

SRC Rare Earth Processing Facility



Saskatchewan:

› A Key Player in the Global Mining Industry

As the world looks to secure access to the critical minerals vital for telecommunications, computing and clean energy, Saskatchewan (and Canada) are well-positioned to meet that demand.

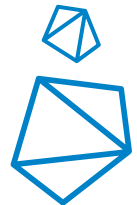


Saskatchewan is among the best places in the world to invest in critical minerals, as the province has a reputation as a world leader in mining investment attractiveness, resource potential, a strong stable government, and ethical and sustainable practices. Saskatchewan has high-quality and easily accessible geoscience and mineral resource information to inform and attract exploration for new discoveries. The province offers attractive exploration incentives and tax credits, and has a highly competitive royalty system for base, precious and emerging critical minerals.

- ▶ The Fraser Institute ranks Saskatchewan as the most attractive jurisdiction in Canada for mining investment and the third highest globally.



- ▶ The Fraser Institute ranks Canada as the number one country in the world for mineral investment (based on the combined rankings of all the provinces and territories).



Saskatchewan is home to **23 of the 31** minerals identified by the Government of Canada as essential for an economically secure, low-carbon economy. Saskatchewan's **Critical Minerals Strategy** (released in 2023) includes goals around doubling the number of critical minerals being produced in Saskatchewan by 2030 and establishing Saskatchewan as a Rare Earth Element Hub.

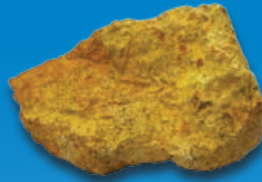
The scale of production and the amount of resources Saskatchewan lands offer is extensive.



▶ WORLD'S LARGEST PRODUCER OF POTASH

***30%**

OF GLOBAL PRODUCTION



▶ LEADING GLOBAL PRODUCER OF URANIUM

16%

OF GLOBAL PRODUCTION



▶ CANADA'S LARGEST PRODUCER OF HELIUM

60M ft³

OF HELIUM PRODUCED IN SASKATCHEWAN ANNUALLY



Rare Earth Elements Industry

Rare earth elements (REEs) are a group of 17 elements in the periodic table. They exist in low concentrations in many places worldwide but finding REE deposits in high concentrations suitable for commercial extraction is rarer.

- ▶ REEs are predominantly recovered from mineral concentrates of monazite and bastnaesite.
- ▶ Lanthanum and cerium are the most widely produced elements and feed into various end-use applications.
- ▶ Neodymium and praseodymium are the critical elements for permanent magnet manufacturing.
- ▶ Terbium and dysprosium are key elements for high-performance magnets.

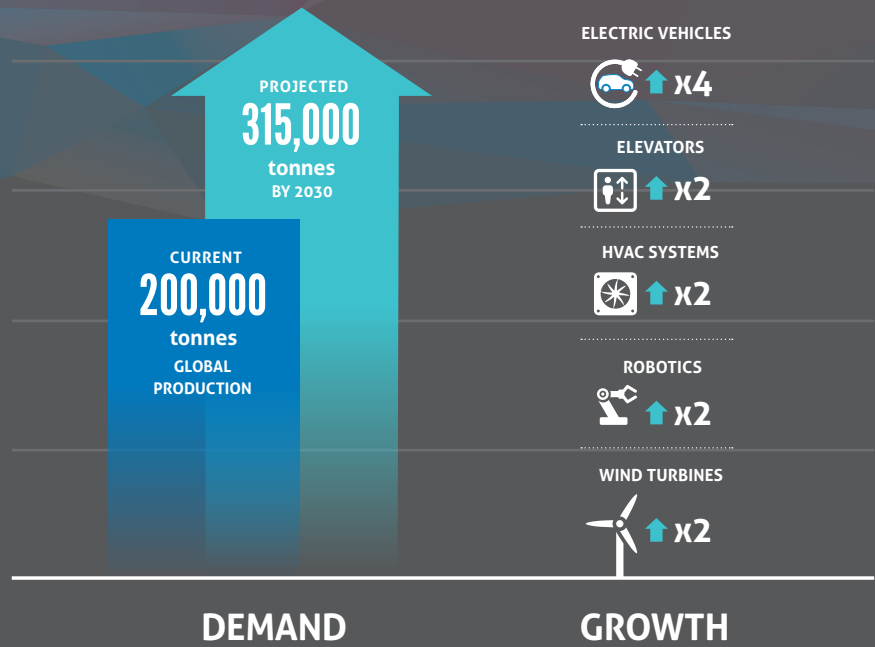
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	65 Tb Terbium	66 Dy Dysprosium
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REE Market Growth

