

SASKATCHEWAN RESEARCH COUNCIL

Rare Earth Processing Facility

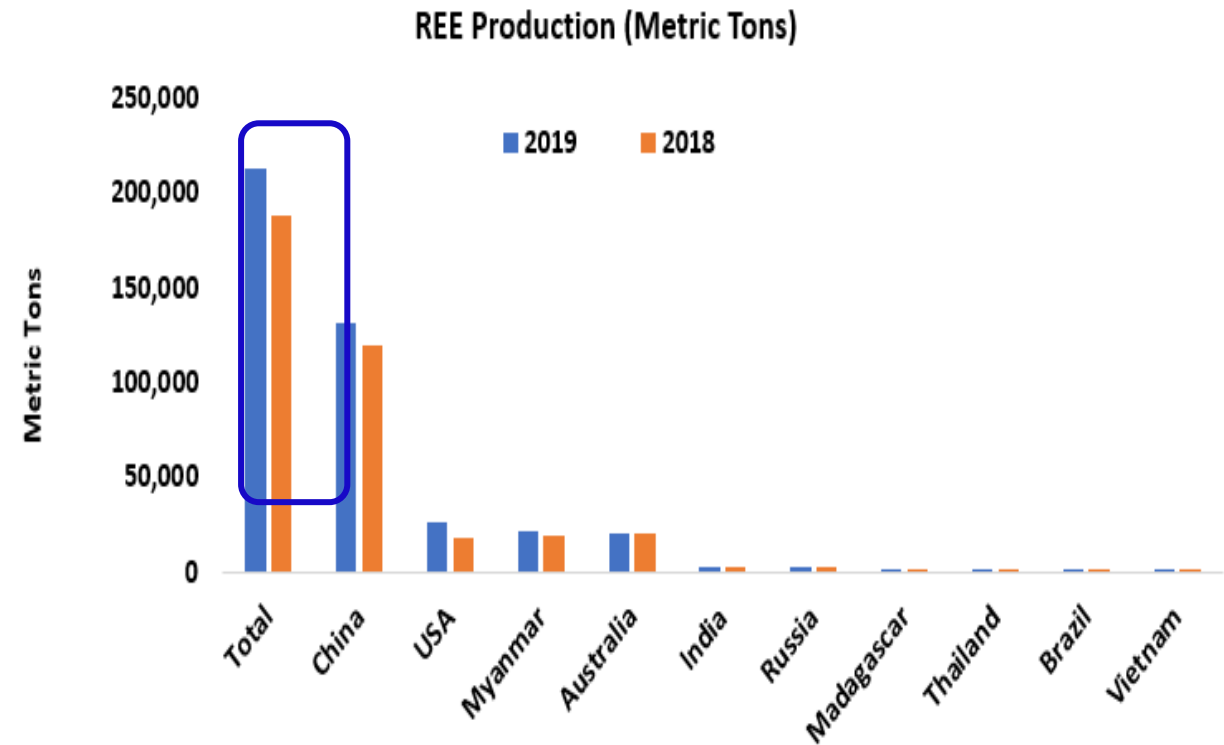
Critical Minerals

- Rare Earth Elements (REEs) are not particularly “rare” - they exist in low concentrations in many places across the world
- Deposits with high concentrations suitable for commercial extraction are more rare
- These elements have unique properties and are an essential component in many modern technologies
- Their unique and vital importance means that they are deemed “Critical or Strategic” Minerals by Governments, including our own
- For over a decade, SRC has been investigating **lithium and REE** technologies as this burgeoning industry has been developing
- SRC’s Minerals group is now recognized nationally and internationally as a center of expertise in REE extraction and processing technology



REE Global Market Overview & REE Reserves

- China currently dominates the REE Market (over 70% global production)
- Until recently, China was a net exporter of REEs – they are now a net importer, currently trying to secure REE sources globally
- China's stance on REEs of increasing concern
- Current global production around 200,000 MT, demand set to double by early 2030's
- REE ore prices increased by many times from June 2020 to date



