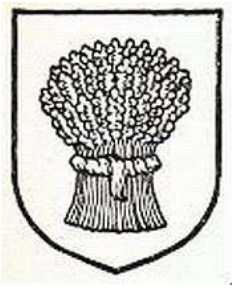
Friday, July 28, 2023



HALLGARTEN + COMPANY

Country/Sector Coverage

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Nuclear Energy and Uranium in Argentina

Vertical Integration – Mine to Power?

July 2023

Nuclear & Uranium in Argentina

Vertical Integration – Mine to Power?

- + The country remains as committed as ever to its aggressive nuclear energy expansion, working from an existing base of several reactors
- + A fourth reactor is under construction (with a Chinese collaboration) and a fifth on the drawing board
- + The Uranium spot price has awoken from its long slumber
- + Public opposition to nuclear power is minimal and the country has an energy shortage
- + The CNEA estimates that required supply for the remaining lives of just the traditional reactors in Argentina is 16.5mn lbs of U_3O_8
- + Argentina has been paying significantly more than the spot price for U supplies from Kazakhstan and Canada
- + A new Canadian-listed Uranium developer has appeared on the scene, seemingly dedicated to production, in a major change from its predecessors
- × Uranium's spot price has not moved to levels which unleashes a feeding frenzy amongst the denizens of the promotorial space
- × The uranium mining space has long been hampered by the backwash for Fukushima and unserious TSX-v listed explorers
- × The government has still not enunciated publicly a policy of promoting vertical integration by producing an in-country source of U3O8 from mining

On the Road Back to Vertical Integration

It's not quite all change in the Argentine nuclear space, but it definitely has shown forward momentum since we last reviewed the situation. The Argentine uranium exploration space had been reduced by the middle of last decade to only U3O8 Corp. and Blue Sky Uranium. However, now there is a changing of the guard afoot with Consolidated Uranium (TSX-v: CUR) having moved in and taken over U3O8 Corp's Laguna Salada project and now bolted on the past-producing Huemul mine (and associated areas) in Mendoza province. Blue Sky continues doing what it does. With its two moves, Consolidated Uranium has pulled to the front of the race in Argentina to restore the country's former "soup to nuts" nuclear industry, where it both mined and generated from domestic uranium sources.

As far as nuclear energy is concerned, Argentina continues to be the Latin American leader with three operational plants and a fourth on the way (and a fifth in contention). Currently the country is by far the leader in technology, not only locally, but a contender at the international scale exporting technology in all directions - as well as products such as heavy water and medical isotopes. Anyone who underestimates the country's commitment to nuclear is deceiving only themselves as even the Chinese

have found out when it comes to the topic of technology transfer.

In this note we shall review the current nuclear industry as well as highlighting the new kid on the block, a Canadian developer, that may lead Argentina back only the road to being fully vertically integrated.

The Low-Key Nuclear Powerhouse

It is a bi-partisan matter of faith in Argentina political circles that nuclear power is a vital part of Argentina's energy-generating capacity to meet rising demand. To this end the development of the industry in recent decades has advanced under governments of the Centre (Menem et al.), the Left (the Kirchners) and the Right (Macri).

This long-term cohesive policy stance resulted in Argentina being a nuclear power in the sense that it is a leader in the small group of countries that generate electricity from nuclear power. Moreover, unlike many of those in retreat from an activity they hate to need, Argentina without any fanfare is adding a fourth reactor to its existing three reactors. Once again Argentina has shown it has the best infrastructure in Latin America. That the legacy of past investment is badly managed and frequently neglected is undoubted, but the country has been ahead of the pack since the 1920s, received a mighty overhaul in the 1990s and has spent most of the last fifteen years backsliding (except in nuclear).

Argentina has also been active in nuclear power generation & research and uranium mining since the middle of last century. Between 7% to 10% of current electricity needs are met from nuclear power stations in the country.

The *Comisión Nacional de Energía Atómica* (CNEA - Atomic Energy Commission) was set up in 1950 to oversee nuclear R&D, including construction of several research reactors. Currently, five research reactors are operated by CNEA and others. Another is under construction, similar to the Opal reactor built in Australia by Argentina's INVAP. An example of the country's membership of the front ranks of nuclear technology nations is that Argentina's CAREM small modular reactor design is under consideration for massive desalination projects in Saudi Arabia.

Vertical Integration in Sight?

A number of things have happened in recent times to spur us to refresh our coverage of the Argentine nuclear industry. These are:

- The Laguna Salada project moving out of the hands of the lame-duck explorer U3O8 into those of Consolidated Uranium (TSXV: CUR, OTCQX: CURUF)
- Then, in June of 2023, Consolidated Uranium announced that it has entered into purchase agreements to acquire 100% of the past-producing Huemul-Agua Botada Uranium mine in Mendoza province

With three reactors currently generating over 7% of the country's electricity, a fourth under

construction and a history of producing, converting and enriching its own uranium. Consolidated Uranium believes developing uranium mines in Argentina has “strong merit” and may ultimately garner support by all levels of government. We would concur.

The Power Program

Currently, three nuclear reactors generate a meaningful percentage of the country's electricity. The backstory to these is that in 1964, the focus shifted to nuclear power, and following a feasibility study for a 300-500 MW unit for the Buenos Aires region, bids were invited. With the country's policy firmly based on using heavy water reactors fuelled by natural uranium, Canadian and German offers for heavy water designs were most attractive, and the offer from Kraftwerk Union was accepted. The 100% financing that came with the deal was a major attraction for the Argentine authorities.

That plant, known as **Atucha 1** was built at Lima, 115 km northwest of Buenos Aires, and entered commercial operation in 1974. It has a pressure vessel, unlike any other extant heavy water reactor, and it now uses slightly enriched (0.85%) uranium fuel which has doubled the burn-up and consequently reduced operating costs by 40%.

Embalse

In 1967, a second feasibility study was undertaken for a larger plant at Embalse in the Córdoba region, 500 km inland. In this case a CANDU-6 reactor from Atomic Energy of Canada Ltd (AECL) was selected, partly due to the accompanying technology transfer agreement, and was constructed with the Italian company, Italimpianti. The Embalse plant entered commercial operation in 1984, running on natural uranium fuel. In 2010, an agreement was signed to refurbish the plant to extend its operating life by 25 years and increase its power output by around 7%. It was for a long while running at about 80% capacity to limit neutron damage to pressure tubes. It has now been taken down for a refit.

The life of the Embalse CANDU-6 type plant was extended in partnership with Candu Energy Inc. This latter firm is a subsidiary of SNC-Lavalin Group which took over the reactor division of Atomic Energy of Canada Ltd in 2011.

