

**ARGENTINEAN URANIUM
EXPLORATION AND PRODUCTION
PART OF AN INTERNATIONAL NUCLEAR INDUSTRY**

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TABLE OF CONTENTS

FOREWARD	3
INTRODUCTION	3
BACKGROUND OF THE ARGENTINEAN NUCLEAR INDUSTRY.....	5
RENEWED COMMITMENT TO NUCLEAR ENERGY	7
Other Argentinean Nuclear Involvement.....	11
CAREM Reactor Project.....	13
OBSTACLES TO LOCAL PRODUCTION	13
Foreign Investment Conditions.....	14
Regulatory Environment.....	15
Environmental Concerns.....	18
COMPARATIVE PERSPECTIVE: ARGENTINA AND SURROUNDING COUNTRIES	20
Chile.....	21
Peru.....	22
Brazil.....	23
CONCLUSION.....	24

Foreward

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Introduction

Argentina's nuclear experience yields a case study of a fully integrated nuclear industry and the potential for a country with a past nuclear history to embrace present trends favouring nuclear energy in order to achieve future growth of its domestic and export markets. In light of the recent trends upwards in uranium prices and the popularity of nuclear power solutions to meet developing and developed countries' energy requirements, Argentina finds itself in a favourable landscape for growth. Concurrent with this substantial growth opportunity, Argentina and other similarly situated nations face a new set of challenges in terms of legal and regulatory responses to the sector and the need to balance the interests of various stakeholders from consumers to Governments and from industry to mining exploration.

Argentina is a leading nuclear nation, unique among its South American counterparts for its vertically integrated nuclear industrial structure. Since the mid 1940's, Argentina has possessed an internationally competitive nuclear industry. Two efficient operating nuclear plants currently produce approximately 8% of Argentina's

electrical energy output. A third plant, in which construction was stopped in early 1994 at 81% completion, is now slated for completion over the next two to three years. In August 2006, Argentina confirmed its commitment to nuclear power when it announced the signing of agreements for the completion of the Atucha II reactor, the refurbishment of the Embalse reactor and the commencement of studies for the construction of a fourth nuclear reactor at an aggregate estimated cost of USD\$3.5 billion for the three projects.

Besides a commitment to industrial renewal and the construction and refurbishing of reactors, there are two more key factors to Argentina's potential growth story: domestic market demand in the face of an acute electrical power shortage that demands an increase of baseload electrical capacity, and, quite importantly, the presence of current known uranium reserves.

Although Argentina does not at the current time have any commercial uranium production, a number of companies are actively exploring in the country and the Government of Argentina is contemporaneously encouraging the restarting of two formerly producing mines which are owned by the Comision Nacional de Energia Atomica (the "CNEA"). If current known reserves are mined, they are capable of supplying the necessary nuclear fuel for Argentina's current and projected reactors over the short term, with any exploration success adding to the longevity of Argentina's nuclear fuel supply both for its domestic reactors and for export.

Opportunities are strong. Argentina's unique nuclear mineral endowment may facilitate the rise of a regional mining contender on par with Chile, Peru and Bolivia. Growth may be driven by both a hungry internal market and the obvious potential to ride the wave of global demand and high market prices to develop a thriving export market.

Yet, with economic opportunities come regulatory challenges. Foreign investment conditions mark one challenge: Federal authorities have not yet determined a process to privatize uranium assets, an objective that could lead to the same growth in the nuclear mineral sector as that experienced in recent years when other mineral commodities were privatized by provincial Governments. Argentina's federal structure itself presents a challenge with some provinces passing legislation which inhibits federal initiatives to promote uranium exploration and development. Environmental concerns require a robust regulatory response, incorporating the coordination of environmental activities among the federal, provincial and local authorities. Uranium waste from both mining sites and nuclear facilities has presented concern. Deposit production in some areas has been opposed by various non-governmental organizations and local businesses.

The overview that follows presents a snapshot of the Argentinean nuclear industry, its history, and where it could be going. In so doing, this case study will illuminate the opportunities and challenges as they shape Argentina's economic and legal landscape.

