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HALLGARTEN & COMPANY

Country/Sector Coverage

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Nuclear Energy & Uranium in Argentina

Seeking Synergies in Nuclear's Top Tier

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Seeking Synergies in Nuclear's Top Tier

- + The country has an aggressive nuclear expansion campaign, from an existing base of several reactors
- + Public opposition to nuclear power is minimal and the country has an energy shortage
- + The CNEA estimates that required supply for the remaining life of just the traditional reactors in Argentina is 16.5mn lbs of U_3O_8
- + The transition to the Macri regime in the 2016 elections has improved financial and operating conditions, as well as confidence, in the mining sector in Argentina
- + Argentina has been paying significantly more than the spot price for U supplies from Kazakhstan and Canada
- + Several Canadian Uranium explorers have soldiered on through the grim years of the post-Fukushima downturn and now have credible mining projects in Argentina
- × Uranium's spot price remains in the doldrums
- × The government has still not enunciated publicly a policy of promoting vertical integration by producing an in-country source of U_3O_8

Argentina – Powering On

The club of those countries with nuclear capabilities, outside the military ones, is a small one but one of its most surprising members is Argentina. It is the low-key nuclear powerhouse with a strong presence in generating technologies, production of inputs (e.g. heavy water) and in the development of reactors for medical applications (e.g. isotope production).

While countries like Germany equivocate over their nuclear future Argentina, with little fanfare, has added a third reactor to its existing two reactors and is moving to add two or three more reactors in the next decade. 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. Some 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 planned, 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.

The Power Program

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 now the Right (Macri).

Currently two nuclear reactors generate nearly 10% of the country's electricity and a third reactor has been taken down from operation for refurbishment. 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 will be extended by 25-30 years in partnership with Candu Energy Inc. This latter firm is a subsidiary of SNC-Lavalin Group which took over Atomic Energy of Canada Ltd reactor division in 2011.

Embalse's power output is being increased by about 35 MW under the latest plan. Contracts for $440 million were signed in August 2011, the main work was originally planned to commence in November 2013, with the reactor is due to be offline for about 20 months then, though the whole project will take five years. Total cost was put at $1.37 billion. The refit was delayed by the delays at Atucha 2's start-up.

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 NA-SA 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.

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%.

It is important to note that Argentina 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.

Further Expansion

As mentioned earlier, in August 2006, the government announced a US$3.5 billion 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 was undertaken, originally planned to start construction after 2010 with a US$2bn capex projected. 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 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. A final decision on Atucha 3 & 4 was pending Atucha-2 completion and the refurbishing process of Embalse. In October 2012 the government said that Areva, China National Nuclear Corporation (CNNC), Kepco, Rosatom and Westinghouse were pre-qualified for tendering in 2013. In September 2014, the government signed an agreement with CNNC to conduct pre-project, design, construction, commissioning and operation of the new 800 MWe Candu 6 unit. Meanwhile, CNNC was to provide technical support, services, equipment and instrumentation under a $2bn long-term financing arrangement. In addition, China will also supply materials needed by Argentina to locally produce components for the unit.

CNNC operates two Candu 6 units at its Qinshan plant in China's Zhejiang province, which will be the reference plant for the new Atucha unit.

At the Ezeiza Atomic Center, the National Atomic Energy Commission is carrying out the construction of RA-10, the multipurpose reactor with which Argentina seeks to expand current capabilities in the areas of health, industry and scientific research, guarantee the production of radioisotopes of medical use and consolidate its leadership in the nuclear sector.

In medicine, it 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. Thanks to 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.

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 industrial level, in this reactor it will be possible to face the production of doped silicon, which is used in cell phones and computers; and in sources of industrial iridium, used for the evaluation of the integrity and quality of large-scale constructions, trains and hybrid and electric automobiles.

Since 2010, CNEA has been carrying out this project that includes the design, construction and start-up of a multipurpose nuclear reactor. This ambitious project also includes a joint initiative with Brazil, which consists of the construction of reactors with similar characteristics in each country that will ensure 100% of the radioisotope supply in Latin America.