In late 2016, the plant received the last two of four steam generators, fundamental elements for the life extension of the plant. The plant was reconditioned to deliver power for another 30 years through the replacement of the four steam generators. The plant was restarted in early January 2019, with power upgraded to a gross capacity of 683 MW and 635 MW net.

Atucha 2

In 1979, a third plant – Atucha 2 – was ordered following a government decision to have four more units coming into operation in the period 1987-97. It was a Siemens design, a larger version of unit 1, and construction started in 1981 by a joint venture of CNEA and Siemens-KWU. However, work proceeded slowly due to lack of funds and was suspended in 1994 when the plant was 81% complete.

Interestingly, this coincided with the years in which the Menem administration was most vigorously privatizing electricity assets. To our memory we cannot remember the nuclear plants ever being proposed for sale. Certainly, mothballing the new nuclear plant would have been good news for the newly minted owners of the thermal generators that the government had just sold.

In 1994, Nucleoeléctrica Argentina SA (NA-SA) was set up to take over the nuclear power plants from CNEA and oversee construction of Atucha 2.

In 2003, plans for completing the 692 MW Atucha 2 reactor (745 MW gross) were presented to the government. The Siemens design of the Atucha PHWR units is unique to Argentina, and NASA was seeking expertise from Germany, Spain and Brazil to complete the unit. In 2003, plans for completing the 692 MW Atucha 2 reactor (745 MW gross) were presented to the government. Completing Atucha 2 by 2010 was expected to cost US$ 600 million, including $400 million for heavy water.

The Neuquen heavy water plant completed production of 600 tonnes of heavy water in June 2012, and this was expected to be loaded around April 2013, after loading the 9.76 metre-long fuel assemblies, which commenced in December 2012.

Effective completion of Atucha 2 construction was in September 2011. On June 3, 2014 reached its first criticality, and on June 27, 2014 began to produce energy. On 19 February 2015, the plant reached 100% power production for the first time, increasing the percentage of nuclear power in Argentina's energy mix from 7% to 10%.

Uranium Supply

It is important to note that Argentina’s nuclear program currently sources its uranium supplies from Kazakhstan and Canada, which is a strange situation considering that it has its own supplies in the shuttered CNEA mines and the prospects of potential uranium miners (principally Canadian) in Argentina.

Argentine uranium resources listed in the International Atomic Energy Agencies’ Red Book total only about 15,000 tonnes of U_3O_8, though the CNEA estimates that there are some 55,000 tonnes as "exploration targets" in several different geological environments. Uranium exploration and limited mining was carried out from the mid-1950s, but the last mine closed in 1997 for economic reasons. Cumulative national production until then from open pit and heap leaching at seven mines was 2,509 tonnes of Uranium.

The Torturous Road to Further Plants

As mentioned earlier, in August 2006, the government announced a US$3.5bn strategic plan for the country's nuclear power sector. This involved completing Atucha 2 and extending the operating lifetimes of Atucha 1 and Embalse.

A feasibility study on a fourth reactor (Unit IV aka Atucha 3) was undertaken, originally planned to start

construction after 2010 with a projected US$2bn capex. In July 2007, NASA signed an agreement with AECL to establish contract and project terms for construction of a 740 MWe gross Enhanced CANDU 6 reactor, as well as completing Atucha 2. A further 740 MWe Enhanced CANDU 6 unit was proposed.

The government began talks with reactor vendors from France, Russia, Japan, South Korea, China and the USA, indicating that its fourth and fifth reactors were more likely to be LWR type, with Atucha as the most likely location. Russia was offering two AES-2006 units, and China is offering 1000 MWe units. Areva claimed that its Atmea1 reactor was pre-qualified by NASA.

In October 2012 the government said that Areva, China National Nuclear Corporation (CNNC), Korea Electric Power Corporation (Kepco), Rosatom and Westinghouse were pre-qualified for tendering in 2013.

Enter The Dragon

In February 2014 NA-SA and CNNC signed two agreements covering operations and technology. Under the first, NA-SA and CNNC would cooperate on issues related to reactor pressure tubes, including engineering, fabrication, operation and maintenance. It also covers the manufacture and storage of nuclear fuel, licensing, life extension and technological advances. This agreement is aimed at both operating and future nuclear power plant projects.

The second 2014 agreement called for the transfer of Chinese technology to Argentina. Under the accord, Argentina could act as a technology platform, supplying third countries with nuclear technology incorporating Chinese goods and services. In July 2014 a high-level agreement was signed by the Argentine and Chinese presidents towards construction of Unit IV (Atucha 3) as a PHWR unit, though with NA-SA to be designer, architect-engineer, builder and operator of it. CNNC would assist by providing most of the equipment and technical services under long-term financing (it operates two similar units at Qinshan).

Candu Energy would be a subcontractor to CNNC. In September NA-SA signed a commercial framework contract with CNNC to progress this, with CNNC's Qinshan Phase III units (678 MWe net) as reference design for a Candu 6 unit.

In February 2015, the 2014 agreement to build Unit IV (Atucha 3) was ratified by CNNC and the federal planning minister. The then president said that the cost was likely to be US$5.8bn. It was stated at the time that NA-SA "in the role of owner, architect, and engineer will conduct the pre-project design, construction, commissioning and operation of the new 750 MWe plant". The technical and commercial contracts involving SNC-Lavalin were signed in November 2015. Local content would be about 70%.

In November 2015, NA-SA signed a commercial contract with CNNC to build Unit IV (Atucha 3) and a framework agreement for a further reactor. The projects together are worth about US$15bn and China would contribute 85% of the required financing. In June 2016 a further agreement was signed with China National Energy Administration, firming up these arrangements and specifying early 2017 and

2019 for construction starts.

In May 2017 further contracts were signed between NA-SA and CNNC for construction of Unit IV (as Candu 6) and Unit V (as Hualong One) reactors.

However, in January 2019 reports suggested that the fourth unit would now be a 1150 MWe Hualong One unit (which had been planned as the fifth unit). China is to finance 85% of the reactor's construction. This was confirmed in 2021, and in February 2022 an EPC contract was signed by NA-SA and CNNC. In a further sign that Argentina was “doing a China” on China, in September 2022 it was reported that progress was being hampered by Argentina's desire to fabricate the unit's fuel assemblies domestically, see anon.

The Fifth Reactor

Another July 2014 agreement signed by the Argentine and Chinese presidents covered Chinese cooperation in pressurised water reactor (PWR) construction in Argentina, and CNNC claimed that NA-SA had issued a pre-qualification certificate for the ACP1000 design.

Then in February 2015 a cooperation agreement was signed, by the federal planning minister and the president of China's National Energy Administration and vice president of CNNC, to "participate in the construction of a new nuclear plant featuring a light water reactor and enriched uranium in the Republic of Argentina, adopting ACP1000 technology."