Background of the Argentinean Nuclear Industry

Argentina has a long and successful history in the nuclear industry. The end of World War II marked the beginning of Argentina's nuclear involvement. The CNEA, Argentina's atomic energy commission, is responsible for much of this success. In 1950, it was created with the mandate to regulate all domestic nuclear activity.

Argentina's quest for nuclear power began with a research facility established at San Carlos de Bariloche. Here research staff were trained and an experimental reactor

was constructed. At the same time, uranium exploration began to be carried out throughout Argentina.¹ Soon after San Carlos de Bariloche was established, a second research reactor was built, fuel bundles developed and manufactured for both existing research reactors, a uranium concentrate production plant was built in Mendoza, and radioisotope production was carried out. In the mid 1960's, a study recommended building a nuclear electric plant capable of producing between 300 to 500 megawatts of power near Buenos Aires. International bids were sought for the construction of a new water-cooled reactor. A German Siemens AG designed product known as Atucha I was selected and commercial production began in 1974.²

In 1967, Argentina requested bids for a second operating reactor designed to produce 600 megawatts of power. This reactor was to be built at Embalse, near Cordoba. Atomic Energy of Canada Ltd. and an Italian construction company, Italmimpianti, won the bid. Their proposal was based on a CANDU design, which utilized natural uranium (U_3O_8). This reactor was successfully completed and started operating commercially in 1984.³

In 1979, a contract was awarded to an Argentinean/German consortium to build a third nuclear reactor. This reactor was to be a 700 megawatt Siemens designed heavy water cooled, moderated pressurized reactor and was named Atucha II.⁴ Unfortunately,

¹ Roberto Mario Ornstein, "Argentina as an Exporter of Nuclear Technology, Past, Present and Future" (2001), excerpt from *La Cooperación Internacional del la Argentina en el campo Nuclear*, published by the Consejo Argentino para las Relaciones Internacionales (1998).

² *Ibid.*

³ *Ibid.*

⁴ *Ibid.*

construction was stopped in 1994 because of financial difficulties and a design flaw. To date, this reactor has not been completed.⁵

Therefore, at the present time, Argentina has two nuclear power plants in operation and the one under construction, 6 research reactors, 4 particle accelerators, 3 atomic centers, 1 technology center, 1 heavy water plant, 2 irradiation facilities and 1 uranium purification plant as well as numerous nuclear medicine schools, nuclear medical centers and radioimmunoassay laboratories. Argentina's three nuclear centers have been under the direction of NASA since 1994. Production concentrate occurs principally in the province of Mendoza and is converted and purified to nuclear quality in the city of Cordoba. The Government of Argentina also owns Investigacion Aplicada ("INVAP") a company it set up in 1976 to undertake applied nuclear research, engineering development and services to both domestic and foreign customers. INVAP has designed, built and sold research reactors in the international market and along with the CNAE designed the CAREM reactor, which Argentina hopes to build a prototype of in the immediate future. All of this makes Argentina a leading nuclear nation.

Renewed Commitment to Nuclear Energy

Until recently, Argentina's nuclear industry has suffered from a period of stagnation which can be attributed to low uranium prices, global concerns about the safety and stability of nuclear energy, a lack of funding in the sector and the financial crises Argentina faced in the 1980's and 1990's.⁶ Global demand for uranium and for

⁵ "Nuclear Power in Argentina," Briefing Paper # 96, November 2006.

⁶ *Supra* note 1.

nuclear energy have swung the pendulum of nuclear energy back into popular demand. Conventional energy plants that produce 60,000 kw of electricity consumed on average 18,000,000 kg of coal per month compared with a nuclear plant of equal size, which only requires 7 kg of uranium of type 235 each month.

Argentina's renewed commitment to nuclear energy was confirmed in August 2006 when Argentina announced the signing of agreements for the completion of the Atucha II reactor, the refurbishment of the Embalse reactor and the commencement of studies for the construction of a fourth nuclear reactor at an aggregate estimated cost of USD\$3.5 billion for the three projects.

Production of uranium in Argentina has been believed to amount to approximately 2,500 tons until the last year of production in 1997. In addition, between 1991 and 2002 Argentina imported approximately 74 tons of uranium from Canada. The existing nuclear power plants in Russia consume approximately 140 tons of uranium per year. This is estimated to increase by approximately 100 tons per year by the time Atucha II goes into production. Although Argentina does not at the current time have any commercial uranium production, a number of companies are actively exploring and the Government is contemporaneously encouraging the restarting of two formerly producing mines which are owned by the CNEA. Mining these reserves would result in short term supply solutions in Argentina.

