy, while much of Africa, Asia, and South America currently using least.

Figure 6. Primary energy consumption per capita 2011
(Tonnes oil equivalent)



Source: http://www.bp.com/extendedsectiongenericarticle.do?categoryId=9041234&contentId=7075077

3.5 Industry Competitors

The top 5 companies alone comprised 70% of world supply in 2011 (Table 7). Cameco is more vertically integrated in the uranium industry than most publicly traded companies, being the largest non-government controlled miner deriving a majority of its revenue from uranium mining. The large uranium mining companies are often vertically integrated. Often the largest uranium miners have significant government ownership due to deemed strategic importance of the mineral, amongst these are: France's Areva, Kazakhstan's Kazatomprom, Uzbekistan's Navoi Mining & Metallurgy Combinat (NMMC), Russia's Rosatom subsidiary ARMZ (JSC Atomredmetzoloto) Uranium Holding Company which is majority owner of Uranium One, China's Guangdong Nuclear Power Corp (CGNPC), India's Uranium Corporation of India (UCIL). The largest uranium suppliers without direct government ownership are: BHP Billiton, Rio Tinto, Energy Resources of Australia (ERA), Paladin, Denison, and Cameco.

The worlds largest uranium resource is at Olympic Dam in Australia with an estimated 50 years of uranium remaining at the current mining rate. This resource is a low grade (percent of uranium per ton of rock mined) uranium, unlike Cameco's high grade ore in Saskatchewan that contains up to 20% uranium, but the accompanying minerals present in the ore mined at many sites make the uranium economical even at a lower grade. Cameco continues to be amongst the largest uranium miners.

Table 7. Largest uranium miners in 2011

Company	Tonnes U	%
KazAtomProm	8,884	17
Areva	8,790	16
Cameco	8,630	16
ARMZ-Uranium One	7,088	13
Rio Tinto	4,061	8
BHP Billiton	3,353	6
Navoi	3,000	5
Paladin	2,282	4
Other	8,521	15
Total	54,610	100

Source: http://www.world-nuclear.org/info/inf23.html

An additional source of uranium since the end of the USA-USSR cold war has been a large supply of strategic uranium reserves and enriched uranium and plutonium available from decommissioned nuclear weapons. Cameco is one of the companies involved in the Megatons to Megawatts program, 1995 to 2013, after the highly enriched uranium (HEU) is converted into low enriched uranium (LEU) in Russia (USEC 2011). The uranium mining industry is concentrated, with the largest 3 companies providing over 49% of annual uranium mined (Table 7). The largest companies are Areva, Cameco, and Kazatomprom which have competitive advantages due to vertical integration, and excepting Kazatomprom multinational diversification. While greater diversification may be viewed as increasing exposure to risk, it is positively related to long term performance (Li and Tallman 2011).

3.6 Relative Size of the Industry

The size of the uranium mining industry is small relative to the coal, copper, iron, or gold mining industries. There are only a few companies worldwide capable of developing a new discovery into a producing mine. With even fewer companies in the enrichment market due to government regulations, technology, and costs involved. The concentration of resources in a few countries poses a risk of an OPEC of uranium suppliers forming or simply supplying their own national demands. Three countries have 48% of known recoverable uranium resources (Table 8), and 3 mining companies produce 49% of world production seen in Table 7 and Section 3.5. There was approximately 5.5 million tonnes of recoverable resources of uranium in 2007 at a price of US$ 130/kg. The estimates of uranium resources provided in the Red Book have not been very accurate, and may be overestimated (Dittmar 2009).

Table 8. Known recoverable resources of uranium to US$ 130/kg as of 2007

	Tonnes U	Percentage of world
Australia	1,243,000	23%
Kazakhstan	817,000	15%
Russia	546,000	10%
South Africa	435,000	8%
Canada	423,000	8%
USA	342,000	6%
Brazil	278,000	5%
Namibia	275,000	5%
Niger	274,000	5%
Ukraine	200,000	4%
Jordan	112,000	2%
Uzbekistan	111,000	2%
India	73,000	1%
China	68,000	1%
Mongolia	62,000	1%
Other	210,000	4%
World total	**5469000**	

Source: Reasonably Assured Resources plus Inferred Resources, to US$ 130/kg U, 1/1/07, from OECD NEA & IAEA, Uranium *2007: Resources, Production and Demand* ("Red Book").

3.7 Economic Impact

The economic impact of uranium mining is significant in the remote locations where the mines operate often using local businesses, and is a major export earner improving trade balances for many countries. Socially conscious companies use local contractors, employ locally, and help the educational, social, and health development of communities they operate in, which reduces opposition to mining and improves public relations. Cameco introduced the use of fly in and fly out labourers at its Northern mines in Saskatchewan instead of building long term company towns which was subsequently adopted by many other miners since 1975 (Russel 1999).

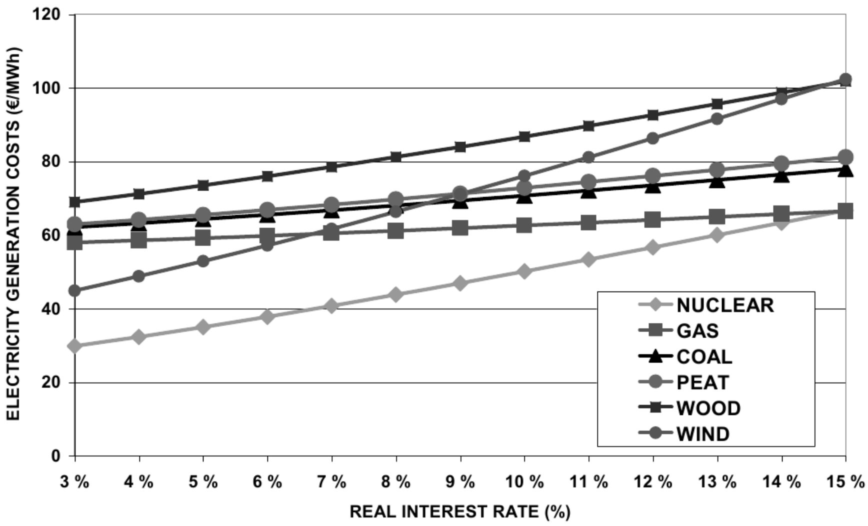
3.8 Taxes, Royalties, and Interest Rates Impact

