MATERIALS FOR AN ENERGY EFFICIENT FUTURE



October, 2017



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#### JORC Code (2012) Competent Person Statement – Mineral Resources and Ore Reserves

The information in this report that relates to Mineral Resources is based on information compiled by Mr Robin Simpson, a Competent Person who is a Member of the Australian Institute of Geoscientists. Mr Simpson is employed by SRK Consulting (UK) Ltd ("SRK"), and was engaged by Greenland Minerals and Energy Ltd on the basis of SRK's normal professional daily rates. SRK has no beneficial interest in the outcome of the technical assessment being capable of affecting its independence. Mr Simpson has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Robin Simpson consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.

The information in the statement that relates to the Ore Reserves Estimate is based on work completed or accepted by Mr Damien Krebs of Greenland Minerals and Energy Ltd and Mr Scott McEwing of SRK Consulting (Australasia) Pty Ltd.

Damien Krebs is a Member of The Australasian Institute of Mining and Metallurgy and has sufficient experience that is relevant to the type of metallurgy and scale of project under consideration, and to the activity he is undertaking, to qualify as Competent Persons in terms of The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 edition). The Competent Persons consent to the inclusion of such information in this report in the form and context in which it appears.

Scott McEwing is a Fellow and Chartered Professional of The Australasian Institute of Mining and Metallurgy and has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration, and to the activity he is undertaking, to qualify as Competent Persons in terms of The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 edition). The Competent Persons consent to the inclusion of such information in this report in the form and context in which it appears.

The mineral resource estimate for the Kvanefjeld Project was updated and released in a Company Announcement on February 12<sup>th</sup>, 2015. The ore reserves estimate was released in a Company Announcement on June 3<sup>rd</sup>, 2015. There have been no material changes to the mineral resource estimate, or ore reserves estimate since the release of these announcements.



### **Executive Summary**



### **Globally Significant**

Long term supplier of rare earth elements critical for clean, green technologies

#### **Rare Earth Prices**

Strong demand outlook and constrained supply given China led policy changes

### Advanced Stage of Development

10 years of sustained research and development. Multiple successful pilot plant operations

### Nd, Pr, Tb and Dy

Largest projected output of key rare earth elements from first major non-refractory orebody

### **Shenghe Resources**

Largest shareholder providing technical input & fully integrated value chain connecting mine to end users

## **Regulatory Framework**

Implemented by Greenland & Danish Governments to manage project

## >1 Billion Tonne JORC Resource

Initial 37 year mine life enabling infrastructure development. Year round shipping access

# **Environmental Outcomes**

GMEL provides REO & uranium for clean energy and efficient energy use



### The Clean, Green & Smart Revolution

The clean, green and smart revolution has arrived, facilitated by promising technological innovations on clean energy, energy storage and efficiency.

From off-shore wind turbines, to electric cars and smart phones, our highly smart and climate friendly future is dependant on rare earths.

Driven by government policy and cultural shifts, the road to the low-carbon, high tech future will pave the demand for rare earths.

Through enabling a long-term sustainable supply of these critical elements, Greenland has a very important role to play



### Fast Track - To the Future

"China to establish timeline to phase out combustion engine vehicles"

The electrification movement is underway.
Rare earth permanent magnets create
electric motors with greater torque,
efficiency and range



"UK, France to ban petrol and diesel vehicles by 2040..."

"Volvo to go electric..."

"Every Jaguar Land Rover model line will be electrified from 2020"

"India aiming for all-electric car fleet by 2030..."

"New electric London taxi launches..."

"Volkswagen plans to leapfrog Tesla in electric car race..."



