

A sustainability assessment framework to guide decision-making about rare earth element mining

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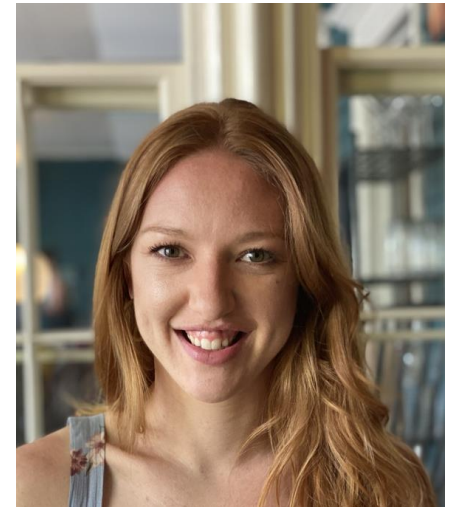
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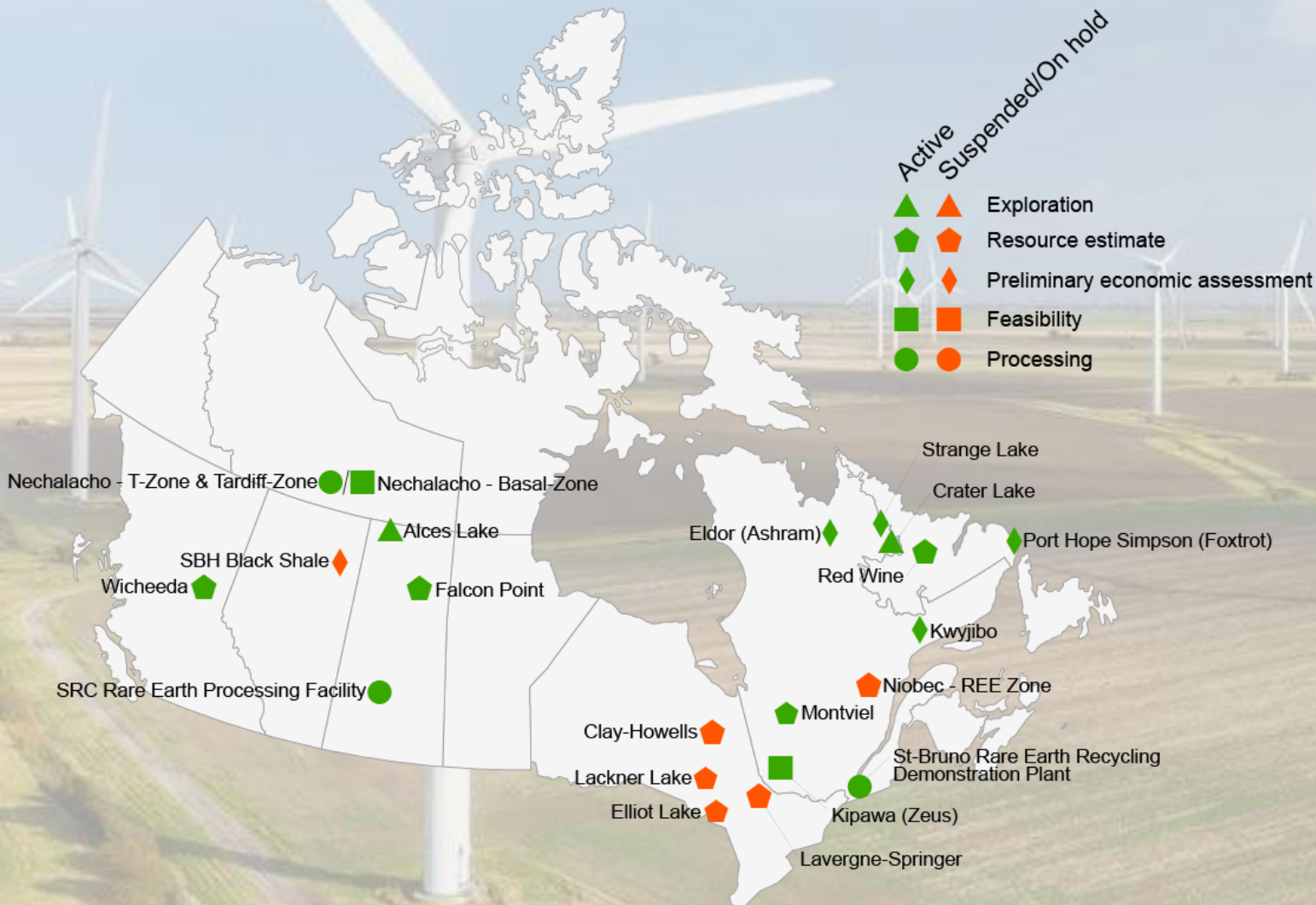
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WHAT ARE RARE EARTH ELEMENTS (REE)?