Source: U.S. Geological Survey, Reston, Virginia: 2020

REE Global Market Overview & Reserves

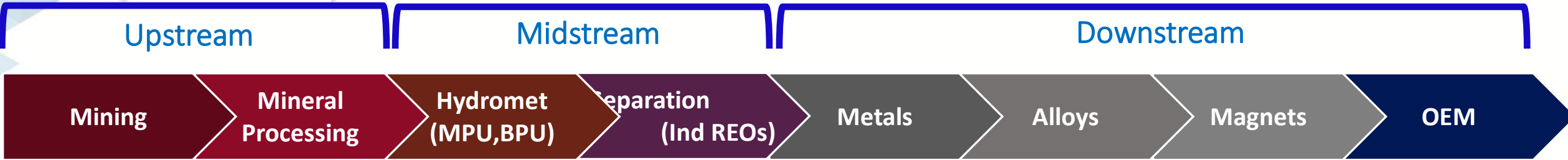
Country	Reserves (MT) ¹	Resources(MT) ²
China	44,000,000	164,000,000
Brazil	22,000,000	55,000,000
Vietnam	22,000,000	14,300,000
Russia	12,000,000	47,800,000
India	6,900,000	
Australia	3,300,000	49,000,000
Greenland	1,500,000	43,000,000
United States	1,400,000	14,300,000
Canada	830,000	33,460,000
South Africa	790,000	-
Other countries	1,200,000	57,360,000

- Reserves by US Geological Survey 2020
- Resources by review paper 2017
- China stands at 1st place
- Canada is 10th place by reserve and **6th place measured by resources**
- Canada currently has 7% of world resources of REEs

1: pubs.usgs.gov/periodicals/mcs2020/mcs2020.pdf

2: <https://www.mdpi.com/2075-163X/7/11/203/pdf>

Existing REE Supply Chain – Canada



Ore \$10,000/MT Mixed REO \$30,000/MT Ind. REO \$60,000/MT Metal Alloys \$200,000/MT

**Average Estimates April 2022*

Development of Midstream
Processing Facilities are critical
To Canadian Value-Added Production

Saskatchewan is taking the lead

Junior Mining CO,s



SRC REE Facility



Opportunity



SRC Rare Earth Processing Facility

- In August 2020, the Government of Saskatchewan announced \$31M for a large scale, fully commercial demonstration Rare Earth Processing Facility
- Facility is first-of-its-kind in Canada, will be operated by SRC, is ~80,000 square feet and located in Saskatoon
- Facility is first step in establishing a REE hub in Saskatchewan and supply chain, outside of China



SRC Rare Earth Processing Facility

- Intermediate mixed Rare Earth Oxides will be produced from a Monazite Processing Unit (MPU)
- The product from the MPU is fed to a Solvent Extraction Unit (SXU) to produce separated Rare Earth Oxides, namely Nd/Pr
- These individual Oxides are fed to a Metal Processing Unit to produce Didymium metal alloys

RARE EARTH PROCESS



Monazite
3,000 MT



MPU

Rare Earth	MT/Year	MT/Year
Lanthanum Oxide (Le ₂ O ₃)	312	265
Cerium Oxide (CeO ₂)	687	585
Praseodymium Oxide (Pr ₆ O ₁₁)	77.7	66.1
Neodymium Oxide (Nd ₂ O ₃)	294	251
Samarium Oxide (Sm ₂ O ₃)	47.1	74.5
Europium Oxide (Eu ₂ O ₃)	2.40	
Gadolinium Oxide (Gd ₂ O ₃)	38.1	
Terbium Oxide (Tb ₄ O ₇)	5.10	
Dysprosium Oxide (Dy ₂ O ₃)	21.6	
Holmuin Oxide (Ho ₂ O ₃)	3.30	
Erbium Oxide (Er ₂ O ₃)	10.2	
Thulium Oxide (Tm ₂ O ₃)	1.20	
Ytterbium Oxide (Yb ₂ O ₃)	5.70	
Lutetium Oxide (Lu ₂ O ₃)	0.90	
Yttrium Oxide (Y ₂ O ₃)	95.7	122
TREO	1602	
		1364

SXU

95%
Recovery

Metals

Metal – MT/Year	
Didymium (NdPr)	256

REE Facility – Current Status

Completed:

- MPU Building shell
- Pre-Feasibility
- Feed

In progress:

- Procurement
- Construction

MPU Operational – Q1 2023

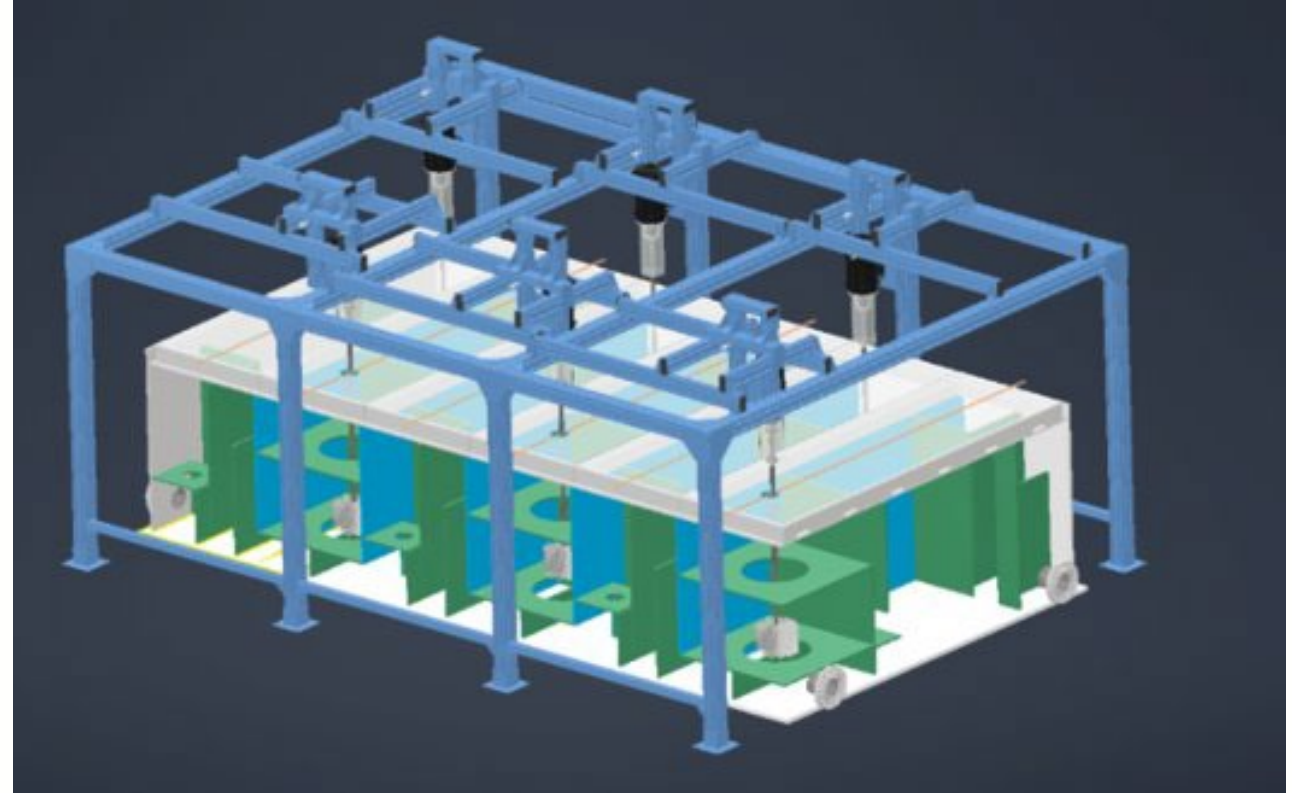
SXU and Metals Operational – Q2 2024



SRC Monazite Processing Unit

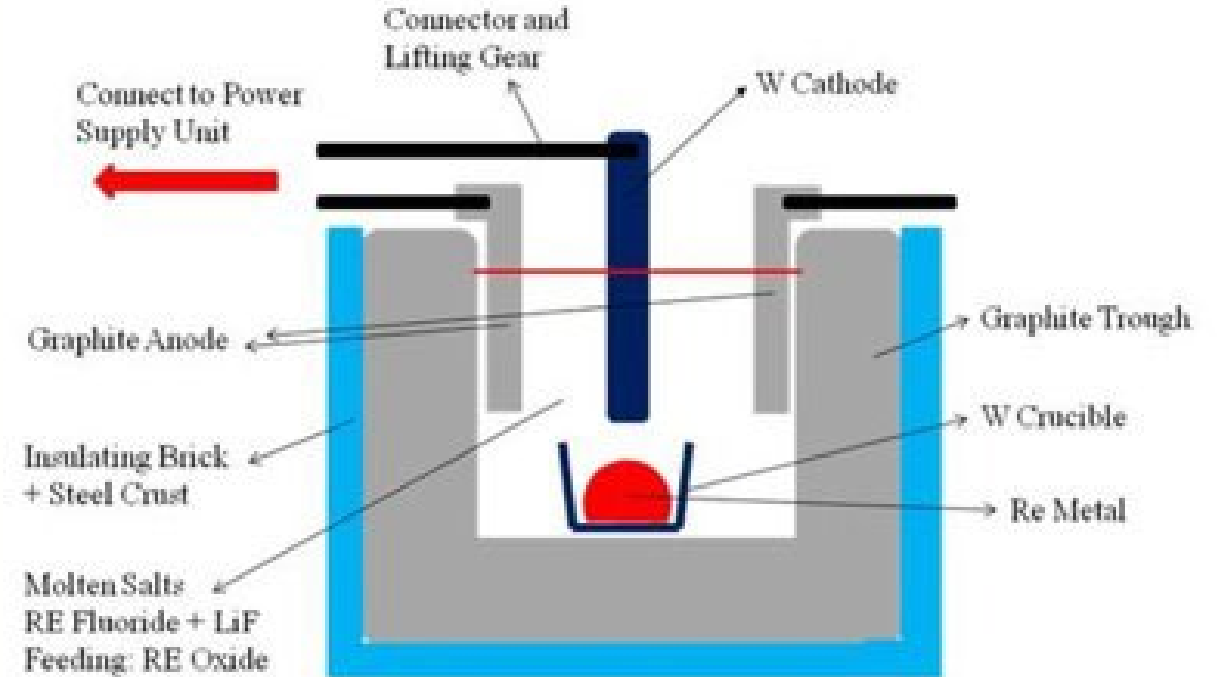
SRC's REE SXU Pilot

- SRC is designing the SX cells and constructing a Pilot to de-risk SXU operations
- We will perform the test with six cells and validate the design/process parameters – Expected to complete the test in June 2022
- Engaging support for design validation
- Global fabrication options



SRC's REE Metal Processing Pilot

- SRC is constructing a Pilot to de-risk Metal Processing operations
- The Pilot capacity is ~43 t/y and is expected to produce metal ingots in June 2022
- Exploring global procurement options for electrolytic furnaces



Schematic of the 4000A Electrolysis Furnace

Feed Supply

- SRC's Facility will require 3,000 tonnes per year of monazite concentrate on a minimum 80 per cent basis
- In July 2021, SRC procured up to 800 tonnes of monazite concentrate from Indústrias Nucleares do Brasil (INB), S.A., in Brazil from their mine and processing facility
- The monazite concentrate is arriving at SRC in the spring of 2022 and will be used as a feedstock for the MPU
- SRC is continuing to source additional preconcentrated monazite globally prior to the MPU commissioning
- Open to discuss off-take agreements with a term of 3 to 5 years