Mining companies provide royalties and tax revenues to the governments in the countries and territories they operate in. Changes in tax or royalty rates can have a significant economic impact on operations and impacts future investments. Governments commonly increase tax rates and royalties during boom times to increase their share of the wealth (Garnder 2008). These changes can occur in both developed and developing countries. Canada introduced a tax in 2011 on Income

Trusts which paid no taxes at the corporate level and ran businesses paying out large dividends to their stockholders. The USA is proposing introduction of a 12.5% royalty for uranium mining on federal lands known as The Uranium Resources Stewardship Act (Burgert 2011). Developing countries are also increasing taxes and royalties. The uranium rich country of Namibia has introduced a new law giving its state owned mining company Epangelo first rights to strategic minerals such as uranium, but existing projects and prior submitted applications for approval are not to be affected (Murray 2011). Indonesia is proposing changes in taxes, exports of unprocessed minerals, and ownership of mines including a 50% tax on exports by 2013, and reduction of foreign ownership in mines to 49% within 10 years of starting operations (Rondonuwu 2012).

Low interest rates lead to bubbles building up in sectors of the economy like commodities, financial instruments, and real estate until it started to deflate in 2007-2008, even now some economists opine that the real estate bubble has still not deflated in many countries such as Australia, Canada, or even in the USA (Li 2010; ElBoghdady 2011). Interest rates also have an impact on the cost of constructing and running electric generating plants. Continued low interest rates and creation of money should benefit producers of commodities over the long term, with uranium being no exception. Power generation costs for nuclear power are most advantageous at low interest rates, while progressively losing advantage compared to other forms of electricity with rising interest rates (Tarjanne and Kivistö 2008).

Figure 7. The Impact of Real Interest Rate on Power Generation Costs



Source: http://www.doria.fi/handle/10024/39685

3.9 Uranium Industry Trends

There is increasing consolidation within the mining industry, to increase mineral resources and reserves, to increase profits, and take advantage of scale and integrate vertically (Xstrata plc Annual Report 2010). A significant concentration, both country and company, exists in the supply of many key minerals: platinum group metals, gold, rare earth metals, nickel, and diamonds. The same concestration is occuring amongst the large uranium miners as seen in Table 7 and Sections 3.5).

"According to Raw Materials Group (RMG) figures, in 2007 the international mining industry was comprised of about 150 majors, 957 mid- and small-tier companies and more than 3 000 explorers. However, by value, about 83% of metals were allotted to the majors, while small and medium sized companies only accounted for 17%. " (Hill 2008).

The uranium exploration market is very diversified with hundreds of new companies appearing during the last uranium bull market that ended suddenly in 2008. Exploration has a low success rate and financial resources are often exhausted before any economically viable resources are discovered. The acquisition of undervalued explorers and small to medium sized miners by larger cash rich miners will continue in the current economic environment (Mining transactions and industry consolidation 2011); (Permatasari 2011). This provides financially healthy companies like Cameco with opportunities to pick the best prospects for its vision of growing the company and being top uranium miner in the world (Gordon 2011). Many national governments seeking to guarantee supplies of resources, including uranium, and have also become buyers. The industry must contend with increasing environmental regulations, stricter enforcement, and growing public involvement in mining decisions (Garnder 2008).

3.10 Porter's Five Forces Competitive Analysis

Porter's Five Forces model plus a sixth force can lend some insight into the current situation in the uranium mining industry (Porter 1996). The forces are:

(1) Threat of new entrants,

(2) Power of suppliers,

(3) Power of buyers,

(4) Threat of product substitutes,

(5) Competitive rivalry in an industry, and also

(6) Complimentary forces (co-operation with competitors to reduce risk at a particular mine or plant, government or social encouragement or discouragement)

3.10(a) Threat of New Entrants

The threat of new entrants is low in the uranium mining industry. This is primarily due to the costs and time of developing a new mine, even after the difficult task of first finding a viable resource, getting governmental permission, and acceptance from local people and environmental groups. There are few companies with the experience and resources to bring a deposit into production. Cameco's advantage is having a majority of it mined uranium coming from high grade deposits in a mining friendly province, Saskeatcewan, and a politically stable country, Canada, in addition to being active in Australia, the USA, and Kazakhstan.