The Minister of Planning wants to reactivate the Sierra Pintada uranium deposit in Mendoza which is believed to have mineral reserves containing approximately 2,600 tons of contained uranium reserve which would give the project approximately a twenty year mine life. This deposit is owned by the CNEA. The Ministry also wishes to

reactivate the Cerro Solo project which has estimated contained reserves of 4,672 tons and is located in Chubut.

If Argentina is able to put the Sierra Pintada property back into production or is successful in getting the Cerro Solo project into production it will be able to provide the necessary uranium to supply its two existing reactors during their remaining lives as well as fuel Atucha II when it comes online. If current exploration activity is reflective of potential production additional uranium deposits will be found in Argentina and if economically viable Argentina should be in a position to export uranium in the future.

However, the CNEA has run into opposition by local wine producers, the local chamber of commerce, 40 local non-governmental organizations and a court order by the Federal Court of San Raphael.⁷ The opposition to the planned reopening is intense because of environmental problems resulting from uranium waste that had not been properly reclaimed when operations were halted over a decade ago. At the present time the Government has not announced reopening of the mines.

Hand in hand with the recommencement of uranium production, it is imperative for Argentina to stimulate new exploration and development of additional uranium resources and reserves. Argentina is naturally endowed with great potential to host uranium bearing structures. In 1955 there began a systematic study of uranium reserves with a result that after the initial geological studies 1.3 million km² were identified as having uranium potential and 400,000 km² of which were catalogued as being of

⁷ "Uranium Mine Ownership," WISE Uranium Project (2006), available online at: <http://www.wise-uranium.org/uosam/html>.

immediate or primary interest. According to the World Energy Council, Argentina is believed to have approximately 7,500 tons of uranium in reasonably assured resources and approximately 2,450 tons in additional estimated resources with undiscovered resources said to approximate 1,440 tons.

Argentina, unlike its neighbours Chile and Peru, has economic deposits of uranium. These deposits are of relatively moderate grade and tonnage and are geologically categorized as of the volcanoclastic, sandstone, granite or calcrete types. Although the known uranium deposits in Argentina are not in production at the present time they are economically viable at the present uranium prices. Argentina has uranium exploration potential and an internal market capable of absorbing all foreseeable production. At the present time, given the current spot price for uranium, there are a number of exploration companies pursuing approximately 20 uranium exploration projects. This great potential mineral endowment could become a significant factor to the Argentinean economy.

As a result of the growing demand for uranium globally and the increased price of uranium, the Argentinean Government is expressing a positive and supportive attitude towards delivering its own national uranium production. The Minister of Planning, who is in charge of energy and mining wishes to create a national strategic reserve of uranium to be used in its current and future power plants. The Minister also has an objective of achieving Argentinean production of uranium for export.

Other Argentinean Nuclear Involvement

Argentina is a leading nuclear nation in South American because of its vertically integrated nuclear industrial structure. In the past, Argentina has exported minor amounts of uranium contained in fuel bundles but, it has not been a large exporter of yellow-cake. Argentina's main export in the nuclear industry has been small nuclear reactors for research and radioisotope production.

Argentina has developed a nuclear support and service industry which not only competes domestically but also internationally. Over the years, Argentina has developed its own expertise in the nuclear sector. For example when the first nuclear center in Argentina or nuclear reactor in Argentina Atucha I was built, Argentinean participation in such construction was only about 40% of the reactors value. In the second reactor (Embalse), Argentina acted as sub-contractor for the principal sub-contractor of the foreign company which was responsible for the nuclear portion of the work and in fact Argentineans contributed significantly to the technological complexities and construction of the project and with Atucha II, Argentina again built on its previous experience to assume the principal responsibility for engineering and architecture industrial engineering of the project along with the other principal party involved in the construction of the reactor.