The ACP1000 technology will become Hualong One, in the light of China’s policies, and China will supply the fuel. This is curious as China is a net uranium importer itself and Argentina potentially having its own uranium supplies restored.

The agreement provides for NA-SA to be the architect-engineer of the project. It calls for the parties to strive for the maximum local content in the new unit in terms of materials and services. This will be achieved through the transfer of technology to Argentine companies, including the manufacturing of components and fuel fabrication. Between 50% and 70% of components and 100% of the civil works for the reactors will be sourced in Argentina, limiting foreign inputs to components and engineering services not available there. The agreement also guarantees the supply of enriched uranium and fuel assemblies throughout the life of the plant.

The framework agreement for the project was signed by CNNC and NA-SA in November 2015. A commercial contract and financing agreement were envisaged by the end of 2016. The president suggested that the reactor cost was likely to be US$7bn. A further contract between CNNC and NA-SA was signed for construction of the Hualong One unit in May 2017.

Reports in January 2019 suggested that plans for this Unit V project might be cancelled, but in August 2021 NA-SA was reported to be considering it as a Canadian project for a CANDU reactor with the site undecided. This might be a case of trying to ginger up the Chinese by adding some competitive tension.

Technology – Who is Hugging Whom?

In line with the agreement a year earlier, the parties are also to consider "establishing a joint strategic partnership for the purpose of developing and building nuclear reactors in Latin America," so that Argentina becomes a Latin American technology platform, supplying countries with nuclear technology incorporating Chinese goods and services. Under this PWR agreement, CNNC had three months in which to provide NA-SA with a proposal "covering technical, commercial aspects, pricing and financing." NA-SA then had three months in which to respond to CNNC's proposal. The proposal and its corresponding response then had to be approved by the Ministry of Federal Planning and China's National Energy Administration.

Further Locales

Possible sites mentioned, but unconfirmed, for further plants are in Monte Lindo, La Emilia, Riacho Tohué, Riacho Pilagá – all on the Paraguay River in Formosa province in the north. Colonia Bouvier in Formosa has also been mentioned, but in connection with a full-sized (100-200 MWe) CAREM reactor.

In 2017, Río Negro province came to the fore as a possible location but was then withdrawn. How much more likely this province might have been to being in contention, if Blue Sky had actually advanced to development of its uranium mining project, remains moot.

Russian Overtures

In February 2010, the government signed an agreement with Rosatom to share technical information related to the construction of nuclear power plants and to look at possibly using Russian technology in the country. In April 2010, a nuclear cooperation agreement was signed with Russia, and in May 2011 Rosatom and the Argentine planning & investments minister said they were discussing the possibility of joint development and construction of a 640 MWe reactor of unspecified type.

In July 2014 a high-level and wide-ranging nuclear cooperation agreement was signed with Russia. This had special significance considering Rosatom’s proposal to help build and fund Unit IV (Atucha 3). President Putin said that the new agreement "will become a strong foundation for close cooperation" with Argentina in nuclear power. In 2014 Rosatom Overseas had signed an agreement with Corporación América, an Argentinian holding company, for cooperation in future nuclear energy projects in Argentina. This included the potential construction of new nuclear plants and cooperation in promoting floating nuclear plants in Argentina and other countries.

After China secured the contract to build Atucha 3 as a Candu 6 PHWR (see above, now likely to be Hualong One), in April 2015 the government signed an agreement with Russia establishing a framework for cooperation in construction of a 1200 MWe VVER unit, with Russian financing. Rosatom Overseas and NA-SA also signed a preliminary project development agreement on construction of the reactor. The government agreement calls for the two countries to work together to sell VVER reactors in South America and Africa. In addition CNEA and INVAP signed agreements with TVEL which provide for a broad

cooperation and joint initiatives in the field of nuclear energy, including deliveries of low-enriched uranium fuel and its components for research and power reactors in Argentina, supplies of TVEL-manufactured zirconium components of the nuclear fuel cycle, and joint research and development projects.

In December 2018, a further cooperation agreement with Rosatom was signed for "the development of various project execution strategies to be applied to large and small capacity nuclear power plant construction projects in Argentina" and other countries.

As a footnote we would note that in 2021, Alpha Lithium signed a deal to have Uranium One, a subsidiary of Rosatom, buy into the Tolillar lithium project in Salta. This deal was then cancelled in May of 2022. We would note that Argentina has taken a negative stance at the UN towards Russia's invasion of the Ukraine without taking more severe actions against Russia and its interests. However, we would not expect to see Rosatom gaining any advantage over the Chinese nuclear putsch at least until after the Russia/Ukraine invasion is resolved.

The Ezeiza Atomic Centre

While better known as the locality of Buenos Aires' international airport, Ezeiza is also at the epicentre of Argentina's nuclear technology efforts. The Ezeiza Atomic Center was created in 1951 as a nuclear research facility. The plant covers roughly 20 acres but the total territory is around 800 hectares. The site includes research reactors, productions plants for radioisotopes and nuclear fuel, and a facility for the management and storage of spent fuel and other radioactive waste.

At the Ezeiza Atomic Center, the National Atomic Energy Commission is carrying out the construction of RA-10. In March 2016 the works began on the new reactor and in May 2017, concreting of the foundation slab was completed. The new facility was deemed to be 80% complete as of July 2023.

This multipurpose reactor, the most advanced in Latin America, is intended to expand Argentina's current capabilities in the areas of health, industrial and scientific research, guarantee the production of radioisotopes for medical use and maintain the country's leadership in the nuclear sector.

RA-10 will replace the RA-3 reactor, a 10 MWt pool-type reactor which began operations in 1967. The RA-10's design is based on the 30MW Opal reactor which Argentina sold to Australia (see anon). However, the RA-10 is expected to be used for purposes that the Opal does not have, such as the irradiation of materials and fuel rods and elements. These applications demand a higher power and therefore a different core design, with its associated cooling system, also with other parameters. In addition, they require innovations in the reactor protection system, which in this case is also of Argentine design.

In medicine, the new reactor will be the main producer of Molybdenum-99, a radioisotope that breaks down into Technetium-99m, widely used in nuclear medicine for the early diagnosis of oncological diseases. As a result of the new reactor, the Radioisotope Production Plant that will operate within the RA-10, 100% of the national needs can be covered and contribute to the worldwide demand of Molybdenum-99 and other therapeutic radioisotopes. It is expected that the plant will supply 20% of global demand for Molybdenum-99.