In March 2016 the works began at the Ezeiza Atomic Center and almost one year later, in May 2017, concreting of the foundation slab was completed. With a significant degree of progress, recently, the tasks of placing the grounding mesh in the Services Building and Neutron Guide Building of the LAHN began. In addition, the foundation plaza of the Auxiliary Building has already been concreted.

Scientific Development and Cooperation

In February 2010, the government signed an agreement with Russia's Rosatom to share technical information related to the construction of nuclear power plants and look at possibly using Russian technology in the country. In April 2010, a nuclear cooperation agreement was signed with Russia, and in September 2010, another was signed with South Korea. 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 June 2012 the government signed a nuclear cooperation agreement with China, involving studies for a fourth nuclear power plant, financed by China, and a transfer of fuel fabrication and other technology.

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 refueled annually. The prototype will be followed by a larger version, possibly 200 MWe, in the northwestern province of Formosa by 2021. Recent studies have explored scaling it up to 300 MWe.

Another aspect of the 2006 plan was to build a 27 MWe prototype of the CAREM reactor, and this is still under construction, next to Atucha. Civil works next to the Atucha site were to start in 2012, the electromechanical installation was due in the first half of 2013 and fuel loading then grid connection in 2016 (now pushed out to the end of 2018). Some 70% of components were slated to be of local manufacture. A second CAREM plant is planned for the province of Formosa.

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.

Many in Argentina were surprised when at the Davos conference earlier this year the Argentine President Mauricio Macri announced that Argentina had made a sale of a nuclear reactor to the Netherlands. This sale was the fruit of the long-term policy at the heart of which is INVAP, a state company of Rio Negro that has two directors of the national state and an extensive international prestige. 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 revenues from the provision of all the technology of this 35 MW reactor will amount to around USD$400mn. The role that this INVAP reactor will have is significant. Currently, some 10,000 European hospitals use these radioisotopes produced by the reactor and every year more than 40 million diagnostic procedures and treatments are performed, mostly oncological cases. 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 March of next year the sale of a small LPRL reactor to Saudi Arabia for an estimated value of USD$20mn is expected to be finalized. While it is a only a small 1 MW thermal reactor, this initiative agreed to with the Saudis opens an advantage of opportunities for Argentina since Saudi Arabia and the rest of the countries in the region are investing millions of dollars in renewable energy with a long-term view taking into account that in 50 years that oil will cease to be a major income stream.

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. Between 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 recognized 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 $1 billion, 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

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 is 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.

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:

