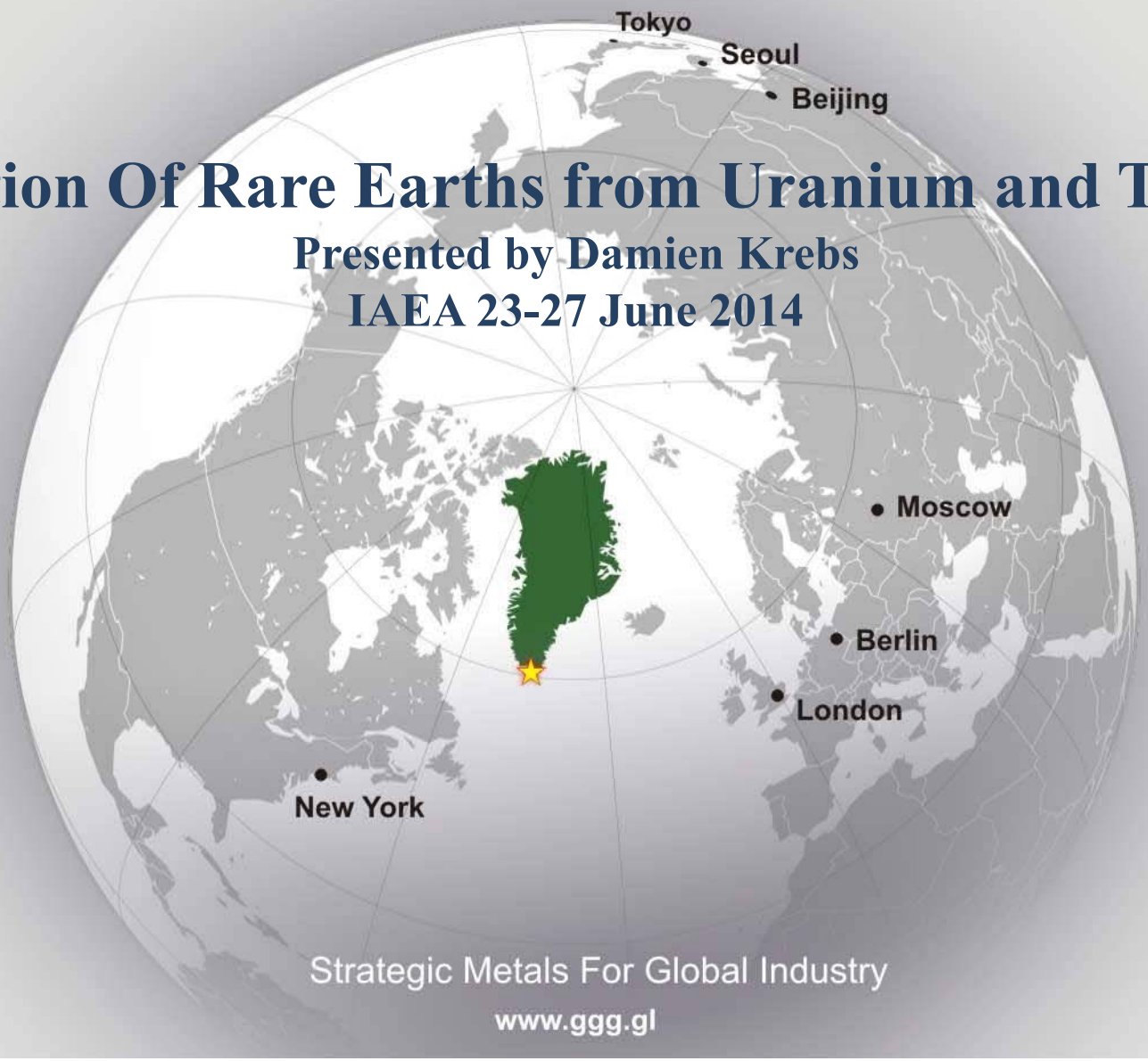
GREENLAND
MINERALS AND ENERGY LTD

Separation Of Rare Earths from Uranium and Thorium

Presented by Damien Krebs

IAEA 23-27 June 2014



Greenland Minerals and Energy Ltd

ASX-listed, Greenland-focussed mineral explorer and developer

Kvanefjeld multi-element project (REEs, uranium, zinc):

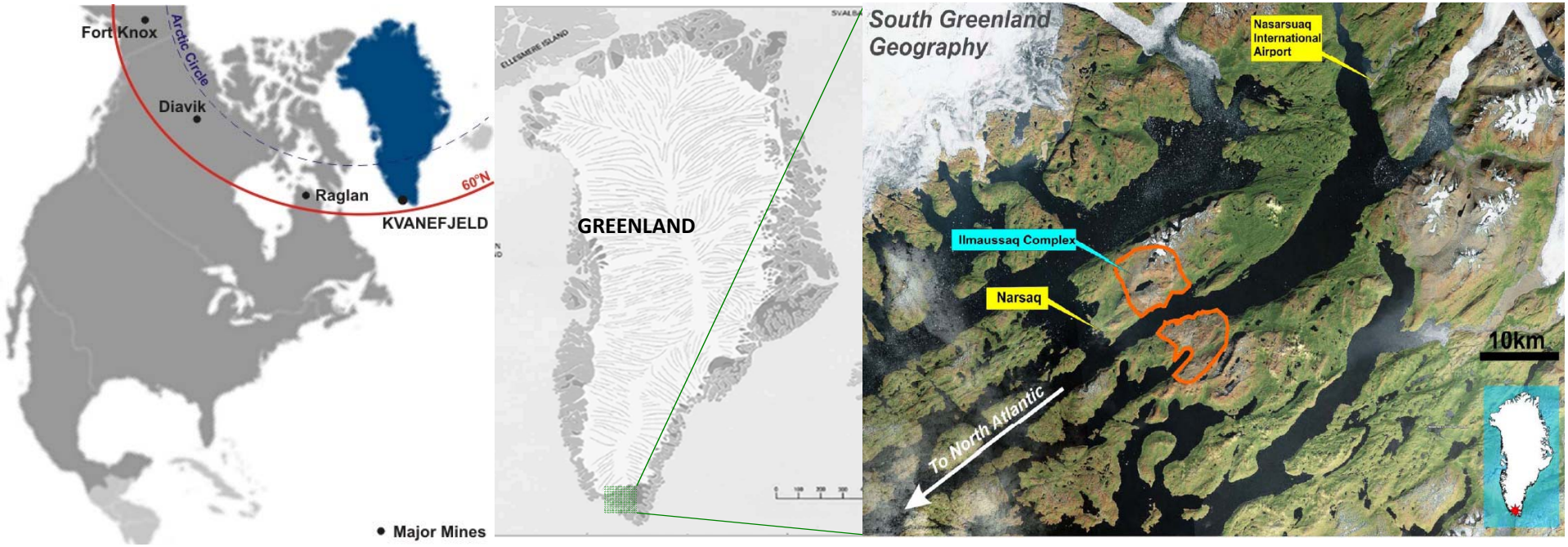
- A mineral project of world-wide strategic importance
- One of world's largest REE-uranium resources
- Highly accessible – able to mine all year round
- Non-refractory ore type – beneficiates and leaches well with low-technical risk
- Long-life, cost-effective production of rare earths
- Environmental and social impact risks are low and manageable

