

Scandium in Lithium-Ion Batteries? Now it gets interesting...

Scandium International Mining Corp. (TSX: SCY) says that it could have the world's first primary scandium mine at Nyngan, NSW, Australia. The project has received all key approvals, including a development consent and a mining lease necessary to proceed with project construction.

The market should know this, so that's really is not the story here. But let's back up a moment.

As you probably know by now, scandium is a critical material that is used as an additive to aluminum alloys that hardens and strengthens the end product. Not unlike titanium alloys, a scandium alloy allows for lighter weight but equivalent (or better) strength components. The usage is being embraced by specific industries, but notably, two Russian jet fighters (MiG-21 and MiG-29) use scandium alloys in their construction. Other uses for scandium alloys include (but not exclusive to) automobiles, fuel cells, and other defense products.

While the company had an initial 50% interest in 2010, it closed the acquisition to become a 100% owner of the Nyngan Scandium Project in 2014. With an NI 43-101 report on the property in 2014, a Definitive Feasibility Study in 2015 and an updated NI 43-101/Definitive Feasibility Study in 2016, the company conducted process testing as recommended in the 2016 DFS prior to commencing detailed engineering on the project. An initial Mining Lease was granted in 2017 but due to a prior filing of objection by a local landowner, it was not until July 2019 that a revised Mining Lease was received due to local landowner objections.

Here we are in 2021 – that's a long time to work on a mining

project, but it is not uncommon. All the company needs is a product purchaser and capital to fund the mine development.

Now it gets interesting

In the interim, management also commenced work on the processing side of scandium. Like most resource business, the more of the value chain that you can capture, the more return for your shareholders, so that makes sense. The company was successful in its work and successfully demonstrated the ability to manufacture an aluminum-scandium master alloy (Al-Sc2%), from scandium oxide, using a patent-pending melt process involving aluminothermic reactions.

As an offshoot of the process technology work, the company has also developed ion exchange (IX) technology and knowhow to recover scandium, cobalt, and other critical metals from solvent extraction (SX) raffinate and other acidic waste streams in certain acid leach operations of the copper mining process. Copper ore bodies have a number of associated metals that usually wind up in the waste stream. Many of these “waste” metals include nickel, beryllium, scandium, and zinc to name a few which are in low enough concentration to not necessarily be economic to recover. Some might notice that these metals are “critical materials” and can be used in batteries.

As a follow on to their work in metals recovery technology, the company announced in September 2020 that it had filed a provisional patent application with the US Patent Office seeking patent rights on various applications of scandium in lithium-ion batteries. The patent application covers a number of scandium enhancements, including doping potential for both anodes and cathodes and for solid electrolytes.

So you can see that with Scandium International Mining Corp., investors have exposure to a project-ready scandium mine in Australia. But they also have exposure to critical metals

recovery technology and potential usage in lithium-ion batteries as well as solid oxide fuel cells.

It's not just a mining company anymore...and potentially more valuable as a critical materials or battery technology company.

Watch this space!

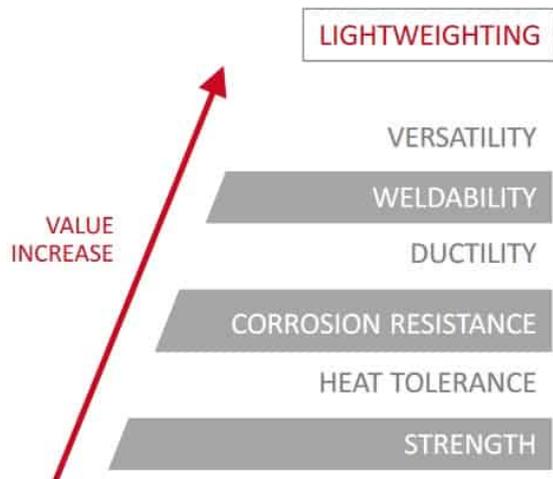
Is there a meteoric market rise for scandium next?

It is extremely rare to find a metal where the potential demand is much greater than what anyone can supply. It has happened the past year with the emissions metals palladium and rhodium which were up 75% and 366%; so it makes good sense that scandium may be next.

Scandium-Aluminum alloy is a key material in the lightweighting industry

Lightweighting of vehicles is a massive new trend this decade as we switch over to electric vehicles. Just 2% scandium added to aluminum increases strength, heat tolerance, corrosion resistance, and weldability. A lighter vehicle will require less energy (less gasoline or less lithium-ion batteries) to move a set distance.