### **Fast Track – To the Future**



Sources - ADAMAS, IEA, IRENA, Wind energy association's websites



### International Policy Developments & Rare Earth Demand

- Over 150 countries have adopted specific policies for renewables-based power
- By 2025
  - Between 70 and 75 million EV's and HEV's will be produced annually requiring between 12-13,000 tpa of NdPrDy
  - 135M passenger vehicles will require approximately 10,000tpa REO (Ce) for catalytic converters
  - 'Cracking' 7.1B Bbl of oil will require 50,000 tpa REO (40,000t La, 10,000t Ce)
  - 150,000t of NdPrDy will be needed for wind turbine production in the period to 2025
  - China's wind power capacity will increase by 175% to 2025, this will require ~ 50,000t
     NdPrDy
  - To meet the goal agreed at the Paris climate change conference Europe will require 230Gw of offshore wind capacity by 2045 equivalent to 50,000t of NdPrDy



illegal supply

### **China Policy Developments & Rare Earth Supply**

#### Outlook **Status Future** New ex-China mines needed for China dominates both primary The 2016-2020 strategic plan will see mine supply and downstream enforcement of strict environmental primary supply, but China's role in processing technology and regulations, continued curtailment of downstream processing will capacity illegal supply remain integral China's policy and management of The plan will see Chinese domestic The value chain necessitates that its RE sector will continue to shape production capped at 140,000tpa by new mines need to be integrated global supply networks 2020, leading toward a shift to net with downstream processing to create viable new supply networks importer status China's 2011-2015 strategic plan Demand for Neodymium (Nd) and **Integration commences:** saw the consolidation of RE Praseodymium (Pr) already exceeds **Internationally focussed Shenghe** Resources invests in Greenland and producers and curtailment of primary mine supply, and Chinese

domestic mine supply will not meet

projected demand

commences strategic co-op, also

bids for Molycorp's Mountain Pass





### **GMEL Development Strategy Considering China Policy**

In 2016, Shenghe took a 12.5% interest in GMEL, commenced strategic cooperation

### 盛和资源控股股份有限公司 Shenghe Resources Holding Co., Ltd.

- Listed Shanghai Stock Exchange (code 600392), Market Capitalisation ~\$5-6 billion AUD (Sept 2017)
- Business: RE mining, beneficiation, metallurgy, separation and downstream processing
- Internationally focussed extensive customer base in Europe, North America, Japan, Middle East, China
- Sits within the Chinalco group under China RE industry structure
- Acquired Vietnam Rare Earth Co Ltd in 2016 (downstream processing)
- Successful bidder for Molycorp
- Technical studies with GMEL progress through 2017



Shenghe, GMEL Aim – optimise Kvanefjeld project, integrate with downstream processing



### **Kvanefjeld Project Overview**



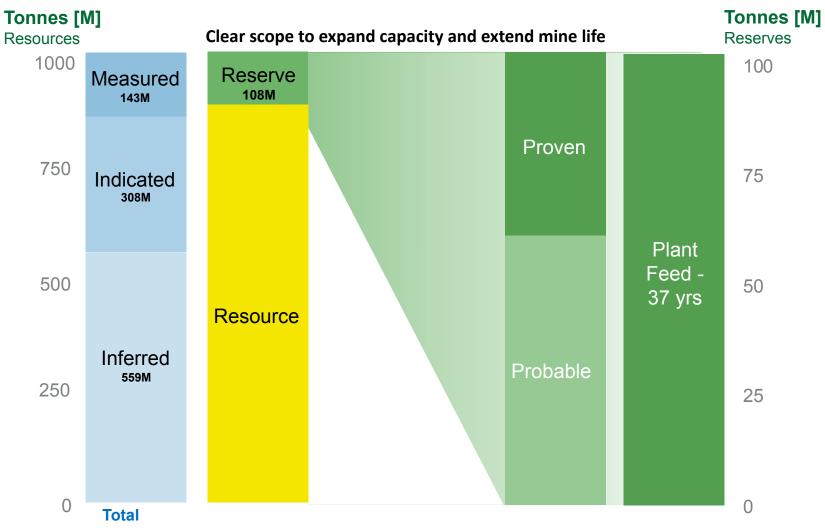
- >1 billion tonne multi-element resource through 3 deposits, largest REO inventory under JORC code
- 108 Mt of the upper portions have been converted to 'ore reserve' status
- 1:1 strip ratio over initial 37 year mine life = simple, low-cost mining
- Ore to be transported across contour to processing plant, tailings stored in Taseq Basin
- Year round direct shipping access via deep water fjords
- Narsaq town (10km) and Narsarsuaq airport (35km) short distance away from project area