Drilling at the 242Mt Sørensen Deposit, Kvanefjeld Project, South Greenland

The Kvanefjeld Project – Favourable Location

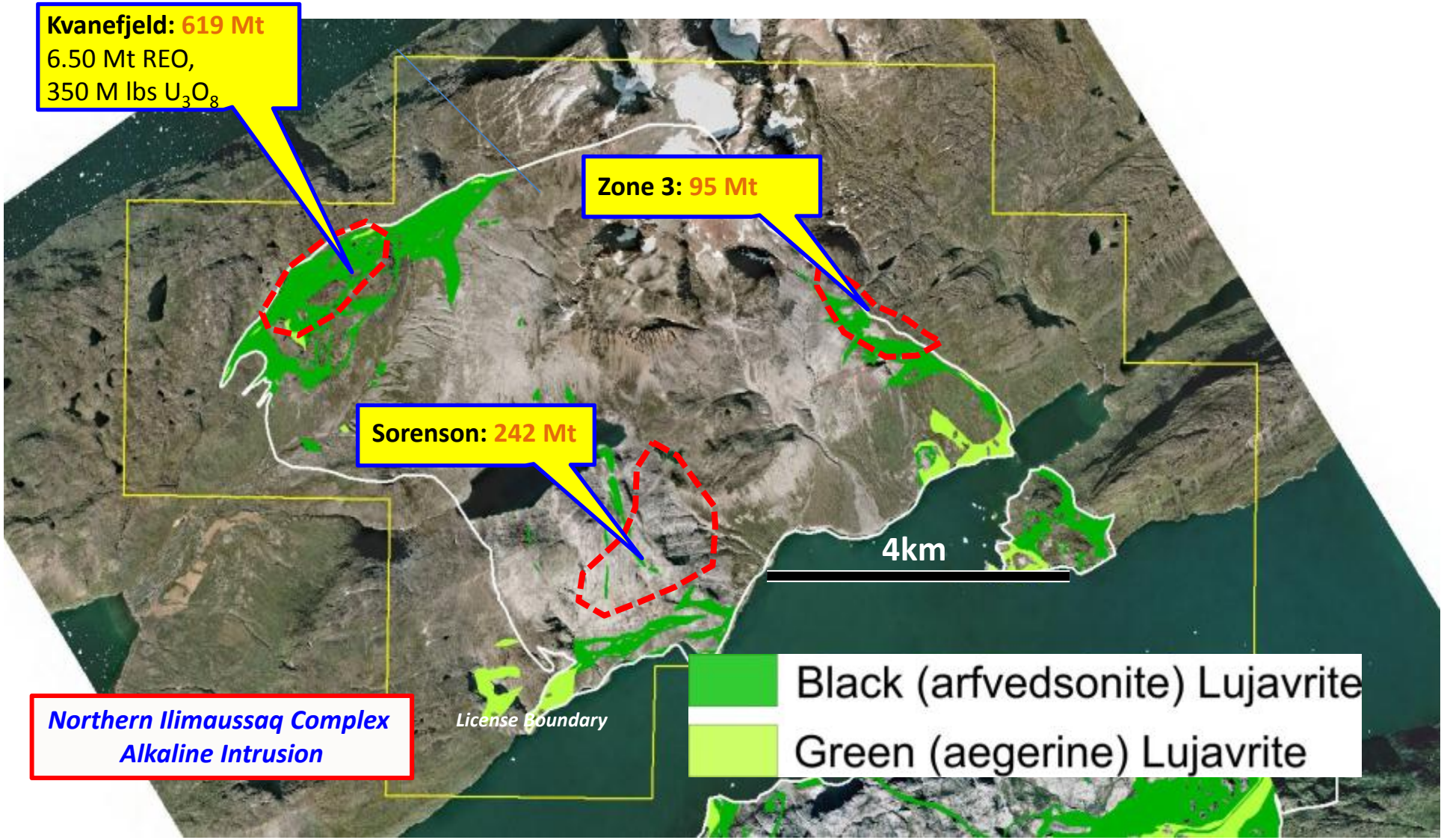
Readily accessible location near existing infrastructure

- Located at a latitude lower than long established mining regions of Alaska and northern Canada
- Adjacent to deep water fjords which run directly out to the North Atlantic Ocean
  - *Mine and concentrator can be built within 10kms of harbour;*
  - *Access to nearby hydropower, minimal infrastructure requirements*
- Town of Narsaq located 10km from Kvanefjeld can provide both labour and services



The Kvanefjeld Project – Unique Geology

Location of Deposits within Northern Ilimaussaq Complex



The Kvanefjeld Project – Significant Resources

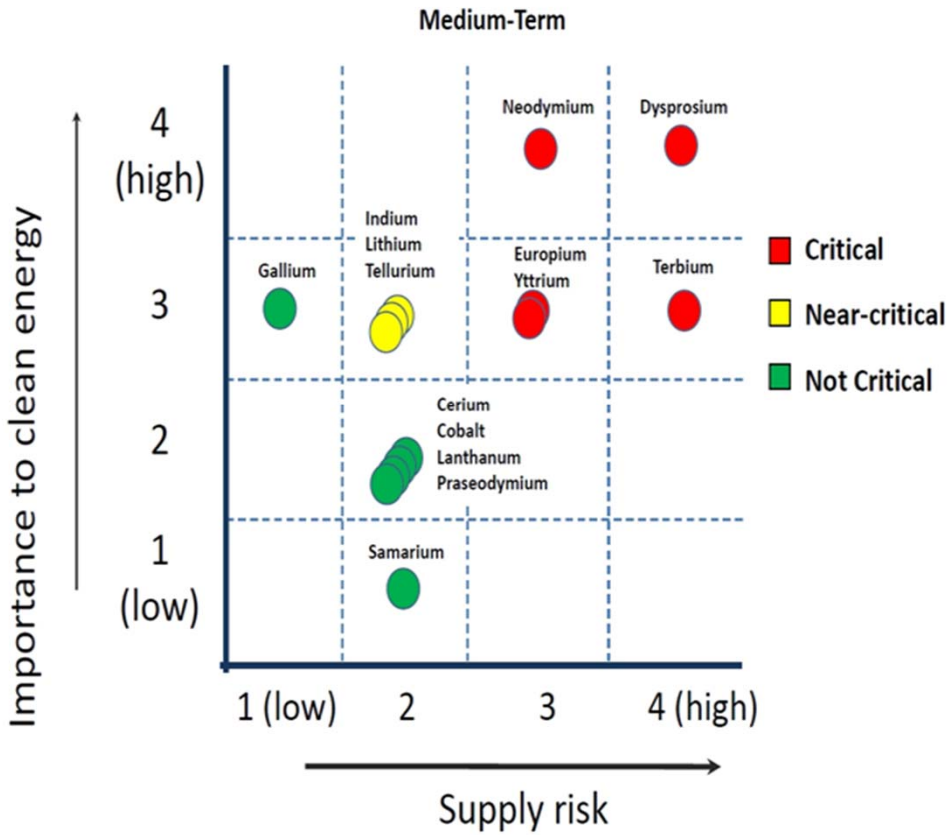
Exploration and Resource Estimation continuing success