This reactor will also have facilities that will allow the advancement of science and technology. This is

the case of neutron techniques used in research and development in materials science, biology and biochemistry. For its part, the Laboratorio Argentino de Haces de Neutrones (LAHN) will make available to the local and international scientific community a series of latest generation instruments that will contribute to the study of materials, condensed matter, industrial parts, biological samples, drugs, among other applications.

The RA-10 will also have an Irradiated Materials Testing Laboratory (LEMI), where the behavior of nuclear materials can be studied, expanding existing capacities to produce and qualify new fuels and components for future experimental and power reactors.

At the industrial level, this reactor will produce around 80 tonnes per annum of doped silicon, mostly for export, which is used in cellphones and computers. It will also be a source of industrial Iridium, used for the evaluation of the integrity and quality of large-scale constructions, trains and hybrid and electric automobiles.

There is a joint initiative with Brazil consisting of the construction of reactors with similar characteristics in both countries, that will ensure 100% of the radioisotope supply in Latin America.

CAREM

Mention should be made of the CAREM-25 nuclear reactor, which has been developed by CNEA with INVAP and others, since 1984. It is a modular 100 MWt simplified pressurised water reactor with integral steam generators, designed to be used for electricity generation (27 MWe gross, 25 MWe net) or as a research reactor or for water desalination. As mentioned earlier, a CAREM plant is under consideration for desalination in Saudi Arabia.

CAREM has its entire primary coolant system within the reactor pressure vessel, self-pressurised and relying entirely on convection. Fuel is standard 3.4% enriched PWR fuel, with burnable poison (a neutron absorber that is incorporated in the fuel or fuel cladding of a nuclear reactor and gradually burns), and it is refuelled annually.

Nuclear Technology Exporter

INVAP has built several research reactors for CNEA and international customers in Egypt (ETRR-2), Algeria (NUR), Peru (RP-0 & RP-10) and Australia (OPAL). Its first was RA-6, a 0.5 MWt open-pool multi-purpose research reactor designed by CNEA and inaugurated in 1982. It is located in San Carlos de Bariloche, Rio Negro, on the premises of the Centro Atómico Bariloche (CAB) belonging to CNEA. It is principally for training and uses 20%-enriched fuel. RA-8 followed it and operated 1997-2001 in Pilcaniyeu, Río Negro, testing fuel enriched up to 3.4% and control rods for CAREM. It was an open-pool zero power unit.

Holland: At the Davos conference in 2018, the then Argentine President Mauricio Macri announced that Argentina had made a sale of a nuclear reactor to the Netherlands. The deal was with the Pallas Foundation of Holland for the design and construction of a radioisotope research and production

reactor for medicinal uses in the city of Petten, in the North of Holland. The tender was won against competing offers from France and South Korea.

The design and construction of the reactor was tendered at a European level. PALLAS chose ICHOS at the beginning of 2018: a consortium consisting of the Dutch companies Mobilis and Croonwolter & dros of the TBI holding, and INVAP. In 2020, PALLAS restructured and the contract structure with the consortium INVAP / TBI was adjusted. TBI left the consortium at the end of 2020. INVAP, which carries out the design of the reactor, was the remaining partner. Construction began in May of 2023.

The revenues from the provision of all the technology of this 35 MW reactor will amount to around USD$400mn. The original INVAP bid was chosen in June 2009, but at that time the authorities decided to discontinue the project due to the global economic crisis, until in 2015 the Pallas Foundation called for a new tender and Argentina won it.

INVAP has three other major projects underway: in Brazil, Bolivia and Saudi Arabia.

Brazil: The other project that INVAP signed with Brazil in late 2017 was the sale of engineering for the development of a high-tech research RMB reactor. The cost of this agreement was of US$35mn. There is also a research agreement for two reactors, intended for the production of radio-isotopes, the carrying out of irradiation tests on fuel and other materials as well as research with neutron beams. They will have a capacity of 30 MW and will be developed taking as reference the OPAL reactor designed and built by INVAP for the Australian Organization of Nuclear Science and Technology (ANSTO) and inaugurated in April 2007.

Bolivia: Argentina developed another nuclear project for Bolivia that is in process and consists of three nuclear research assistance centers. The intention of INVAP in this case is to develop a Center for Nuclear Medicine and Radiotherapy of the latest technology, which will have three components: a cyclotron (generator of radioisotopes, tumor marker), a Pet Scan (scanning system) and a Linear Accelerator (for focused treatments). In addition, a Radiopharmaceutical Production Center will be implemented in the Nuclear Complex in Tarija.

Saudi Arabia: In recent years Argentina has made a sale of a small LPRL reactor to Saudi Arabia for an estimated value of USD$20mn. The reactor is of an open-pool design cooled by natural circulation of light water with a power rated at 30 kW. This initiative with the Saudis gives Argentina a foothold in both the country and the region. The reactor is sited at King Abdulaziz city for science and technology on the outskirts of Riyadh.

All this goes to show that Argentina is not just a technology taker in this very sophisticated area but an innovator as well. Indeed, the club of those with nuclear industrial capacity is very small indeed. The glaring absence at this point is primary mines within the country to source material.

The Rest of the Argentine Nuclear/Industrial Complex

Having a domestic nuclear energy industry has also brought Argentina industrial spin-offs in the creation of various plants and technologies that otherwise the country would have no need for. In reviewing these ancillary services, it is glaringly apparent that the missing component is an actual mine capability. Amongst the industrial facilities is a 150 tpa mill complex and refinery producing uranium dioxide powder operated by Dioxitek, a CNEA subsidiary, which is located at Córdoba.

CNEA has a small enrichment plant at Pilcaniyeu, near Bariloche, Rio Negro province, with 60 t/yr capacity. Over 1983-89, INVAP operated a small (20,000 SWU/yr) diffusion enrichment plant for CNEA at Pilcaniyeu, but this proved to be unreliable and produced very little low-enriched uranium. After this plant was mothballed enrichment services were imported from the USA.

In August 2006, the CNEA announced that it wanted to recommission the enrichment plant, using its own Sigma advanced diffusion enrichment technology which it claimed to be competitive. The principal reason given was to keep Argentina within the circle of countries recognised as having the right to operate enrichment plants, and thereby support INVAP's commercial prospects internationally. It was proposed to restart enrichment on a pilot scale in 2007 and work up to 3 million SWU per annum in three years. In 2010 the Argentine President inaugurated the recommissioning of the plant.

Production of fuel cladding is undertaken by CNEA subsidiaries. Fuel assemblies are supplied by CONAUR SA, also a CNEA subsidiary, located at the Ezeiza Centre near Buenos Aires. The fuel fabrication plant has a capacity of 150 tpa for Atucha-type fuel and Candu fuel bundles.

