

KELIBER - Lithium Mining for Rapidly Growing Markets

High-Purity Lithium Carbonate for Sustainable Energy



PERTTI LAMBERG / CEO / November 1, 2017



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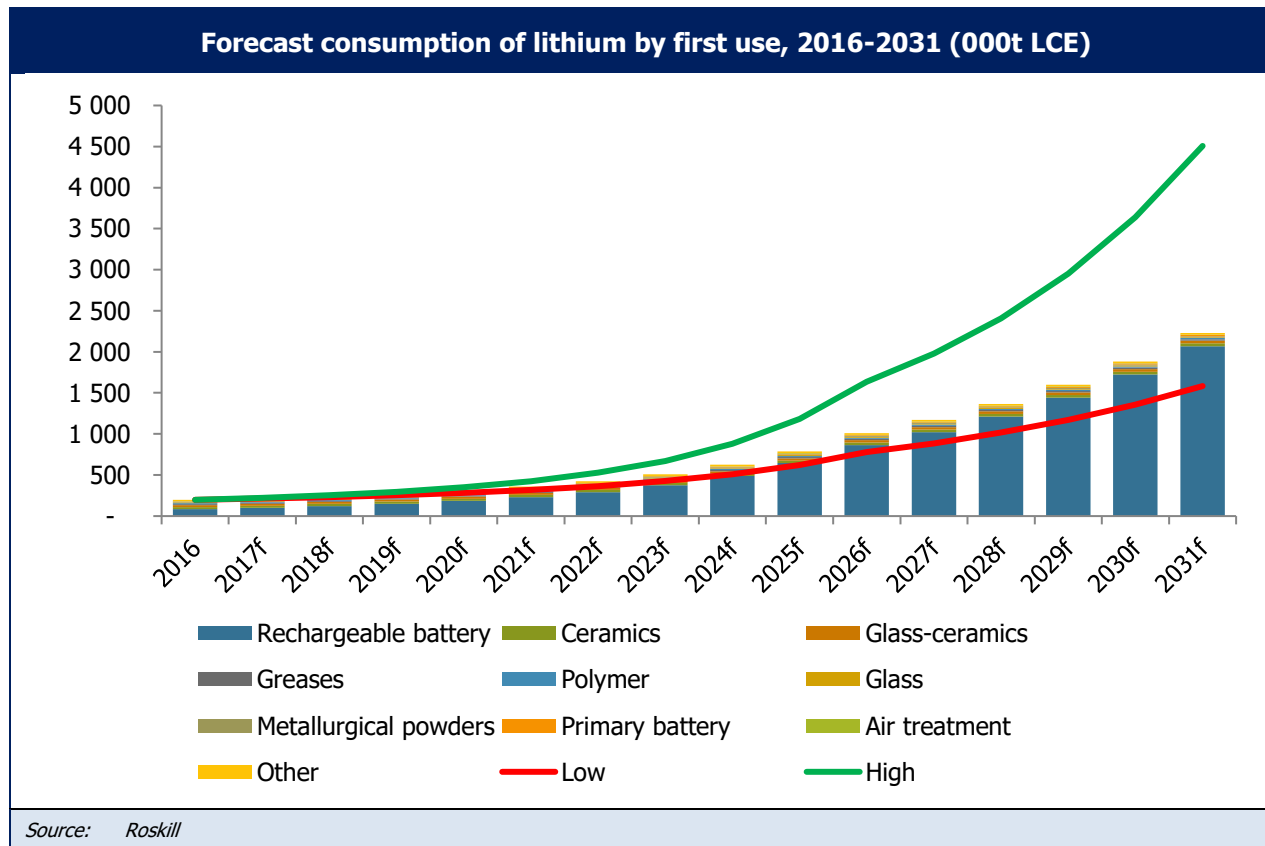
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Global Demand for Lithium