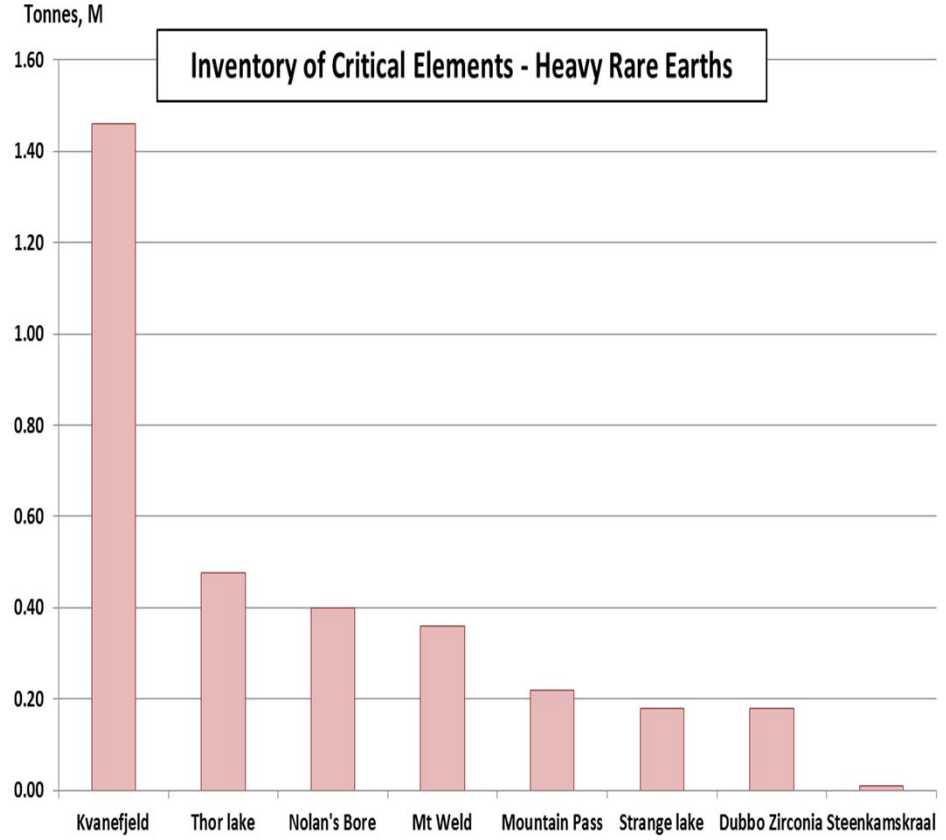
- GME has invested over $75M over past 6 years in exploration and research
- Overall Project JORC-code compliant resource inventory is 956Mt containing 10.33 Mt TREO and 575 Mlbs U_3O_8

Deposit Name	Tonnage (Mt)	U_3O_8 Grade (ppm)	REO Grade (%)	Contained U3O8 (Mlbs)	Contained REO (Mt)
Kvanefjeld	619	257	1.06	350	6.55
Sorensen	242	304	1.10	162	2.67
Zone 3	95	300	1.16	63	1.11
Total	956	273	1.08	575	10.33

Rare Earths Market – Focus on Strategic Elements

Kvanefjeld's Endowment of Critical Rare Earths





Source: US DoE Critical Materials Strategy Report November 2011

Greenland – An Important New Minerals Region

Pro-mining government looking to foreign investment and expertise

- **Greenland moved from *'Home Rule'* to *'Self Rule'* in 2009, and assumed full authority over its mineral and hydrocarbon resources, formerly shared with Denmark**

- **Looking to mining as a cornerstone of its future economy; the key to economic independence**

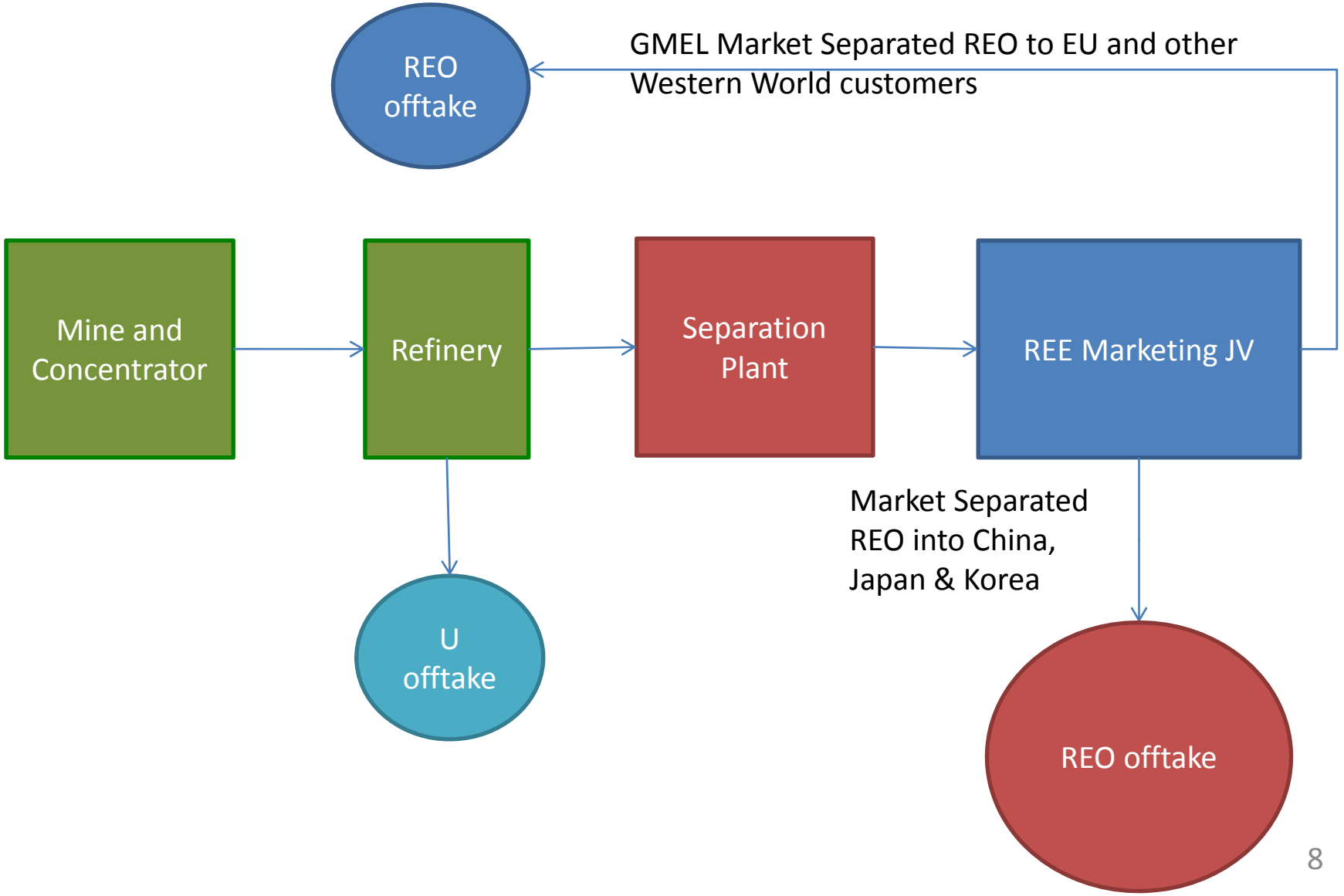
- **New government elected in March 2013; three party coalition headed by Siumut Party**

Why is this of particular significance??