The CNEA established a 35% owned subsidiary company to manufacture fuel assemblies for Argentina's two producing nuclear plants as well as for its research reactor. The CNEA also created a 100% owned subsidiary company, known as Deioxitek S.A. to manufacture uranium dioxide powder (UO₂). Another 55% owned the CNEA subsidiary company, known as Faesa manufactures Zircaloy tubes for fuel

element cladding. The CNEA is also involved in radioisotope production. Large amounts of cobalt-60 and molybdenum-99 are used for medical purposes. The CNEA also owns and operates a small conversion plant near Bariloche with a 60 ton per year capacity. The CNEA and the Province of Neuquen jointly own and operate a heavy water facility at Arroyito which produces approximately 200 tons per year of heavy water. This facility has capacity to export heavy water and has been able to do so successfully in recent years. The facility which is operated by Empresa Neuquina de Servicios de Ingeniería needs a major expansion if it is to supply the 600 tonnes of heavy water required for the Atucha II when the plant goes online in 2010.

The National Regulatory Authority (the “NRA”) was created by legislation which came into force in April 1997 to succeed the National Nuclear Regulatory Board. The NRA reports directly to the Presidency and is empowered to regulate and control nuclear activity with regard to radiological and nuclear safety, physical protection and nuclear non-proliferation. The NRA is governed by a board of directors. It operates by granting authorizations, licenses or permits in connection with practices associated with radioactive sources. The NRA interacts with the International Atomic Energy Authority (“IAEA”) and other countries in connection with safeguarding and securing nuclear plants and facilities and providing the appropriate non-proliferation assurances.

CAREM Reactor Project⁸

The CNEA and INVAP developed the CAREM nuclear reactor. This reactor is a modular 100 megawatt simplified pressurized water reactor with integral steam generators designed to be used: (1) to produce electric power, (2) as a research reactor, or (3) for water desalination. The CAREM design has its total primary coolant system within the reactor pressure vessel, self-pressurized and relying entirely on convection. The fuel is 3.4% enriched fuel and the module is refuelled annually. The CAREM is a small modular and highly innovative nuclear electric generation power plant which is designed for safety and as mentioned is ideal for use by countries with no prior nuclear experience.

The Carem Nuclear Power Plant is ideal to supply electric power in isolated locations that are not connected to electrical power distribution systems. The CAREM nuclear reactor design, would be a powerful source of energy to be used for the desalination of sea water in remote areas.

Obstacles to Local Production

The National Law on Nuclear Activity passed in April of 1997 provided, in Article 209, that the state, through the NRA will have the first option to purchase, under usual market conditions and price, the nuclear mineral produced by private companies in Argentina – this could be either an obstacle or an opportunity for local nuclear production depending on the terms imposed by the Government on producers.

⁸ See generally, “Nuclear Power in Argentina,” Briefing Paper # 96, November 2006.

Another challenge for Argentina's nuclear export industry will be the perceived economic and political instability that has dogged the country in recent years. Argentina needs to take steps to nurture international confidence in its ability to deliver in this area on a consistent basis, since delays in plant and parts are exceedingly costly.

Foreign Investment Conditions

Essential in order to stimulate foreign investment in the sector, is a clear and transparent process to privatize uranium assets, which needs to be elaborated by the federal Government in Argentina which is primarily charged with responsibility for uranium matters. In the view of the author, this will free captive assets for development and stimulate growth in the nuclear mineral sector in a similar manner to the current significant foreign investment in other mining projects, which were liberated to foreign investment when privatized.

Since 2003, some Argentinean provincial Governments have attempted to privatize provincial mining companies in hopes of attracting foreign exploration investment. This action, coupled with the increase in metal prices which has occurred simultaneously with the dramatic growth in the Argentinean economy has led to an across-the-board increase in the production of mineral commodities in Argentina except for uranium.

Foreign mineral industry investors were not actively exploring in Argentina in the period from 1999 to early 2006 because a great many of the known uranium showings were acquired by local provincially owned mining companies or were controlled by the CNEA. Explorationists went elsewhere to places where they could acquire title interests

at cheaper prices rather than having partnership interests with provincial Governments who had neither the money nor the technical ability to contribute to the joint ventures or partnerships which had to be set up with the provincial authorities to advance the projects.