Heavy water is produced by ENSI SE (Empresa Neuquina de Servicios de Ingeniería), which is jointly owned by CNEA and the Province of Neuquén where the 200 tpa plant is located (at Arroyito). It is operated by Neuquen Engineering services, majority-owned by the provincial government. This was rebuilt and scaled to produce enough for Atucha 2 and the three following reactors at a cost of about $1bn, and so now has capacity for export.

There are no plans currently for reprocessing used fuel, though an experimental facility was operated in the early 1970s at Ezeiza.

Radioactive waste management

Under the guiding legislation for the sector, the National Law of Nuclear Activity passed into law in April 1997 the law assigns responsibility to CNEA for radioactive waste management and creates a special fund for the purpose. The operating plants pay into this fund, even though they, like the CNEA, are owned by the government anyway.

Those wastes of low- and intermediate-levels, including used fuel from research reactors, are handled at CNEA's Ezeiza facility. Used fuel is stored at each power plant. There is some dry storage at Embalse.

The CNEA is also responsible for plant decommissioning, which must be funded progressively by each

operating plant, though as yet no plant has been decommissioned and one wonders how much money would really have been squirrelled away for this purpose in light of the past and present Argentine governments' propensity to raid the piggybank for ongoing budgetary needs (not to mention the regular wipe-outs for currency value from inflationary outbursts).

Uranium Deposits

Last decade, talk circulated in recent years about reopening the CNEA's Sierra Pintada mine (also known as the San Rafael mine and mill) in Mendoza in the central west, which closed in 1997. Reserves there, and at Cerro Solo in the south, total less than 8,000 tonnes of U_3O_8. A resumption of uranium mining was part of the 2006 plan in order to make the country self-sufficient.

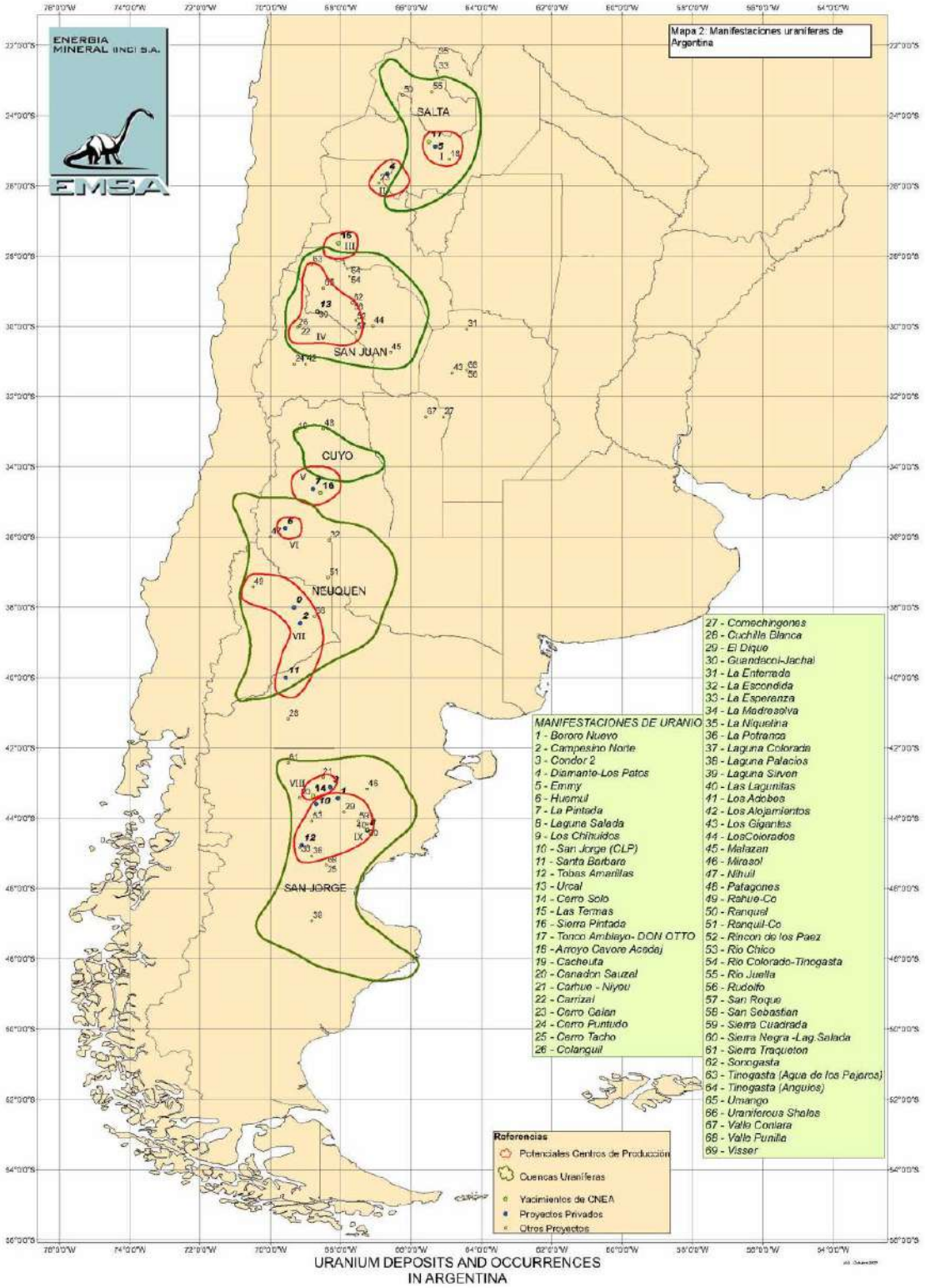
The San Rafael Mine and mill is shown in the photograph above. The complex consists of:

- Open pit with 0.025% U cut-off.
- 6,500 tonnes of U_3O_8 reserves.
- Stripping ratio 10/1.
- Average uranium grade: 0.076%.
- 13.4 million m^3 of tailings
- 2,500,000 tonnes of mill +feed

There is also the unmined Cerro Solo deposit, likewise owned by the CNEA and located 15 km south of Bororo Nuevo and is reported to contain a historical resource estimate of 15.4 million pounds of U_3O_8.

Both Sierra Pintada and Cerro Solo projects face difficulties related to obtaining permits. Waste remediation is being carried out, or is under study, at former mining/milling sites. The efficient completion of remediation will be very important for obtaining social licenses for new production, as the social perspective on nuclear and mining activities is as controversial in Argentina as in other countries.