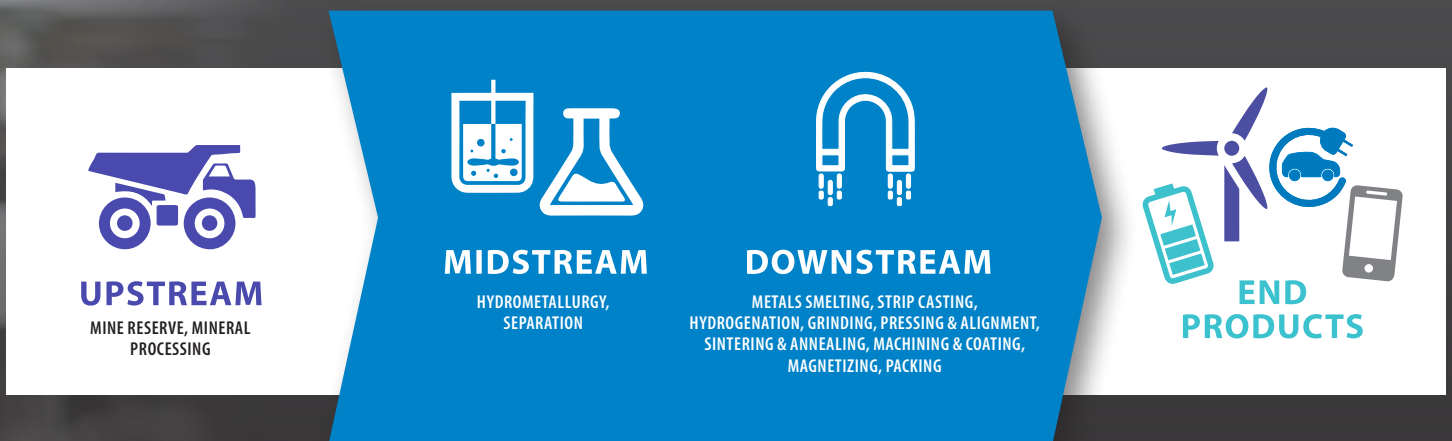
REEs are essential in many modern technologies, including wind turbines, cell phones and electric vehicles. Governments worldwide have deemed REEs "critical or strategic" minerals because of their unique properties and economic importance.

The REE market has experienced exceptional growth over the past couple of years and is expected to continue to grow in the coming years. This growth is directly related to the evolution of the energy sector, shifting from conventional fossil fuels to electric base sources, and net-zero emissions goals.



The annual demand for rare earth oxides is projected to climb from around 200,000 tonnes currently to about 315,000 tonnes by 2030, creating enormous pressure and opportunity for global production.

REE Global Supply Chain



Most of the world has been dependent on foreign sources of critical materials for many decades. This import dependence can be a concern because it puts supply chains and material users at risk.

With the evolution in both the auto and energy industries, hydrocarbon demand is

diminishing and REE demand is increasing. The secure supply of rare earth elements and the resiliency of their supply chains are essential to meeting this demand.

The REE supply chain is complex and poses many challenges to develop because there are many individual stages of the full

REE production chain including mining, beneficiation, hydrometallurgy, separation, metal alloys, magnets, original equipment manufacturers (OEM) and finally end use.

▶ REE Industry in Canada and Saskatchewan

Canada has some of the largest known reserves (measured) and resources (indicated) of rare earths in the world, estimated at over 15.1 million tonnes of Rare Earth Oxides (REOs) in 2022. Canada has about 7 per cent of the world's REE resources and is in tenth place in terms of reserves.

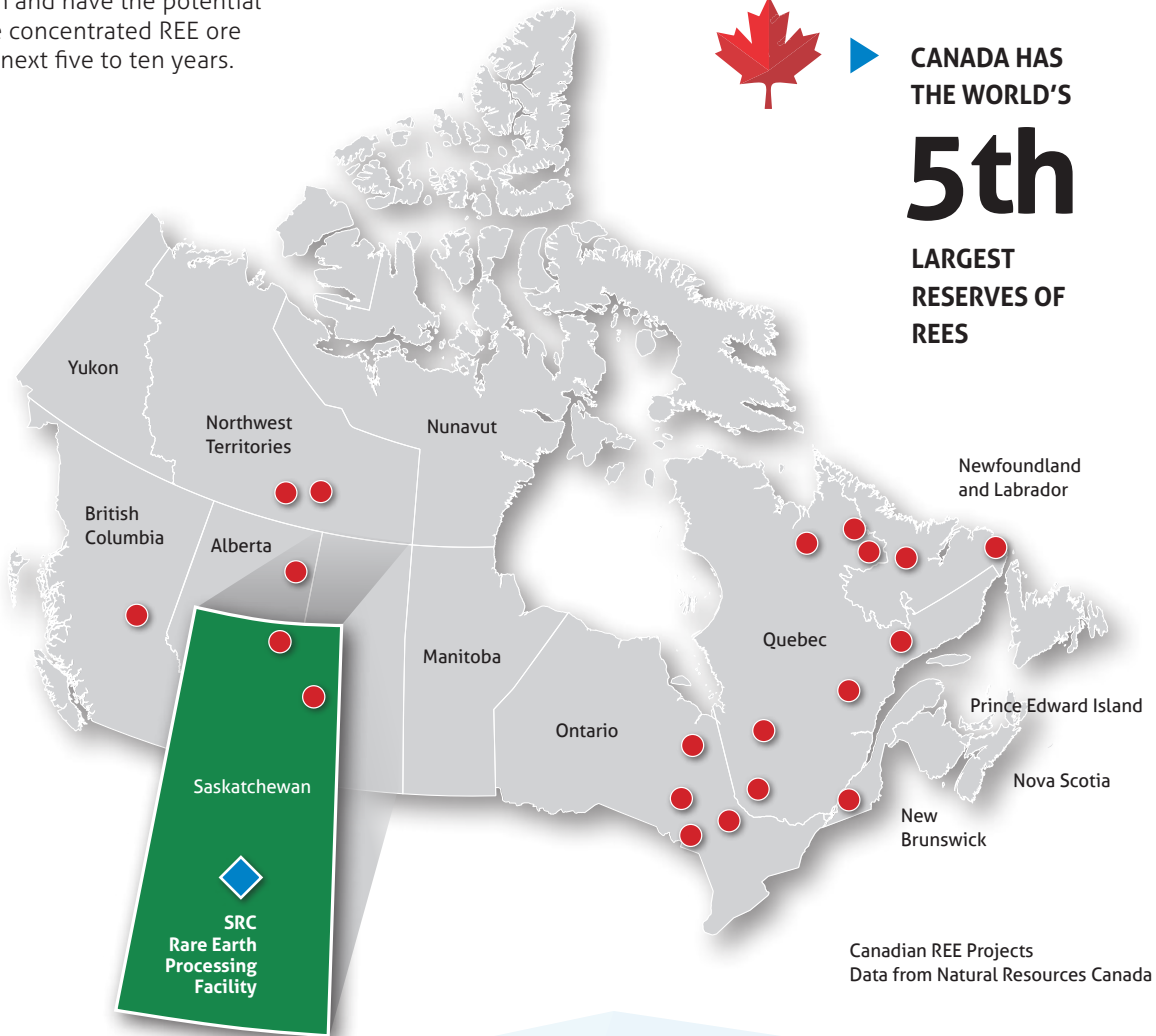
▶ These deposits are located in the Northwest Territories, northern Saskatchewan, Quebec, Ontario, Newfoundland and Labrador, and Alberta shale deposits. Currently, most of them are under exploration and have the potential to produce concentrated REE ore within the next five to ten years.