Left: Proposed open pit mining operation on the Kvanefjeld plateau



### **Vast Mineral Inventory**



Mineral Resource Estimates and Ore Reserve Estimates are independently established by SRK Consulting



### **Advanced Pilot Plant Process**

- The advantageous Kvanefjeld process route has been developed by industry experts and successfully tested by a number of pilot plant campaigns
- The pilot plants were conducted in leading laboratories in Australia and Finland
- Largely funded through the EURARE program (a European Union,
   R&D initiative investigating rare earth supply)
- Both flotation and refinery (leach) circuits operated successfully
- High purity intermediate rare earth product produced







Various photo's from second and third flotation Pilot Plants & EURARE Refinery Pilot Plant - (2011-2015), Finland & Australia

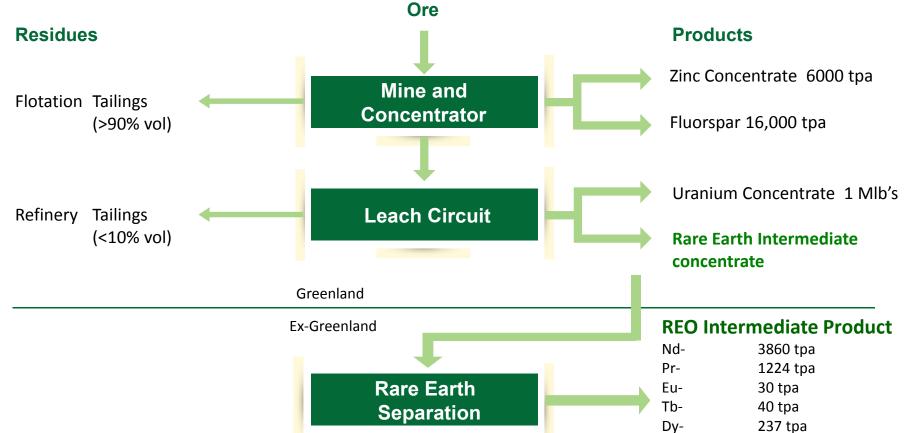


### **Process Flowsheet**



37 Year Mine Reserves at Kvanefjeld Deposit (~10% of resource base)											
Classification (JORC 2012)	Inventory (Mt)	REO (ppm)	U₃O <sub>8</sub> (ppm)	Zn (ppm)							
Proven	43	14,700	352	2,700							
Probable	64	14,000	368	2,500							
Total	108	14,300	362	2,600							

JORC 2012: 1.01Billion tonnes through 3 deposits contains 11.13 Mt REO, 593 Mlbs U<sub>3</sub>O<sub>8</sub>, 2.42 Mt zinc





### **Feasibility Study**

Mine throughput	3Mt/a
Mine reserve	108Mt
nitial Mine Life	37 years
Capital Cost	\$832M USD
Annual Revenue	
(as of RE prices Sept, 2017)	\$573M USD
(forecast prices, Adamas Intelligence)	\$711M USD
Annual Operating Cost	\$254M USD
Separation (downstream) Costs	\$80.2M USD
Margin After Separation Costs	
(as of RE prices Sept, 2017)	\$ 240M USD
(forecast prices, Adamas Intelligence)	\$ 376M USD
Key Rare Earth Outputs	
Praseodymium	1,224 tpa
Neodymium	3,860 tpa
Europium	30 tpa
Terbium	40 tpa
Dysprosium	237 tpa
By Products	
Zinc	6,000 tpa
Fluorspar	16,000 tpa
U <sub>3</sub> O <sub>8</sub>	I M lbs pa
La and Ce oxides	19,000 tpa

