

# Assessing contributions to sustainability from rare earth element mines



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# WHAT ARE RARE EARTH ELEMENTS (REE)?

- 15 Lanthanides, scandium and yttrium

Periodic Table of the Elements

H	He																
Li	Be	B	C	N	O	F	Ne										
Na	Mg	Al	Si	P	S	Cl	Ar										
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og	
La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu																	
Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr																	

- Electronics
- Defence
- Renewable Energy Technologies: wind turbines, solar panels, nuclear energy, LED lighting, electric and hybrid vehicles
- Paris Agreement: 1.5-2°C
- Net zero by 2050
- 73.2% Greenhouse gas emissions currently emitted by the energy sector
- Projected 5%-8% increase in REE demand annually from 2012 to 2037
  - Neodymium 700% increase annually
  - Dysprosium 2600% increase annually

# 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

# 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



# GENERIC CRITERIA FOR SUSTAINABILITY ASSESSMENT

- Sustainability Assessment Frameworks
  - United Nations (2015): Sustainable Development Goals
  - Gibson et al. (2005): Generic Criteria for Sustainability Assessment
  - Bond et al. (2012): “State-of-the-art Characteristics”
  - Hacking & Guthrie (2008): Comparative Framework for Assessment Techniques
  - Yaylaci & Düzgün (2016): Indicator-based Sustainability Assessment Framework
- Process Features
  - Sinclair et al. (2020): Criteria for Next Generation Assessment
- Trade-Offs
  - Gibson et al. (2005): Trade-off Rules



UN's 17 Sustainable Development Goals

# GENERIC CRITERIA FOR SUSTAINABILITY ASSESSMENT

## ASSESSMENT 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

## 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 Managing 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

## Criteria for Sustainability Assessment of Rare Earth Element Mines

### Description

<b>I. Contribution to Sustainability</b>	Social, economic and ecological well-being, sufficiency and opportunity.
<b>I. Early Planning</b>	Transparent, assess alternatives, precaution, cumulative effects.
<b>I. Indigenous Rights, Authority and Traditional Knowledge</b>	Co-governance, collaboration not consultation.
<b>I. Climate Responsible</b>	Efficiency, recycling, circular economy.
<b>I. Public Inclusion and Collaboration</b>	Transparency, continual learning, public monitoring.
<b>I. Fair and Transparent Governance</b>	Strong and fair governance, continual learning.
<b>I. Positive Legacies</b>	Intergenerational equity, positive legacies for host communities and the planet.

## CRITERIA FOR SUSTAINABILITY ASSESSMENT OF RARE EARTH ELEMENT MINES

# REE MINING IN CANADA: NECHALACHO, NWT



- Canada's first REE mine
- Thor Lake, NWT about 100 km southeast of Yellowknife in the Mackenzie Mining District
- Traditional lands of Northwest Territory Métis Nation and Yellowknives Dene First Nation
- Operation began in June 2021
- NWT assessment process has a co-governance foundation in modern land claim agreements with the Indigenous authorities in the Mackenzie Valley.
- Mackenzie Valley Environmental Impact Review Board
  - Considers the biophysical, socio-economic and cultural implications of an undertaking
  - Assessed cumulative effects
  - Incorporated Indigenous Knowledge



## 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 not only supply these critical elements, but do it in a way that contributes to overall well-being.

# Let's continue the conversation!

Post questions and comments via chat in the IAIA22 platform.



## #iaia22

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