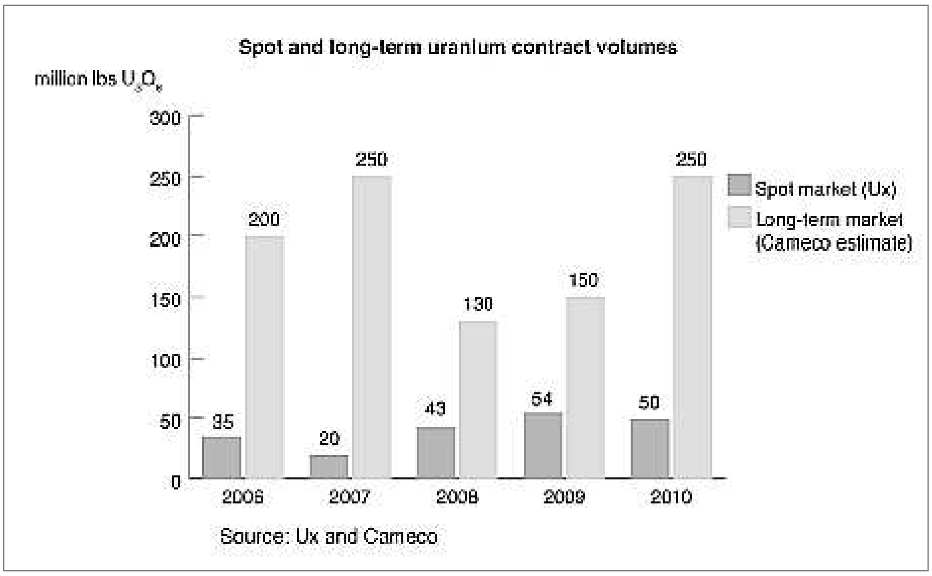
3.10(b) Bargaining Power of Suppliers

The power of suppliers is moderate in the uranium mining industry. The mining equipment, labour, electricity, materials, and fuel to run the equipment are all major expenses. Currency is also an important factor because Cameco's expenses are in the local currency, currently mainly in Canadian dollars, but uranium is usually priced in US dollars. The access to mining equipment is currently not a significant concern. The major costs of mining are labour and energy. With energy being from 25% to 33% of total costs for many miners, some like Barrick Gold, have purchased oil companies to secure a cheaper supply of fuel and reduce fluctuations in oil expenses (French 2008). The rising costs of skilled and unskilled labour during the mining and energy boom has since abated due to higher unemployment rates in many countries, but may reappear due to retirement of skilled labour in the coming decades in many countries.

3.10(c) Bargaining Power of Buyers

The power of buyers is moderate in the uranium industry. Energy utilities often sign long term contracts at prices for uranium that are either set or have a mechanism that adjusts to market changes such as inflation, currency value, and spot prices, with only a small percent of uranium sold at spot prices thereby reducing the threat of switching suppliers (Figure 8). The percent of total uranium sold in long term contracts seen in Figure 8 was greatest in 2007 at over 92%, and lowest during 2009 at over 73%.

Figure 8. Spot and long-term sales of uranium



Source: www.cameco.com

Cameco has the benefit of being financially strong and operating in a politically and economically stable country that can supply large quantities of uranium. The largest expansion of nuclear energy at this time is in China, to which Cameco sold 52 million pounds of uranium under long term contracts in 2010. Electric utilities operating nuclear reactors have little choice as to sources of uranium from the limited number of suppliers, and is currently in a primary supply deficit. There is also limited choice of suppliers for refining, enrichment, and fuel rods used in reactors.

3.10(d) Threat of Product Substitutes

The threat of product substitutes for uranium is very low in the nuclear industry since uranium is a must for current nuclear reactors. There is the possibility of reprocessing spent reactor fuel, but only 2% of total uranium fuel is from reprocessing due to few facilities (Table 4 and Section 2.9), costs, technical challenges, and political reasons. Thorium is not a near term threat because the current reactors other than CANDU's are not designed for thorium, but is being studied in several countries, specifically India and China, to be used in future reactors. Other threats are the declining costs of wind and solar energy, and fusion nuclear power which has been 30 years away for the last 30 years.

3.10(e) Competitive Rivalry in the Industry

The intensity of rivalry is high do to the interchangeability of uranium. Vertical integration, financial strength, a skilled workforce, geographic diversity, and a large resource base are important mining company strengths. Cameco has the advantage of processing its uranium for reactor use, and being part owner of a nuclear power plant providing steady revenue. Public mining companies like Cameco must often compete with state companies that have financial advantages of seemingly unlimited funds. Kazakhstan has significantly increased their production to overtake Canada and Australia as the worlds largest uranium supplier in 2009 (Table 5). Cameco, Uranium One, and Kazakhstan's state uranium mining corporation are major competitors operating in Kazakhstan. Kazakstan's advantage is the use of cheaper in-situ leach mining, and relatively cheaper labour costs than in Western countries. Areva, ARMZ, Rio-Tinto, BHP, and state miners of India, China, are significant competitors and potential acquisitors of Cameco, where it not for Canadian incorporation rules of Cameco limiting individual foreign ownership to 15 percent (Lachapelle et al. 2011).