Although uranium exploration is now being carried out on a grassroots basis, to some extent, no transactions have materialized on former historically advanced stage or producing properties as they are all owned or controlled by the Argentinean provincial Governments or Argentinean state owned uranium companies or regulators. It appears that the Argentinean federal authorities have not yet determined the process to be used to privatize these uranium assets this is one critical area for the effective development of uranium resources within Argentina, which is, itself, a key element for a complete vertically integrated nuclear sector in Argentina.

Regulatory Environment

Argentina's political structure is a federal presidential representative democratic republic. The regulatory control over uranium mining and the nuclear industry falls within the purview of the federal Government. The evolution of the Argentinean nuclear sector was characterized by the development of its own proprietary technology and product line concurrent with the creation of a comprehensive series of governmental bodies to continue to research and study strategic areas and provide technical assistance to the private sector in the industry. The third and final prong of Argentina's approach in this area, was the creation over time of the required regulatory framework, norms and codes under which the industrial and mineral nuclear sector would operate. The result of this reasonably steady commitment over 60 years has been the concentration of know-

how together with skilled professionals in the nuclear science and nuclear industrial applications. It is this depth of experience and expertise that places Argentina in a unique position vis a vis nuclear energy, when compared with its Latin American neighbours.

In the sixties, the nuclear industry flowered in Argentina, with exports of radioactive products to Latin America comprising as much as 20% of total local production. As well, the CNEA formed a joint venture with the Nuclear Energy Junta of Spain (“JEN”), whereby both countries developed a unified code of norms and specifications which were applied in a variety of countries. This collaboration lasted into the seventies, and included a manual of radiofarmic control which was ultimately adopted throughout Latin America by the Latinamerican Association of Biological and Nuclear Medical Companies.

The Mining Code, which was first enacted in 1886 and amended several times since, is the principal documentation that “regulates the rights, obligations, and procedures for the acquisition, exploration, exploitation, and use of mineral substances.”⁹ It is the basic statute that governs mining in Argentina and sets out the basic premise that all mineral deposits are state owned.

The Mining Code specifies that each province or the federal Government is the owner of the minerals within their jurisdictions. Article 8 of the Mining Code sets out that concessions that are required for individuals and companies to explore, develop and dispose of minerals extracted from Argentinean mines. The Mining Code provides for

⁹ Pablo Velasco, “The Mineral Industry of Argentina” (1996), excerpt from *U.S. Geological Survey – Mineral Information*.

two basic types of mining concessions – exploration concessions and development concessions.¹⁰ Exploration concessions are necessary to be to explore for minerals within a certain area and vital to obtaining a development concession if a discovery is made.

If a discovery is made during the exploration phase, a development concession is automatically granted as of right. For nuclear minerals special additional regulations apply in addition to the terms of the Mining Code.¹¹ The legislation provides that the mine of the deposit, buildings, machinery and equipment used to develop and operate the mine are immovable property distinct from the title to the surface land on which it is located. Once title to the development concession has been granted and registered, it can be transferred and/or mortgaged. Minerals, once mined, are movable property and can also be sold or pledged.¹²

Provinces are permitted to reserve for themselves certain mining properties on which they may perform prospecting activities using their own mining companies or award rights to private mining companies through public auctions.¹³

In Argentina, the ownership of minerals is vested in the twenty-two provinces¹⁴. Accordingly the regime and procedure for obtaining, transferring, maintaining and cancelling mineral rights as well as the regulation thereof is carried out by each province independently of one another and of the federal Government. The environmental

¹⁰ “Doing Business in Argentina,” available online at: <http://www.marval.com.ar/publicaciones/doing/capitulo12.pdf>.

¹¹ *Ibid.*

¹² *Ibid.*

¹³ *Ibid.*

¹⁴ Section 124 National Constitution, as reformed in 1994.

stewardship regulation of mineral exploration and mining activity (although separately regulated from the mineral industry) falls mainly on the provinces, although federal and sometimes municipal regulations and ordinances are applicable.¹⁵

A number of governmental and regulatory bodies have been created since the 1950's, many of which helped lay the foundation for Argentina's leading role in the sector in Latin America. Notably in 1955, the CNEA created the Metallurgical Department which was subsequently called the Department of Materials and which began the first modern metallurgical lab in Latin America of its kind. In 1955 as well, the CNEA began to establish norms and regulations which would secure social protection in this sector and this ultimately ended in the formation within the CNEA of an organization which became the Nuclear Regulation Authority, and which set out a system a regulation system and a legal structure that is still one of the most complete in Latin America.