# Joint technical committee established in 2017 for technical optimisation and downstream integration (GMEL/Shenghe)

#### Aim:

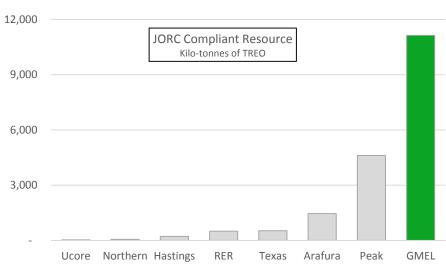
- technically align intermediate product with downstream processing (offshore)
- simplify, reduce infrastructure and associated capital costs,
- assess the recovery of additional by-products,
- reduce operating costs, position Kvanefjeld as lowest cost rare earth mine
- jointly establish a complete value chain to deliver high purity products to international market

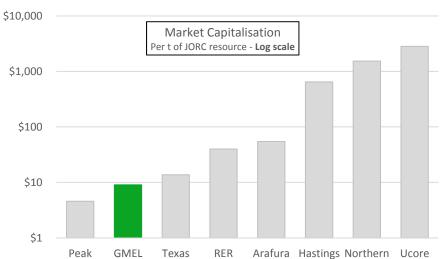
#### Status:

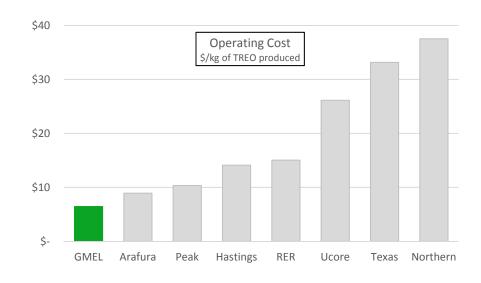
- IMUMR conducting work in China on concentrator circuit
- Increased efficiency and reduction in flotation reagent costs targeted
- Hydrometallurgical work underway in Australia to investigate reagent strategy enhancements
- Results expected Q1, 2018

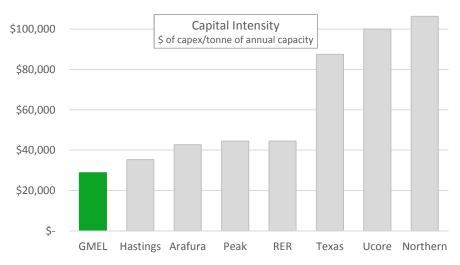


### **Peer Comparison**



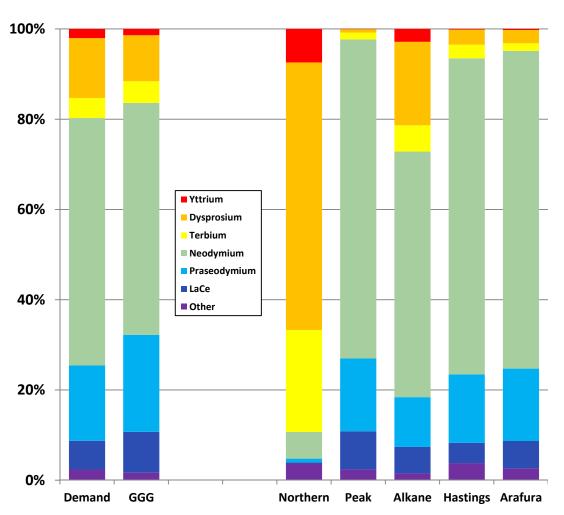


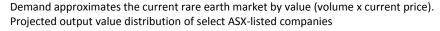


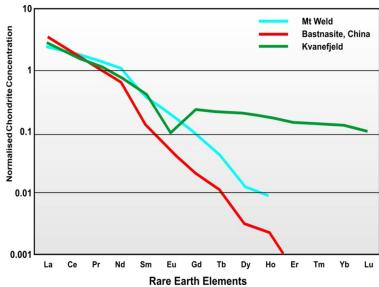




### **Projected Output Strongly Aligned with Market**







Rare earth plot highlighting the enrichment across the rare earth spectrum. Kvanefjeld is compared to Mt Weld, and typical bastnasite (source: ANSTO).