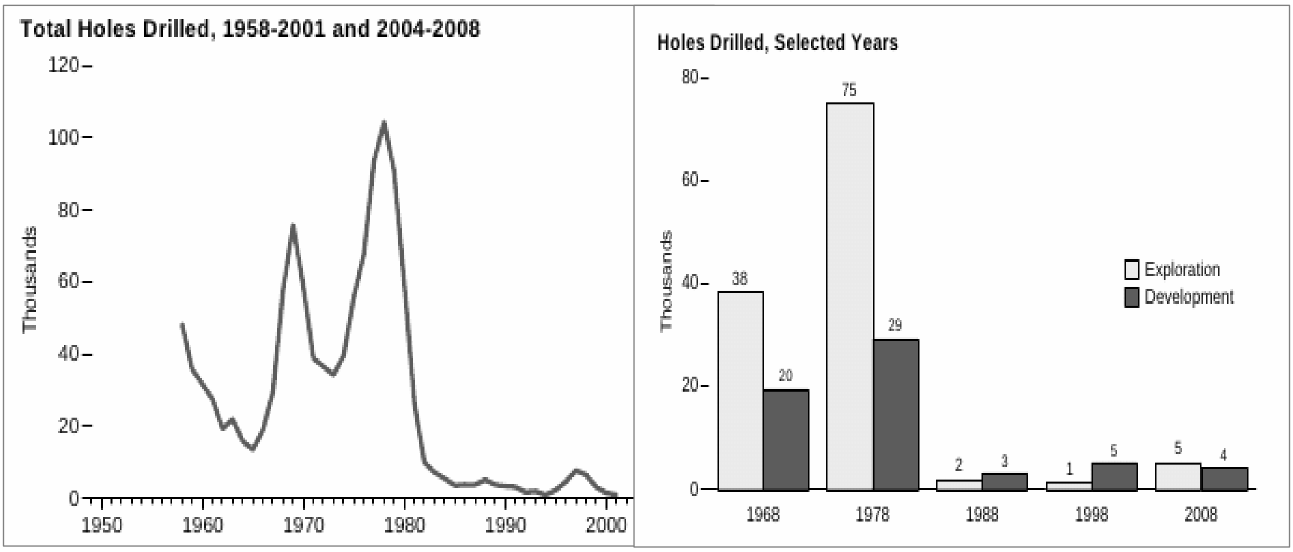
3.10(f) Complimentary Forces

A sixth force in Cameco's advantage is its cooperation with many of its rivals in operating mines and processing plants. Forming of joint ventures creates synergies, reduces duplication, reduces risk, and diversifies benefits of the companies involved (Kumar 2011). Cameco often works with other companies including state owned: France's Areva in Saskatchewan, Kazakhstan's Kazatomprom in Kazakhstan, and Russia's ARMZ Uranium One in Wyoming, USA. The forming of joint ventures and cooperating amongst resource companies in a region reduces costs by avoiding unnecessary duplication among competitors. The uneven geographic distribution of resources, often in remote locations, naturally results in the formation of clusters of mining companies and their suppliers in the location (Porter 2000). Cameco's part ownership in the Bruce nuclear plant shares risks and benefits, and working together to develop laser enrichment of uranium thereby reducing individual risk while gaining valuable knowledge from its partners: General Electric 51%, Hitachi 25%, and Cameco 24% (Cameco Joins GE-Hitachi Uranium Laser Enrichment Venture 2008). The government or public are important complimentary forces. Laws or regulations may encourage mining, or may be overly restrictive even imposing a moratorium on uranium mining as existed in Australia permitting only 3 mines to operate at any single moment. Corruption can be a hidden cost of business in both developed and developing countries, as an example the Indonesian Chamber of Commerce estimated that 17.4% of investment money goes to pay illegal costs to receive permits (Heffernan 2012).

3.11 Exploration and Resources

With the growing demand for uranium there is a concern that a shortage in supplies will result. It has been suggested that the estimates of uranium resources are frequently greater than later proven, and therefore the long term sustainability of the nuclear energy industry is questionable due the estimated available uranium being able to fuel the planned worldwide expansion of nuclear reactors for approximately 50 years (Dittmar 2011). The long depressed uranium price which was only $7 per pound in 2000 (Figure 2, and Section 2.2), discouraged exploration for uranium for decades in the USA (Figures 9 and 10), and many other countries, led to a supply shortage developing and depletion of resources and reserves. Two drilling peaks are seen during the late 1960's and late 1970's respectively, with a sharp decrease soon after the peak of the late 1970's with a low level of drilling the following 2 decades. The percent of exploration drilling was double in the 1960's and triple in the 1970's that of the development drilling (Figure 10) shows the absolute number has declined significantly since then and has not recovered its previous high levels. During the 1980's and 1990's drilling was mostly developmental, and only during the first decade of the 2000's has exploration drilling surpassed development drilling again. During 1978 there were 104 thousand drilled holes for uranium in the USA, which was over 11.5 times the 9 thousand holes drilled in 2008. The most immediate increase in uranium production will come from developing existing reserves.

Figures 9, 10. Uranium exploration and development drilling in the USA

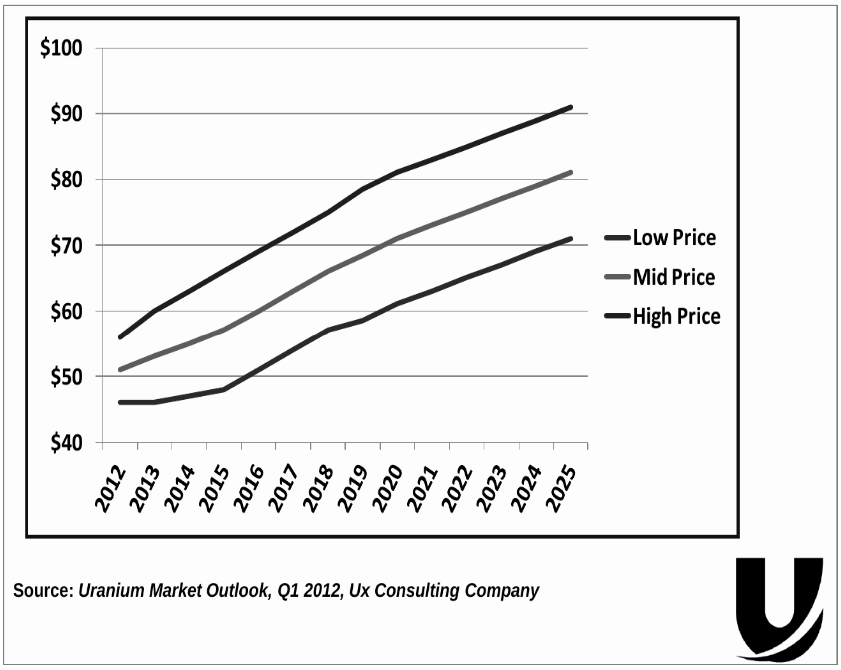


Source: Annual Energy Review 2009, pg. 120, http://www.eia.gov/aer

3.12 Future Price Projections

The uranium price projection shown in Figure 11 has $70 US per pound at the low end, and $90 per pound at the high end by 2025.

