

# Keliber – Lithium from Europe for future energy solutions

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Battery Supply Chain Europe / Düsseldorf

March 13, 2018



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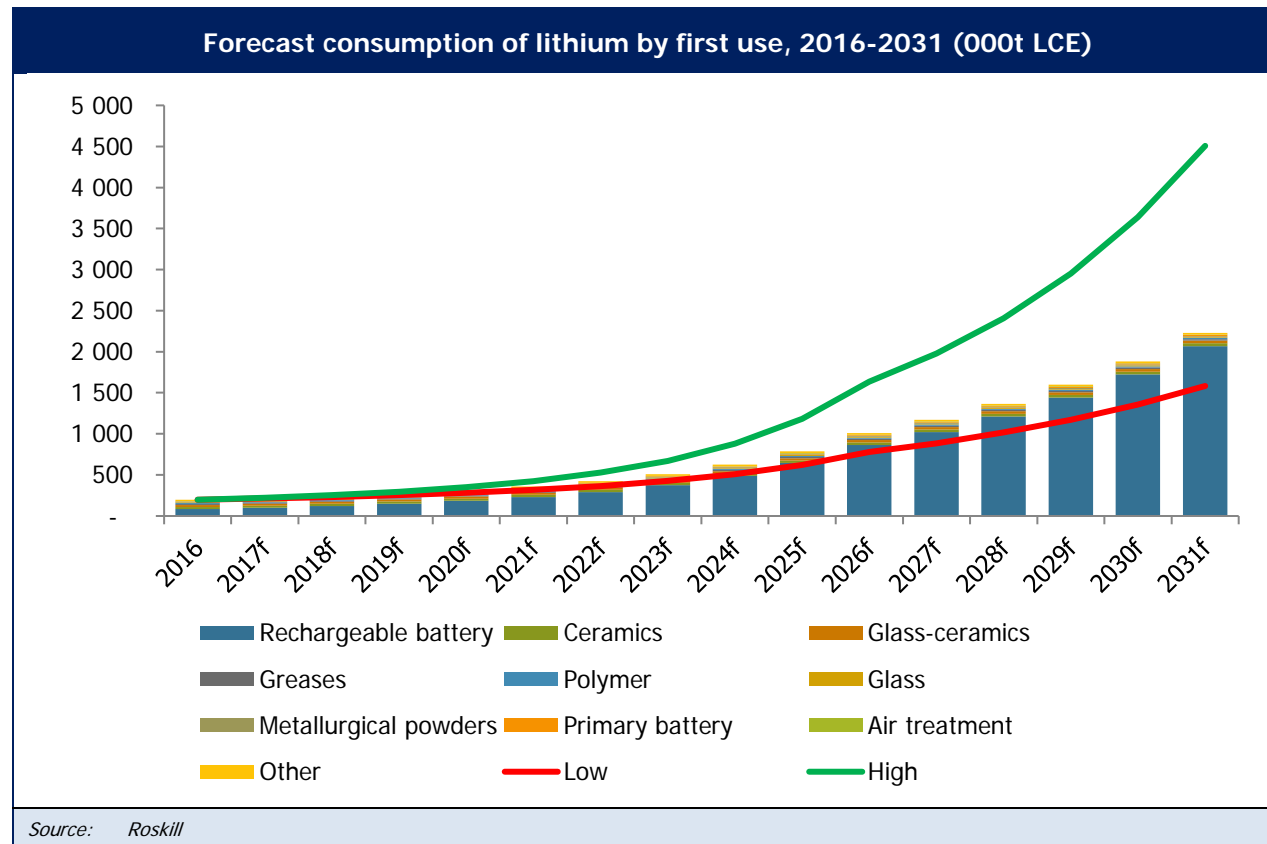
# Global demand and production of lithium