Increase in need for lithium

Rechargeable battery sector driver for growth

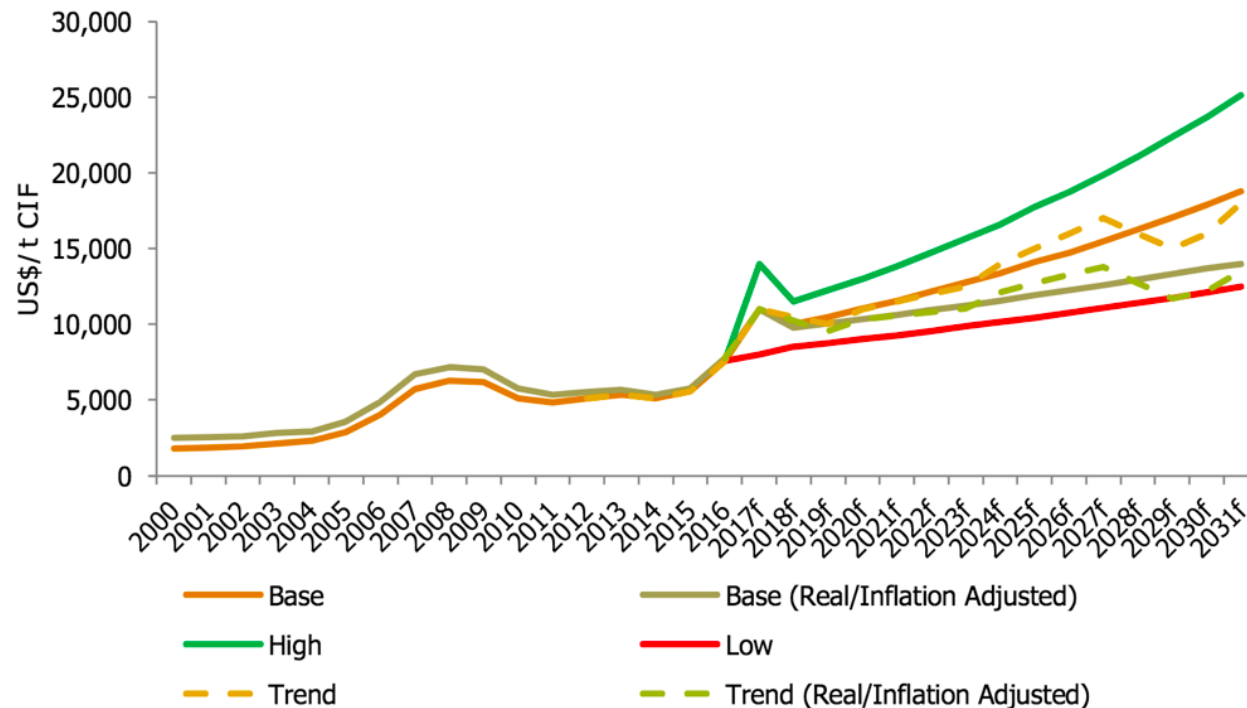


- Increasing global demand driven by the rechargeable battery sector, which is forecast to register 23.9%py growth through to 2031
- Other markets for lithium are also forecasted to provide areas of growth (ceramics and glass-ceramics, polymers, metallurgical powders)
- Annual global demand is forecasted to grow from 197,200 tons in 2016 to 1,008,900 tons in 2026 and 2,231,000 tons in 2031

Increase in need for lithium

Price forecast for battery-grade lithium carbonate

Figure 35: Average annual price forecast for battery-grade lithium carbonate, 2000-2031 (US\$/t CIF Asia)



Source: Global Trade Atlas

Note: Real prices adjusted to constant US dollars using World GDP deflator data from the International Monetary Fund's World Economic Outlook Database

- Lithium carbonate prices started to rise in Chinese spot market in H2 2015
- Contract pricing started to rise in China and elsewhere in Asia in 2016 and have continued to rise world wide in 2017
- US\$10 000/t is expected to be the new floor in the base-case scenario for battery grade lithium carbonate

Increase in need for lithium

Towards a more mobile and sustainable world

Increasing demand for Lithium-ion batteries

- mobile electronics
- portable hand tools
- hybrid and electric vehicles
- stationary grid batteries
- stationary home batteries



Estimated lithium requirement in batteries

Mobile phone	1 – 3 g
Smartphone	2 – 3 g
Tablet	20 – 30 g
Laptop	30 – 40 g
Power tool	40 – 60 g
Hybrid vehicle – Plug-in hybrid vehicle	1.6 – 12 kg
Electric car	15 – 50 kg