Figure 11. Uranium spot price projections



Source:http://www.uraniumparticipation.com/SiteResources/data/MediaArchive/pdfs/investor_presentations/upc_asia_mar_2012_vweb.pdf

4. Internal Analysis of Cameco

Internal analysis may encompass resources, finances, management, mission, employees' skills, and ethics. The use of SWOT (Strengths, Weaknesses, Opportunities, and Threats) is often used by organizations and corporations to develop plans and responses (Nikolaou, Evangelinos 2010), although some have questioned its usefulness (Hill, Westbrook 1997).

4.1 Corporate Mission

Cameco's vision statement is "Cameco's goal is to be a dominant nuclear energy company – the supplier, partner, employer and investment of choice in the nuclear industry." (www.cameco.com). The strong medium and long term fundamentals for uranium have led Cameco to introduce the "Double U" logo with the aim to double its annual production from 20 million pounds (9,000 metric tons) U3O8 to 40 million (18,000 metric tons) by 2018. The majority of increased production will come from expanding existing mine production at McArthur River, completing development of new mines, specifically Cigar Lake, and bringing new resources into production at Inkai in Kazakhstan.

Exploring adjacent to proven deposits, brownfields, to expand resources and reserves is lower risk than in areas without previous discoveries, greenfields. New mineral deposits are important for miners to replenish resources and reserves, with Cameco spending approximately $50 million annually on exploration in 6 countries: Australia, Canada. Kazakhstan, Mongolia, Peru, and the USA. (www.cameco.com 2012). Cameco's unsuccessful bidding war with Rio-Tinto for Hathor mining was an attempt to expand resources by aquiring explorers (Hathor 2011). It has since acquiried BHP's Yeelirrie uranium deposit in Australia (US $430 million), Nukem energy ($300 million) (Jordan 2012), and increased its share of the Millennium uranium deposit in Saskatchewan to 69.9%, and recieving uranium byproduct from the Sotkamo nickel mine in Finland (www.cameco.com)

Close to 80% of Cameco's profits came from uranium mining in 2011, but it also offers uranium services and generates more than 1,000 MW of electricity in Ontario with its 31.6% ownership of the Bruce nuclear facility with 4 CANada Deuterium Uranium (CANDU) reactors. Cameco is unique in the uranium industry since it is the only non-state owned publicly traded uranium miner that offers such a varied array of services and products. The only other companies offering a comparable or greater range of uranium mining and nuclear services are: Areva, China Guangdong Nuclear Power Group (CGNPG), China National Nuclear Corporation (CNNC), Kazatomprom, and Rosatom. The refining and enrichment of uranium, and manufacturing of fuel pellets occurs at only a few locations worldwide, often by state owned corporations. Cameco's facility at Blind River is one of only 4 conversion suppliers in the West, with 35% of the world's capacity to produce uranium hexafluoride (UF6) at the Port Hope facility, a form necessary for enrichment in gas centrifuges. It is also the sole commercial producer of natural uranium dioxide (UO2) used in CANDU reactors, and manufactures fuel bundles for use in CANDU fission reactors (www.cameco.com). Cameco is not involved in waste disposal.

4.2 Financial Analysis

Cameco trades on both the Toronto (symbol CCO) and New York (symbol CCJ) stock exchanges. When comparing companies to Cameco only the major producers that obtain a majority of their revenue from uranium mining, and those not state owned or controlled were included: Paladin, ERA, Uranium One, and Denison (Table 9). The latest year data for these companies was obtained from http://finance.yahoo.com. The sale of Cameco's stake in Centerra Gold at the end of 2009 gave Cameco a stronger financial position while making it more focused on uranium. The range in company sizes and stages of development of their resources, in addition to variable political and environmental risks makes it challenging to compare them.

While smaller miners may offer greater capital gain potential than Cameco, they also have fewer financial resources and experience, with greater risks of: dilution of stock, high debt, political, permitting issues, and natural disasters due to less geographic diversification.

4.3(a) Profitability Analysis

Some of the factors taken into consideration by institutional and private investors are profitability and financial health of companies. The profits of uranium miners have declined from the uranium price peak of 2007, while costs and regulations of uranium miners has increased with time. The sale of Centera provided cash for expansion while reducing revenue. A comparison of miners primarily involved with uranium (Table 9), that are not state owned show Cameco is the largest by market capitalization and in comparably good financial shape, particularly price to earnings, profit margin, operating margin (proportion of a company's revenue remaining after variable costs of production), return on equity, revenue, operating cash flow, and total debt to equity. The price to book value, and PEG ratio for Cameco is the highest and least attractive of the compared group.

Table 9. Comparison of selected financial metrics of selected uranium miners

Data from: http://finance.yahoo.com (Aug12, 2012) (1CAD=0.954AUD)	**Cameco ($CAD)**	**Paladin Energy ($CAD)**	**Denison Mines ($CAD)**	**Energy Resources of Australia: ($AUD)**	**Uranium One ($CAD)**
Market Capitalization	8.18B	1.10B	507.75M	735.17M	2.09B
Enterprise Value	8.27B	1.81B	464.72M	172.38M	2.45B
Trailing P/E	18.46	N/A	N/A	N/A	27.25
Forward P/E	13.26	18.86	N/A	N/A	9.48
PEG Ratio (5 Year expected)	2.15	-1.84	N/A	0.22	0.32
Price to Sales	3.32	3.63	5.23	1.25	4.02
Price to Book	1.63	0.93	1.23	0.60	1.05
Enterprise Value/Revenue	3.37	6.01	4.82	0.29	4.67
Profit Margin	18.10%	-61.45%	-120.12%	-15.65%	15.05%
Operating Margin	20.90%	-14.20%	-81.99%	-16.67%	40.10%
Return on Assets	4.36%	-1.12%	-9.44%	-3.61%	4.10%
Return on Equity	8.70%	-15.97%	-24.56%	-8.91%	3.98%
Revenue	2.45B	301.40M	96.39M	586.12M	524.40M
EBITDA	809.49M	1.40M	-13.50M	100.73M	329.10M
Total Cash	894.85M	96.90M	43.49M	562.78M	512.20M
Total Debt	992.41M	805.60M	456.00K	0.00	875.80M
Total Debt/Equity	19.90	65.25	0.11	N/A	43.63
Operating Cash Flow	755.13M	-120.00M	-29.40M	9.56M	191.40M
Levered Free Cash Flow	-183.48M	-139.80M	-20.05M	-59.57M	19.89M
Trailing Annual Dividend Yield	1.90%	N/A	N/A	N/A	N/A