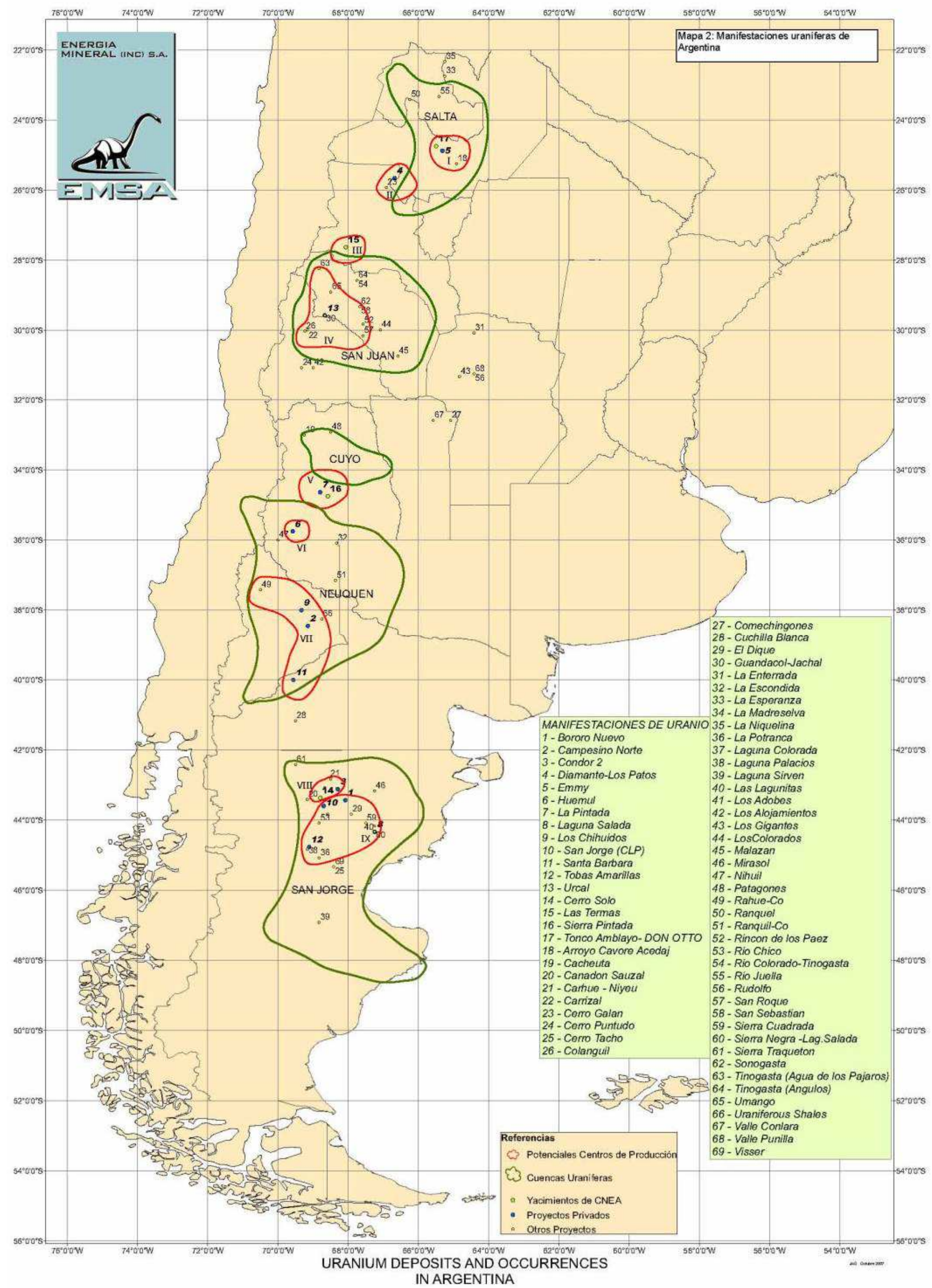
- Open pit with 0.025%U cut off.
- 6,500 tonnes of U_3O_8 reserves.
- Stripping ratio 10/1.
- Average uranium grade: 0.076%.
- Bench height: 2.5m.
- 13.4 million m^3 of tailings
- 376,000 tonnes marginal mineral
- 2,500,000 tonnes of mill feed

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 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% U3O8 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% U3O8 containing 5,630 t of U3O8 (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.