▶ With its plentiful REE deposits and considerable mining expertise and talent, Saskatchewan is well positioned to establish the REE processing industry, from mine to magnets.

▶ Saskatchewan has a secure and stable supply chain that provides the food, fuel, fertilizer and critical minerals needed to support a growing world.



▶ **CANADA HAS THE WORLD'S 5th LARGEST RESERVES OF REES**



Canadian REE Projects
Data from Natural Resources Canada 2023

► SRC Rare Earth Processing Facility – First of Its Kind in Canada

With support from the Government of Saskatchewan, the Saskatchewan Research Council (SRC) is constructing North America's first fully integrated, commercial, demonstration Rare Earth Processing Facility, with hydrometallurgy, separation and metal smelting units.

► The SRC Rare Earth Processing Facility is positioned as a catalyst to stimulate the resource sector in Saskatchewan and across Canada, providing the early-stage supply chain needed to generate industry investment and growth.

► The Facility will begin to establish an REE technology hub in Saskatchewan, forming an industry model for future commercial REE initiatives and supply chain development.



Artist's rendering of SRC Rare Earth Processing Facility.

SRC, one of Canada's leading research and technology organizations, has investigated lithium and REE technologies for over 15 years. SRC's Mineral Processing group, led by world-class REE experts, is recognized nationally and internationally as a centre of expertise in REE extraction and processing technology.