Table created by the author

4.3(b) Financial Strength Analysis

Cameco's debt to equity ratio is relatively low, giving it ability to take advantage of the current market situations with undervalued and distressed uranium explorers and miners. Ratios associated with leverage in Table 9 include: Debt to Equity, and Total Debt Ratio. Cameco has the second lowest price to sales of the compared group except for Energy Resources of Australia (which reduced its resource estimate, and suffered mining stoppage for months due to rain flooding of its open pit in Northern Australia.) Cameco has the largest cash flow of the compared group, while the financing of expansion and new mines results in the largest negative levered free cash flow of the compared group.

4.3(c) Dividend Analysis

As a more established company Cameco has been paying an increasing dividend for many years, in 2011 it was the only one that paid a dividend (Table 9). Many of the companies are still in the early stages of developing their resources, and have not begun to pay dividends. As share prices decrease the dividend yield rises.

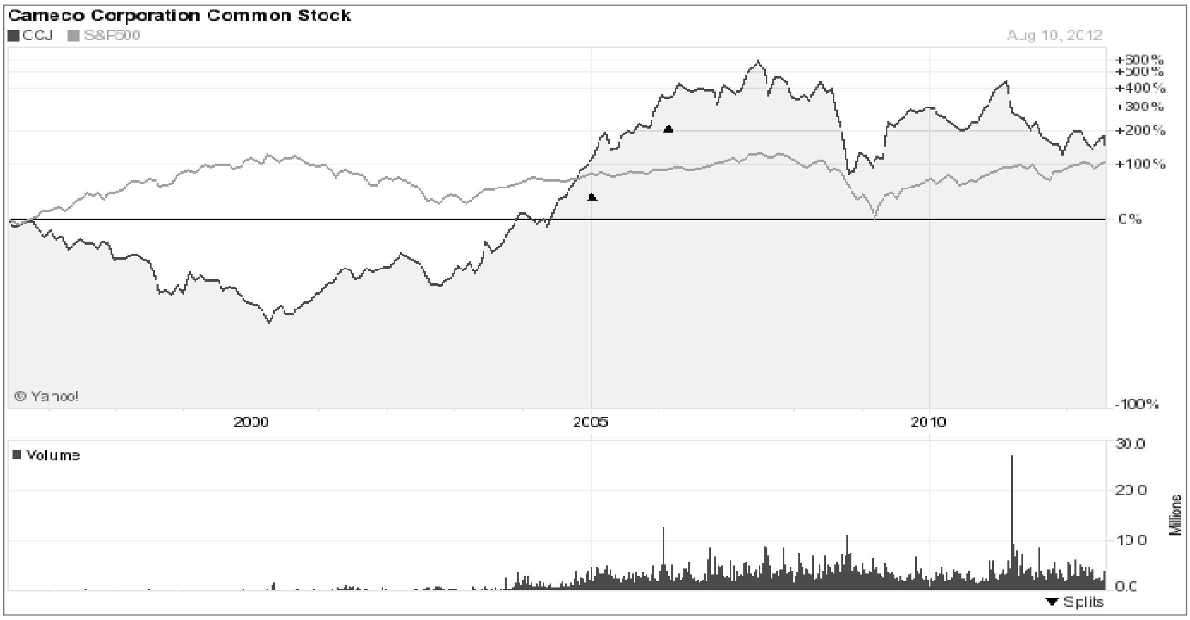
4.3(d) Management Efficiency Ratios

The efficiency of management can be compared by looking at: Return on Assets and Return on Equity. This gives an indication of efficient use of assets to produce sales. EBITDA, and return on assets and equity indicate Cameco has used its assets productively, with Uranium One a close second amongst the studied competitors. This is a difficult measure to apply since many of these companies are either beginning or expanding operations that require large long term investments.

4.3(e) Stock Price Analysis

Earnings per share is an important and commonly used indicator. The PEG (price to earning growth) ratio expected for the next 5 years indicates it is the most expensive of the compared group. The chart of the Standard and Poors 500 and the stock price and volume of Cameco seen in Figures 12, is affected not only by fundamentals of supply and demand, but also by external factors such as: natural disasters, wars, currency exchange rate changes, interest rates, public opinion, and financial crisis. The stock chart clearly shows the impact of the financial crisis of 2008 (Cameco and S&P 500 declined), and of the Fukushima Daiichi nuclear accident with a sharp rise in trading volume and reduction of Cameco stock price.

Figure 12. Maximum stock price history and trading volume of Cameco and S&P 500 on the NYSE.



Splits: Jan 7, 2005 [3:1], Feb 23, 2006 [2:1] Scale: Log
Source Yahoo Finance Aug. 12, 2012

4.4 SWOT analysis

Cameco must be aware of its weaknesses and strengths to properly position itself in the uranium and nuclear industries. The major opportunity that has arisen for all uranium miners is the planning and construction of nuclear power plants to provide electricity and heating, concerns about greenhouse gas emissions, increasing energy independence, and desalination of water for a developing world. Some of the threats that have arisen are major new competitors from consolidation of miners, and national programs that classify uranium as a strategic mineral, regulations, taxes, interest rates, and growing mining operation costs.