# Increase in demand for lithium

Rechargeable battery sector driver for growth

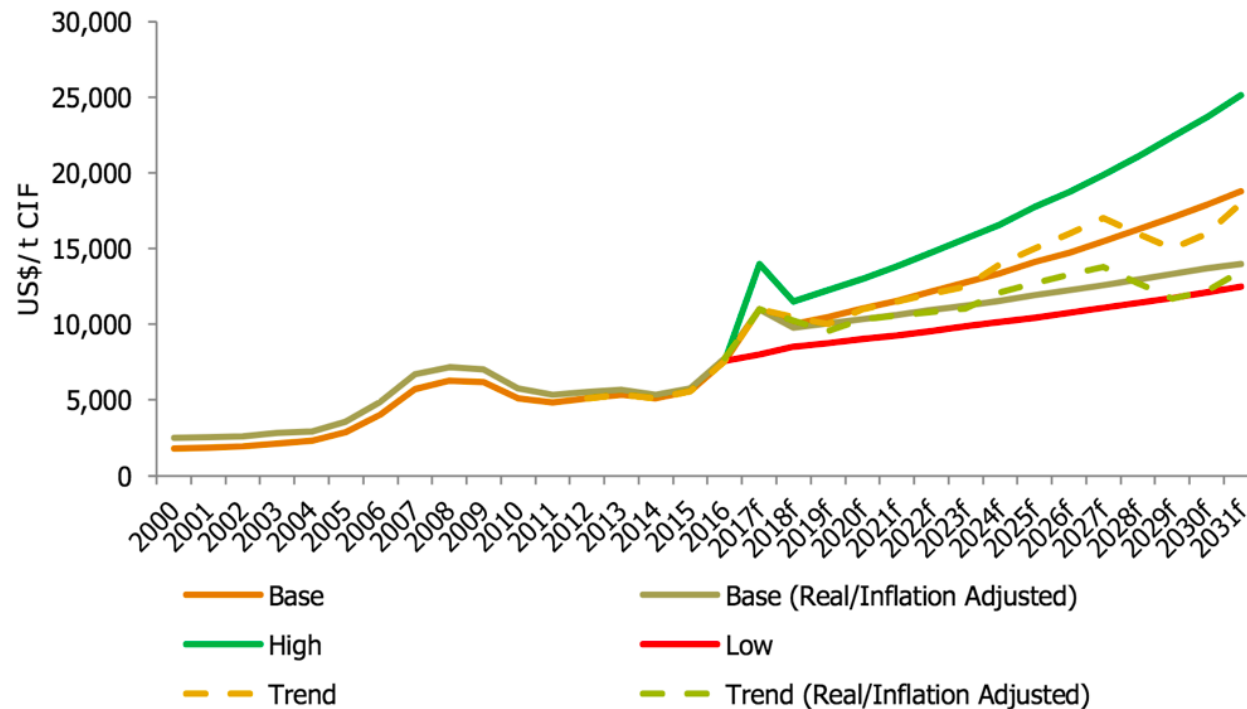


- Increasing global demand driven by the rechargeable battery sector, which is forecast to register 23.9 % pa growth through to 2031
- Other markets for lithium are also forecasted to provide areas of growth (ceramics and glass-ceramics, polymers, metallurgical powders)
- Annual global demand is forecasted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

# Increase in demand 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 demand 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