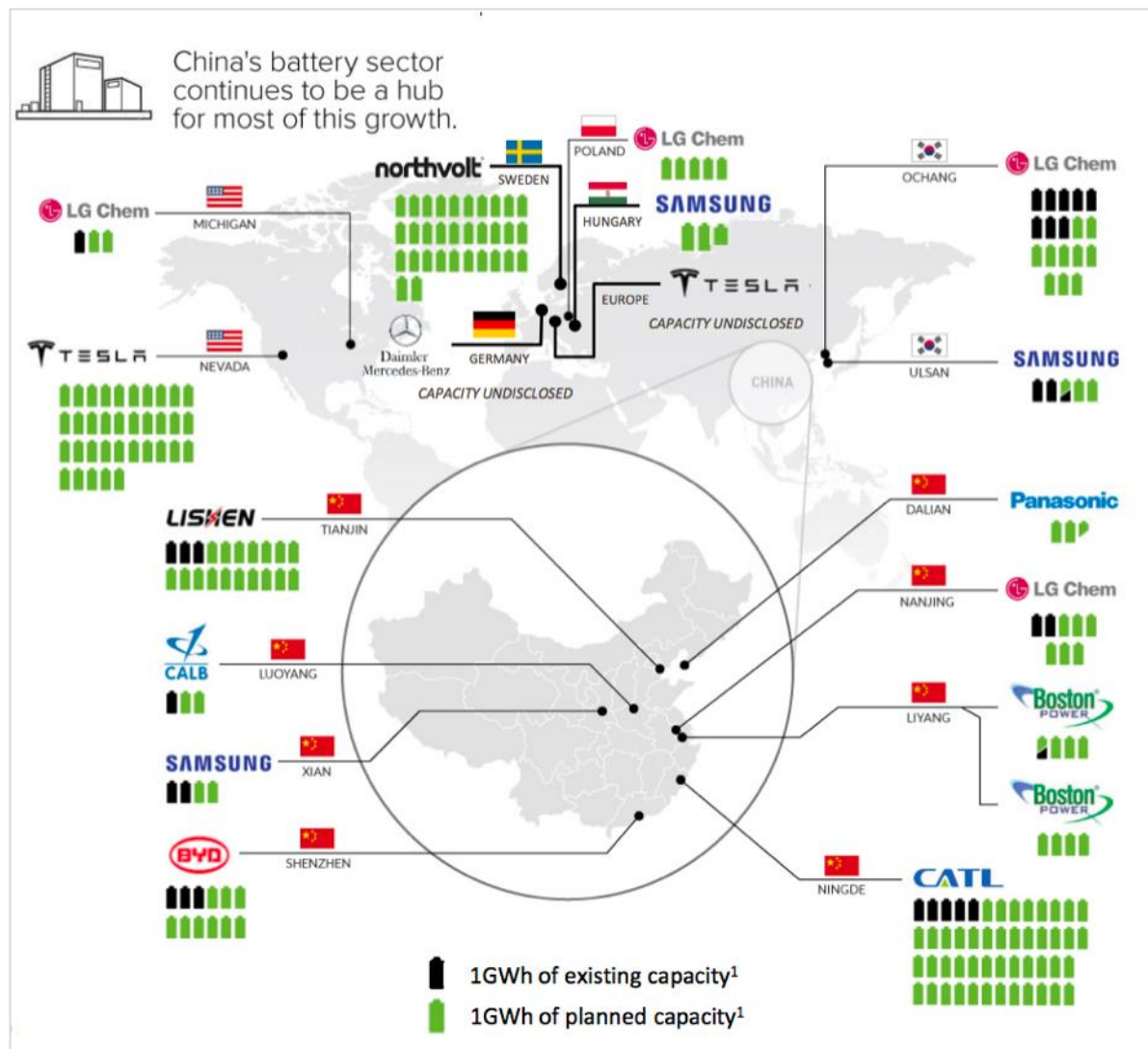
Source: IM Research, FMC Lithium



Global megatrend

Global electrification of transportation with continuing political and regulative support accelerate investment in the lithium value chain

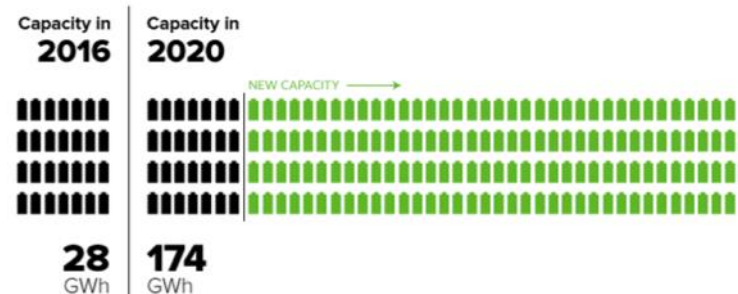
Lithium-ion Megafactories



New lithium battery projects have been announced in Europe by SDI Samsung (Hungary), Daimler (Germany), Nissan (UK), Northvolt (Sweden), LG (Poland) and Tesla (location TBD)



Global lithium-ion battery production capacity will increase by **521%** between 2016 and 2020.

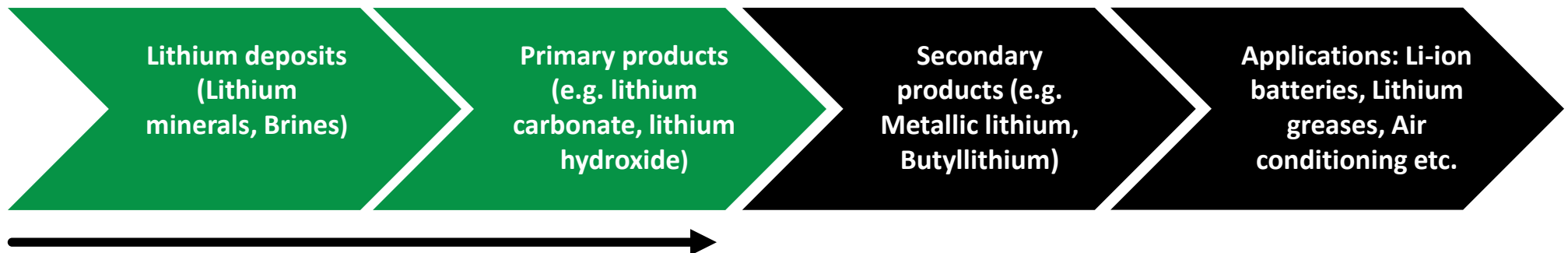


Source: Benchmark Mineral Intelligence, 2017

Keliber as a European Producer

Key strengths

- Definitive Feasibility Study on-going –project is in excellent development phase for the global, growing markets
- Geographical location offers stable regulatory environment and excellent infrastructure with a strong existing logistics chain
- Selected production process technology secures supply reliability, high-quality end-product and environmentally sound operations
- High potential for growing mineral resources and ore reserves in the future
- Chosen strategy enables optimization of production and gives a strong position in the lithium value chain



KELIBER

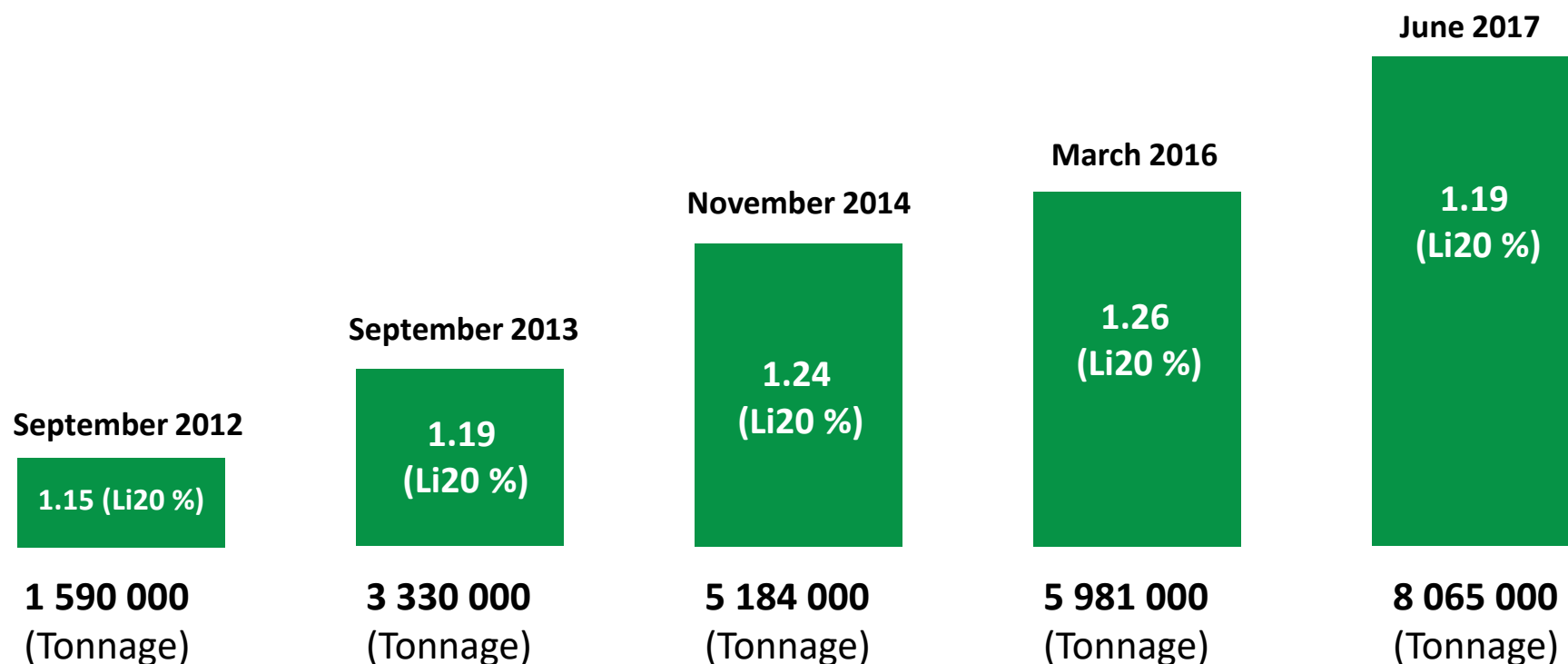
An aerial photograph showing a mining operation in a forested area. A large, dark, irregularly shaped pit or excavation is visible in the center, surrounded by a dirt road and gravel. Several pieces of heavy machinery, including a red truck, a yellow excavator, and a yellow loader, are positioned around the pit. The surrounding area is covered in dense green forest. The text "Growing Resources and High Exploration Potential" is overlaid in large white letters.