Kvanefjeld's enrichment across the RE spectrum creates a strong alignment with RE market, through exposure to Nd, Pr, Dy and Tb.



### **Kvanefjeld Project Evolution Defines Advanced Status**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
e Development										
d Deposit										
Deposit										
Deposit										
Resource >1B tonne										
serve Established										
nical Studies										
sibility Study										
ering Design Study										
asibility Study										
ility Update										
nmental Baseline Studies										
Interital baseline studies				I I				1		
lurgy										
trator flowsheet										
heric leach flowsheet										
trator pilot plant #1										
E Program										
ntrator pilot plant #2										
circuit pilot plant										
try Engagement										
ustry										
Korean										
Entered with NFC										
echnical work										
he - Invests										
Optimisation Commences										
itting										
Pre-Hearing										
of Ref. Approved										
EIA, SIA Maritime Study										
g Licence Reviews										
mendations Addressed										
me Study Approved										



### **Regulatory Framework & Permitting Process**



Jakob Rohmann Hard (Chief of Protocol, Foreign Department, Greenland), Liselotte Plesner (Danish Ambassador, Vienna), Nuka Møller (Greenland Business), Jørn Skov Nielsen (Deputy Minister, Industry Trade and Labour, Greenland), Kim Kielsen (Greenland Premier), John Mair (MD, GMEL), Yukiya Amano (Director General, IAEA)

- The Governments of Greenland and Denmark have worked to establish a regulatory framework to manage the production and export of uranium from Greenland
- Enabling legislation passed by both respective parliaments to implement safeguards and export controls in accordance with IAEA and EURATOM
- In September 2016, Greenland formalised status as signatory to IAEA conventions

- Mining licence application submitted end of 2015
   Key components include Environmental, Social and Maritime Safety Study
- Maritime Study APPROVED (11/10/2017)
- ➤ EIA 80% Complete
- ➤ SIA 90% Complete



### **Long Term Stakeholder Engagement**

Uranium is a projected by-product at Kvanefjeld, but establishing regulations to manage the production and export of uranium has been important to project permitting and development. On this front, a solid foundation is in place.

	IBA	
1	PUBLIC CONSULTATION	
7	ADDRESS RECOMMENDATIONS	201
EX	PERT REVIEW OF APPLICATION	201

MINING LICENSE

2016

2013

2007

**URANIUM EXPORT LEGISLATION** 

APPLICATION FINALISED 2015

**TERMS OF REFERENCE APPROVALS** 

SUPPORTIVE & PROACTIVE GOVERNMENT

**URANIUM ZERO-TOLERANCE GONE** 

URANIUM ON LICENSE Creates actionable 2011

CONCEPT – UNIQUE MULTI-ELEMENT PROJECT developmental path forward for 2018

**OPPORTUNITY** 



### 2018 – Key Growth Catalysts

Timing	Description
Q4 - 2017	<ul> <li>Updated Environmental Impact Assessment incorporating additional data and studies conducted through 2017</li> </ul>
Q1 - 2018	<ul> <li>Project update drawing on test work conducted jointly with Shenghe through 2017; addresses optimisation and integration with downstream processing</li> <li>Commence update of Feasibility Study (2016)</li> </ul>
Q2 - 2018	<ul> <li>Update operating costs</li> <li>Incorporate updated workforce requirements into SIA, conduct required EIA revisions that arise from optimisation</li> </ul>
Q3 - 2018	<ul> <li>Pilot plant operation of final configuration</li> </ul>
Q4 - 2018	<ul><li>Finalise Feasibility Study</li><li>Revise capital costs</li></ul>