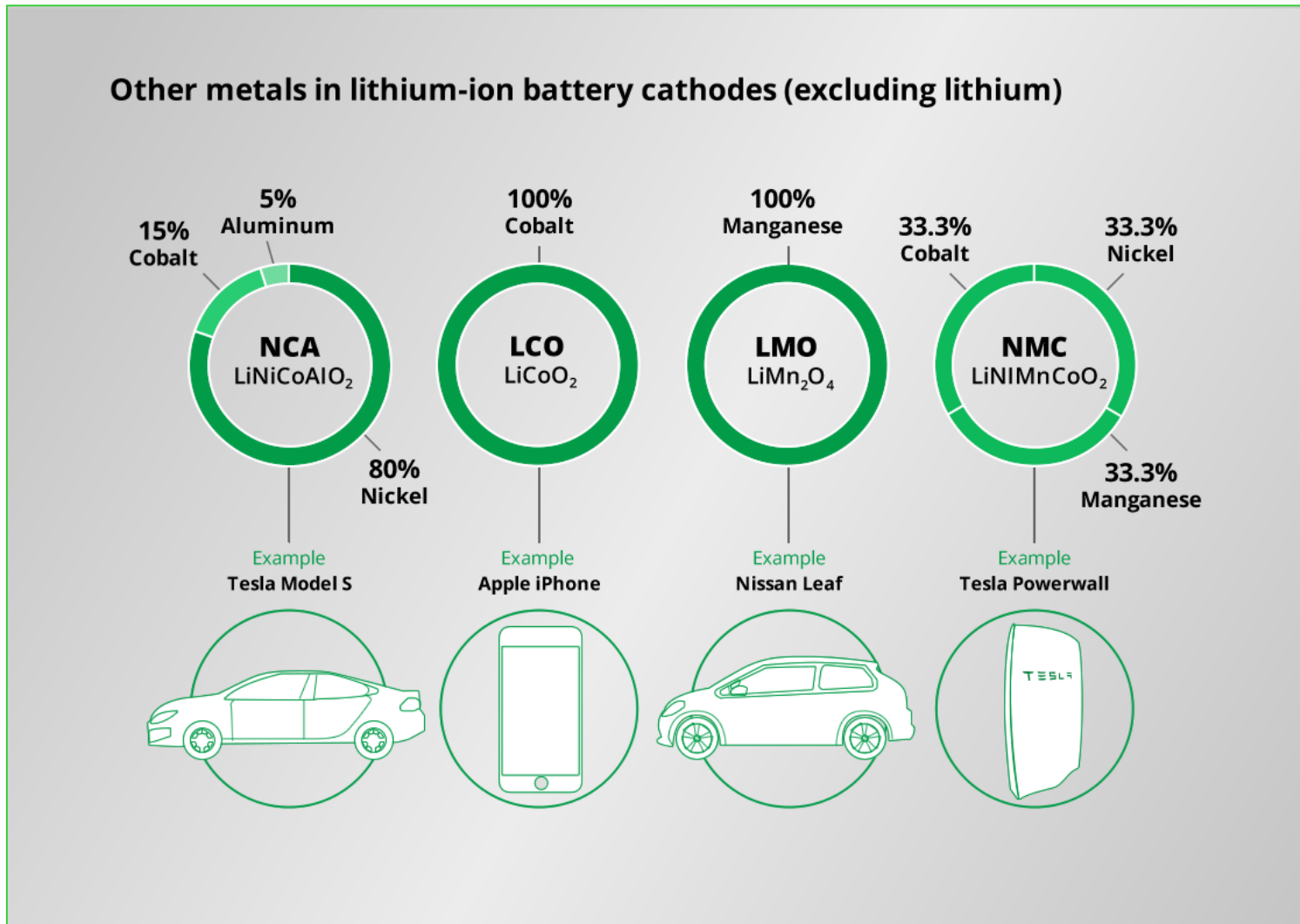
Source: IM Research, FMC Lithium

## Global megatrend

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

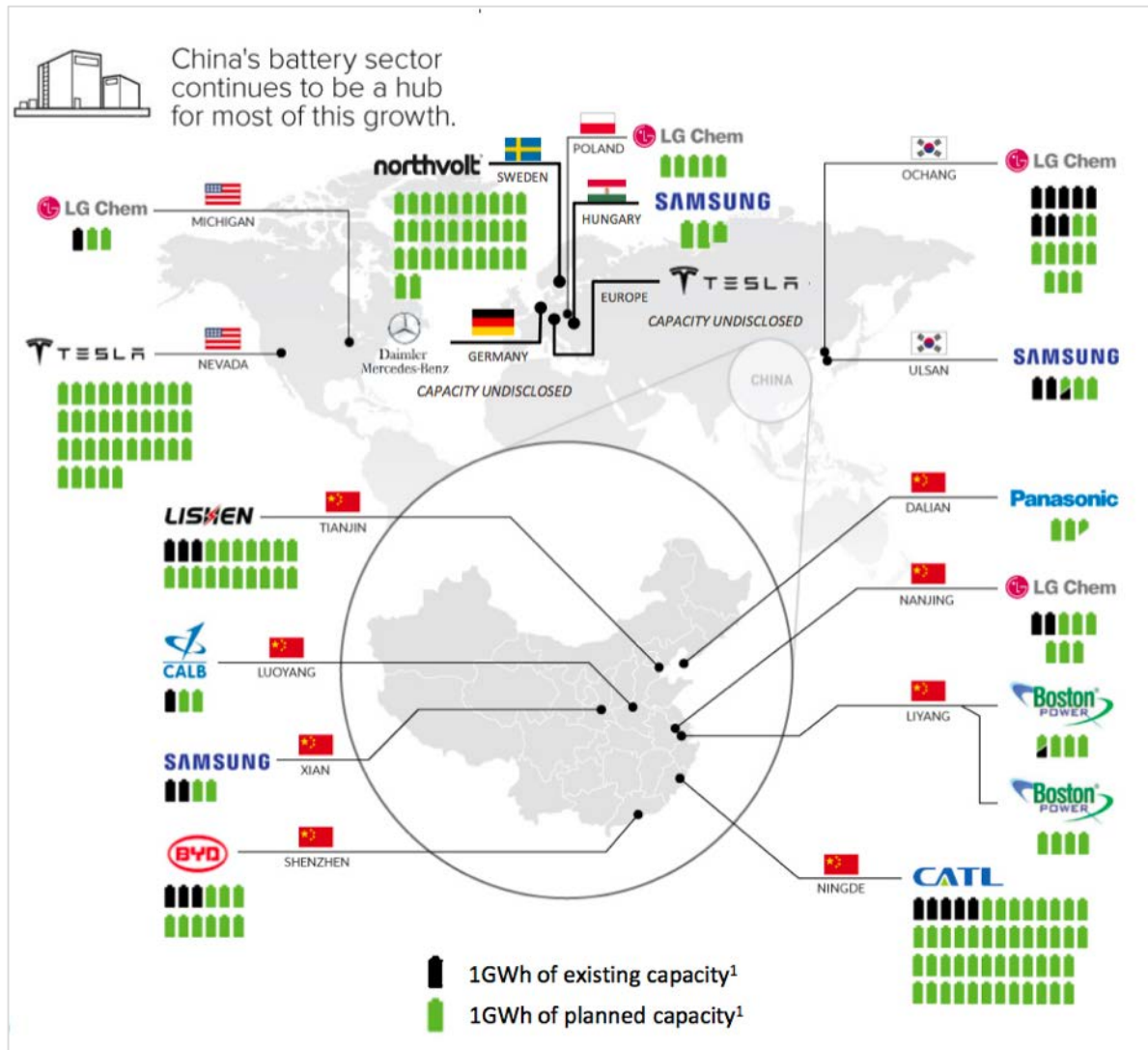
# Increase in demand for lithium

Other metals in lithium-ion batteries



**Global megatrend** increases the demand also for