Growing Resources and High Exploration Potential

Development of mineral resources

Sufficient for production of 9,000 tons of lithium carbonate per annum for +10 years

Mineral Resources (0.5 % Li₂O cut-off)



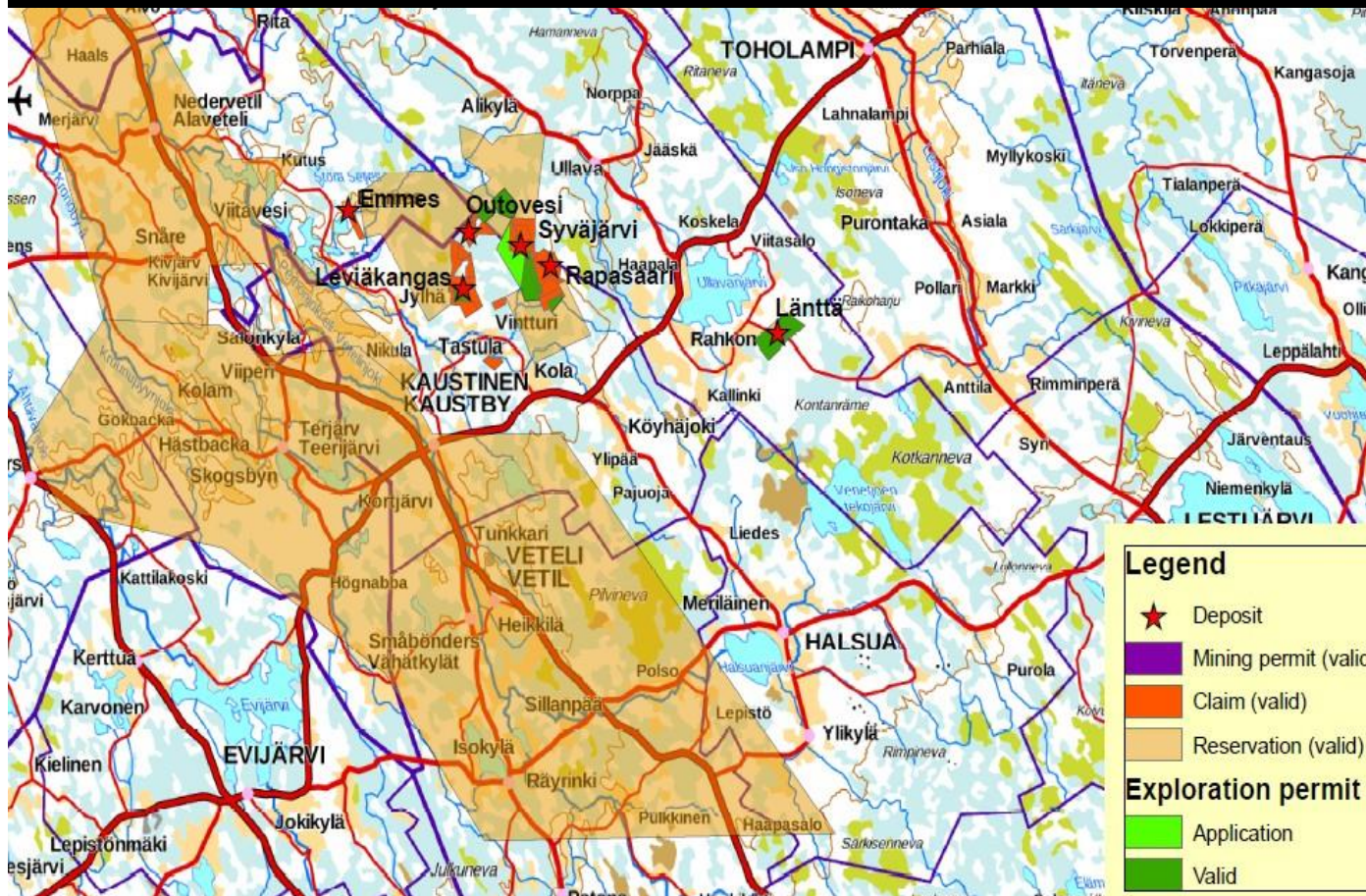
Estimates prepared by Competent Persons in accordance with 2012 JORC code