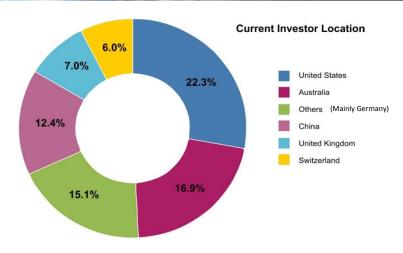


### **Corporate Snapshot**



#### **Board**

Non-Executive Chairman	Tony Ho
Managing Director	Dr John Mair
Non-Executive Director	Simon Cato
Non-Executive Director	Wenting Chen
Top Shareholders	
Shenghe Resources Holdings	125M shares (12.4%)
Shenghe Resources Holdings Global X Uranium ETF	125M shares (12.4%) 88M shares



International Shareholder Base

#### **Capital Structure**

Shares outstanding	1004M
Options outstanding	187M ex \$0.08, Sept 20 2018
	7.5M ex \$0.2, Feb 24 <sup>th</sup> 2018
	7.5M ex \$0.25, Feb 24 <sup>th</sup> 2018
Undiluted market capitalization	<b>A\$100M</b> (@10 cents)

#### **Kvanefjeld Project Ownership - 100%**

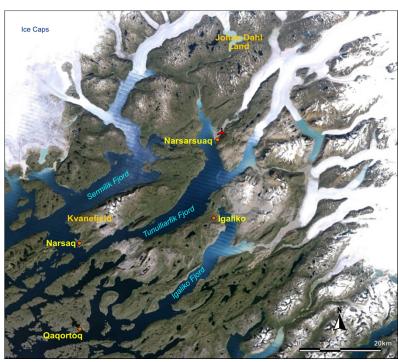


# **Appendix**



### **Kvanefjeld Project – Location and Access**

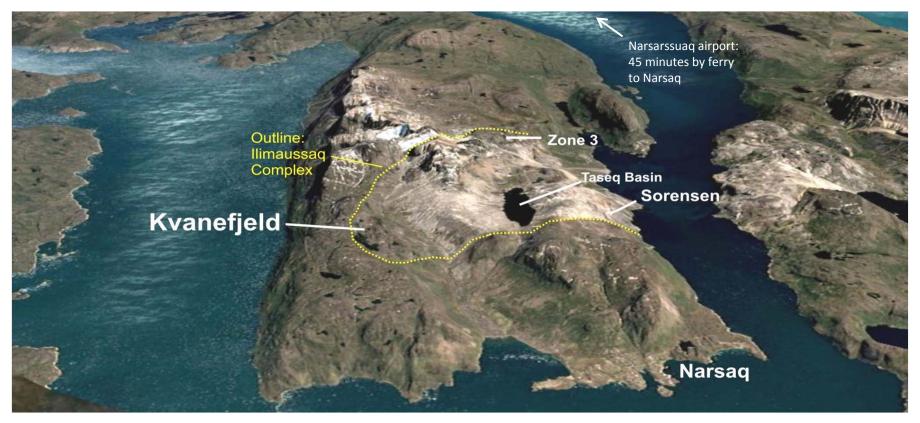




- The Kvanefjeld Project area is favourably located in southern Greenland
- Narsarsuaq international airport is located 35km away, 4h 50m flight from Copenhagen
- Project area features year-round direct shipping access, via deep water fjords that lead directly to the North Atlantic Ocean
- Climatically mildest part of Greenland with average temperate ranging from -2 to +10°c
- Narsaq town, located approximately 8-10km from project area



### Narsaq Peninsula – Southern Greenland



- The footprint of proposed operations is largely restricted to the Kvanefjeld plateau, Narsaq valley, and Taseq basin.
- Rocks of the Illimaussaq Complex are strongly enriched in rare elements and have been actively dispersed into the surrounding environment by erosional processes, thereby strongly influencing the natural (baseline) chemistry.
- Taseq Basin is underlain by impermeable crystalline rocks (naujaite), and owing to the influence of the unusual rock chemistry, contained water is naturally enriched in a range of elements, is non-potable, and is devoid of life.