- *Greenland Government has lifted the ban on uranium mining (24 Oct 2013)*
- *Looking to finalise regulations and prioritise the development of the Kvanefjeld project*
- *This pivotal move will be a critical step in opening up one of the world's largest resources of both rare earth metals and uranium to mine development; a move that could change the dynamics of global REE supply*

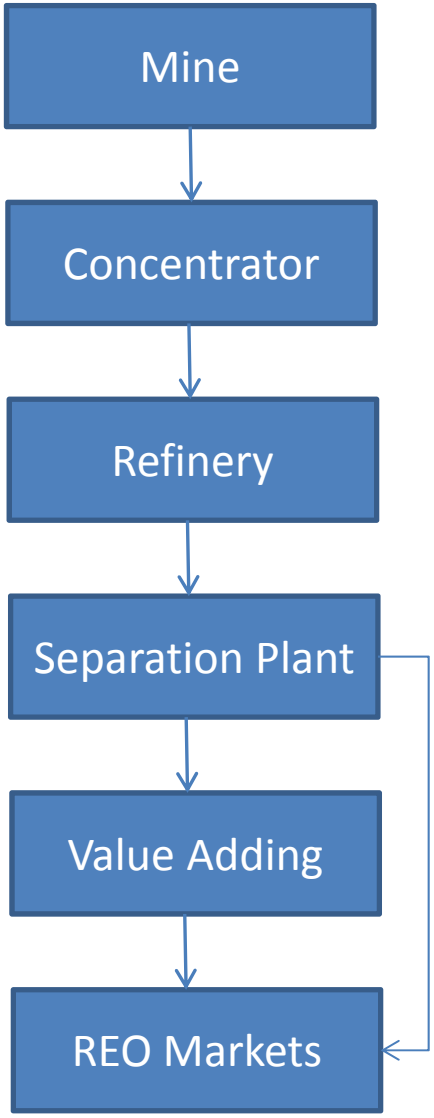
Our Goal: Build Global Rare Earth Business

MOU Recently Signed with Established REE Producer – Non Ferrous China (NFC)