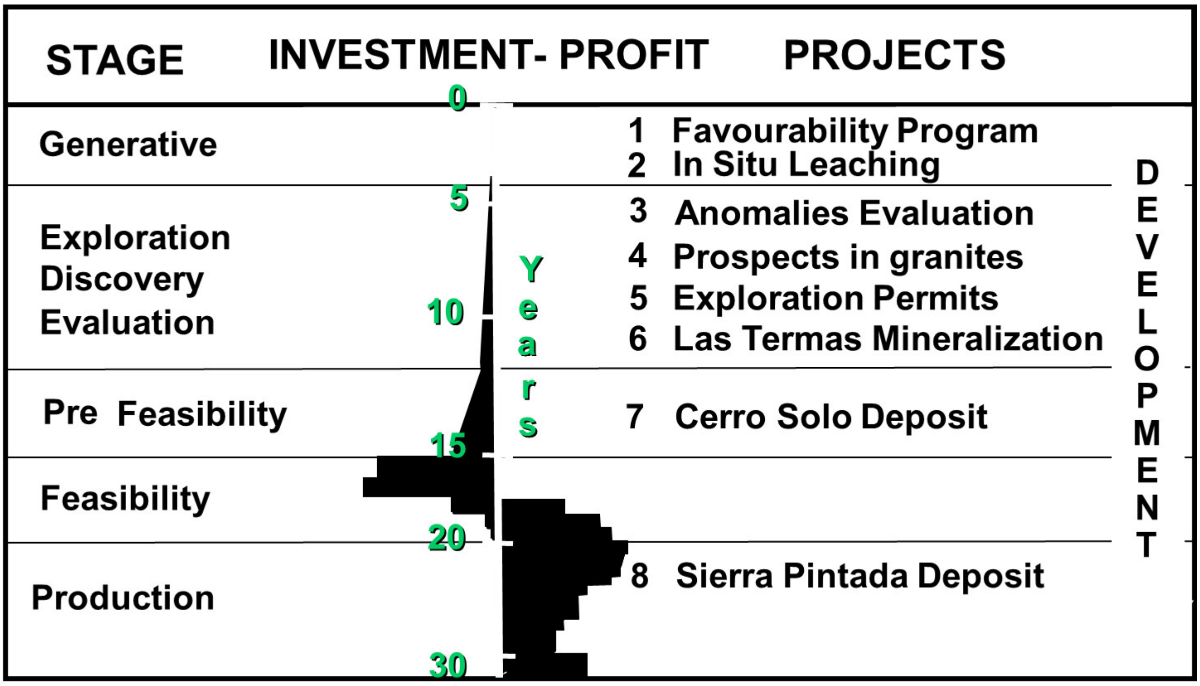
The map of the following page shows the Uranium appearances in Argentina.



URANIUM DEPOSITS AND OCCURRENCES IN ARGENTINA

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 215 tonnes 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, but this was then delayed until 2018.

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 would at best be only a stop-gap measure.

A Case Study – Blue Sky Uranium (BSK.v):

BSK is a Uranium (and more recently Vanadium) exploration company with more than 4,600 km^2 (460,000 ha) of tenements. Its mission is to acquire, explore, and advance a portfolio of uranium & vanadium projects with an emphasis on surficial deposits, and management is focused on advancing its discoveries.

The Grosso Group

Blue Sky is a member of the Grosso Group, a management company specializing in Argentina since 1993 and headed by the Argentine mining executive, Joe Grosso.

The group is also comprised of Golden Arrow (GRG.v) and Argentina Lithium & Energy Corp (LIT.v).

The Amarillo Grande Project

This project is the company's main focus and is located in central Rio Negro province, in the Patagonia region of southern Argentina. This new uranium district was an in-house discovery for Blue Sky.

The properties are all road accessible from major centres, such as Viedma or Neuquen, Provincial Capitals from Rio Negro and Neuquén provinces, respectively. Valcheta is the closest city to the south-eastern end of the project, located at 20km by paved roads from the Ivana deposit. This community is located along National Road #23 that connects to the deep ocean port of San Antonio Oeste, 120km to the east; and it is a train station on the railway that connects with Buenos Aires, the Federal Capital.

The region is flat lying, located at an elevation of approximately 100 metres, has an annual rainfall of less than 300mm, semi-arid environment, very low population density, and allows year-round exploration with access via well-maintained gravel roads.

In November of last year the company added to the long-held existing holdings here with the staking of ten new exploration properties (*cateos*) totaling 100,000 hectares in the core of the 140-kilometre mineralized trend. The company claims that it now controls all of the most prospective targets in this new uranium district, with total land holdings of over 280,000 hectares.

The other 180,000 hectares that the company holds are in Chubut province and other parts of Rio Negro (as per the map on the preceding page).

Deposit Type

The Amarillo Grande project is being explored for both Surficial and Sandstone-type uranium deposits. Most of the mineralization found on the properties to date has the characteristics of Surficial Uranium Deposits in which uranium occurs in sediments or soils of relatively young age (Tertiary to Recent) in association with secondary carbonate minerals that form lenses or blankets of calcrete. Although present, uranium mineralization is not directly related to calcrete blankets at Amarillo Grande. Therefore, these types of secondary deposits are interpreted as being sourced from earlier-formed Sandstone-type uranium deposits along a regional-size redox front or "uranium trap".