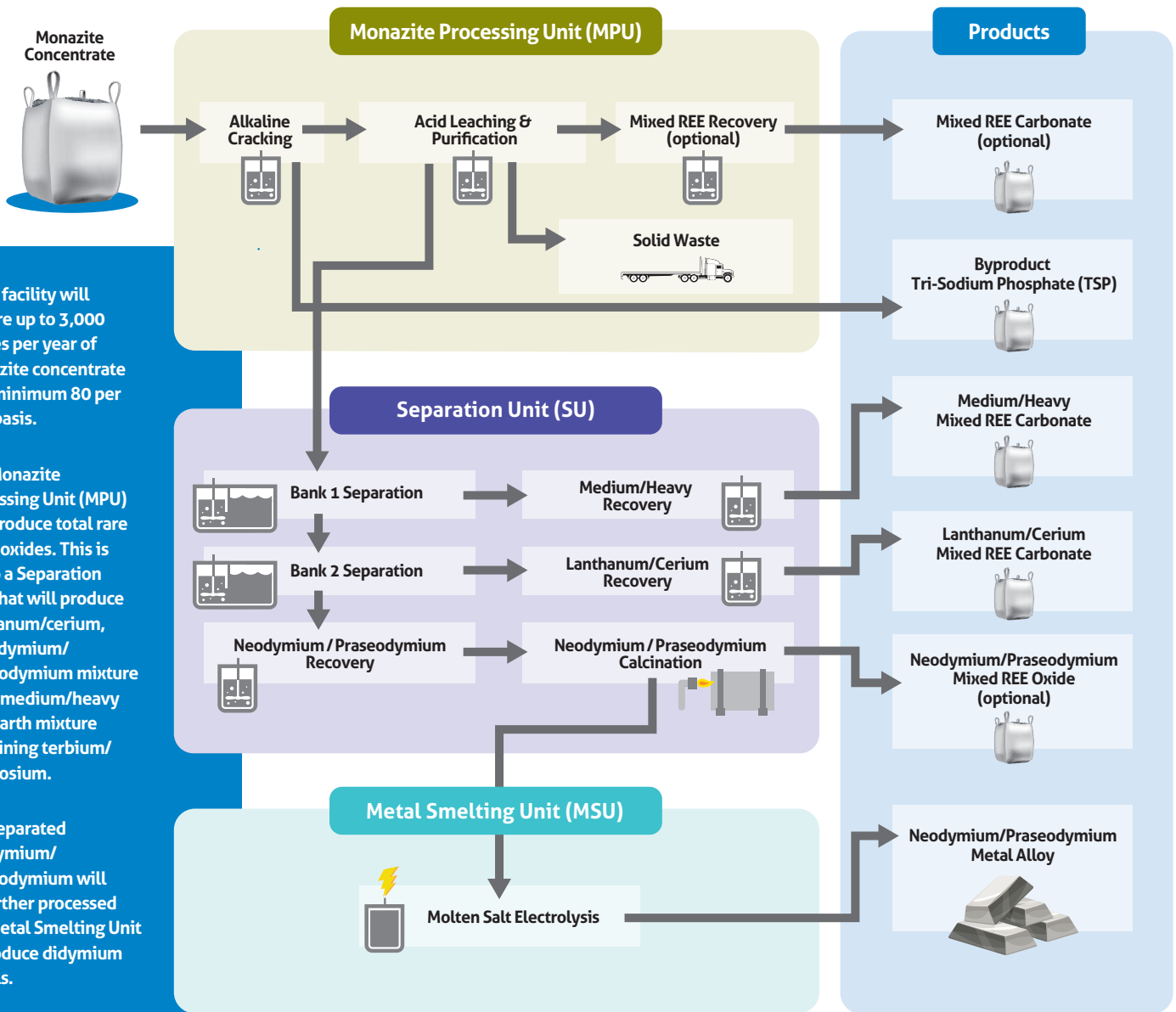
Production Capabilities

▶ The SRC Rare Earth Processing Facility will be operational in 2024.

▶ SRC is open to discussing the offtakes for monazite feed and the Separation and Metal Smelting Units product line.

▶ SRC will also consider the toll processing of various materials in its facilities from 2026 on.

SRC Rare Earth Processing Facility (Zero Liquid Discharge)




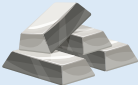


SRC's facility will require up to 3,000 tonnes per year of monazite concentrate on a minimum 80 per cent basis.

The Monazite Processing Unit (MPU) will produce total rare earth oxides. This is fed to a Separation Unit that will produce lanthanum/cerium, a neodymium/praseodymium mixture and a medium/heavy rare earth mixture containing terbium/dysprosium.

The separated neodymium/praseodymium will be further processed in a Metal Smelting Unit to produce didymium metals.

REE Facility Products

Product	Tonnes per year (Up to)	REO Distribution (tonnes per year, tpy)
<p>Byproduct Tri-Sodium Phosphate (TSP)</p> 	3,000	Tri-sodium Phosphate = ~3,000
<p>Medium/Heavy Mixed REE Carbonate</p> 	450	<p>Medium REOs Samarium, Europium, Gadolinium = ~75</p> <p>Heavy REOs Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium, Yttrium = ~125, with ~5 tpy of Terbium and 20 tpy of Dysprosium</p>
<p>Lanthanum/Cerium Mixed REE Carbonate</p> 	1,900	<p>Cerium Oxide = ~600 Lanthanum Oxide = ~300</p>
<p>Neodymium/Praseodymium Metal Alloy</p> 	400	<p>Neodymium Oxide = ~320 Praseodymium Oxide = ~80</p>