Comparison of REE Project with U Project

Kvanefjeld will be more complex than a uranium project



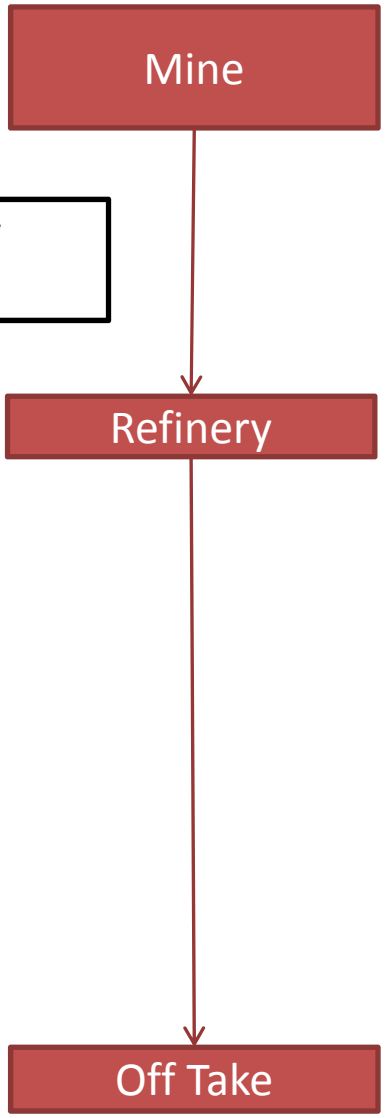
U Ores not typically concentrated

U Refinery half as complex

Technology Hurdle

Differentiation for REO

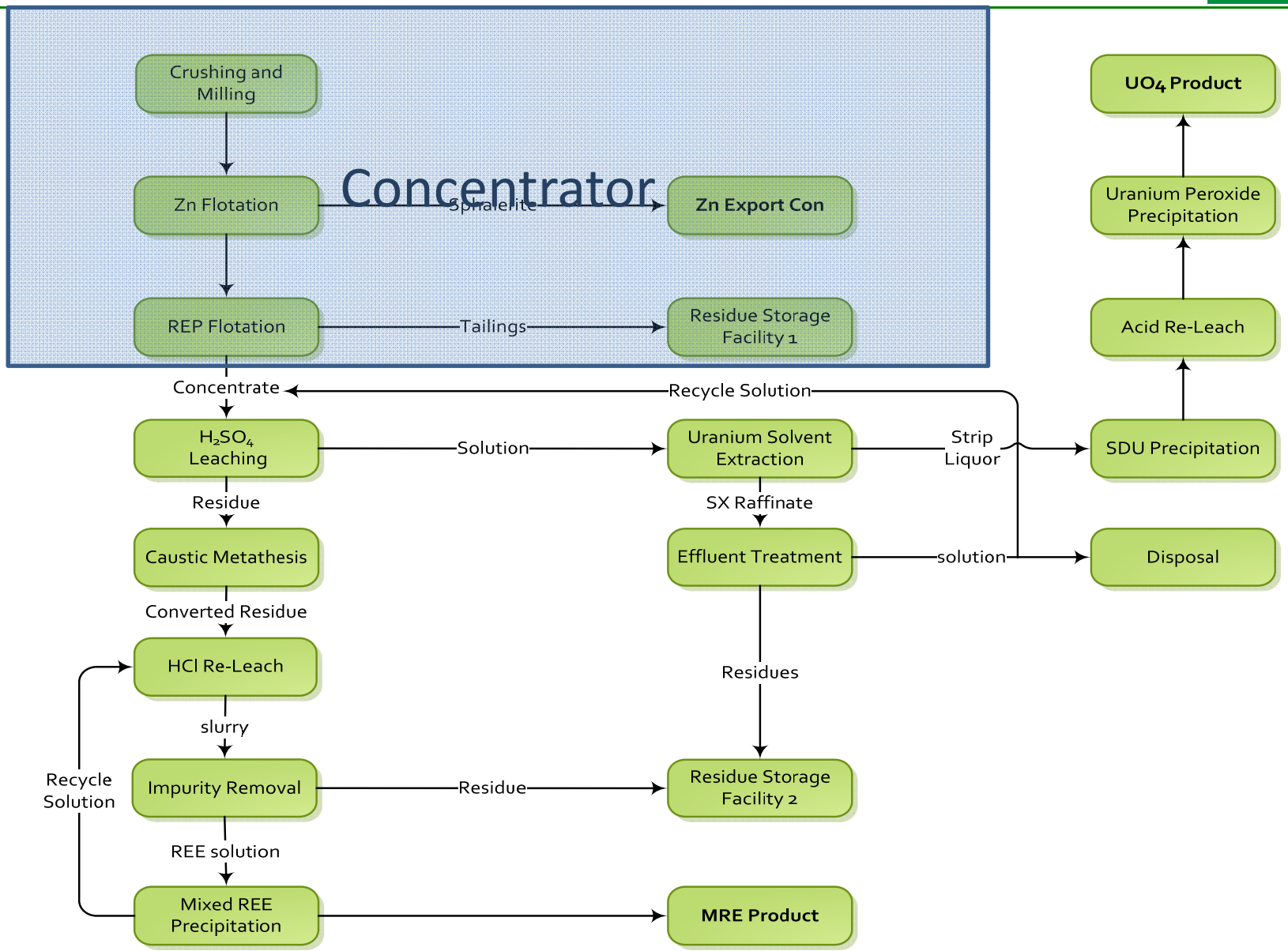
Limited U Customters



U Less Complex

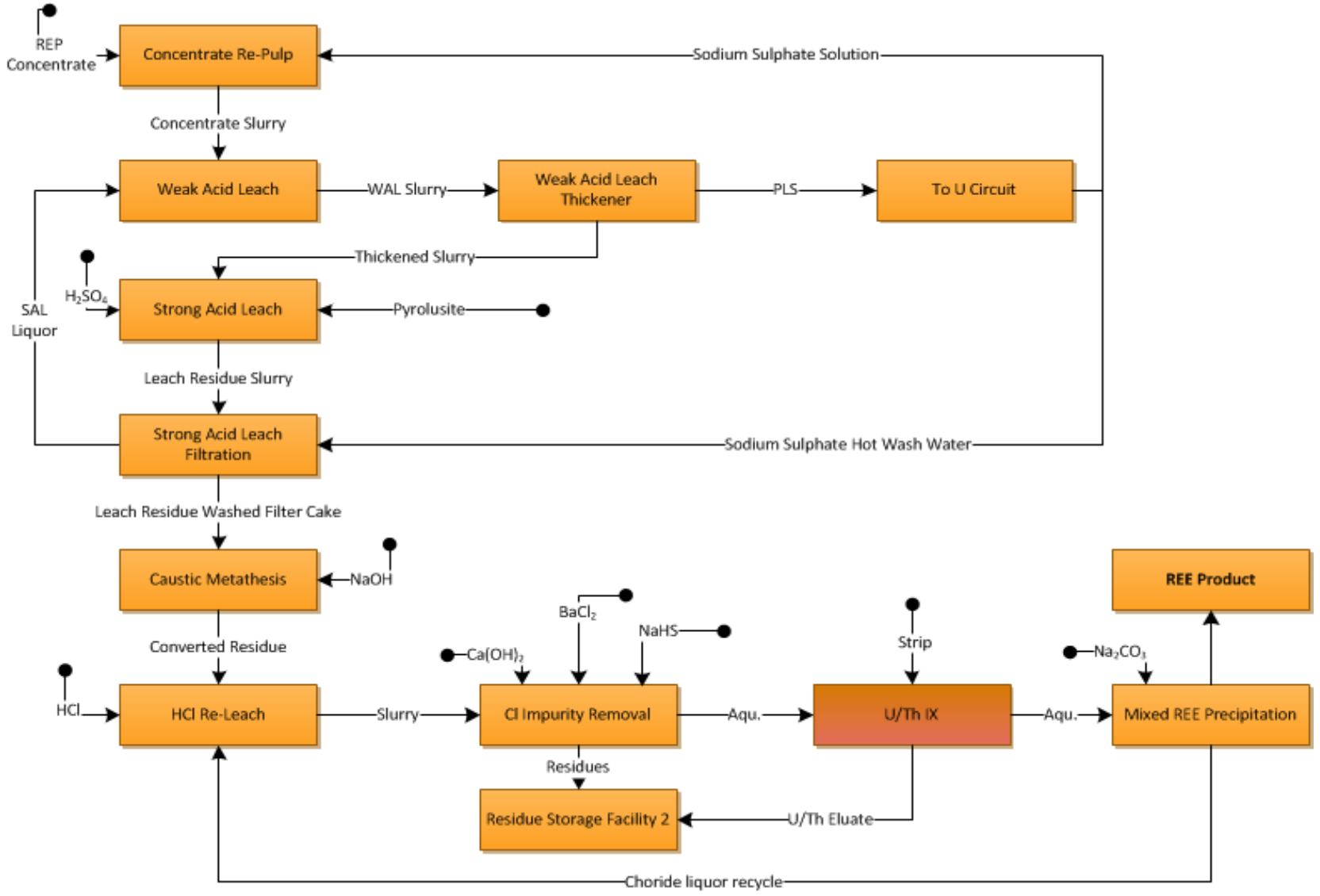
Kvanefjeld Multi-Element Project Flowsheet

Concentrator and Refinery in Greenland.