Excellent exploration potential

One of the most significant lithium-bearing areas in Europe



Overview of concession areas



- The lithium-rich province of Central Ostrobothnia covers over 500 sq. km
- A number of unexplored areas and excellent potential for further discoveries
- More than 1400 erratic boulders in the area

Active exploration

First exploration programs already in 1960's

- Six well-known deposits have been explored in various stages
- Geological Survey of Finland and Keliber alone have drilled these deposits for circa 50 kilometers, total of almost 500 drill holes

Amount of diamond drilling at the areas of main deposits

	Historical drilling (GTK & other)		Keliber Oy		Total	
Deposit	Number of ddholes	Metres	Number of ddholes	Metres	Number of ddholes	Metres
Länttä	49	5649.25	51	3493.60	100	9142.85
Syväjärvi	28	3311.90	69	5042.10	97	8354.00
Rapasaari	26	3651.90	108	12271.50	134	15923.40
Outovesi	6	468.70	31	2622.80	37	3091.50
Leviäkangas	46	5322.42	30	2244.10	76	7566.52
Emmes	41	4101.02	10	1105.50	51	5206.52
	196	22505.19	299	26779.60	495	49284.79

Active exploration

Lithogeochemical exploration method

- Lithogeochemical halo: Anomalous values of some indicator elements and the ratios of some specific elements in the rim of spodumene pegmatites give a broader target area for exploration
- Lithogeochemical exploration method can be used for samples of till, boulder and bedrock



An aerial photograph of a mining operation. In the center, a large area of dark, rocky material (ore or waste) is being processed. Several pieces of heavy machinery are visible: a red truck, a yellow conveyor system, and an orange excavator. The area is surrounded by dense green forest. A small stream or road runs along the top edge of the processing area.

From Ore Reserves to High Quality Product

Growing Reserves

Latest estimate of mineral resources and ore reserves (million metric tonnes)							
Mt	Länttä	Syväjärvi	Outovesi	Rapasaari	Leviäkangas	Emmes	Total
RESOURCES (June 2017)							
Measured	0.437	0.810	-	-	-	-	1.247
Indicated	0.910	1.160	0.283	3.456	0.190	0.820	6.818
Total	1.347	1.970	0.283	3.456	0.190	0.820	8.065
<i>Ore grade (Li20 %)</i>	<i>1.06</i>	<i>1.24</i>	<i>1.43</i>	<i>1.15</i>	<i>1.14</i>	<i>1.40</i>	<i>1.19</i>
<i>Inferred</i>	-	-	-	-	0.300	-	
RESERVES (March 2016)							
<i>Proven</i>	<i>0.470</i>	-	-	-	-	-	<i>0.470</i>
<i>Probable</i>	<i>0.540</i>	<i>1.480</i>	<i>0.250</i>	<i>1.750</i>	-	-	<i>4.020</i>
Total	1.010	1.480	0.250	1.750	-	-	4.490
<i>Ore grade (Li20 %)</i>	<i>0.94</i>	<i>1.19</i>	<i>1.20</i>	<i>1.09</i>	-	-	<i>1.10</i>

Ore reserves are included in the Mineral Resources

Estimates prepared by Competent Persons in accordance with 2012 JORC code

Sizeable deposits

Significant upside potential

Rapasaari deposit



Rapasaari deposit - consists of several pegmatite veins -thickness of the veins varies from a few meters to tens of meters

Syväjärvi deposit



Syväjärvi deposit -consists of a main vein, which is divided into two separate pegmatite veins in places - also parallel veins exists -the maximum thickness of the main vein is about 30 meters

Favourable mineralogy

- Host rock of lithium ore is spodumene pegmatite. Spodumene is comprising on average 18 weight % in modal abundance
- Spodumene is favorable mineral (high in lithium, no harmful elements, easy to concentrate)
- Main gangue minerals: Albite, Quartz, Potassium feldspar, Muscovite
- Only rarely negligible amount of sulphide minerals, e.g. sphalerite, chalcopyrite, pyrite, pyrrhotite, galena
- Low heavy metal contents, very low grades of minerals having acid generation potential