› Solvent Extraction Cells

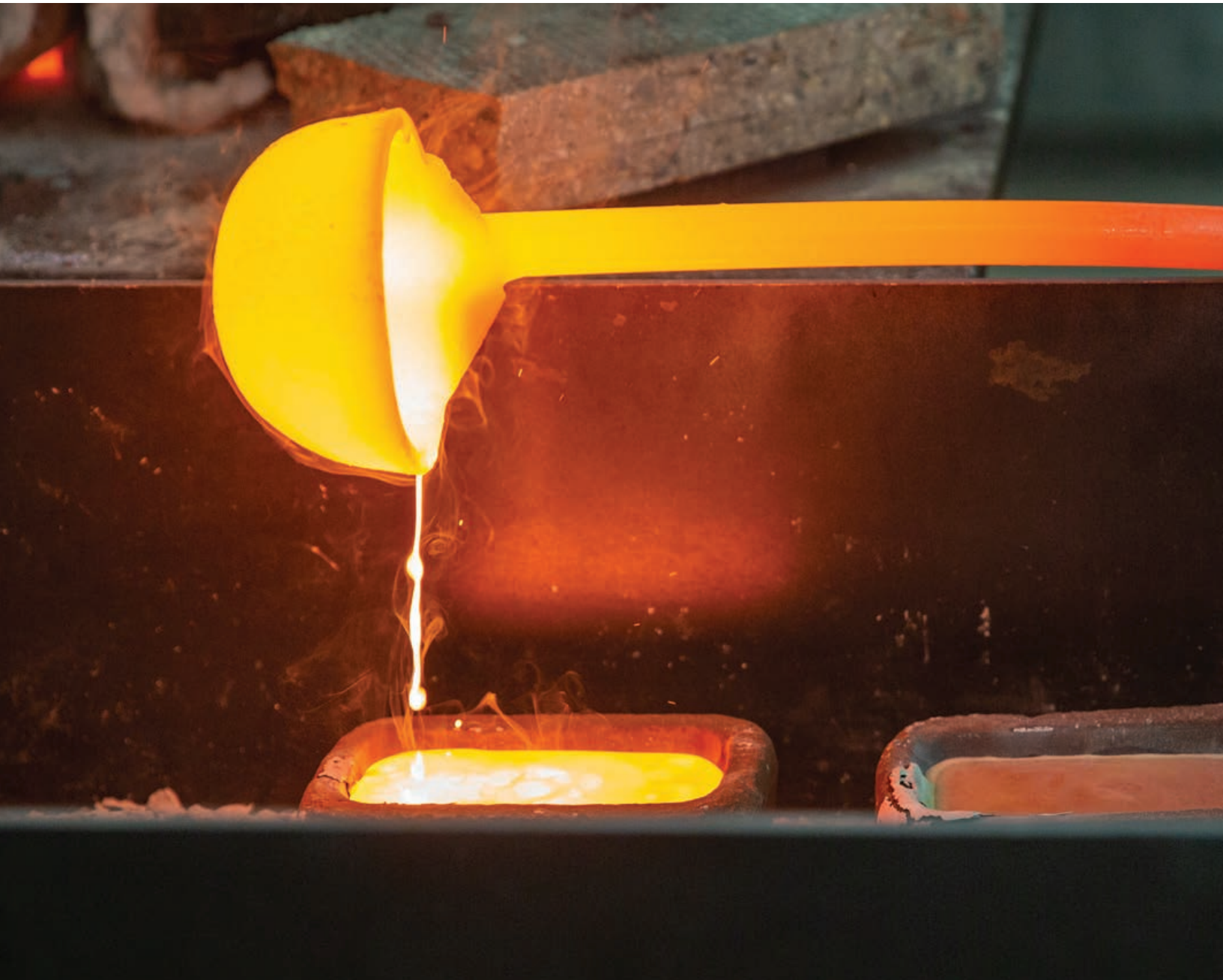
- ▶ SRC designed and manufactured proprietary commercial-scale solvent extraction cells for its Rare Earth Processing Facility.
- ▶ Saskatchewan is now only one of a handful of jurisdictions in the world with this capability.
- ▶ SRC is developing solvent extraction cell automation algorithms to improve productivity and efficiency.



▶ Metal Smelting

▶ SRC's industrial-scale REE Metal Smelting Unit is capable of producing neodymium, praseodymium, and didymium metals.

▶ SRC is developing operational automation to reduce costs and improve process efficiency.

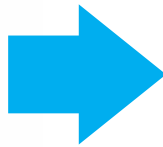


Completing the Strategic Supply Chain

- ▶ After a successful test run of its Metal Smelting Unit, the under construction SRC Rare Earth Processing Facility became the first large-scale producer of magnet metals in Canada.
- ▶ Metal ingots, a rare earth metal, are the key ingredient used to manufacture permanent magnets which are used in electric vehicles, wind turbines, electronics, etc.



Metal ingots



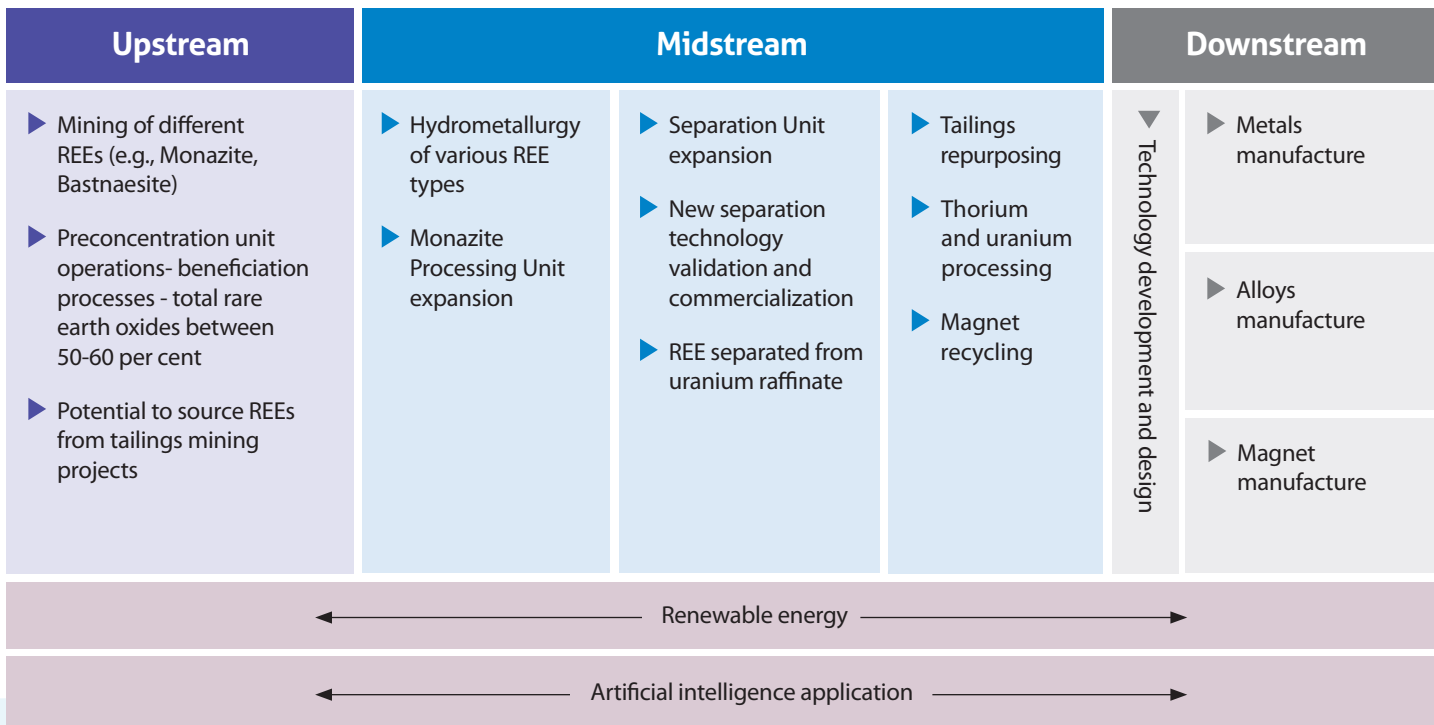
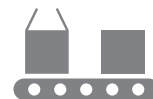
The SRC Rare Earth Processing Facility will produce enough metals to create 500,000 electric vehicles annually.