other metals used in lithium-ion cathodes

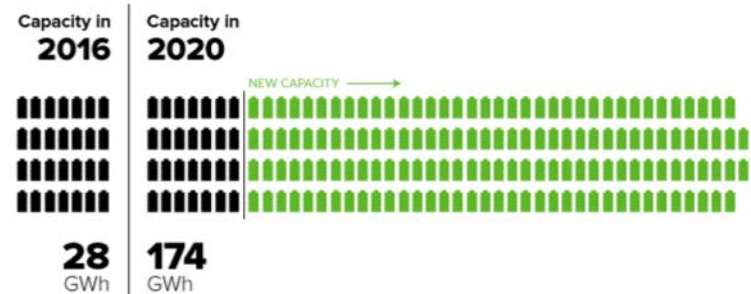
# Lithium-ion megafactories



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)



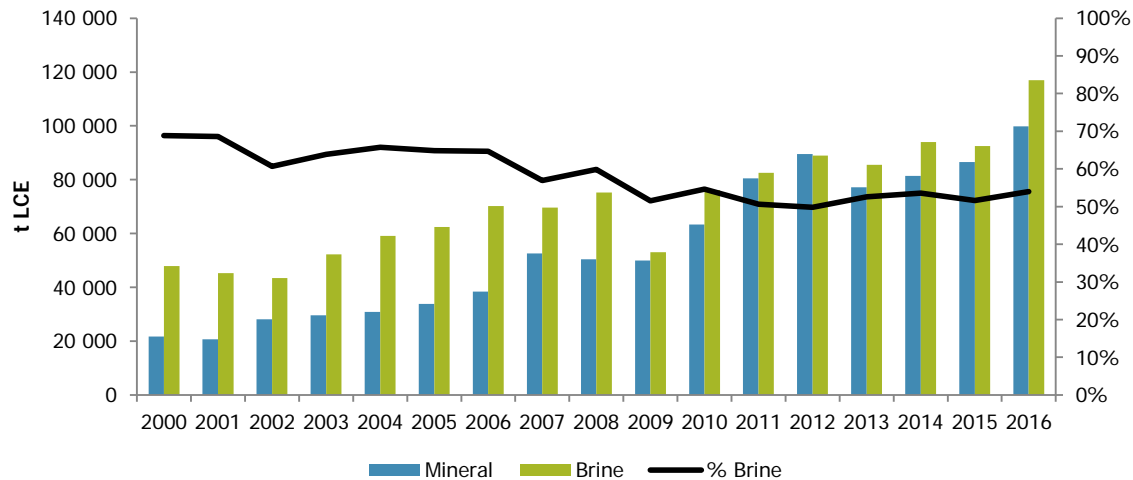
Global lithium-ion battery production capacity will increase by **521%** between 2016 and 2020.