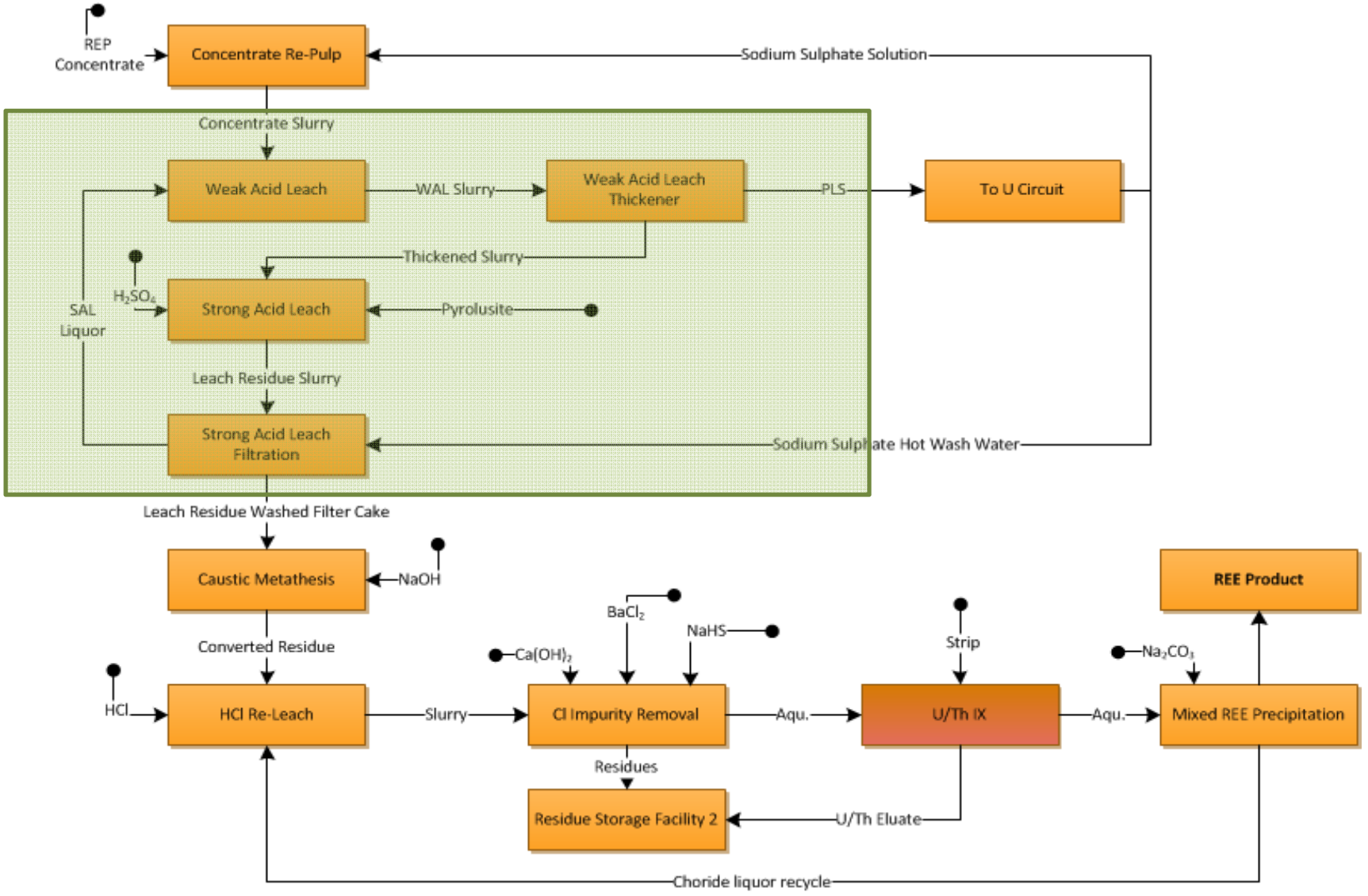
Rare Earth Hydrometallurgy Flowsheet

Simple Equipment and Elegant Chemistry



Sulphuric Acid Atmospheric Leaching

Two Stage Counter Current Leaching of Concentrate



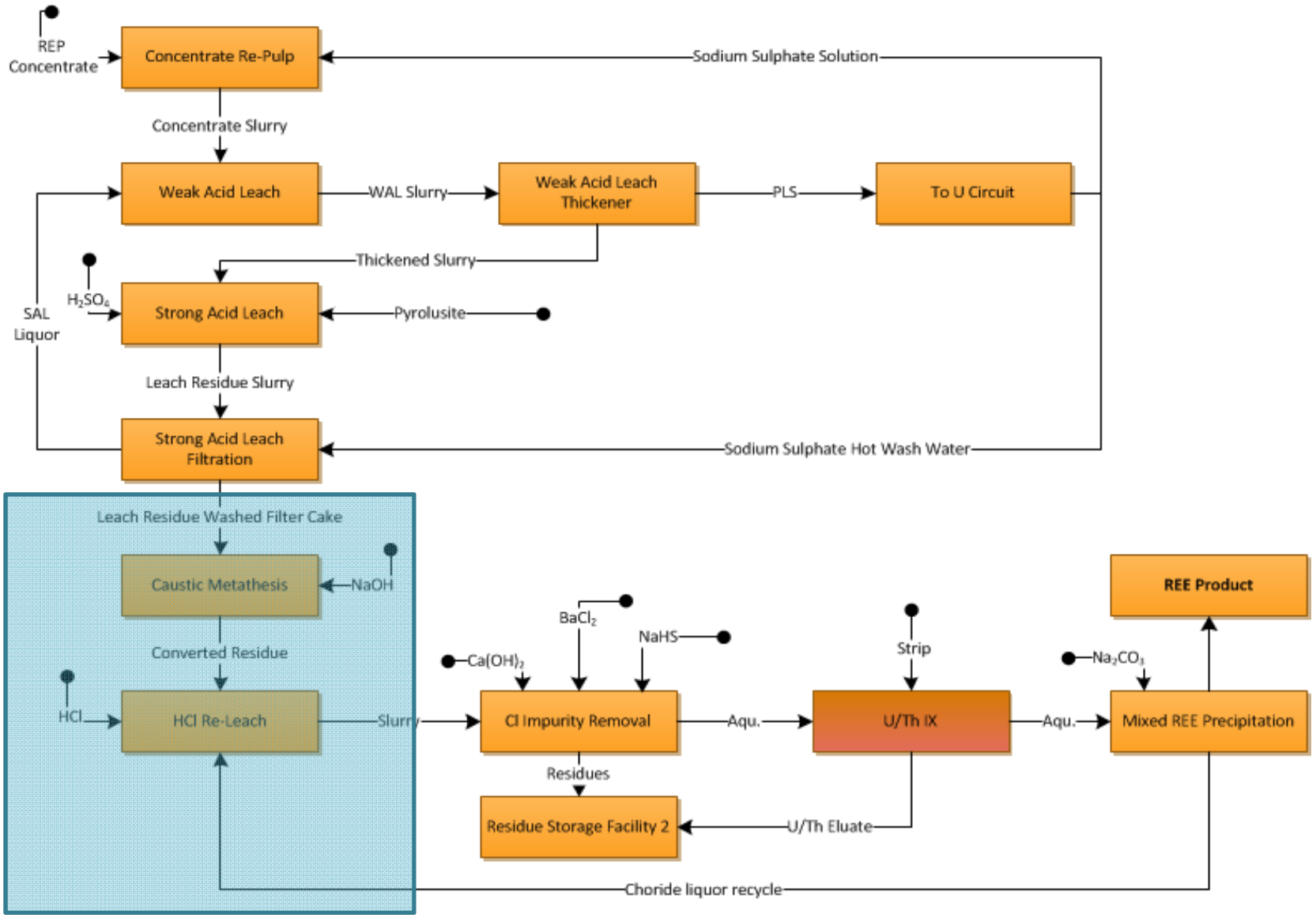
Sulphuric **Leaching** Chemistry

Simple Equipment and Elegant Chemistry

- Atmospheric Leaching at 98°C
- Two stage leaching reduces acid consumption
- Steenstrupine main mineral
  - $Na_{14}REE_6Mn_2Fe_2(Zr,Th)(Si_6O_{18})_2(PO_4)_7(OH)_23H_2O$
- Standard uranium leach chemistry
  - $UO_2(SO_4)_3^{4-}$ formed
- REE Leach then precipitate as double salts
  - $Na^+ + REE^{3+} + 2SO_4^{2-} + xH_2O = NaREE(SO_4)_2.xH_2O$
    - Effectively separates REE from U