Scandium offers improvements in aluminum particularly suited to the transport sector; marine, automotive, and aerospace.



Scandium's place in lightweighting is on the rise which means the need for new scandium mines has never been greater. Whilst still a niche industry with a high scandium metal price, if a miner was able to produce significant volumes then prices would go down, which in turn would mean order volumes would go up.

A 2019 scandium report stated:

"The major factors driving the growth of market studied are the accelerating usage in solid oxide fuel cells (SOFCs), and growing demand for aluminum-scandium alloys. On the flipside, lack of awareness, high cost, and inconsistent supply are hampering the growth of the studied market."

"According to the aircraft designers, about 0.1% to 0.5% trace amount of scandium added to aluminum can help to increase not only the strength of aluminum but also helps to reduce the weight of aircrafts by 15% – 20%."

Scandium demand will surge as scandium prices fall as new scandium supply comes online

SCANDIUM

DEVELOPING A NEW ALUMINUM ALLOY MARKET — NOW



Scandium is used in some fuel cells

A little known fact is that scandium is used in certain fuel cells as the electrolyte. For example, Bloom Energy sells a solid oxide fuel cell (SOFC) that produces electricity directly from oxidizing a fuel. Scandium oxide (Scandia) with zirconia (ScSZ) is the electrolyte. Scandium in SOFCs enables a lower operating temperature resulting in longer-lived equipment and less costly materials of construction. Bloom Energy in the US is the leading SOFC manufacturer and one of the largest scandium users.

Scandium's greatest potential is in light-weighting such as with aluminum alloys

The space and aviation industry is very aware of scandium and its lightweighting effects. Given the massive fuel savings lightweighting has enormous potential.

With the current movement to vehicle electrification, lightweighting becomes so much more important for mass market vehicles. A lighter electric car will mean more power and range for the same size battery.

Airbus has already been involved in designing new lightweight scandium-magnesium-aluminum alloys. One example is the lightweight bike shown below.

A super light weight bike made from Sc-Mg-Al alloy by Airbus subsidiary APWorks



Source

The problem to date has been that global scandium supply is only around 10 tonnes, which means scandium is expensive. Once larger scandium supply is made available then prices can fall. Miners with good grade scandium projects can still be profitable.

The potential market for Al-Sc alloys is enormous once costs come down

SCANDIUM

THE MARKET FOR Al-Sc ALLOYS IS LARGE AND DIVERSE



Scandium International Mining Corp.

Scandium International Mining Corp. (TSX: SCY) 100% owns the Nyngan Scandium Project, located in New South Wales, Australia. Scandium International's New South Wales lateritic clay belt, represents a recent game-changing discovery of scandium grades approximately four times the grade of existing sources. The resources are surface mineable enabling the company to deliver scandium at a large enough economical scale to promote much wider use and development of the metal.

Scandium International is at the stage where they can now offer an aluminum-scandium alloy (Al-Sc2%) master product using scandium from their Nyngan Scandium Project. This is highly significant as potential customers can now sample a final Al-Sc product. As the Company stated in their recent news release:

"The aluminum industry largely relies on independent master alloy manufacturers to make and supply alloying products, including small amounts of Al-Sc 2%."

Sampling a product is an essential stage that most miners go through before having their product accepted and subsequently sign off-take agreements.

Also of utmost importance is increasing scandium production volumes so as economies of scale kick in to lower scandium prices to more affordable levels. Scandium International stated:

“The Nyngan mine scandium output will change the scale of Al-Sc2% master alloy manufactured, globally, and the Company can utilize that scale advantage to effectively minimize the manufacture cost of scandium feedstock to the aluminum alloy customer.”

The next step for Scandium International is to assess and then build a large-scale demonstration plant for conversion of scandium oxide to Al-Sc2% master alloy.

Scandium International stated:

“The size of the demonstration plant is being investigated, but will be flexible in operation and output, and will allow for much more direct customer/supplier relationships with potential scandium product customers globally.”

Scandium International's goal is to build the world's first primary scandium mine as soon as possible (~2021) from their 100% owned Nyngan Scandium Project. All key approvals are in place, including a mining lease, making the Project 'shovel ready'. The May 2016 Definitive Feasibility Study resulted in a Phase 1 project NPV8% of US\$225 million, and a IRR of 33%, and only US\$87 million CapEx, based on a cost estimate for the Project of US\$557/kg scandium oxide, selling price of US\$2,000/kg scandium oxide, and 37,690 kilograms (37.69 tonnes) of scandium oxide production per year. The Project has potential to expand as scandium product demand grows. Exploration at the site has defined a measured and indicated resource 7x larger than what was used in the currently planned

20 year mine life outlined in the DFS.