Facility Product Line

- SRC intends to develop the following products from its Rare Earth Processing Facility for sale to market:
 - ~1500 t/y of Rare Earth Carbonate/Chloride (from MPU) - Expected to be available for purchase from Q2 of 2023
 - ~3000 t/y of Trisodium Phosphate (from MPU) - Expected to be available for purchase from Q2 of 2023
 - ~30/70 mixture of Lanthanum/Cerium Chloride (from SXU) - Expected to be available from Q3 of 2024
 - ~300 t/y of 75/25% Nd/Pr metals (from Metal Processing Unit) - Expected to be available from Q3 of 2024



Collaboration Opportunities

There are several potential collaboration and investment opportunities:

- Offtake agreements for REE Products, REO and Metals
- Supply agreements for Monazite, we are looking for international sources of Monazite, as well as from Canada
- Major equipment procurement: crystallizers, evaporators and grinding mills
- Chemical procurement: Nd/Pr/Lithium fluorides and solvent extractant P507
- Potentially an opportunity to invest in expansion of the SRC Facility
- Lab/pilot scale service offerings – hydrometallurgy, solvent extraction and metal processing



SASKATCHEWAN
RESEARCH COUNCIL



Saskatoon

Bay 2D, 820 51st Street East | 306-933-5400

Regina

129-6 Research Drive | 306-787-9400

Toll-free 1-877-772-7227 | www.src.sk.ca | info@src.sk.ca