# Global mine production of lithium

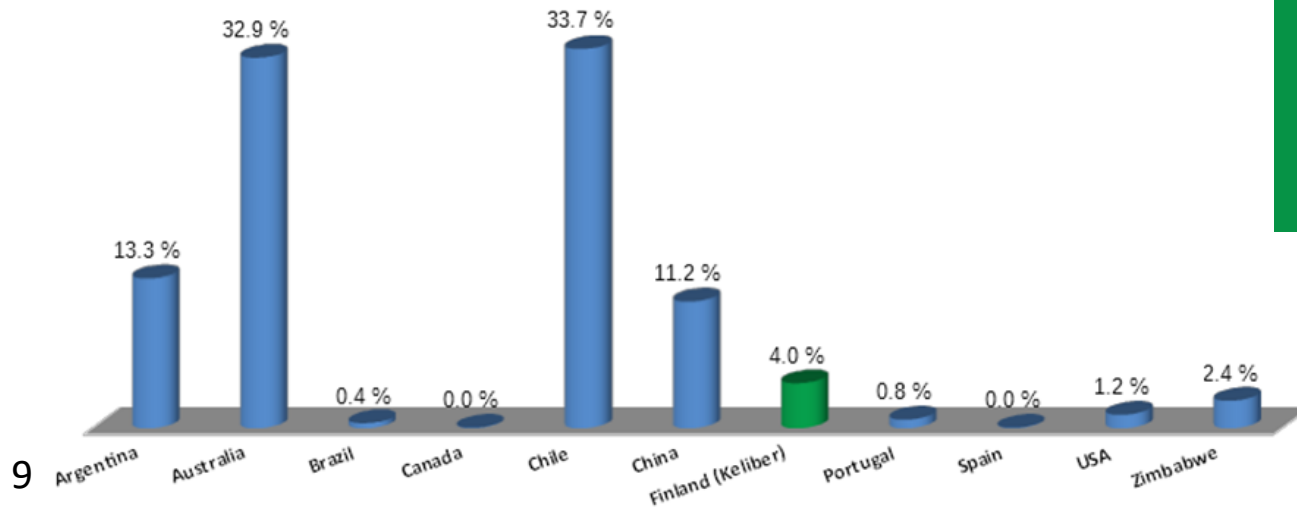
Figure 1: World: Mine production of lithium by type, 2000-2016 (t LCE and % brine)



In 2016 mine production of lithium totalled 216 740 LCE tons

- 20 % increase in production compared to 2015
- Mine production of lithium from hard rock sources growing
- Keliber first Company to produce battery grade lithium carbonate from own ore reserves in Europe

Keliber's future production compared to mine production of lithium by country in 2016 (t LCE)