Putnam on the US-China Trade Deal and its effect on scandium developers



“Scandium and yttrium have been called out specifically in the latest trade deal between China and the US. I think this is very encouraging to scandium developers...We are laser-focused on building the markets for scandium sales from our Australian project, the Nyngan Scandium Project.” States George Putnam, President, CEO, and Director of Scandium International Mining Corp. (TSX: SCY), in an interview with InvestorIntel’s Tracy Weslosky.

George went on to say that the trade deal is going to benefit both Canada and Australia as both countries have prospects for scandium production in the near to intermediate term. He said that Scandium International is at the front end of that effort in Australia. George also said that the US Commerce Department has published positive initiatives with both Australia and with Canada on encouraging and supporting the development of critical metals projects including scandium.

To access the complete interview, [click here](#)

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Making scandium mainstream in the very near future

Light weighting of vehicles using aluminium-scandium alloys can reduce costs, increasing range, and reduce emissions

More than ever before, new innovations are reshaping the automotive industry. One trend that is gaining in importance is “light weighting”. That is, making vehicles lighter, and hence more fuel efficient. Even tiny reductions in aircraft weight can lead to significant fuel cost reductions.

By using composite materials and alloys that are strong, but lighter than steel, companies are able to manufacture vehicles that require less fuel and create fewer emissions to meet tightening emission standards. China and Europe are tightening their emission standards in 2020, so this is of imminent concern for auto manufacturers. In the case of electric vehicles, a lighter vehicle offers a greater range. By using a lighter vehicle a smaller battery is needed, and the vehicle cost is reduced.

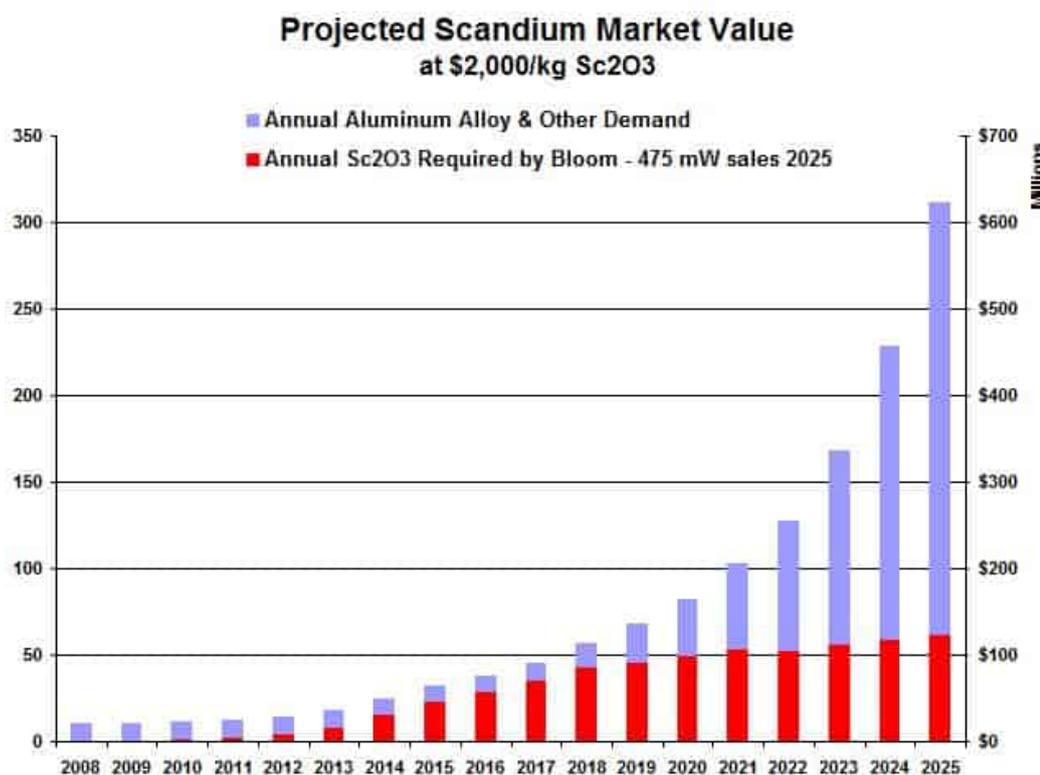
Scandium

Scandium (Sc), combined with aluminium (Al), is an effective way of light weighting vehicles. It can be added to aluminium to make alloys lighter, stronger and more malleable. This can dramatically reduce the weight of parts for not only cars, but also aircraft and ships, helping deliver savings on fuel costs. Right now a lack of scandium supply, and hence an expensive price, is holding back the industry. Scandium supply is a mere <50 tons pa.