Surficial deposits typically form in semi-arid to arid uranium-rich districts adjacent to uranium source rocks (granites or ash flow sequences) or primary uranium deposits. The main uranium mineral in these deposits is typically carnotite, a yellowish hydrated potassium uranium vanadium oxide.

A prime example of a Surficial Uranium deposit is the Yeelirrie deposit in Australia operated by Cameco. That deposit contains 127.3 million pounds of U_3O_8 in Measured and Indicated resources and will be mined from shallow pits up to 10 metres deep with the ore being processed using alkaline leaching.

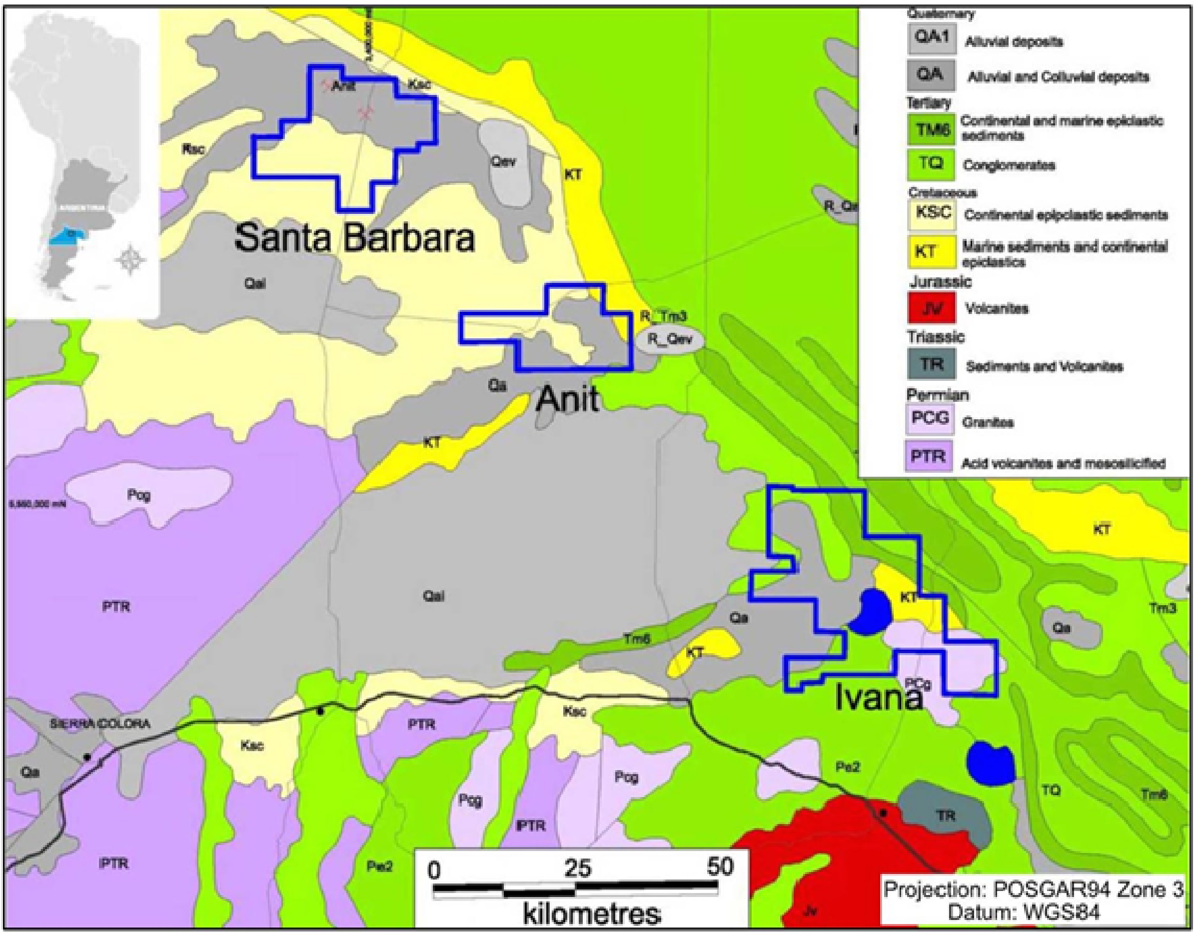
In some of the recent strongly mineralized holes at Blue Sky's Ivana deposit, potentially primary mineralization was observed and the deposit style appears to include more characteristics of sandstone-type deposits. Sandstone deposits represent approximately 18% to 30% of known world uranium resources, with grades of typically 0.05 to 0.35% U.