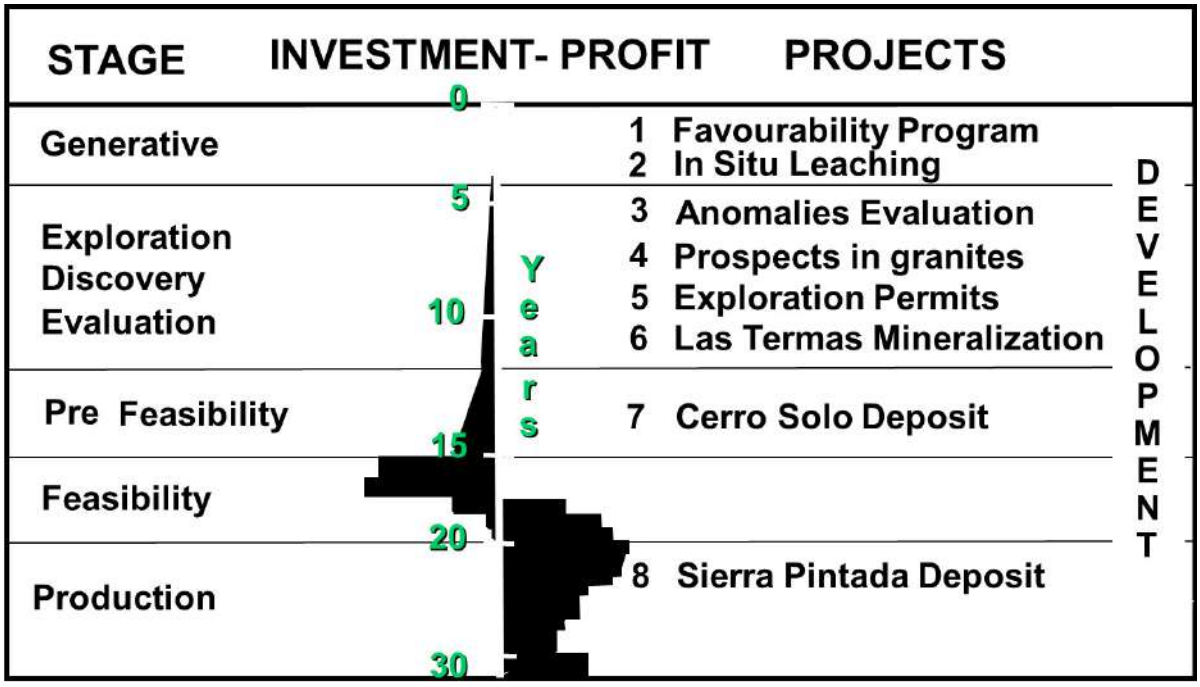
The map of the following page shows the known Uranium occurrences in Argentina.



URANIUM DEPOSITS AND OCCURRENCES IN ARGENTINA

The Don Otto uranium mine is located in Salta in the far north of the country, and was the largest mine operated to date in that area, reportedly (Romano, 1999) produced approximately 479,000 t of 0.084% U_3O_8 between 1963 and 1981, although this total may include production from the nearby Los Berthos Mine and possibly the Emmy Mine. Published government resource figures for the Tonco district (Romano, 1999) total 15.9 million tonnes at 0.035% U_3O_8 containing 5,630 t of U_3O_8 (at a 0.01% cutoff). In 2007, CNEA reached agreement with the provincial government of Salta to reopen the Don Otto uranium mine. At that time block leaching was envisaged as the extraction method. However, the reopening did not occur.

The schematic below is interesting and comes from a presentation produced by the CNEA. It shows the timeline to (potential) production of various types of U deposits and some specific Argentine deposits.



It is noticeable that the ISL projects seem to be the ideal for quick insertion into the current nuclear expansion in Argentina while various known projects are significantly off in the future, even with the best will in the world.

It is useful to note that the current Argentine consumption of Uranium in its plants is around 474,000 lbs per annum, all of which is currently imported. The CNEA estimates that required supply for the remaining life of just the traditional reactors (Atucha I, II y Embalse) in Argentina is 16.5mn lbs of U_3O_8.

Farther Afield

Beyond Argentina there are regional possibilities, but these do not have the internal logic that the slogan “Argentine uranium for uranium plants” has. Brazil’s nuclear power generation capacity consists

of two pressurized water reactors, Angra I, with a net output of 637 MWe, first connected to the power grid in 1985 and Angra II, with a net output of 1,350 MWe, connected in 2000. Work on a third reactor, Angra III, with a projected output of 1,405 MWe, began in 1984 but was halted in 1986. Work started again in June 2010 for entry into service in 2015.

We learnt recently that Brazil's own uranium mine isn't sufficient to supply its newest reactor and thus the country will start importing uranium, which opens another ready market in South America for Argentine output. We would note though that Brazil has the sixth largest uranium reserves in the world and in light of the traditional Brazilian self-sufficiency policies, buying uranium from Argentina (if it returned to being a uranium-mining nation) would at best be only a stop-gap measure.

Consolidated Uranium

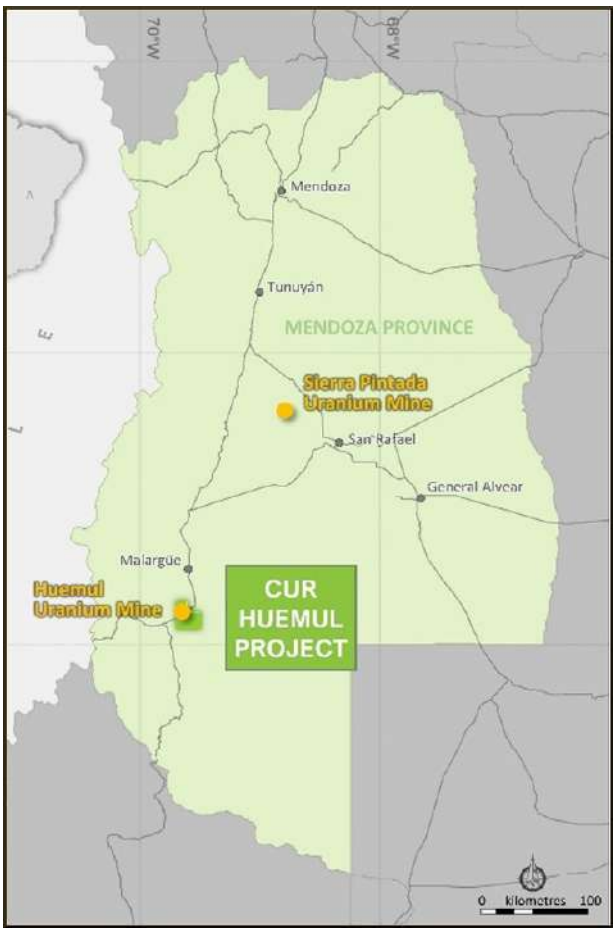
(TSXV: CUR, OTCQX: CURUF)

New Kid on The Block

A Serious Contender?