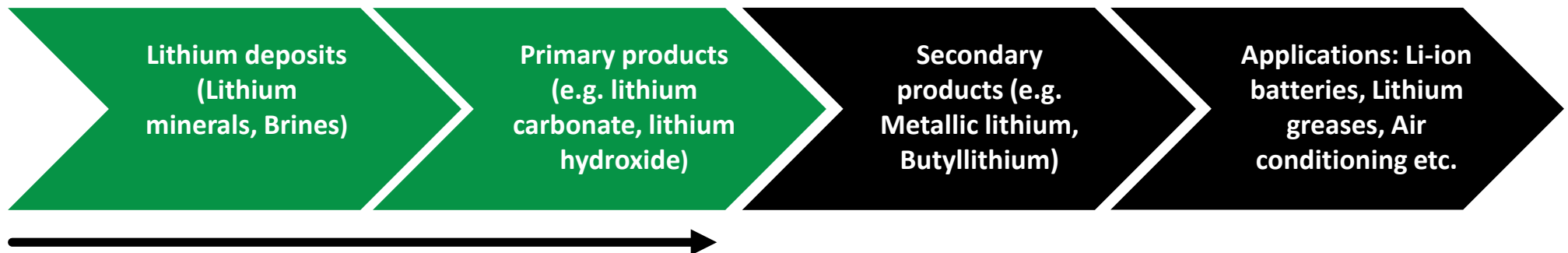


Source: Roskill Consulting Group Ltd, 2017

# 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



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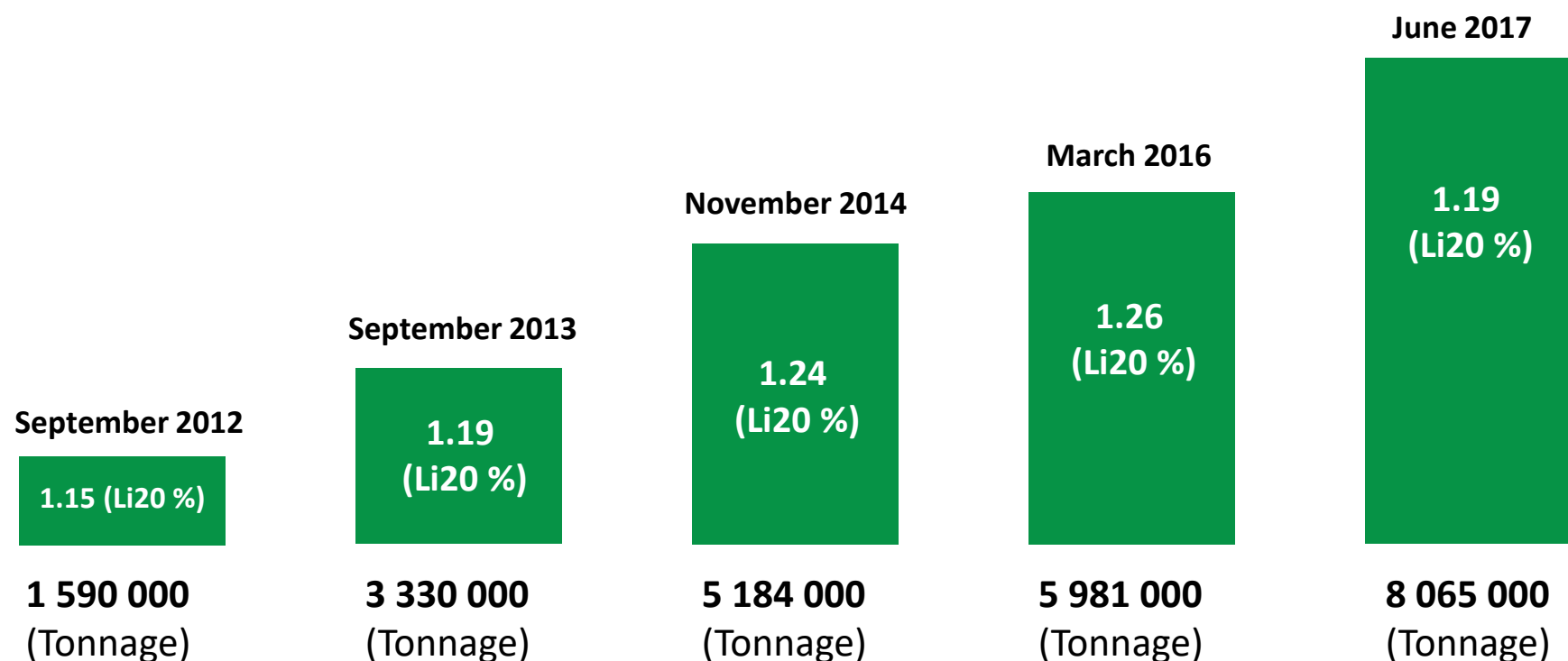
# Growing resources and high exploration potential



# Development of mineral resources

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

## Mineral Resources (0.5 % Li<sub>2</sub>O cut-off)



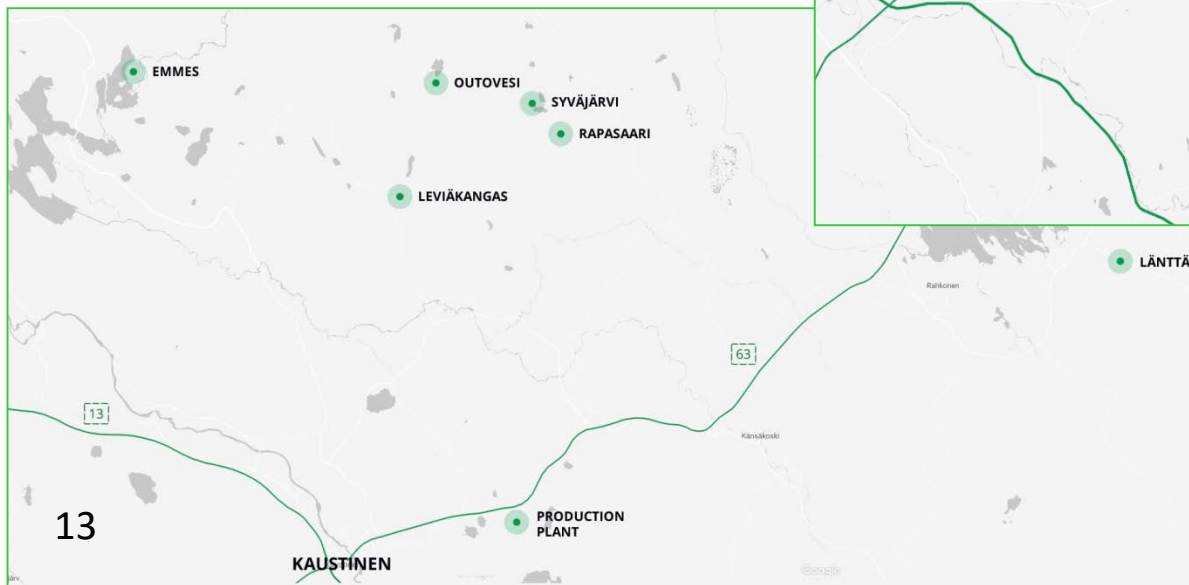
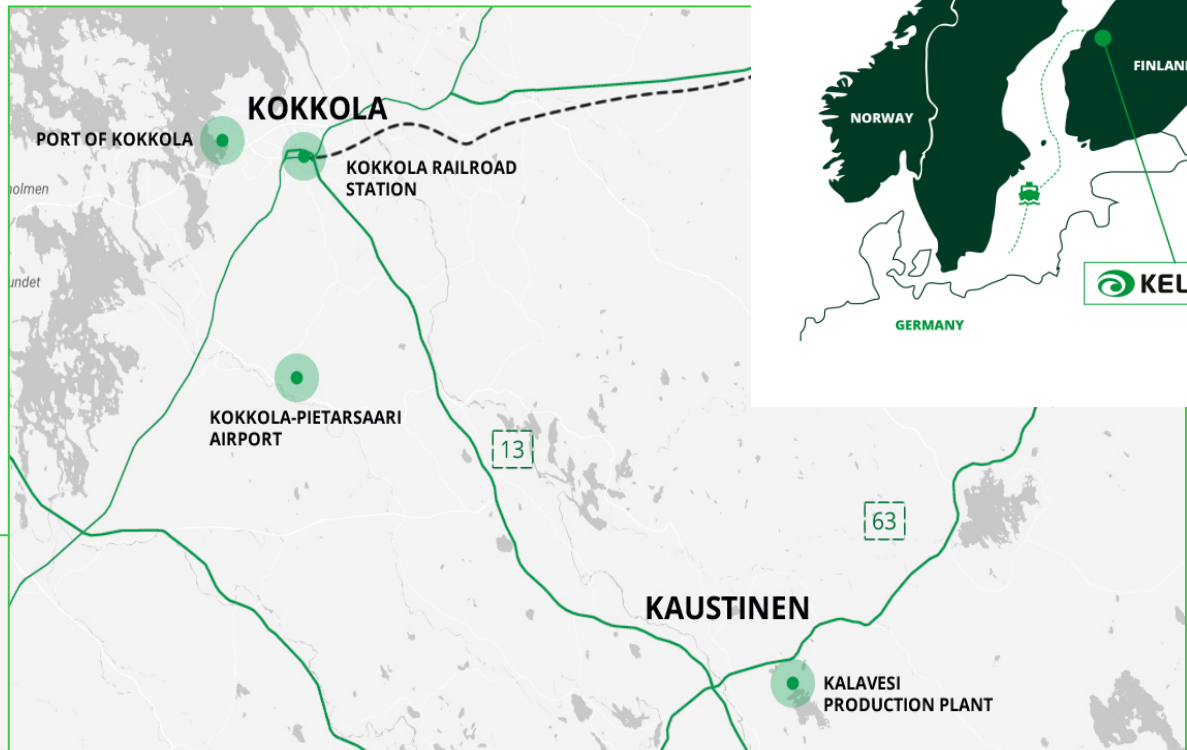
Estimates prepared by Competent Persons in accordance with 2012 JORC code