SRC Collaboration Opportunities

In the future, SRC will be seeking investment into further developing and expanding the REE sector.

SRC offers a fee-for-service model that provides services and expertise to clients.

- ▶ As a Treasury Board Crown Corporation, SRC works closely with the Government of Saskatchewan, including the Ministry of Trade and Export Development, the Ministry of Energy and Resources and the Ministry of Environment. SRC can help facilitate communication between the private sector and the Government of Saskatchewan for licensing and permitting, funding opportunities and investment credits.
- ▶ Over the past 75 years, SRC has built strong relationships within the mining sector in Canada and Saskatchewan. We are working closely with the burgeoning rare earth mining industry in Saskatchewan to help develop this emerging sector.
- ▶ SRC protects any intellectual property it develops on its own or as required for its clients. This may include copyrights, patents and trade-secret information. SRC and its employees will not knowingly infringe upon the intellectual property of an organization or individual. Intellectual property is covered under a standard clause as part of client agreements and negotiated on a case-by-case basis.



World's Most Environmentally Sustainable Rare Earth Processing Facility


SRC will solely operate the commercial demonstration facility at the highest environmental standards and we own all the necessary permits. Our target is to be net zero on REE within the first few years of operation. There will be zero liquid discharge from the Facility.

Tailings Management

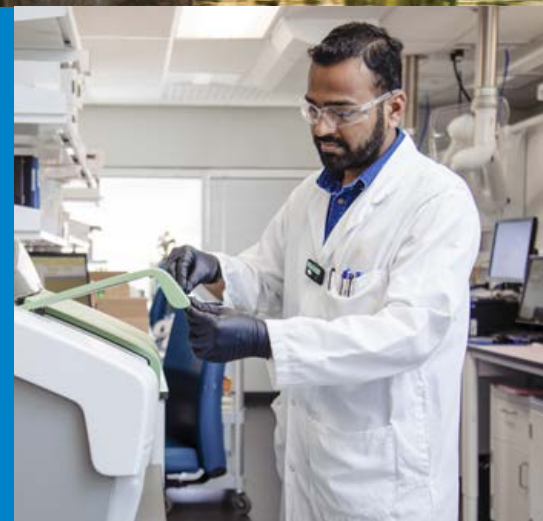
SRC has years of scientific, technical and management knowledge dealing with tailings, as well as experience working with regulators, communities, Indigenous groups and industry. Our capabilities in this area also include holding licences from the Canadian Nuclear Safety Commission (CNSC), as well as expertise at our Pipe Flow Technology Centre™ and through our remediation project in northern Saskatchewan that involves managing tailings remediation work at a large abandoned uranium mine site.

Environmental Compliance

- ▶ SRC works closely with its clients and stakeholders to explore opportunities and develop sustainable solutions for now and in the future. We are committed to providing positive environmental impacts in our province and around the world through diverse projects and initiatives.



For more than 60 years, SRC has actively engaged with the uranium and nuclear industry on numerous fronts. Our work has encompassed research to improve analyses and processes, project management and on-the-ground operational support.













SRC Expansion Plans for Permanent Magnet Facility





REE magnet capability is a strategic Canadian imperative. The Government of Saskatchewan and SRC have the capacity and capabilities to develop the REE industrial sector, from minerals to magnets.

▶ The fully integrated supply chain demonstrates the techno-economic viability of REE processing, which is compatible with global industry and acts as a catalyst for growing this industrial sector.