Scandium is mostly used in aerospace and high end sports

equipment. It has enormous potential to reduce fuel costs in the aviation sector as Al-Sc alloys may reduce aircraft weights by 15%-20%. As the price falls the use could spread into the auto sector, initially into high end electric vehicles.

The chart below highlights the potential enormous growth for the scandium market should lower price (US\$2,000/kg) scandium oxide be available. The potential growth forecast below is a 6 fold increase in the scandium market from 2018 to 2025.



Source: Kaiser Research

Scandium International Mining Corp. (TSX: SCY) is a junior scandium developer. The Company has a 100% interest in the advanced stage Nyngan Scandium Project, located in New South Wales, Australia. Completing a DFS for the Project in May 2016 they are now focused on advancing the Nyngan Scandium Project to construction, with the goal of being the first company to achieve production from a primary scandium mine.

The 2016 DFS for the Nyngan Scandium Project

Looking at the DFS results below a key is that the unit cash cost is just US\$557/kg Sc oxide. This means the project is very economic (after tax NPV8% is US\$225 million) at US\$2,000/kg Sc oxide. Also at this price the scandium market can grow strongly if new supply becomes available.

Nyngan Scandium Project - Feasibility Study Financial Highlights

Summary Nyngan Scandium Project Key Project Parameters	NI 43-101 DFS Result
Capital Cost Estimate (US\$ M)	\$87.1
Average Plant Feed Grade (ppm Sc)	409
Resource Processed (tpy)	71,820
Mill Recovery (%)	83.7%
Oxide Production (kg per year)	37,690
Scandium Oxide (Scandia) Product Grade	98-99.9%
Annual Cash Operating Cost (US\$ M)	\$21.0
Unit Cash Cost (US\$/kg Oxide)	\$557
Oxide Price Assumption (US\$/kg)	\$2,000
Annual Revenue (US\$ millions)	\$75.4
Annual EBITDA (US\$ millions)	\$49.5
NPV (10%i) (After Tax)	\$177.5
NPV (8%i) (After Tax)	\$225.4
IRR (%) (After Tax)	33.1%
Payback (years)	3.3

The Nyngan operation is forecast to produce around 40 tonnes of scandium oxide per annum. Some may say this would flood the market, but the reality is the market can absorb a lot more scandium if prices were lower (US\$2,000/kg Sc oxide).

The Company has completed all required governmental approvals required for construction. The Company also owns a 100% interest in the Honeybugle Scandium property, an exploration property adjacent to the Nyngan Scandium Project.

The absence of a reasonably priced and reliable source of scandium has limited commercial uptake of scandium. Despite

this low level of use, scandium offers significant benefits. Both the aircraft and automotive industries discovered in the 1970's that if they alloyed aluminium with scandium it could produce a stronger, more corrosion resistant material. The bonus was the alloy was strong enough to be welded rather than riveted, resulting in lighter, more fuel-efficient crafts that are cheaper to produce and run.

At current prices scandium remains too expensive for anything more than use in the aerospace industry or sports equipment; however, with increased production comes reduced prices. With Scandium International's projected annual production alongside other Australian projects like Clean TeQ's Sunrise Project we could see scandium become mainstream in the very near future.

Scandium International Mining Corp. will be attending the 2020 PDAC Convention March 1-4, 2020 at the Metro Toronto Convention Centre, Toronto, Canada. Note that InvestorIntel will be one of the PDAC media sponsors.

Scandium International soars 41.67% last week on positive news from its Nyngan Scandium Project

Called the "seeds of technology" by the Japanese and the "technology metals" by the US Department of Energy, rare earth elements make it possible for the high tech world we live in today. With rare earth supply concerns centered around China's 70% supply chain dominance and the US-China trade war, did you know scandium is considered one of the 17 rare earth elements?