- 15 Lanthanides, scandium and yttrium
- Electronics
- Defense
- Renewable Energy Technologies
- 73.2% GHG emissions currently emitted by the energy sector
- Global shortages projected by 2030

RARE EARTH ELEMENT MINING

- 120 Mt Rare Earth Oxides Globally
- Radioactive Associations
- Poorly Studied Health Effects
- Mining Process:
 - Resource Intensive
 - Expensive
 - Requires Hazardous Chemicals
 - Deforestation



Toxic sludge pouring into a tailings pond in Mongolia

Liam Young (2015). Unknown Fields. Retrieved from <https://www.bbc.com/future/article/20150402-the-worst-place-on-earth>

HOW CAN REE MINING CONTRIBUTE TO SUSTAINABILITY?

- Mining as a practice is unsustainable
- Anthony Hodge, “Mining’s Seven Questions to Sustainability: From Mitigating Impact to Encouraging Contribution”
- Mines can be used as a “bridge” to the future
- Using Sustainability Assessment in planning to contribute to overall well-being



Silberg (2014). Retrieved from <https://climate.nasa.gov/news/1099/rare-earths-in-rare-form-at-caltech-competition/>

GENERIC CRITERIA FOR SUSTAINABILITY ASSESSMENT

SUBSTANTIVE CRITERIA

(Adapted from Gibson et al. (2005))

1. Socio-ecological System Integrity
2. Livelihood Sufficiency and Opportunity
3. Intragenerational Equity
4. Intergenerational Equity
5. Resource Maintenance, Efficiency and Conservation for a Hospitable Planet
6. Understanding, Commitment and Cooperation in Pursuit of Socio-ecological Well-being
7. Precaution and Adaptation
8. Integration for Mutual Reinforcement

PROCESS FEATURES

(Adapted from Sinclair et al. (2020))

1. Specification of Sustainability Criteria for Context
2. Learning and Capacity Building
3. Comparative Evaluation of Alternatives Including the Null Option
4. Transparent Rules for Avoiding or Mitigating Trade-Offs that Threaten Sustainability Objectives
5. Interjurisdictional Collaboration that Recognizes the Local, Regional and Strategic Levels
6. Incorporation of Indigenous Rights, Authority and Knowledge
7. Early Planning and Follow-up of Compliance
8. Transparency, Fairness and Impartial Implementation

SUBSTANTIVE

CRITERIA FOR SUSTAINABILITY ASSESSMENT OF RARE EARTH ELEMENT MINES

Substantive Criteria

- 1. Expand transitional opportunities to enhance livelihoods, lives, and communities**
- 2. Restore and/or enhance the relationships among social, environmental, and economic systems**
- 3. Increase efficiency and innovation to reduce pressures on natural resources and community capacities**
- 4. Contribute to climate responsibility**
- 5. Enhance equity and fairness**
- 6. Ensure positive legacies**

PROCESS

CRITERIA FOR SUSTAINABILITY ASSESSMENT OF RARE EARTH ELEMENT MINES

Process Criteria

- 1. Early establishment and continued application of a participative planning process**
- 2. Comparative evaluation of alternatives and establishment of clear guidelines for managing trade-offs**
- 3. Broadly engaged and collaborative governance**
- 4. Indigenous rights, authority and Traditional Knowledge**
- 5. Continual learning and adaptation**
- 6. Full lifecycle assessment process**

REE MINING IN CANADA: NECHALACHO, NWT



Retrieved from
<https://www.nsenergybusiness.com/projects/nechalacho-rare-earth-mining-project/>



Retrieved from
<https://vitalmetals.com.au/portfolio/nechalacho-project/>

- Canada's first REE mine, June 2021
- Thor Lake, NWT about 100 km southeast of Yellowknife in the Mackenzie Mining District
- Traditional lands of local Metis and Dene First Nations
- Mackenzie Valley Environmental Impact Review Board
 - Considers the biophysical, socio-economic and cultural implications of an undertaking
 - Cumulative effects
 - Incorporated Indigenous Knowledge

THE NECHALACHO PROJECT

- Participation agreement and accommodation agreement for training, employment and business opportunities
- Operations run by Det'on Cho Nahanni Construction Corporation, owned by the Yellowknives Dene First Nation
- Particle ore sorting using x-ray transmission
- Primary processing in Saskatoon, with additional processing completed in Norway
- Final destination to be electric vehicles in Germany



<https://www.cbc.ca/news/canada/north/rare-earths-plant-opens-saskatoon-1.6588141>

Substantive

Process

1. Expand transitional opportunities to enhance livelihoods, lives, and communities

1. Early establishment and continued application of a participative planning process

2. Restore and/or enhance the relationships among social, environmental, and economic systems

2. Comparative evaluation of alternatives and establishment of clear guidelines for managing trade-offs

3. Increase efficiency and innovation to reduce pressures on natural resources and community capacities

3. Broadly engaged and collaborative governance

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4. Indigenous rights, authority and Traditional Knowledge

5. Enhance equity and fairness

5. Continual learning and adaptation

6. Ensure positive legacies

6. Full lifecycle assessment process

IN CONCLUSION

With today's technology we cannot achieve a transition to renewable energy production without rare earth elements. Canada is in a unique position to serve as an example of how to supply these critical elements, in a way that contributes to overall well-being.