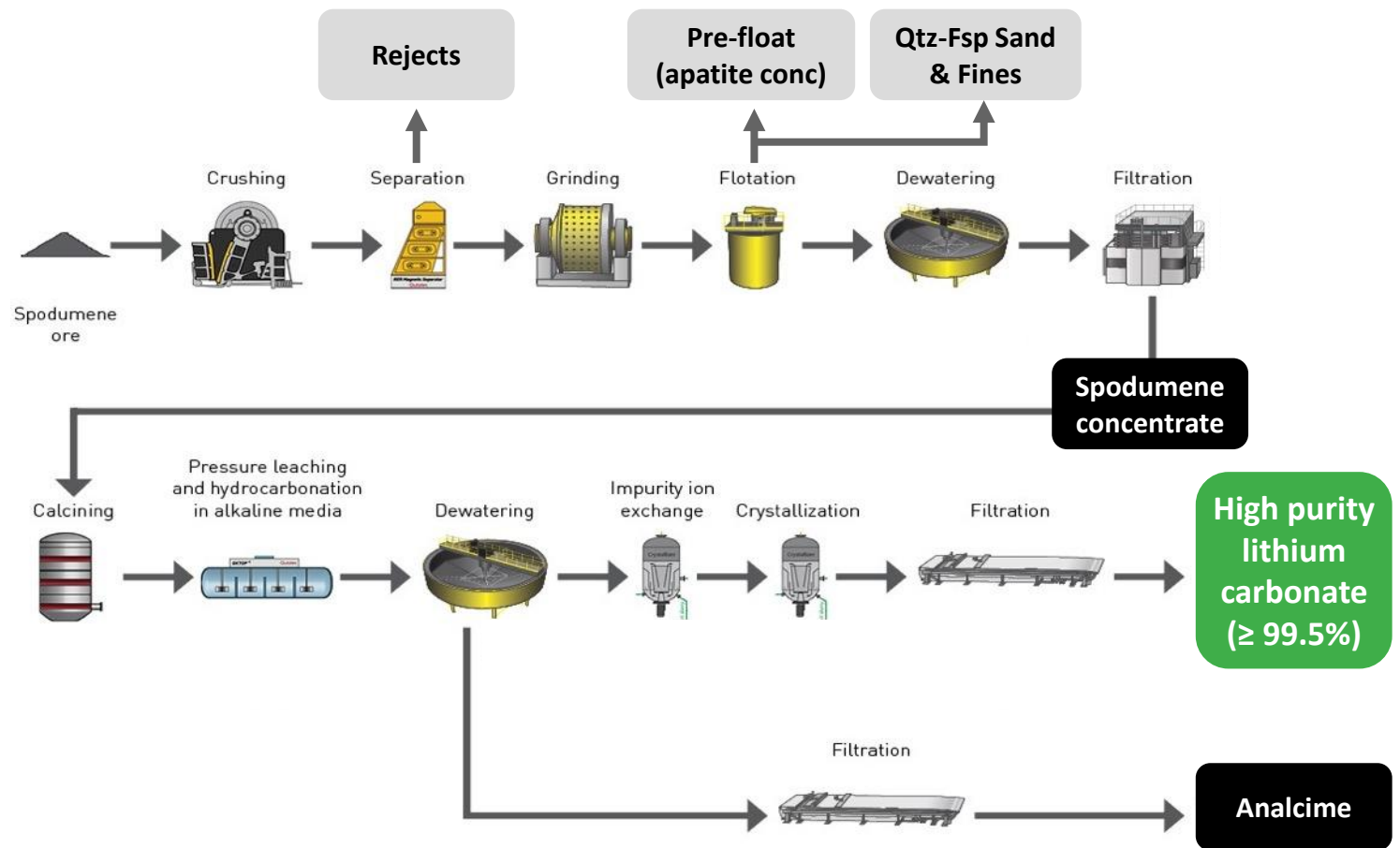


Clean tech process

Efficient and environmentally sound production of high purity lithium carbonate

Soda leaching process developed together with Outotec

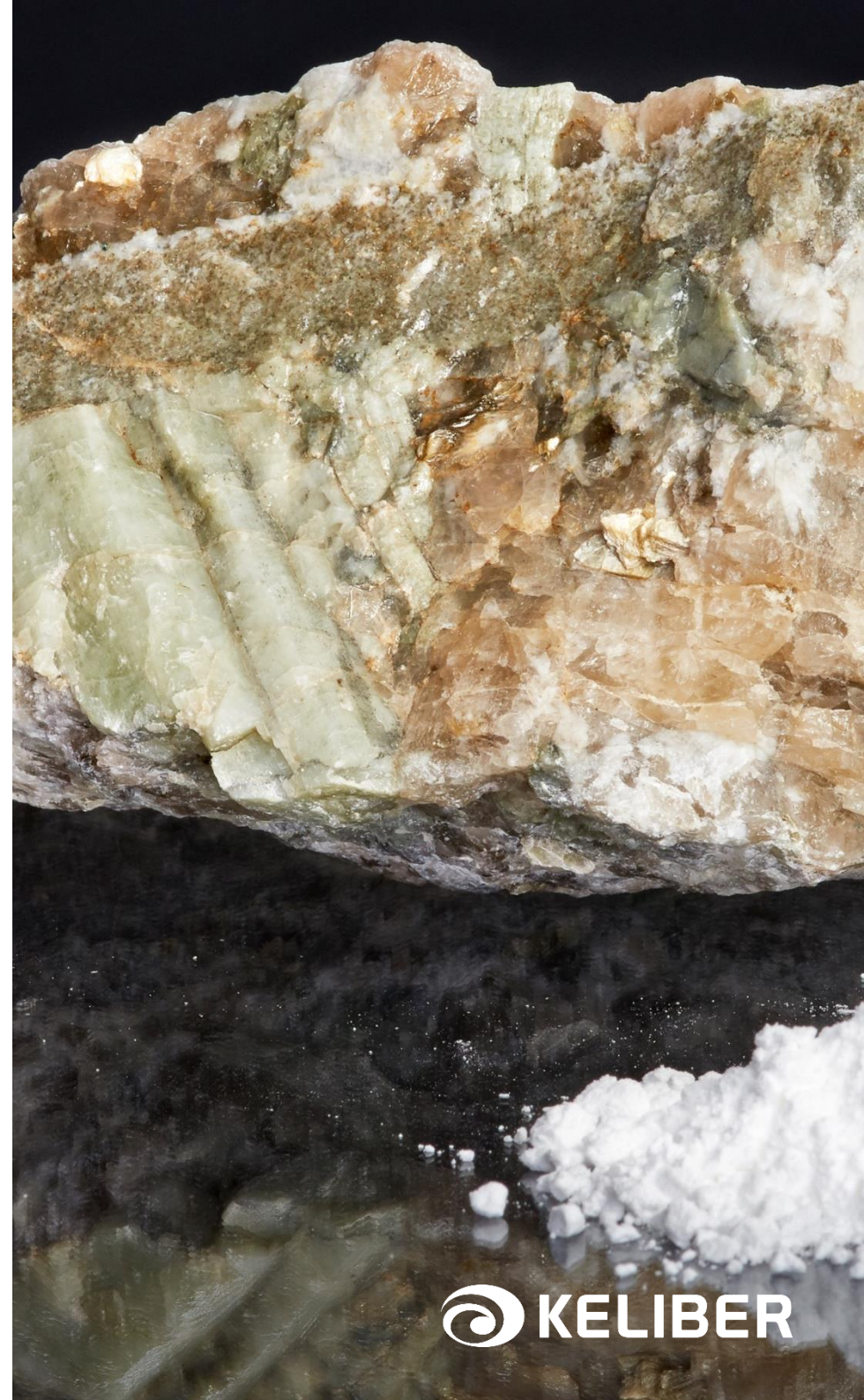
- Optical sorting
- Valuable by-products
- Concentrate grade optimization
- Flexible and environment-friendly soda leaching
- Tailings with no heavy metals nor acid generating minerals