4.4(a) Strengths

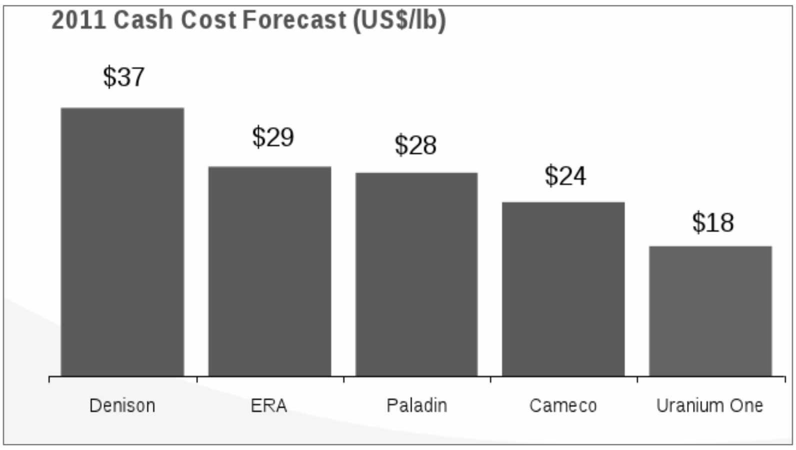
Strengths consist of tangibles (resources and technology), and intangibles (employee skills and reputation). Primary strengths are the resource quantity, quality, and geographic locations of the operating and planned mines of Cameco. A good safety record, financial health with a debt to capitalization under 25% the last 5 years giving it financial strength during challenging economic times permitting exploration and development of its own properties, and to acquire companies that fit Cameco's expansion goals. Cameco is one of the largest uranium miners in the world with over $2.5 billion of cash flow in the last 5 years (www.cameco.com).

“Given our extensive base of mineral reserves and resources, diversified sources of supply, global exploration program and vertical integration, we are well positioned to capitalize on the growing interest in nuclear energy.” Cameco Annual Report (2010).

Cameco's experience make it a leader in exploration, development, maintaining environmental standards, employees safety, containing expenses, remediating challenges created by flooding with pumping or ground freezing, and remote control mining to reduce radiation exposure. In addition processing of uranium for further enrichment, manufacturing fuel bundles, nuclear power generation, and future laser enriched uranium put Cameco in a strong position. Only a handful of companies can offer such vertical integration. Cameco is more specialized in the uranium market segment, than diversified miners like Rio-Tinto, BHP, Teck, Vale, or Anglo-American. The diversification into related markets has synergistic benefits unless the coordination expenses are so high that they negate the savings (Zhou 2011).

The high grades of Cameco's mines in Saskatchewan gives it an advantage with reduced tons of ore mined to produce a kilo of uranium thereby reducing fuel costs, labour costs, materials used, and wear on equipment. In-situ mining commonly used in Kazakhstan and the USA is a cheaper extraction method of minerals making lower grade ores economical. As seen in Figure 13 Cameco's cash cost for uranium is US $24 per pound, and only Uranian One has a lower cost.

Figure 13. Uranium mining cash costs for the largest independent uranium miners



Source: www.uranium1.com

Good public relations are an important intangible strength, with social responsibility building valuable trust, that even buffers a company from stock price declines as compared to similar companies with poor reputations during times of environmental disaster (Muller, Kräussl 2011). Cameco contributed CAD $1 million to the Fukushima Daiichi relief effort. Also, reputation is valuable to relationships with the communities a company operates in, the governments, customers, and local businesses it works with who are frequently local suppliers. The skilled work force is well compensated and provides important income to communities where its mines and services are located. Cameco has received numerous awards for human resource practices, and is rated as one of the top employers in Canada receiving numerous awards (http://www.cameco.com/about/awards/).

4.4(b) Weakness

Uranium suppliers major weakness is an apprehensive public opinion about nuclear power which can change rapidly. Long term projections can be inaccurate due to peoples reaction to disasters like: Three Mile Island, Pennsylvania, USA which froze new construction of nuclear reactors in the USA, Chernobyl, Ukraine which raised opposition to nuclear energy worldwide especially in Europe with Sweden pledging to phaseout nuclear power use which was later withdrawn, and the current Fukushima Daiichi, Japan multiple reactor accident which led many countries to phaseout or abandon nuclear energy. Cameco unlike other miners needs to invest in repairs, upgrades for reactor life extensions, and new nuclear reactors at the Bruce plant once their operating licenses end due to age.

Other weaknesses are rising fuel costs for mining equipment , labour costs, future higher interest rates, taxes and royalty payments, community opposition to mining, and government safety and security regulations, processing, and enrichment. Improving labour efficency by mechanization and training, and keeping fuel, electricity, and material costs from rising by using more efficient equipment, purchasing long term supply contracts where possible to lock-in lower costs of oil prices, or investing in oil producers to lock in prices and secure fuel for its own mining operations, and potentially profiting by selling excess production (Barrick grabs oil company Cadence Energy 2008). Also, the long duration from resource discovery to start of mining, which may take 10 years.

4.4(c) Opportunities

We can be reasonably confident that the world will develop and demands for energy, food, water, and metals will rise regardless of what economic and political system may exist. The projected future increase in the price of uranium is based on the rising demand and assumption of tight supply due to the growing number of nuclear reactors planned and under construction, especially the developing countries of China, India, and Russia.