Period	Group 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H 1.008																	2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16	9 F 19	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52	25 Mn 54.94	26 Fe 55.85	27 Co 58.47	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.9	36 Kr 83.8
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197	80 Hg 200.5	81 Tl 204.4	82 Pb 207.2	83 Bi 209	84 Po (210)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (257)	105 Db (260)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Ds (271)	111 Rg (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Uuh (292)	117 Uus 0	118 Uuo 0
			6 58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (147)	62 Sm 150.4	63 Eu 152	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173	71 Lu 175		
			7 90 Th 232	91 Pa (231)	92 U (238)	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (254)	103 Lr (257)		

Scandium is one of the rare earth elements

Long recognized as a valuable commodity, economic concentrations of scandium are actually rare. Scandium is sourced from low-grade stockpiles or as a by-product from other processing operations. The current supply is limited and has resulted in high market prices and hence limited adoption. Scandium is used typically with aluminum as alloys for the aerospace industry, and for lightweight sports equipment such as bicycle frames, fishing rods, golf iron shafts, and baseball bats.

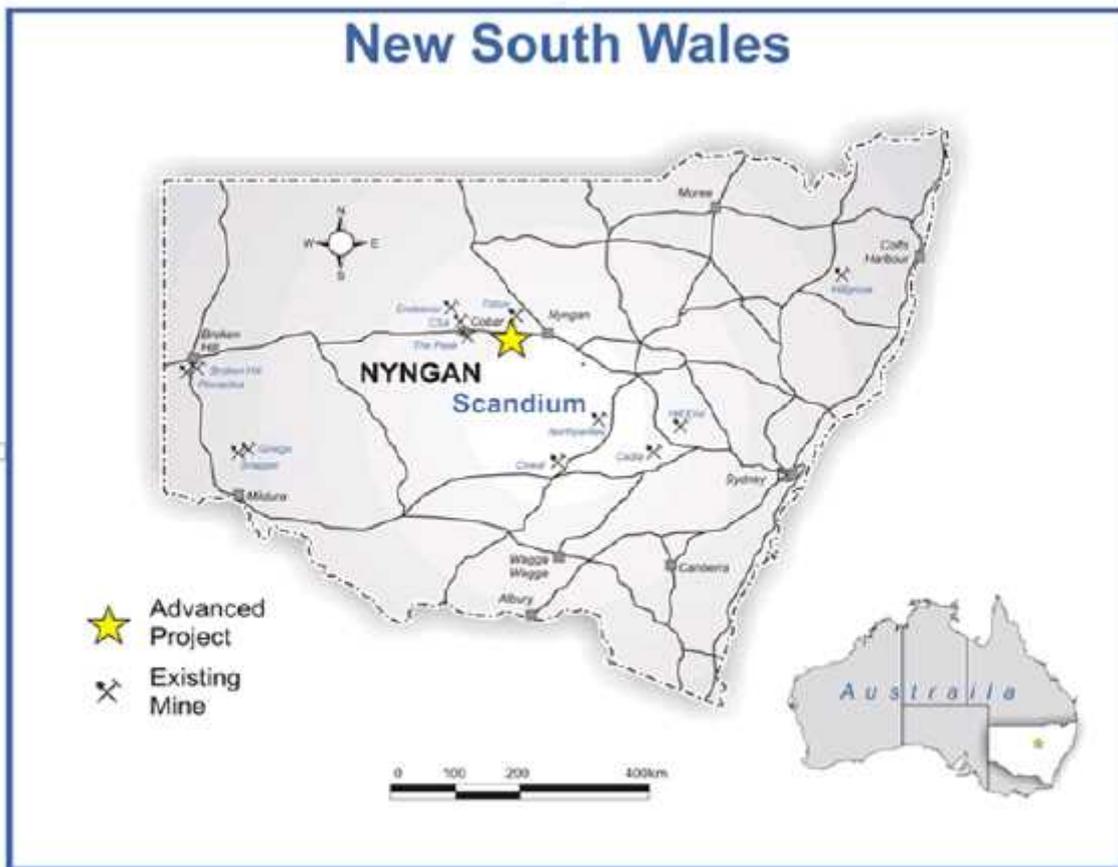
Scandium International Mining Corp. (TSX: SCY) has just advised (July 24, 2019) that its Australian subsidiary, EMC Metals Australia Pty Ltd. (EMC), has been granted a new mine lease pertaining to the Nyngan Scandium Project in New South Wales, Australia. The 100% owned lease will cover 364 hectares of freehold land. The company will be able to construct a mine of similar scale to current plans within the footprint of the new lease. As a result of this great news and interest in the

rare earths sector, Scandium International's stock price soared 41.67% last week.