# Excellent exploration potential

One of the most significant lithium-bearing areas in Europe

- 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 1 400 erratic boulders in the 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
<b>RESOURCES (June 2017)</b>							
Measured	0.437	0.810	-	-	-	-	1.247
Indicated	0.910	1.160	0.283	3.456	0.190	0.820	6.818
<b>Total</b>	<b>1.347</b>	<b>1.970</b>	<b>0.283</b>	<b>3.456</b>	<b>0.190</b>	<b>0.820</b>	<b>8.065</b>
<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	-	
<b>RESERVES (March 2016)</b>							
<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>
<b>Total</b>	<b>1.010</b>	<b>1.480</b>	<b>0.250</b>	<b>1.750</b>	-	-	<b>4.490</b>
<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

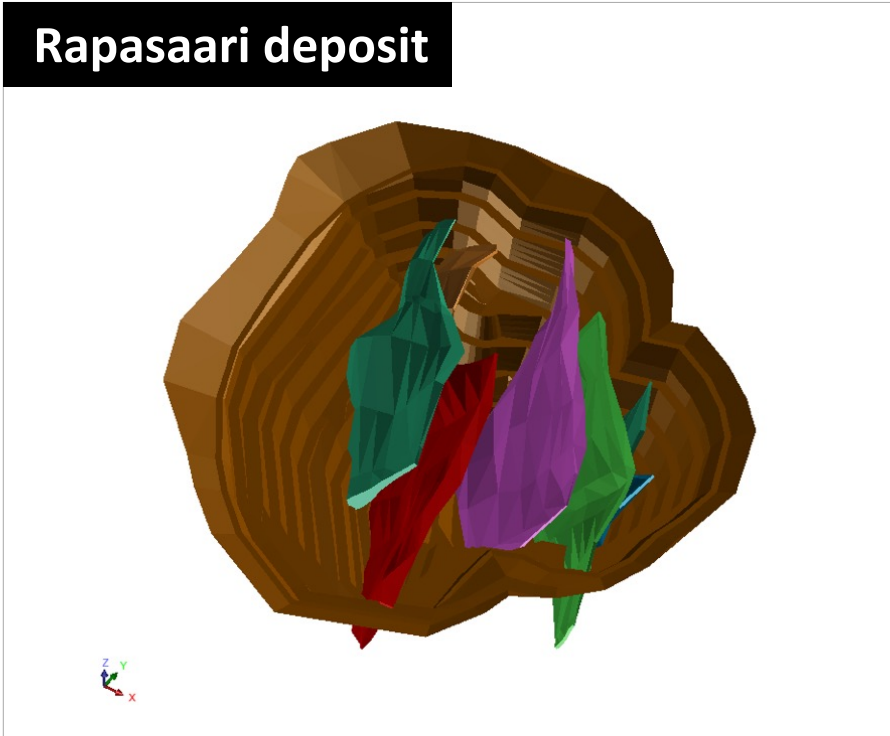
Estimates prepared by Competent Persons in accordance with 2012 JORC code