Sandstone are the leading source of uranium production in Kazakhstan, the USA and Niger, representing over 50% of the world production.

Project Geology

Defined mineralization at Amarillo Grande is found in three properties (Ivana, Anit, and Santa Barbara) along a 140km trend. Mineralization at all three properties occurs at or very near surface, in weakly-cemented host rocks, making simple and inexpensive open pit mining a likely development scenario. Uranium mineralization found to date is in the form of the leach-amenable mineral carnotite as coatings on pebbles or coffinite filling pores. Preliminary metallurgical work on carnotite samples from Anit and Ivana indicates that a simple scrubbing and wet-screening technique could be used onsite to concentrate and upgrade this material, which could significantly reduce transport and processing costs.

Regionally at the Amarillo Grande Project, quaternary gravel and sand deposits cover most of the area, and outcrops are scarce. Middle to Upper Tertiary sedimentary sequences overlap unconformably on the Mesozoic units. The Tertiary sequences include fluvial and marine sediments at the base grading upwards into continental sediments and volcanic flows.



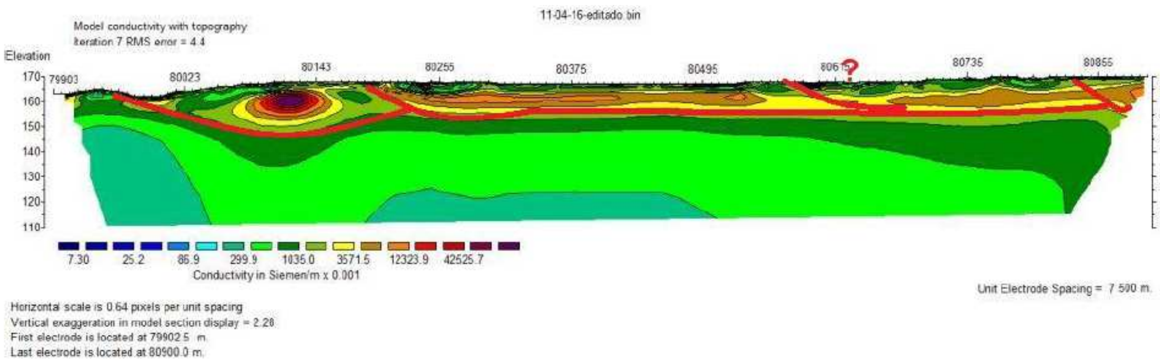
Uranium mineralization on the properties is hosted by unconsolidated to well-sorted reddish and yellowish sands and gravels. These sediments are interpreted as stacked paleochannels of a Tertiary fluvial system developed during an active volcanic period relating to uplift to the west. This fluvial system is intercalated with marine-coastal sediments to the south.

According to the company's geologists there are many possible sources of uranium in the District, including uranium rich-granites, volcanic rocks and primary uranium deposits within the underlying Cretaceous sediments. The presence of different potential sources enhances the chances of having uranium available to be mobilized within aquifers and along paleo-fluvial systems redox front traps where uranium-deposits are formed.