For a long time, the only active uranium player in Argentina was Blue Sky Uranium (BSK.v) part of the Grosso group of companies. Unfortunately though, it has not advanced to any point where it might be a development prospect or even want to develop. We highlighted the potential in our previous Uranium review of Argentina, but have nothing to say on its progress since then.

In contrast, Consolidated Uranium (until recently called rather grandiosely International Consolidated Uranium) has appeared on the scene having picked up the assets of the rather moribund U3O8 Corp. (now renamed Green Shift Commodities Ltd – GCOM.v). It has now been stamping its mark on the Argentina uranium scene in a series of transactions that seem development oriented.



The Potential for Vertical Integration

In mid-June of 2023 Consolidated Uranium announced that it has entered into two purchase agreements to acquire 100% of the Huemul-Agua Botada Uranium-Vanadium-Copper Mine. The deal also brought along surrounding prospective ground totaling ~27,350 hectares located in the Malargüe department of southern Mendoza province, Argentina.

At the right is a map showing location of the

Huemul Project and its proximity to the Comisión Nacional de Energía Atómica's Sierra Pintada Uranium Mine.

Huemul was Argentina´s first producing Uranium mine and operated between 1955 and 1975, recording approximately 500,000 pounds of historical U3O8 production before it closed in 1976.

The Assets

As part of the Huemul acquisition, Consolidated agreed to acquire the Huemul mine lease, the Silvana claim, the Huemul Norte and Huemul Sur claim applications. This territory encompasses approximately ~22,432 hectares.

As part of the NewEra Acquisition (as defined herein), the Company has agreed to acquire two claim applications covering ~2,352 hectares held by NewEra Metal Resources Ltd.

The Cerro Butalo Claims - Cerro Butalo, covering ~2,566 hectares, was previously staked by Energy Minerals/Maple and was acquired by the Company in 2020 pursuant to an option agreement with Green Shift Commodities Ltd. (previously U3O8 Corp.).

On Consolidated Uranium

Consolidated Uranium Inc. (TSXV: CUR, OTCQX: CURUF) was created in early 2020 to capitalize on an anticipated uranium market resurgence using the proven model of diversified project consolidation. Since then it has acquired, or has the right to acquire, uranium projects in Australia, Canada, Argentina, and the United States each with significant past expenditures and attractive characteristics for development.

It is currently advancing its portfolio of permitted, past-producing conventional uranium and vanadium mines in Utah and Colorado, with a toll milling arrangement in place with Energy Fuels Inc., a leading U.S.-based uranium mining company. These mines are currently on stand-by, ready for restart as market conditions permit. This, in theory, positions CUR as a near-term uranium producer.

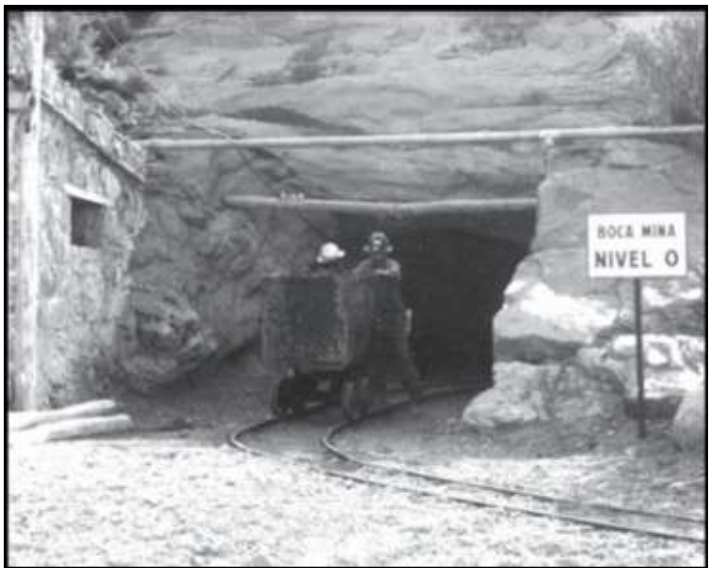
The Deal

Consolidated Uranium has been actively exploring in Argentina since the acquisition of the Laguna Salada project in late 2021 from U3O8 Corp. Beyond the technical merits of Huemul, its location in the mining friendly Malargüe department of Mendoza province was an important consideration in making the acquisition.

The company's technical team in Argentina has decades of experience operating in the country exploring for and developing various commodities, including uranium. The team conducted numerous technical due diligence site visits and stands ready to move quickly to advance the project once required approvals and permissions are granted. It is led by Paul Pearson, a PhD in structural geology.

Huemul

The Huemul area, including the historic mine area, was the subject of exploration by several different owners in the past. This will be the first time the entire package has been held in the same hands opening the potential for a more regional exploration approach.



The Huemul mine historically recorded approximately 500,000 pounds of U_3O_8, ~175,000 pounds of V_2O_5 and 5.2 million pounds of Cu production from approximately 130,000 tonnes of ore.

The ore mined averaged 0.21% U_3O_8, 0.11% V_2O_5 and 2% Cu by flotation at a concentration plant.

The production from the adjacent Agua Botada deposit averaged ~0.13% U3O8 and 0.10% Cu.

The down-plunge and along-strike extensions of mineralization at the Huemul mine and Aguas Botada zones are underexplored and merit, in the opinion of Consolidated's management, additional exploration work. In addition, the target geological sequence is present and mineralized at surface over large areas across the project. Gently dipping conglomerate units hosting the mined ore at Huemul extend southwards from the historic mine workings and are traceable over at least 15 kilometers.

Within this target stratigraphic package, strong Uranium-Vanadium-Copper geochemical anomalies, with broad corresponding Uranium and Thorium radiometric anomalies, have been defined by a previous exploration company. These anomalies have never been drilled.

The Transaction

Under an agreement between a wholly-owned subsidiary of Consolidated Uranium and the vendor of Huemul, inked in mid-June 2023, Consolidated agreed to acquire a 100% interest in ~22,432 hectares within the Huemul Project Area for consideration comprised of:

- US$200,000 in cash
- 500,000 common shares of CUR
- A 2% NSR royalty payable on certain portions of the Huemul Project with CUR having the right to repurchase 1% of the Huemul Royalty by paying the amount of US$2mn

The terms of the purchase agreement with NewEra, inked on the same day in June 2023 give Consolidated's subsidiary the right to acquire a 100% interest of the NewEra Claim Applications for

consideration comprised of:

- US$120,000 in cash
- 119,372 Common Shares
- A 1% NSR royalty payable to NewEra on the claims covered by the NewEra Claim Applications

The Huemul Uranium-Vanadium-Copper Project

The Huemul Project is an early-stage exploration project located in the southern part of Mendoza Province, Argentina. Huemul consists of ~27,350 hectares of exploration claims centred around CNEA´s (Comisión Nacional de Energía Atómica) historic Huemul-Agua Botada mine, Argentina´s first producing Uranium mine. The Argentinian government discovered the Huemul-Agua Botada Zone in 1952 and exploited the deposit between 1955 and 1975. Historically, ore was treated in a concentration plant at the nearby town of Malargüe.