Some provinces have passed legislation against open-pit mining (which includes uranium), bolstering the need for intergovernmental cooperation to reach an optimal regulatory structure that both facilitates / exploits growth opportunities and addresses environmental concerns.

Environmental Concerns

Uranium waste from both mining sites and nuclear facilities has presented concern. Deposit production in some areas has been opposed by various non-governmental organizations and local businesses. While federal authorities have established world-standard policies for the clean-up and restoration of previously

¹⁵ *Ibid.*

contaminated sites, there is a need for the coordination of environmental activities between the federal, provincial and local authorities, as well as a continued regulatory awareness of citizens and consumers as key stakeholders.

The Environmental Protection Mining Code, enacted in November 1995, provides the legal framework and requires that each provincial Government create an enforcement authority within its jurisdiction. This legislation employs the concept of sustainable development and provides for a preventive environmental mechanism in the mining sector.¹⁶ Each province has enforcement authority assessing the environmental impact and monitoring mining projects in the province.

After the major restructuring of the industry the CNEA retained its responsibility for the overall management and disposal of radioactive waste and the dismantling of nuclear and radioactive facilities. The CNEA has established world standard environmental policies for uranium mining and the clean up and restoration of previously contaminated sites.

The CNEA operates by carrying out a site specific Environmental Assessment (“EA”) which identifies the types of contaminants, their extent and potential environmental impact along with their contaminant pathways.

Unfortunately there are environmental problems associated with Argentina’s uranium sector. In the early 1990’s there was little in the way of environmental standards

¹⁶ Ivette E. Torres, “The Mineral Industry of Argentina” (2001).

which related to the uranium extraction industry and as a result there was a harmful accumulation of solid and liquid waste associated with uranium mining and the upstream processing sites.

From a mining perspective the most significant environmental problem relates to the Sierra Pintada near San Raphael, Mendoza which requires reclamation to the environmental contamination. The CNEA is studying a plan to place Sierra Pintada back into commercial production and the reclamation project that will be carried out thereafter in order to reclaim the land and relinquish title to the provincial authorities in Mendoza.¹⁷ The most comprehensive environmental regulations of any province in Argentina have been passed by the province of Mendoza and the CNEA is obligated to co-ordinate its environmental activities with the provincial authorities as well as the local municipality.

In addition to the mining sites previously mentioned, there are a number of other nuclear facilities in Argentina with environmental problems which are in the process of being cleaned up and reclaimed by the CNEA as well as a number of other smaller mining areas.

Comparative Perspective: Argentina and Surrounding Countries

Argentina is surrounded primarily by three countries: Chile, Peru and Brazil. While close in proximity, Argentina differs from these nations in the extent to which it has developed a nuclear industry. Unlike Argentina, which has developed a “cradle to the grave” industry for uranium, these nations have essentially no upstream industry. The

¹⁷ *Supra* note 7.

current legal framework in each of these nations is devoted largely to the regulation of mining generally, rather than uranium or radioactive materials specifically.

The development of mining legislation in this area of the world reflects an increased emphasis on investment promotion and a shift toward free market values. Chile, Peru and Argentina have developed competitive legal frameworks for mining which have come to be referred to as “the Latin American Mining Law Model” which is similar to Mineral legislation developed in the United States and Canada.¹⁸ In addition to the development of domestic law, Argentina and Chile have signed and ratified a Mining Integration Treaty, which allows for the development of mineral deposits along the border areas of both nations.

As in Argentina, in the neighbouring countries mineral resources are vested, pursuant to national Constitutions, in the State. In turn, the regulatory regimes governing these resources have been implemented by the States in the form of Mining Codes.¹⁹

Chile

Mining in Chile is governed by the Organic Constitutional Law on Mining Concessions (1982) and the Mining Code (1983). These laws establish a system of mineral tenure, and effectively create a market of mining rights by providing for rights

¹⁸ Elizabeth Bastida, Ricardo Irarrazabal and Ricardo Labo, “Mining Investment and Policy Developments: Argentina, Chile and Peru.”