Exploration

In 2007 the first airborne radiometric survey led to discovery of zones of uranium mineralization at the Anit and Santa Barbara properties. A second large-scale airborne radiometric survey in 2010 led to the acquisition of the Ivana property. More than 23,000 km^2 of radiometric and magnetic survey has been carried out, the first of survey of its kind ever conducted in the region. This has resulted in the discovery several large new mineralized systems that are associated with the radiometric anomalies. Surface follow-up by Blue Sky of the Santa Barbara and Anit systems has discovered abundant uranium mineralization at and near surface.

Blue Sky has completed an initial ground geophysical survey at the Anit property of the Amarillo Grande Project using Electrical Tomography (ET). Results from the survey indicated that ET is a useful indirect tool to define near-surface ancient river channels, or paleochannels, and high-conductivity horizons that potentially host uranium mineralization. Based on these results, the company launched an initial fifteen kilometre ET survey over the main targets within the Amarillo Grande project. The results of this survey are shown in the cross-section with the red representing the paleochannels. The ET program was later extended by approximately 18km, following up initial drilling confirmation as useful tool for target exploration.



This program has helped to refine targets for an initially estimated 10,000 metre RC drilling program for target ranking, target testing and modeling definition. The campaign began in January of 2017 and finalized when completed around 8,000 metres of drilling in 525 holes (mostly shallow averaging 15-20 metres, with deepest being 43 metres) by January 2018. The RC drilling program conducted included a 100x100m infill program for resource estimation at the main target, Ivana.

The Ivana Deposit

At the Ivana target, RC drilling defined a strongly mineralized corridor with arcuate shape that extends more than 5kms, is between 200 and >400 metres wide, up to 20 metres thick, and is open to expansion to the southeast and to the north.

This largely continuously mineralized zone includes a higher-grade zones, which includes drill intercepts of up to 20,963 ppm U_3O_8 (or +2% U_3O_8) over one metre (AGI-0286). The Ivana deposit displays characteristics of surficial-type and sandstone-type "roll front" uranium-vanadium deposits. Mineralization at Ivana includes carnotite and coffinite, which was interpreted as primary mineral. Coffinite fills pore spaces of poorly-consolidated sandstones and conglomerates; meanwhile the secondary carnotite, occurs interstitially to and coats pebbles and clasts in loosely consolidated sandstones and conglomerates. The arcuate ("C") shape of the Ivana deposit is believed to represent a preserved sector of a regional mineralized redox-front, similar to those observed at Inkai district, in Kazakhstan.

The deposit is characterized by two stacked zones of uranium mineralization, the upper zone and the lower zone. The two zones occur together through most of the deposit but there are localized areas where only one zone is present. The upper zone averages 2.7 metres in thickness, with a maximum of 10 metres, while the lower zone has a maximum of 20 metres and has an average thickness of 6.2 metres.

Resource

In early March of this year Blue Sky published an independent mineral resource estimate for the Ivana Deposit at the Amarillo Grande project. The mineral resource estimate was prepared by BD Resource Consulting Inc. and Lions Gate Geological Consulting Inc. and showed an Inferred mineral resource estimate of 23.9 million tonnes averaging 363 ppm U308 containing 19.1 million pounds of U_3O_8 and 194ppm V_2O_5 representing 10.2 million pounds V2O5 (at a 100 ppm uranium cut-off).

Ivana - Inferred Resource – Base Case at 100 ppm Uranium cut-off grade

Zone	Tonnes (t)	U308 (%)	V2O5 (%)	Contained U308 (lb)	Contained V2O5 (lb)
Upper	3,200,000	0.016	0.023	1,100,000	1,600,000
Lower	20,700,000	0.04	0.019	18,000,000	8,600,000
Total	**23,900,000**	**0.036**	**0.019**	**19,100,000**	**10,200,000**

Note to Table :

- ✓ **The 100 ppm uranium cutoff grade is based on operative costs of $12/t, a price of $50/lb U3O8, and a process recovery of 90%. A density of 1.84 was applied.**

In the opinion of the consultants the mineralization at Ivana is hosted by loosely consolidated sediments from surface to 24 metres depth with the expectation that resources would be extracted via open-pit methods. The Ivana deposit remains open for expansion.