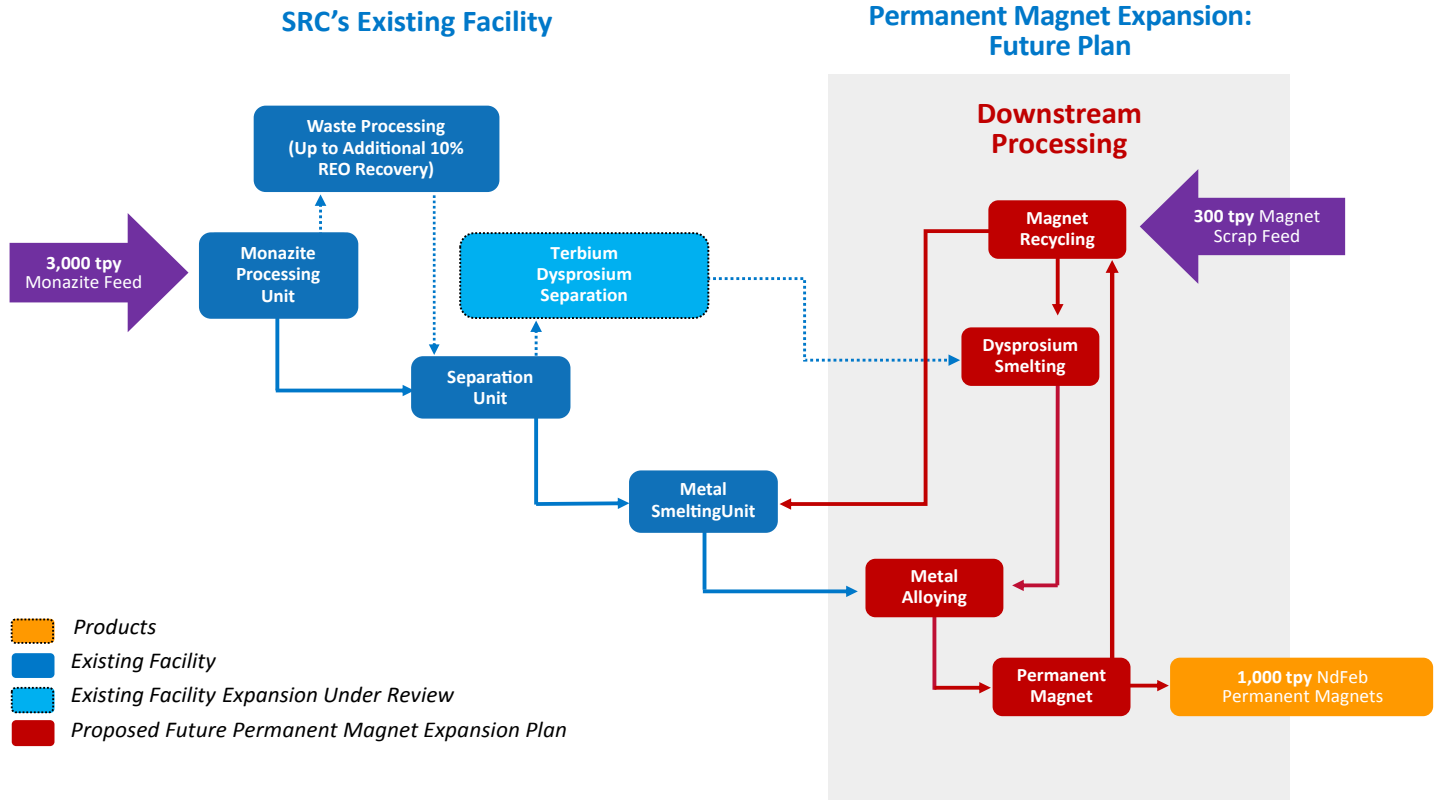
▶ Saskatchewan is positioned to expand the current SRC Rare Earth Processing Facility to produce ~1,000 tonnes per year of permanent magnets. This production is sufficient to manufacture 500,000 electric vehicles per year.

Permanent Magnet Manufacturing	
SRC CAPABILITIES	CONSIDERATIONS
 DUE DILIGENCE	 Human Capital
 DUE DILIGENCE	 Intellectual Property
 DUE DILIGENCE	 Supply Chain
 DUE DILIGENCE	 Specialized Equipment
	 Dedicated Market
	 Environment

SRC's focus is on NdFeb permanent magnet grades that are used in electric vehicles, wind turbines, energy saving elevators and robotics.

ELECTRIC VEHICLES 	ROBOTICS 
ELEVATORS 	WIND TURBINES 

Downstream Expansion



Metal Alloying

- Proposed future MA unit takes feed from SRC's existing Metal Smelting Unit and proposed Dysprosium Smelting Unit

Neodymium Iron Boron (NdFeB) Permanent Magnet

- Proposed future facility will produce **~1,000 tonnes/year** of NdFeB magnets

Dysprosium Smelting

- SRC Facility will produce up to **20 tonnes per year** of dysprosium oxide
- An additional **~20 to 30 tonnes per year** of dysprosium obtained from magnet recycling
- Production capacity is **~20 to 40 tonnes per year** of dysprosium metal

Magnet Recycling

- The recycling unit can produce **~100 tonnes per year** of neodymium/praseodymium oxides and **~20 to 30 tonnes per year** of dysprosium oxides

SRC Services for REE Sector Growth

Technoeconomic Evaluation of Rare Earth Processing Technologies

SRC has decades of experience in technoeconomic evaluation of rare earth technologies related to beneficiation, hydrometallurgy, separation and metal smelting.