Battery-grade lithium carbonate

9000 tonnes per year

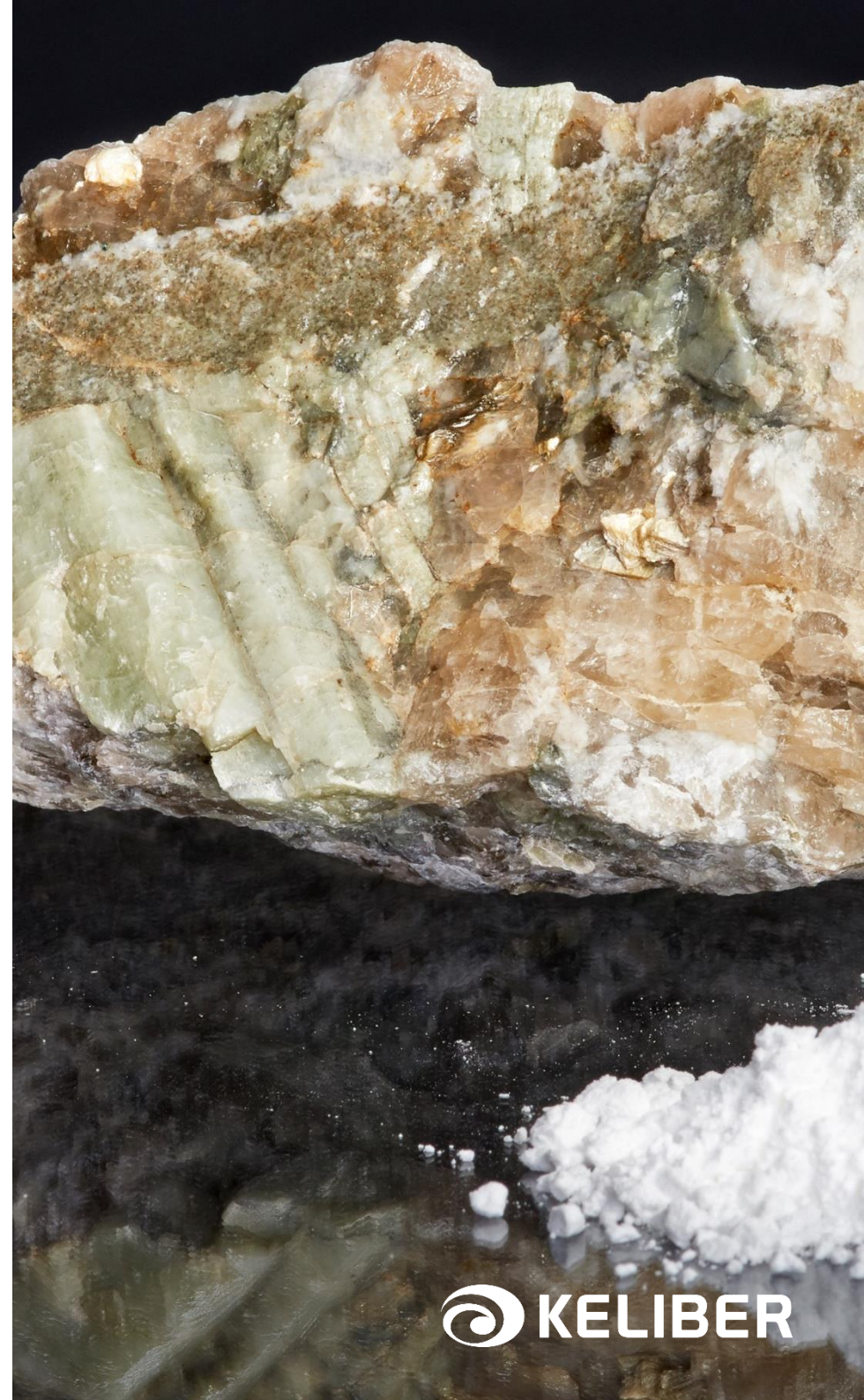
- Battery grade lithium carbonate (Li_2CO_3 min. 99.5 %) can be used in the manufacturing of batteries intended for
 - portable electronics,
 - electric tools,
 - electric means of transport
- Lithium carbonate from Länttä spodumene pegmatite ore test program
 - 99,61- 99.91 % Li_2CO_3
- Lithium carbonate from Syväjärvi spodumene pegmatite ore test program
 - 99,5 % Li_2CO_3



Potential by-products

Analcime and Quartz-feldspar

- Analcime is a porous zeolite with a number of potential industrial uses
 - a molecular sieve
 - an agent in the manufacture of cement, concrete, ceramic tiles and asphalt
- Fine-grained quartz feldspar sand
 - various uses as a filler, in for instance, asphalt coatings



Innovation and R&D

Several areas

- Exploration methods
- Ore characterization
- Metallurgical flowsheet development
- On-line measurement methods
- By-product development
- Battery chemicals R&D