¹⁹ See for instance, Elizabeth Bastida, “Integrating Sustainability into Legal Frameworks for Mining in Some Selected Latin American Countries,” in *Minerals, Mining and Sustainable Development*, No. 120, January 2002.

over concessions that are transferable and mortgageable.²⁰ Bastida et al. report that these laws have been very successful in effecting the goal of enhancing foreign investment.

Recent amendments and proposed amendments to Chilean mining law centre around special taxes and royalties. Effective October 2005, a 5% tax on the operational profits of mining companies (both foreign and Chilean) with annual output over 50,000 tons has been implemented.²¹ Notably, the debates leading up to the implementation of this tax were highly politicized. Existing challenges in Chile involve ensuring that the push towards attracting and securing foreign investment in mining resources is balanced against sustainable development and protection of the environment.

Peru

Peru's General Mining Law was enacted in 1981. However, in 1991 significant changes were brought about through the enactment of the Mining Investment Promotion Law, which amended the General Mining Law. These documents were consolidated in the Single Revised Text of the General Mining Law of 1992. Responding to devastation in the mining industry at the time, the new legislation represented a significant shift towards privatization. Its success in achieving the goal of enhancing investment and development is demonstrated by the tremendous quantum of foreign investment which followed.²² However, this has been scaled back to some extent within the past few years, primarily due to political and social pressure.²³ Additionally, a royalty ranging from 1%

²⁰ *Ibid.*

²¹ *Supra* note 18.

²² *Ibid.*

²³ *Ibid.*

to 3% has been imposed. As in Chile, current challenges involve balancing the promotion of a regime that is friendly to foreign investment, and ensuring that sustainability and environmental protection are not neglected.

Brazil²⁴

The Brazilian Mining Code was enacted in 1967. Mineral issues later gained constitutional status, through the enactment of the Constitution of 1988. According to the Constitution, activities relating to nuclear minerals are to be carried out by the federal Government and must comply with specific regulations. Initially, private entities were not permitted to contract with the Government with respect to activities evidencing the “risks and results” arising from oil, gas and nuclear activities. Amendments to the Constitution in 1995 allowed for private contracting with respect to oil and gas, but did not expressly provide for this in relation to activities involving nuclear minerals. Further Constitutional amendments in 2006 removed production, trading and use of radioisotopes from the monopoly of the federal Government, but to date, no steps have been taken that have the effect of similarly altering the monopoly with respect to nuclear minerals.

While there are differences between the regimes that have developed in each of the above nations, there are also some similarities. Particularly with respect to Chile and Peru, the current mining regime has been shaped by a drive to attract foreign investment over a relatively short period of time.

²⁴ Taken generally from a memo from Carlos Vilhena to Steve Vaughan regarding “Nuclear Mineral Legislation in Brazil,” dated February 27, 2007.

Conclusion

Argentina has the most developed and complete nuclear energy program in South America, the legislative and regulatory regime to control and regulate it and the technical ability to develop and grow Argentina's nuclear industry into a dynamic and internationally competitive industry. The regulatory and policy challenges facing Argentina will involve balancing an investment-friendly framework with the goals of sustainability and environmental protection.

While Argentina still has a number of challenges to overcome before it sees the complete evolution of its nuclear industry into a complete and developed vertically integrated sector, it uniquely among its Latin American sister countries, possesses all of the nascent tools, know-how, technology and skilled personnel to achieve this objective. Essential areas that require solutions include: (1) developing a transparent and reliable process whereby private actors can participate in the exploration and development of uranium resources, (2) effectively addressing environmental and safety concerns, (3) presenting an economically and politically stable competitive option for nuclear technology, when compared with other countries that have had historical profile in the nuclear arena, and (4) increased governmental cooperation among all levels of government to stimulate research, exploration and development of the sector, while balancing these with health, safety and environmental concerns.

The future looks bright for the Argentinean uranium industry – it has over half a century of studied policy and well-paced industrial experience in one of the most desirable areas of the mineral industry. It is well placed to emerge as a leader in nuclear

energy in Latin America and could vault its economy skyward if it can capitalize on its former capacity for the export of its technology, products and can build up sufficient reserves of uranium for export to its neighbouring countries as well.