Metallurgical and beneficiation test work in progress to provide additional data for a maiden Preliminary Economic Assessment in 2018.

Additional resource potential exists in the Ivana area and throughout the 140-km long trend at the Amarillo Grande project.

Vanadium in the Mix

Last decade Vanadium surfaced as a subject of interest primarily tied to the fortunes of the then-booming steel industry through its use as an alloy. Now Vanadium is coming back with a vengeance due to underinvestment in new projects, the Chinese decision to increase the metal's percentage in steel alloys and for its potential application in mass electricity storage devices, namely the Vanadium Redox Battery (or VRB). The recently soaring price of this metal has swung the focus onto upcoming projects, of which there is a paucity. In the absence of pure Vanadium plays the most obvious candidates with projects being advanced (or in a holding pattern) is the Uranium space where sandstone-hosted Uranium deposits frequently come with Vanadium as the co-product. This is the case with Blue Sky.

This offers the interesting possibility that Vanadium can be a new factor in economics of otherwise paralysed uranium projects as the Vanadium component makes the projects imminently (and eminently) viable as the price of this metal rises.

Deal with AREVA

One of the interesting things about Blue Sky is that it appears to be AREVA's anointed partner in Argentina. In January 2012, BSK announced that the company had entered into a Memorandum of Understanding with the French uranium giant, AREVA Mines, to jointly explore Argentina for uranium deposits. Nothing much happened after AREVA had to do a tactical retreat but it has never taken its eye of the developments in Argentina as this is exactly the type of country (with an extant nuclear industry) that it needs to be positioned. We would not be surprised to see the arrangement revived.

In Summary

In these days of low uranium prices the best logic for a uranium explorer is to position itself in a uranium property with a natural market. 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. Therefore the ideal uranium development story in Argentina is one in a pro-mining province (such as Rio Negro) and at some distance from any substantial settlement (such as Amarillo Grande). 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 as Blue Sky has done.

Argentina Rerated?

The major event in 2016 was the change of government in Argentina. After nearly a decade and a half of irregular iconoclastic governments in Argentina ruled most recently by the dynasts of the Kirchner family, and before that the Duhalde regime, the country has returned to a certain orthodoxy with the election of Mauricio Macri as President in the last quarter of 2016. While not reinserting Argentine fully into the good books of mining investors it has certainly made thinking about the possibilities not being grounds for insanity. Amongst the measures taken so far that have enhanced the perspective for miners are:

- ✓ Lifted currency controls – devalued Peso may result in lower costs for project development
- ✓ Eliminated export taxes on concentrates and gold/silver doré
- ✓ Some import restrictions lifted – may allow better sourcing of equipment

These changes have removed the major bugbears of foreign miners operating in the country. This reopening has coincided with the Lithium boom which has placed Argentina at the centre of the action because of its ample supply of *salares* in its northwestern provinces. Hopefully a uranium resurgence will follow in its wake.

Despite this, things have not played out as orthodoxy might have prescribed. Inflation came briefly under control then as price freezes and subsidies imposed by the previous regime were withdrawn it has now assumed a galloping pace again with a corresponding decline in the value of the peso. The feedback loop from that has (re)created the infamous inflation/devaluation spiral that Argentines know all too well. Despite that, investment is booming with the Vaca Muerta shale gas discovery driving an investment bonanza, while the agricultural sector is in an ebullient state.

Risks

Argentina now has a regime that is both pro-mining and pro-nuclear, a rare combination. Despite those positives we would note the following risks:

- × Uranium prices remain mired in despondency with one camp feeling this is a cycle that shall not be broken
- × Uranium production, even when conducted by the government, has attracted some opposition in Argentina in the past
- × Financing remains a problem
- × 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. 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.

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. What should be an ideal investing environment is clouded by the generalized negativism towards Argentina. 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. So the ideal uranium development story in Argentina is one in a pro-mining province and at some distance from any substantial settlement (a good example being Rio Negro province). 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.

Negotiating concessions and even obtaining funding (helped by giving the Federal government some participation) could go some way towards mitigating the current hostility 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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