Several partners

- Geological Survey of Finland
- University of Oulu
- Kokkola University Consortium Chydenius
- Centria University of Applied Sciences
- Oulu University of Applied Sciences
- Outotec

Public R&D Funding

- Tekes
- EU Horizon 2020



Strong commitment to sustainability

Sustainable production process and proactive environmental actions

- Production process designed to be efficient and environmentally friendly simultaneously enabling superior quality end-product
 - Optical sorting reduces the amount of waste rock going through the process
 - Hydrometallurgical leaching is conducted with soda -an environmentally neutral alternative to sulphuric acid typically used in hard rock lithium production
 - Production process designed to exploit the potential of the possible future by-products
- Proactive environmental actions e.g. protection of moor frogs and golden eagle
- Committed to transparent communication with surrounding community and society at large
- Keliber is a member of the Finnish Network for Sustainable Mining

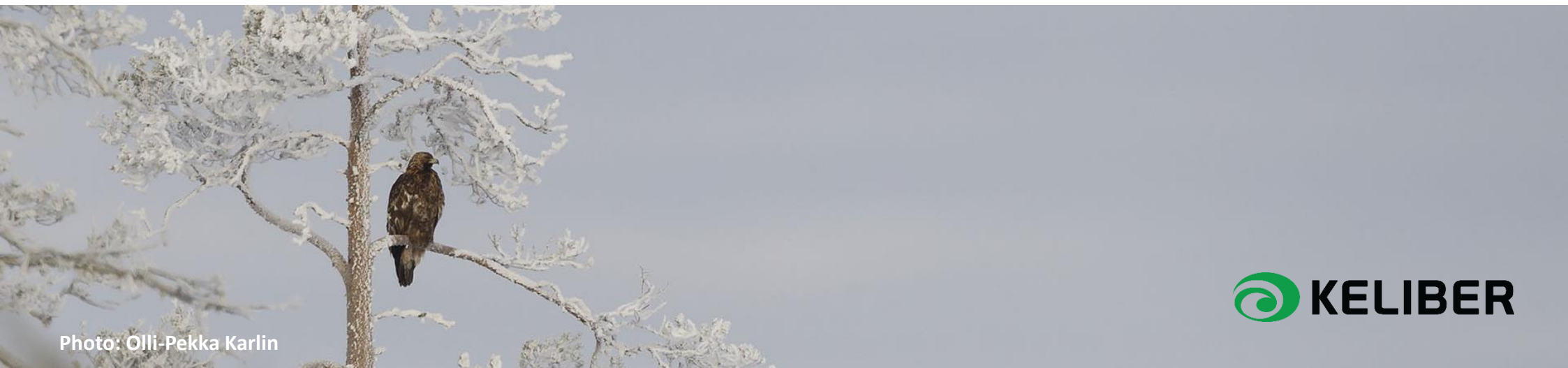


Photo: Olli-Pekka Karlin



From a Project to Production

Way to production

Definitive feasibility study and preparation for production

Tentative timeline for the next stages	2017	2018	2019	2020
Permitting (environmental, mining and other)			October 2017 – April 2018	
Basic Engineering			October 2017 – April 2018	
Detailed Engineering			May 2018 – March 2019	
Main equipment purchases			June 2018 – September 2018	
Start of Earth works			September 2018	
Civil construction		September 2018 – 2019		
Main Equipment Installation		May 2019 – January 2018		
Commissioning and testing			January 2020 – May 2020	

Production estimated to start early 2020

Committed and skillfull management

Management team

Pertti Lamberg



- CEO since 2016
- Chair of the management group

Jaakko Vilponen



- Chief Financial Officer since 2016

Manu Myllymäki



- Chief Production Officer since 2017

Pentti Grönholm



- Chief Geologist since 2017

Olle Sirén



- COO since 2016
- Member of the board since 2016

Kari Wiikinkoski



- Environmental Manager since 2012

Jarmo Finnilä



- Communication and Administration Manager since 2013

Finnish majority ownership

Largest shareholders

- The company is owned by Finnish investment companies and private investors. The largest shareholder is the Norwegian company Nordic Mining ASA

	Total number of shares	Percentage
Nordic Mining ASA	239,044	22.1
Tesi Industrial Management Oy	190,662	17.6
Ab Mine Invest Oy	97,527	9.0
Keskinäinen Eläkevakuutusyhtiö Ilmarinen	70,929	6.6
Thominvest Oy	68,683	6.4
Jorma Takanen	63,123	5.8
Osuuskunta PPO	60,000	5.6
Case Invest Oy	59,547	5.5
Jussi Capital Oy	35,010	3.2
Eero Halonen	20,000	1.9

Current activity

- Additional process test work to reconfirm recent positive results in minerals processing tests
- Additional drilling to further increase of the resource base
- Trade-off study of location of the lithium carbonate plant between Kalavesi Kaustinen and Kokkola Industrial Park (KIP)
- Preparation of the Environmental Impact Assessments (EIA)
- Preparations for the environmental and other permits
- Negotiations with potential clients to obtain end-product supply agreements
- Preparations related to the investment phase financing
- Finalizing the DFS report



Project in a nutshell

Lithium carbonate production with high value creation potential

1 Innovative clean tech process

- Efficient and environmentally sound production
- Potential for recovery of valuable by-products

2 Production of high purity lithium carbonate

- 9,000 tonnes of lithium carbonate per annum for +10 years
- Attractive market driven by Electric Vehicle industry

3 Position in the lithium value chain

- Production strategy enables competitive advantage in the lithium value chain

4 Growing resources

- Deposits located in one of the most significant lithium-bearing areas in Europe
- Significant upside potential

KELIBER – Lithium Mining for Fast Growing Markets