### Process Advantage – the Seismic Shift

- Viability of a rare earth project is more dependant on metallurgical performance than grade
- REE's occur locked within minerals
- The RE minerals in most deposits are highly refractory (vault like), and difficult to crack
- In contrast, the unique minerals at Kvanefjeld are nonrefractory
- This allows simpler processing, leading to lower production costs



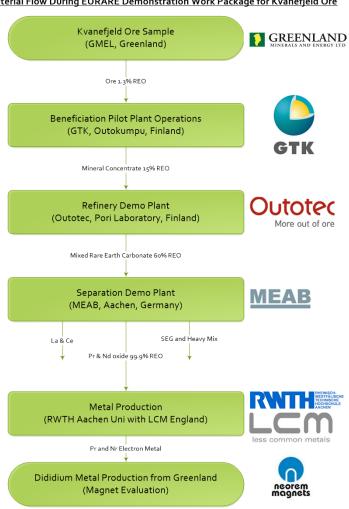
Photomicrograph – steenstrupine grain surrounded by amphibole and feldspar in lujavrite ore

- Steenstrupine is the main RE mineral at Kvanefjeld, and contains ~25% REO
- It is enriched across all key rare earths including Nd, Pr, Dy, Tb
- Can be effectively concentrated with conventional froth flotation (multiple successful pilot plant operations)
- Both REE's and U can be readily leached in acidic solutions under atmospheric conditions (pilot plant proven)
- Detailed mineralogical studies conducted through MDRU, University of British Columbia



### Significant Pilot Plant Work With Tier 1 Technical Consultants

#### Material Flow During EURARE Demonstration Work Package for Kvanefjeld Ore



#### Key EIA, SIA Consultants



Social Impact Assessment



**Environmental Impact Assessment** 



Radiation



Water science and engineering specialist Fjord impacts



Technical University of Denmark



**Baseline Studies: Radiation** 



Air quality, Dust Emissions



Maritime Safety Study





**Port Facilities** 



### Statement of Identified Mineral Resources – (JORC-Code 2012 Compliant)

	Multi-El	ement Resoul	ces Classif	fication, T	onnage a	nd Grade	9				Conta	ained Met	tal	
Cut-off	Classification	M tonnes	TREO <sup>2</sup>	U <sub>3</sub> O <sub>8</sub>	LREO	HREO	REO	$Y_2O_3$	Zn	TREO	HREO	$Y_2O_3$	U <sub>3</sub> O <sub>8</sub>	Zn
$(U_3O_8 ppm)^1$		Mt	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Mt	Mt	Mt	M lbs	Mt
Kvanefjeld - Fe	bruary 2015													
150	Measured	143	12,100	303	10,700	432	11,100	978	2,370	1.72	0.06	0.14	95	0.34
150	Indicated	308	11,100	253	9,800	411	10,200	899	2,290	3.42	0.13	0.28	172	0.71
150	Inferred	222	10,000	205	8,800	365	9,200	793	2,180	2.22	0.08	0.18	100	0.48
150	<b>Grand Total</b>	673	10,900	248	9,600	400	10,000	881	2,270	7.34	0.27	0.59	368	1.53
200	Measured	111	12,900	341	11,400	454	11,800	1,048	2,460	1.43	0.05	0.12	83	0.27
200	Indicated	172	12,300	318	10,900	416	11,300	970	2,510	2.11	0.07	0.17	120	0.43
200	Inferred	86	10,900	256	9,700	339	10,000	804	2,500	0.94	0.03	0.07	49	0.22
200	<b>Grand Total</b>	368	12,100	310	10,700	409	11,200	955	2,490	4.46	0.15	0.35	252	0.92
250	Measured	93	13,300	363	11,800	474	12,200	1,105	2,480	1.24	0.04	0.10	75	0.23
250	Indicated	134	12,800	345	11,300	437	11,700	1,027	2,520	1.72	0.06	0.14	102	0.34
250	Inferred	34	12,000	306	10,800	356	11,100	869	2,650	0.41	0.01	0.03	23	0.09
250	<b>Grand Total</b>	261	12,900	346	11,400	440	11,800	1,034	2,520	3.37	0.11	0.27	199	0.66
300	Measured	78	13,700	379	12,000	493	12,500	1,153	2,500	1.07	0.04	0.09	65	0.20
300	Indicated	100	13,300	368	11,700	465	12,200	1,095	2,540	1.34	0.05	0.11	82	0.26
300	Inferred	15	13,200	353	11,800	391	12,200	955	2,620	0.20	0.01	0.01	12	0.04
300	<b>Grand Total</b>	194	13,400	371	11,900	471	12,300	1,107	2,530	2.60	0.09	0.21	159	0.49
350	Measured	54	14,100	403	12,400	518	12,900	1,219	2,550	0.76	0.03	0.07	48	0.14
350	Indicated	63	13,900	394	12,200	505	12,700	1,191	2,580	0.87	0.03	0.07	54	0.16
350	Inferred	6	13,900	392	12,500	424	12,900	1,037	2,650	0.09	0.00	0.01	6	0.02
350	<b>Grand Total</b>	122	14,000	398	12,300	506	12,800	1,195	2,570	1.71	0.06	0.15	107	0.31