We offer a stage-gated, fast-to-fail approach and bench and pilot-scale platform for technology and process testing.

Solvent Extraction: Pilot-Scale Studies

SRC has built a small-scale separation pilot plant that has 150 stages of mixers and settlers (each stage capacity of ~1 litre) and can be configured to different separation processes for either group separation or individual REE separation. Products with +99.9 per cent purity have been produced from the pilot plant. It can be further upgraded to higher purity with an increased number of stages.

SRC has also built a commercial-scale Solvent Extraction Unit that has six stages



Solvent Extraction Cells Designed and Built at SRC

of mixers and settlers (each stage has a capacity of ~1,200 litres) and is used to improve the impeller design, process control, and mixing and separation efficiencies. These cells are designed for a 1,500 tonnes per year separation plant.

SRC can design, fabricate and install solvent extraction cells at any commercial scale and conduct solvent extraction performance testing and optimization.



Metal Smelting: Pilot-Scale Studies

SRC offers an industrial-scale rare earth metal smelting pilot plant. The electrolytic furnace, with Tungsten cathode and graphite anode, has a capacity of ~43 tonnes per year and operates up to 4,000 Amps and 15 Volts.

This pilot is used to refine the operating parameters, process sequence and operating procedures to yield the highest rare earth metal recovery and purity. The unit is also used to train the operational staff and as a platform to conduct research and development for automation of the metal smelting process.

REE Plant Operational Improvement and Support

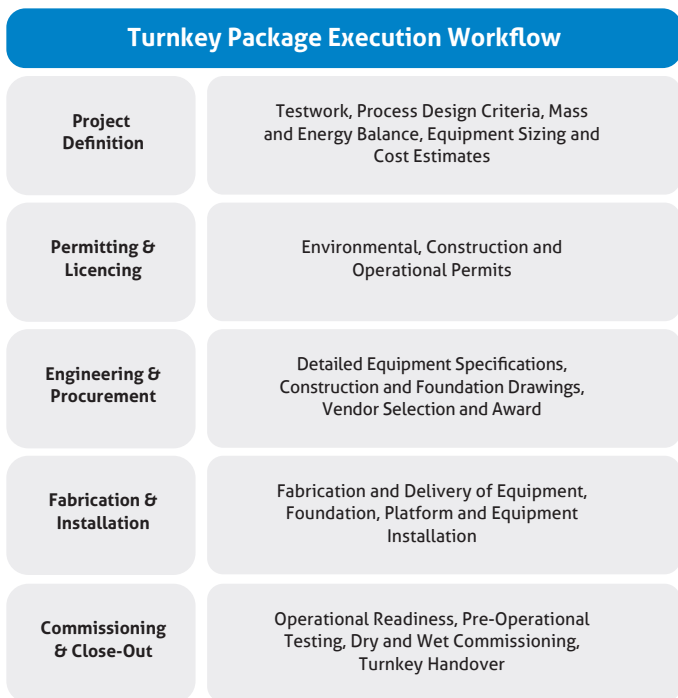
SRC can provide experienced engineers and technologists who have a broad knowledge of REE process plant development and specification to support plant operations with an objective to achieve business benefits, such as reducing production costs, improving quality and increasing throughput.

We can provide support in developing pre- and post-commissioning procedures, safe work practices and standard operating procedures, dry and wet commissioning, plant inspection and operations, operation improvements, quality management, analytical testing, and process safety.

Turnkey Services for Commercial-Scale Rare Earth Processing Facilities

SRC has a diverse team of mechanical and electrical engineers, as well as in-house fabrication capabilities with experience in engineering and designing processes, tools, instrumentation, and equipment relevant to rare earth upstream, midstream and downstream processing facilities.

SRC works closely with the local construction industry to deliver turnkey services for beneficiation, hydrometallurgy, solvent extraction and metal smelting processing.



Mineral Analysis: Geochemistry and Mineralogy

SRC is Saskatchewan's most advanced and complete mineral analysis centre supporting resource industries through its Geoanalytical Laboratories and Advanced Microanalysis Centre™. We have the necessary analytical tools, expertise and experience to provide you with a wide range of services and analytical packages, all available from one location.

Our labs and experts are focused on providing leading-edge research, development and demonstration, as well as analytical services to support companies, consultants, researchers and governments with mineral exploration, mineral processing, tailings management and reclamation and mine closure. We have specialized expertise in mineralogical characterization for sensor-based sorting technologies, which are becoming more important in REE projects.

Environmental Permitting


We work with our clients to develop detailed tailings management, environment emission control and operational planning to support the environmental permitting and licensing process.

SRC is committed to **establishing an REE supply chain from minerals to magnets** in Saskatchewan, Canada.



For more information please visit:

src.sk.ca

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 [Saskatchewan Research Council \(SRC\)](https://www.linkedin.com/company/Saskatchewan-Research-Council-(SRC))

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