Increasing demand due to nuclear energy expansion. The activation of the Cigar Lake high-grade mine with an estimated $12 billion of uranium resources at a time with a worldwide uranium mining supply deficit should increase efficiency and profits for Cameco, at the same time re-affirming the dependability of supply from a politically stable based source. Expansion within the uranium/nuclear industries, increasing production at producing mines, and acquiring smaller competitors.The joint venture project GE and Hitachi to explore new technologies to enrich uranium using lasers will further diversify Cameco withing the nuclear industry (section 3.12(f)). The laser enrichment is expected to use less electricity than currently used centrifuges and be more economical.

4.4(d) Threats

Low probability threats to uranium demand are: major technological breakthrough of fusion nuclear reactors, development of other fuel sources like thorium, mass recycling of spent uranium fuel, uranium from non-conventional sources (oceans, coal ash, phosphates), nuclear accident, earthquakes and tsunamis, and catch all, acts of God. Higher probability threats are: growing public opposition to nuclear power (especially after an accident), lower costs of competing technologies to produce clean energy wind, solar, hydro, geothermal, costs increasing more than expected, lower mineral grades or resources than expected, currency value changes, rising interest rates, financial difficulties of operators and governments, major new deposit discovery or expansion of current mines creating an oversupply of uranium, revolution, labour strikes, mining disasters, terrorism or war in oil producing countries increasing the cost of oil used in mining, increasing government regulations, and nationalization of resources or companies. Coal and gas prices might decrease during an economic crisis reducing the incentive for expansion of nuclear energy and other renewable energy sources.

Another threat is the lack of experience in constructing nuclear reactors because so few were built in recent decades. This problem has shown itself in the current construction of nuclear reactors in Finland and France that are past their initial date of completion and over budget. Even in China some have concerns wheather current nuclear reactor construction plans are achievable. This creates a doubt about how rapidly the planned nuclear reactors may come online and increase demand for uranium. Even thought the financing of contructing new reactors by governments is less risky than private funding there has been growing debt levels and calls for saving money.

There is also concentration of resources and customers. With a smalll number of customers sometimes a single one surpasses 10% of total revenue. The high grade uranium mines in Saskatchewan make up 71% of total uranium reserve of 476 million pounds, of which Mcartur River makes up 49%, the rest in Cigar Lake which has been delayed several times due to flooding and will use new uranium mining techniques. The third largest uranium resource for Cameco is Inkai in Kazakstan making up 13-15% of total production.

With the increasing importance of uranium to the energy security of many countries we have witnessed the acquisition miners by state owned/funded companies. Kazakhstan, Russia, France, India, China, Korea, and Japan are just a few of the countries that have state owned uranium miners. Of the major companies remaining in public hands Cameco is the largest. It is debatable if the Canadian government would allow it to be taken over, especially by a foreign company or soverign fund, as the Canadian government limits the ownership of any single investor in Cameco to 15%. Increasing competition from government owned miners that have far more financial resources and with better political connections is a growing threat; as are overly optimistic demand calculations that may end in an oversupply of the mineral. In the case of uranium most of the world expansion of nuclear power reactors is expected to occur in Asia, specifically in China (Table 3 and Section 2.8). Any change in nuclear energy policy, economic or political upheavals, or simply not having the ability to meet contruction plans will have major effects on demand.

5. Conclusions

Cameco is one of the largest and most diversified publicly traded uranium mining and service companies. It has large resources and reserves of uranium with the technical and financial ability to advance resources into operating mines, is increasingly geographically diversified mining operations that have low political risk other than its operations in Kazakhstan, a steady source of income from generating electricity in Ontario at the Bruce plant, opportunities to expand by acquisitions of explorers, miners, and properties, conversion services, and future enrichment of uranium using laser technology with its joint venture partners. The diversification provides some degree of safety by not depending on a single mine, single country or geographical region, or a single processing facility for source of income. Even though political risk insurance and nuclear accident insurance is available there are still many unknowns that may occur like an earthquake in the Pacific resulting in a nuclear accident, or a financial crisis causing commodity prices to drop. Cameco has the financial health to withstand most challenges, and to expand. Cameco as part owner of nuclear reactors is exposed to liabilities that other miners do not have. In keeping with its focus on uranium and nuclear energy Cameco should expand vertically to provide more services, investigate unconventional sources of uranium, and over the longer term consider other fuels like thorium.

Talk of a nuclear power renaissance had created much optimism in the uranium industry after being ignored for many years with the increased price of uranium resulting in the formation of hundreds of new uranium exploration companies. This may have been premature. It has been questioned after two events: financial crisis in 2008 reducing prices of commodities, and the Fukushima Daiichi nuclear accident starting after the earthquake and tsunami on March 11th, 2011. Humanity has overcome many technological challenges, and political, environmental, and economic setbacks in its history. It is certain that people will require more energy as civilization develops, and it is best that no one source becomes a monopoly. Being overly dependent on oil was ignored until the oil embargoes and oil price shocks of the 1970's. Nuclear energy has many obstacles to overcome to be accepted, and may never be accepted in some countries, but it will increasingly be an important part of a mix of energy sources in many countries. Other than the risk of another nuclear accident the uranium mining industry is also at risk of having set all its hopes on Asia, particularly China, creating demand for their mineral. The concentration of uranium resources and mining in a few countries and increasing concentration of the uranium mining industry, often state giants, does not bring any more energy independence to countries that depend on imports of uranium than those dependent on imported oil or liquid natural gas. There is potential for new cartels developing just like OPEC in oil. Natural resources unlike the sun or wind tend to be concentrated in certain countries: natural gas (Algeria, Iran, Qatar, and Russia), platinum group metals (Russia and South Africa), rare earth minerals (China), and of course uranium (Australia, Canada, Kazakhstan, Namibia, Niger, and Russia). Like Chernobyl, Hurricane Katrina, and the BP oil spill in the Gulf of Mexico, the Fukushima Daiichi disaster will also pass with time, but hopefully with many lessons learned about increasing saftey of nuclear reactors.

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