Independently Prepared by SRK Consulting

### Statement of Identified Mineral Resources – (JORC-Code 2012 Compliant)

	Multi-Ele	ement Resou	rces Classif	fication, T	onnage a	nd Grade	;				Conta	ined Met	:al	
Cut-off	Classification	M tonnes	TREO <sup>2</sup>	U <sub>3</sub> O <sub>8</sub>	LREO	HREO	REO	$Y_2O_3$	Zn	TREO	HREO	$Y_2O_3$	U <sub>3</sub> O <sub>8</sub>	Zn
$(U_3O_8 ppm)^1$		Mt	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Mt	Mt	Mt	M lbs	Mt
Sørensen - Ma	rch 2012													
150	Inferred	242	11,000	304	9,700	398	10,100	895	2,602	2.67	0.10	0.22	162	0.63
200	Inferred	186	11,600	344	10,200	399	10,600	932	2,802	2.15	0.07	0.17	141	0.52
250	Inferred	148	11,800	375	10,500	407	10,900	961	2,932	1.75	0.06	0.14	123	0.43
300	Inferred	119	12,100	400	10,700	414	11,100	983	3,023	1.44	0.05	0.12	105	0.36
350	Inferred	92	12,400	422	11,000	422	11,400	1,004	3,080	1.14	0.04	0.09	85	0.28
Zone 3 - May 2	2012													
150	Inferred	95	11,600	300	10,200	396	10,600	971	2,768	1.11	0.04	0.09	63	0.26
200	Inferred	89	11,700	310	10,300	400	10,700	989	2,806	1.03	0.04	0.09	60	0.25
250	Inferred	71	11,900	330	10,500	410	10,900	1,026	2,902	0.84	0.03	0.07	51	0.20
300	Inferred	47	12,400	358	10,900	433	11,300	1,087	3,008	0.58	0.02	0.05	37	0.14
350	Inferred	24	13,000	392	11,400	471	11,900	1,184	3,043	0.31	0.01	0.03	21	0.07
Project Total														
150	Measured	143	12,100	303	10,700	432	11,100	978	2,370	1.72	0.06	0.14	95	0.34
150	Indicated	308	11,100	253	9,800	411	10,200	899	2,290	3.42	0.13	0.28	172	0.71
150	Inferred	559	10,700	264	9,400	384	9,800	867	2,463	6.00	0.22	0.49	326	1.38
150	<b>Grand Total</b>	1010	11,000	266	9,700	399	10,100	893	2,397	11.14	0.40	0.90	593	2.42

<sup>&</sup>lt;sup>1</sup>There is greater coverage of assays for uranium than other elements owing to historic spectral assays. U<sub>3</sub>O<sub>8</sub> has therefore been used to define the cutoff grades to maximise the confidence in the resource calculations.

Note: Figures quoted may not sum due to rounding.

<sup>&</sup>lt;sup>2</sup>Total Rare Earth Oxide (TREO) refers to the rare earth elements in the lanthanide series plus yttrium.