Simplified Hydrometallurgy Flowsheet

Two Additional Atmospheric Treatment Stages



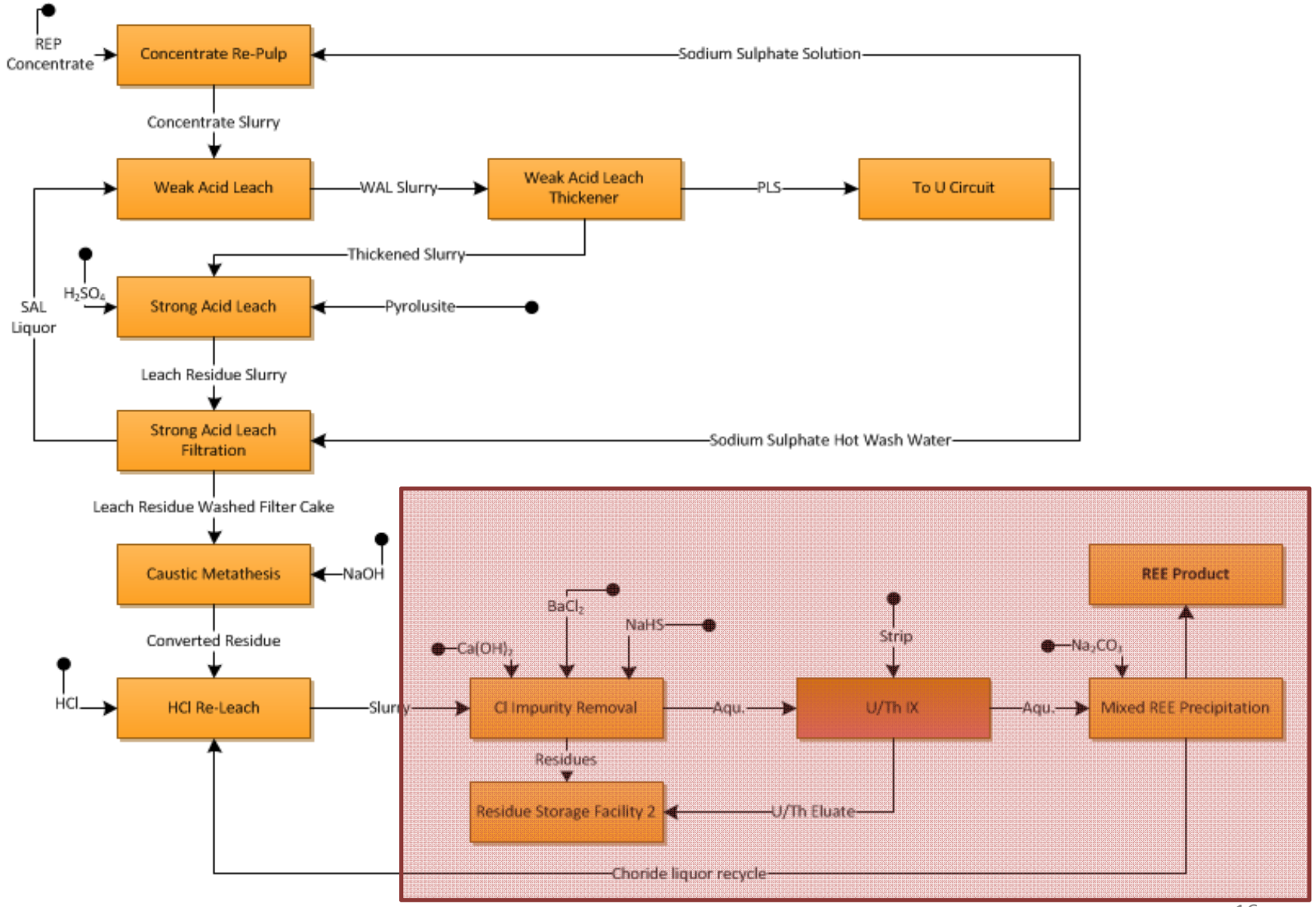
Rare Earth Recovery

Selective and High Recovery of REEs Over Metathesis and HCl Re-Leach

- Caustic Metathesis occurs at pH 11.5
- $NaREE(SO_4)_2.xH_2O + 3NaOH = REE(OH)_3 + 2Na_2SO_4 + xH_2O$
- Caustic Converted Residue Leached with HCl
  - Under mild conditions
    - 25 deg C and pH 2.0.
  - $REE(OH)_3 + 3HCl = REECl_3 + 3H_2O$