Geology

Uranium-Vanadium-Copper mineralization at Huemul is comprised of stacked, metres-thick stratabound lenses hosted by an approximately 50-metre-thick packet of conglomerates and arenites, sandwiched by redbeds and intruded by andesite sills. These sedimentary rocks are part of the fill sequence of the Cretaceous Neuquén Basin. Host rocks to the mineralization are highly bituminous and mineralized zones are likely to have been failed petroleum-gas traps.

In 2005, Energy Minerals (a local subsidiary of Calypso Uranium Corp which was bought by U3O8 Corp. in 2013) conducted radiometric surveys, ground truthing and geochemical sampling over the Huemul district around the historic mines. However, no drilling was ever conducted.

Several kilometers to the east and southeast of the historic mines, Calypso Uranium defined a number of new prospects characterized by strong radiometric and geochemical anomalism plus favourable geology. These being:

- Black Zone / Larga Vega
- Rosa / Uryco
- Cerro Mirano, Tres Diques

CUR´s more recent analysis suggests that these prospects all have both strong geochemical and radiometric similarities with Huemul, plus the size potential to warrant immediate follow up. These prospects only require interpretive geological mapping and radiometric ground traversing before proceeding to preliminary drill testing.

The historic results gathered by Calypso Uranium and Consolidated Uranium field verification indicate

that the Huemul project has, in management's opinion, the potential to host extensive, as yet undiscovered, zones of shallow conglomerate-hosted Uranium, Vanadium and Copper mineralization of a similar style to that historically exploited at the Huemul-Aguas Botadas mine.

The company is awaiting environmental and exploration permits to kick off its 2023 exploration program at Huemul. This will focus on defining the extent of radiometric and geochemical anomalies, through a program of geological mapping, ground scintillometer traversing and systematic rock geochemical sampling. Potentially mineralized targets will later be tested through shallow diamond drilling.

Laguna Salada

In December of 2021, International Consolidated Uranium (as it then was) entered into an option agreement with U3O8 Corp. to acquire a 100%, undivided interest, in the Laguna Salada Project located in Chubut Province, Argentina. The project located in the central part of the province, some 270km southwest of the provincial capital, Rawson and approximately 230km from the main commercial port city of Comodoro Rivadavia. There has been over CAD$15mn spent on the project by U3O8 Corp. with an initial resource estimate published in May 2011 (see below).

Laguna Salada Resource

Category	Tonnes	U3O8 grade ppm	Contained U3O8 mn lbs	V2O5 Grade ppm	Contained V2O5 mn lbs
Indicated	47.3	60	6.4	550	57
Inferred	20.8	85	3.8	590	26.9

A preliminary economic assessment published in September 2014, so rather on the historic side.

Also, worth noting that Chubut is the poster child for being mining unfriendly, but that is largely directed towards gold miners using cyanide and open-pit mining. If this project can be remade as ISL/ISR in its mode of extraction maybe attitudes could soften.

Investment Thesis

We do not give this company a rating at this time due to us not having dialogued with them on their intentions. Certainly, buying a past-producing mine is part of the road to development but as we have seen, the mere explorers that have roamed into Argentina from Vancouver are good at talking the talk but woeful at walking the walk. Time will tell and thus watch this space.

Notes:

Guillermo Rojas, 1999. Distrito Uranìfero Pampa Amarilla, Mendoza. En Recursos Minerales de la Republica Argentina. Pag.1135-1140

Risks

Argentine governments of all persuasions are pro-nuclear. Both sides of the political fence are also projecting themselves as pro-mining or have a track record of being so. Despite those positives we would note the following risks:

- Uranium prices spent most of the last decade mired in despondency so there is a precedent of extreme lassitude in pricing
- Uranium production, even when conducted by the government, has attracted some opposition in Argentina in the past
- Financing uranium developers remains challenging
- Some provincial governments are against open-pit mining and maybe against mining of radio-active materials as well.

Much depends on the level of national sanction given to any given project by the national government (and the mood of the CNEA). Mining by state interests in Argentina has been traditionally very poorly managed and massively loss-making. It also frequently involved pursuing low-grade deposits (e.g. coal and iron) for nationalist considerations. Thus, it is no surprise that despite the resurgent nuclear power program the government has done little to reactivate the mines that CNEA has either exploited in the past or mooted as attractive for future exploitation.

This means that the government, if it truly wants a vertically integrated industry, shall have to give its blessing to one of more of the foreign operators and that blessing (in light of the various carrots and sticks at its disposal) should corral provincial governments into cooperation. This would mitigate then most of the potential internal opposition.

Uranium spot pricing, and thus financing prospects, are joined at the hip. If the former goes up then the latter is enhanced with the trend of recent years being more positive than not.

Conclusion

Clearly Argentina is a natural market with an existing nuclear power plant fleet that is currently under expansion and yet no indigenous mine production of Uranium. This should be an ideal investing environment but has been clouded by the long dormancy of the uranium price and by the generalized negativism towards Argentina as a mining jurisdiction.

This ongoing bad vibe, perversely, is justified by political and financial events but NOT by mining events because the government in Argentina remains pro-mining. It has long been the case that some provincial governments have followed a more erratic attitude to mining in their bailiwicks. Thus the ideal uranium development story in Argentina is one in a pro-mining province and at some distance from any substantial settlement. Few miners dabbling in the Argentine space though appear to have cottoned on to the possibilities presented by making themselves an integral part of the revived nuclear power program in Argentina, though possibly Consolidated Uranium have cottoned on.

Negotiating concessions and even obtaining funding (helped by giving the Federal government some participation) could go some way towards mitigating the current disinterest from capital markets towards funding uranium exploration ventures. A key factor though must be credibility, for as we have noted many uranium companies are as prone as Rare Earth companies were towards pursuing solely the concept of proving up a resource and not developing it, and that in no way moves the Argentine nuclear energy industry towards vertical integration. ONLY those intent upon development and production in the short term can hope to create a real dialogue.

The goal of this note is not to point out winners and losers but rather to illuminate to investors that in Argentina there is a real prospect of a self-supporting uranium industry evolving. There would appear to be a compelling logic for a coherent mine-to-generator vertical integration in the Argentine nuclear industry with the only thing lacking is a project advanced enough to capture the government (and CNEA's) imagination to make this happen.

Important disclosures

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