Background to the mine lease being granted

A formal objection was filed in 2016 by an affected landowner opposing the application of the mine lease. In April 2019, the Company elected to file a new mine lease agreement covering only EMC owned surface rights related to the project that excluded approximately 504 hectares of surface rights owned by the objecting landowner. The validity of the landowner's 'Agricultural Land' objection remains under investigation. Depending on the results of that investigation, it remains possible for EMC to receive several mine lease grants covering a surface area of approx 870 hectares.

George Putnam, CEO of Scandium International Mining Corp. commented: "This replacement mine lease grant for our Nyngan Scandium Project represents a successful resolution to a complicated matter that has been a distraction for both the Company, and for SCY shareholders, since the start of 2019."



The Nyngan Scandium Project location map (NSW, Australia)

Scandium International has remained focused on the work to bring Nyngan Project into production and will make progress with existing LOI partners and continue to court new LOI partners. The Company continues to work on off-take agreements and funding for the Nyngan Project so as to commission the world's first primary scandium mine.

2016 Feasibility Study on the Nyngan Scandium Project

A 2016 a feasibility study at the Nyngan Scandium Project concluded that the Project has the potential to produce an average of 37,690 kilograms of scandium oxide per year, at grades of 98.0%-99.9%, generating an after-tax cumulative cash flow over a 20 year Project life of US\$629 million, with an after-tax NPV10% of US\$177 million (after-tax NPV8% is US\$225 million). The average process plant feed grade over the 20-year project life is 409 ppm of scandium. The capital cost estimate for the project is US\$87.1 million.

Despite its current cost and tiny production volumes, there are multiple potential high-value commercial uses for scandium, especially when used to strengthen aluminium alloys. Just a small amount when alloyed with aluminium produces a stronger lighter, heat and corrosion-resistant, weldable aluminium alloy. The aerospace and aviation industries already use scandium, and the lightweight alloy has the potential to support the emerging electric vehicle industry where weight is also critical. This means the world will benefit from new scandium miners such as Scandium International increasing supply and reducing costs.

Scandium International has a market cap of C\$ 53 million.

Scandium International's CEO on the impact of the US-China trade war on the global supply of scandium

“Depending on what happens in trade talks between the United States and China there could be some disruption of Chinese sources of scandium and I think that is going to be a good thing for Scandium International. It is going to highlight the fact that we are earliest possible producer outside of China, in the Australian clay belt. We are of a good size and of commercial scale to offer scandium to the waiting global markets outside of the disruptions what are apparently going to be caused by this trade dispute...” States George Putnam, President, CEO, and Director of Scandium International Mining Corp. (TSX: SCY), in an interview with InvestorIntel's Tracy

Weslosky.

George went on to discuss Scandium International's mine lease for its Nyngan Scandium Project. He said that the company is in discussions with the New South Wales' Department of Planning and Environment and expects that the mine lease will be reissued soon. George also provided an update on the LOIs with customers. He said that Scandium International is expecting full technical success with two of its LOI partners and are working to add more potential customers in the form of LOIs this year.

To access the complete interview, [click here](#)

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Scandium International's CEO on how scandium increases heat tolerance for stronger parts

Recently during PDAC 2019, George Putnam, President, CEO and Director of Scandium International Mining Corp. (TSX: SCY), shared updates on the results from Eck Industries testing of scandium in alloys with InvestorIntel's Tracy Weslosky.

George said: "We did an interesting announcement on results from Eck Industries which we are pretty excited about. This is a group that has been working to put scandium along with cerium into a casting alloy and they are getting spectacular

results. They are really pleased with the results. Let me tell you what those results are. They are making stronger parts, but they are making parts that are much more heat tolerant. Their customers are asking for that improvement in heat tolerance and they are delivering that with a new recipe that includes scandium.”

Scandium International Mining Corp. is focused on developing its Nyngan Scandium Project, located in NSW, Australia, into the world’s first scandium-only producing mine. The project owned by the Company’s 100% held Australian subsidiary, EMC Metals Australia Pty Limited, has received all key approvals, including a mining lease, necessary to proceed with project construction.

To access the complete interview, [click here](#)

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