Simplified Hydrometallurgy Flowsheet

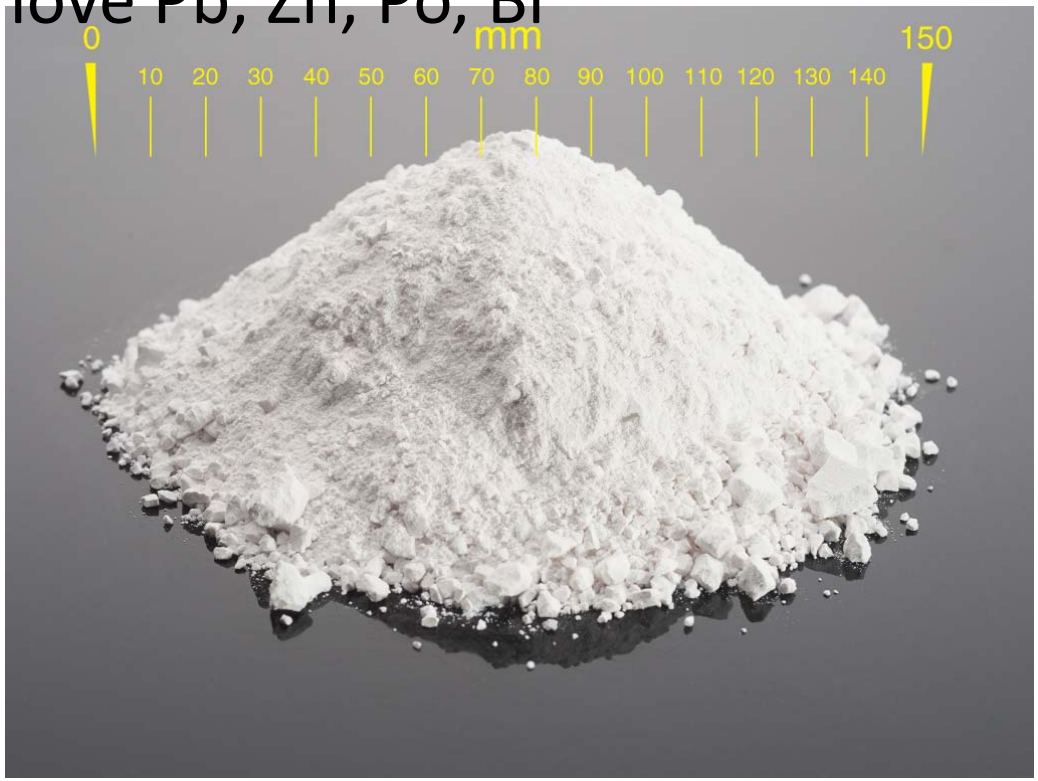
Rare Earth Purification and Recovery



High Purity Mixed Rare Earth Intermediate Produced

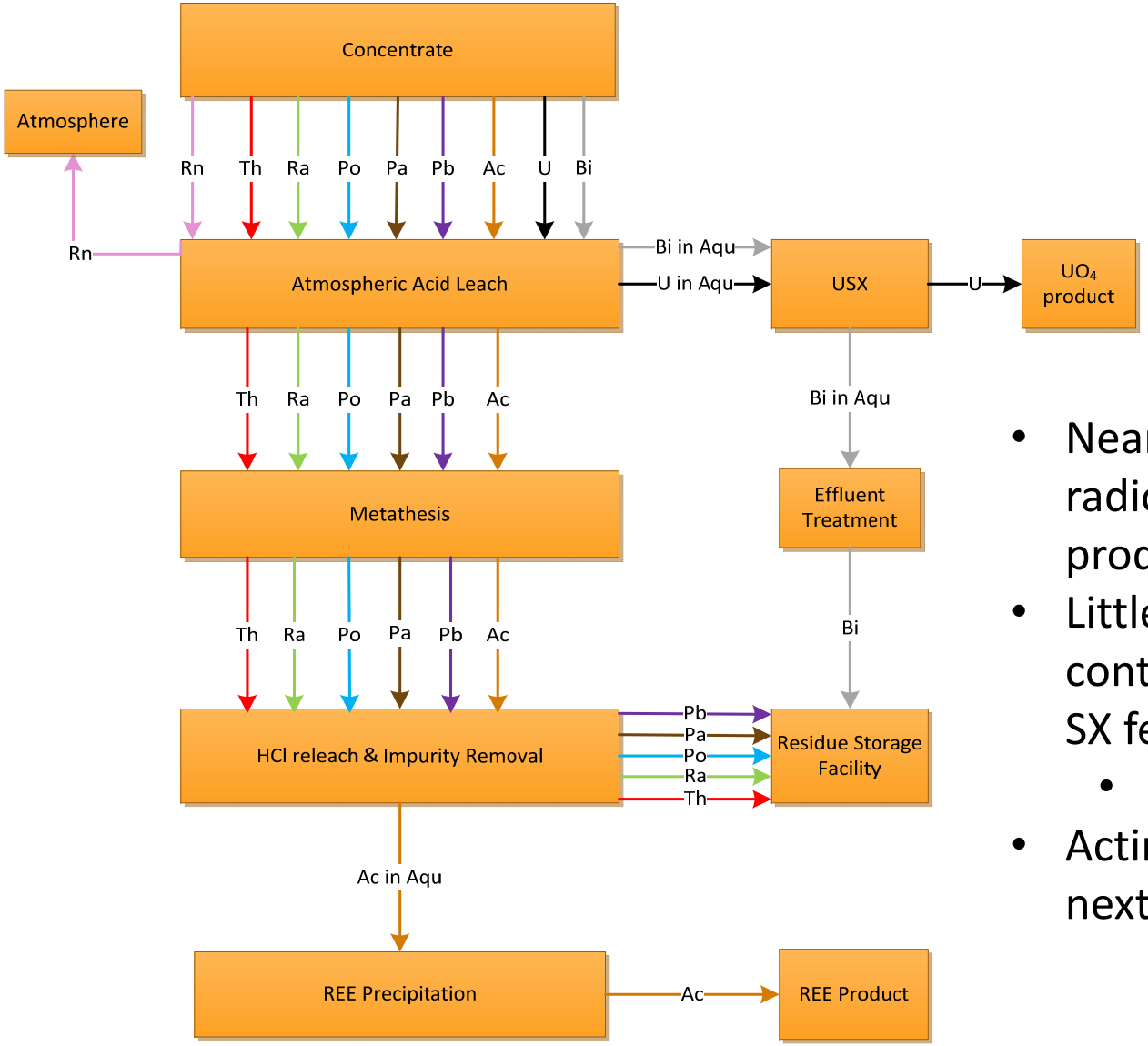
Rare Earth Carbonate is 97% REO after calcining

- Impurities Removed in two stages
  - pH adjustment with lime to remove Fe, Al and Th
  - Barium added to remove radium
  - Sulphide added to remove Pb, Zn, Po, Bi
- Ion Exchange
  - To remove U
- REE Precipitation
  - $REE_2(CO_3)_3.xH_2O$



Radionuclide Control in the Flowsheet

Near Complete Radionuclide Removal from REO product



- Near complete removal of radionuclides from REO product
- Little interfering contaminants in the uranium SX feed
  - Low V, Mo, Fe, Zr
- Actinium removed in the next stage of refining

Greenland Minerals and Energy

Key Highlights – A unique world class mining project

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1

World-class, large scale development project

- Economically robust, proven technology, large-scale, long life production of rare earths concentrate and uranium
- Large JORC resource base to produce ~7kt HREO, 37kt LREO & 3Mlbs U_3O_8 per annum over 30 year mine life
- Ideally located near international airport, existing towns and potential hydro-electric power source

2

Very attractive commodity portfolio

- Heavy rare earths and uranium are both recognised as strategically important commodities for the future
- Rare earths market characterised by limited capacity and increasing demand (particularly Dy, Nd, Tb, Eu and Y)

3

Strong management and technical team

- Experienced management team with proven track record
- Well-respected and knowledgeable technical/project team in place with exceptional local expertise

4

Highly advantageous ore-type, makes for simple cost-effective processing, highly scalable production

- High upgrade through beneficiation brings OPTIONALITY to Kvanefjeld project
- Leaching can be done in Greenland, or owing to the high-grade concentrate, can be shipped to other locations
- Allows to single concentrator in Greenland, multiple refineries/partners globally

5

Globally significant, long life, low cost, multi-commodity asset

- Company to become one of the largest producers of rare earths globally and a significant U_3O_8 mine
- Potential to supply >20% of global critical (including heavy) rare earth element demand
- Company has low cost of production due to multiple by-product opportunities

6

Low political risk

- Stable, low-risk operating environment with government looking to develop new industries and employment
- GME fully permitted to evaluate the project, exploration licence now includes radioactive elements
- Management and board have a solid working relationship with the government and are socially aware

Back Up Slides

Greenland Minerals and Energy

Achievements to date – Key milestones moving forward

	Activity	Timing	Cost
☑	Exploration and Resource Definition - Kvanefjeld	2007- 2010	A$25M spent
☑	Preliminary Technical Studies	2008 - 2011	A$10M spent
☑	Exploration and Resource Definition -satellite deposits	2011 - 2012	A$7M spent
☑	Carry out Pre Feasibility Studies	2008 - 2012	A$16M spent
☑	Acquire full ownership of Kvanefjeld	2012	A$5M (plus shares/options)
☑	Batch test work and Concentrator Piloting	2012	A$4M spent
☑	Finalise design criteria for Concentrator and Refinery	2013	A$1M spent
☑	Zero tolerance policy abolished	2013	
★	REE Separation JV and Refinery location established	2014	
★	Finalise EIA, SIA and FS	2014 - 2015	A$20M Funded
☐	Application for Exploitation Licence	2015	
☐	Refinery Piloting and Detailed Engineering	2014 -2016	A$ 30M
☐	Construction (Mine & Concentrator)	2017 – 2018	A$ TBA

Completed ✓ **Pending** ★