# 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

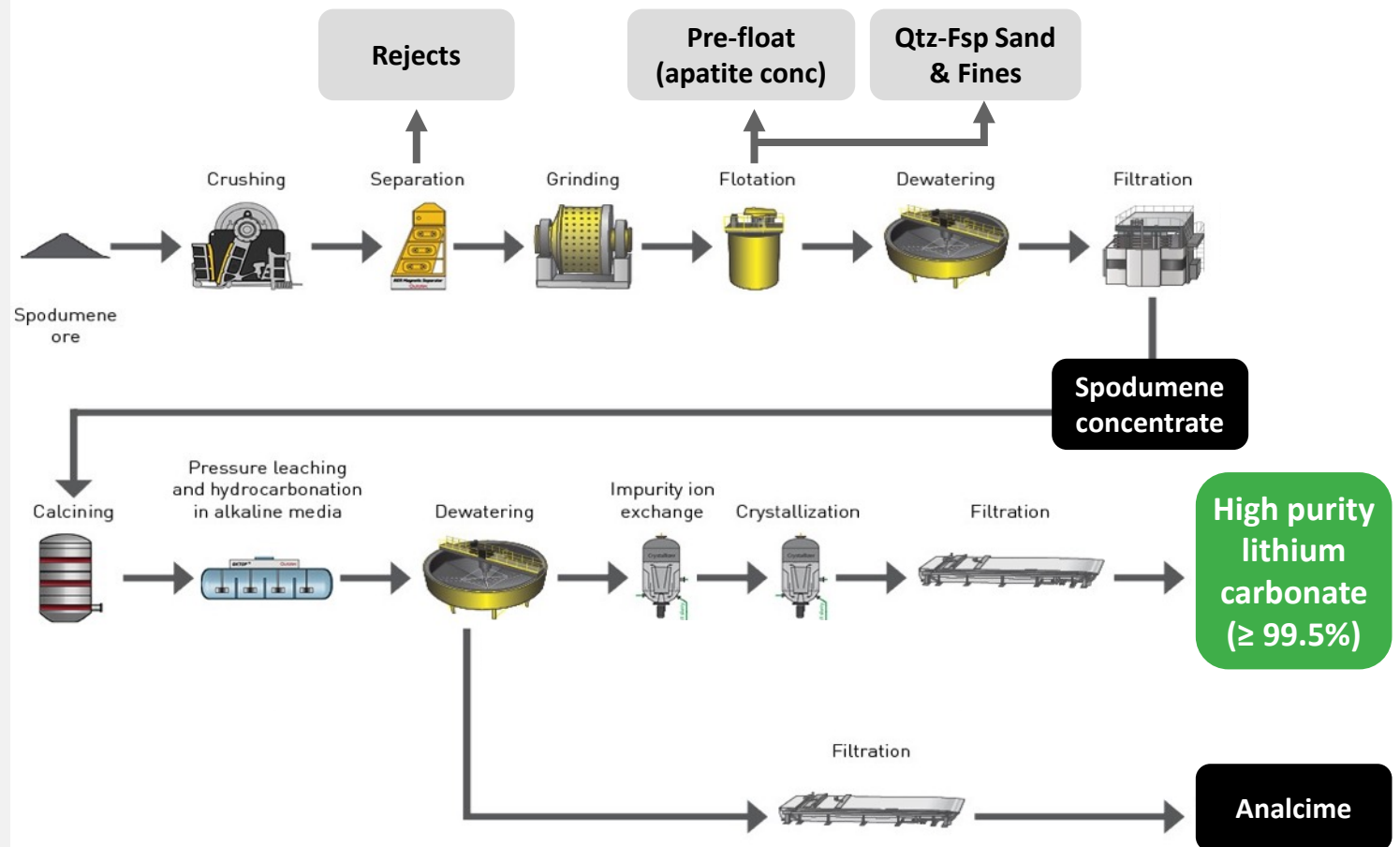


# Clean tech process

Efficient and environmentally sound production of high purity lithium carbonate

## Soda leaching process developed together with Outotec

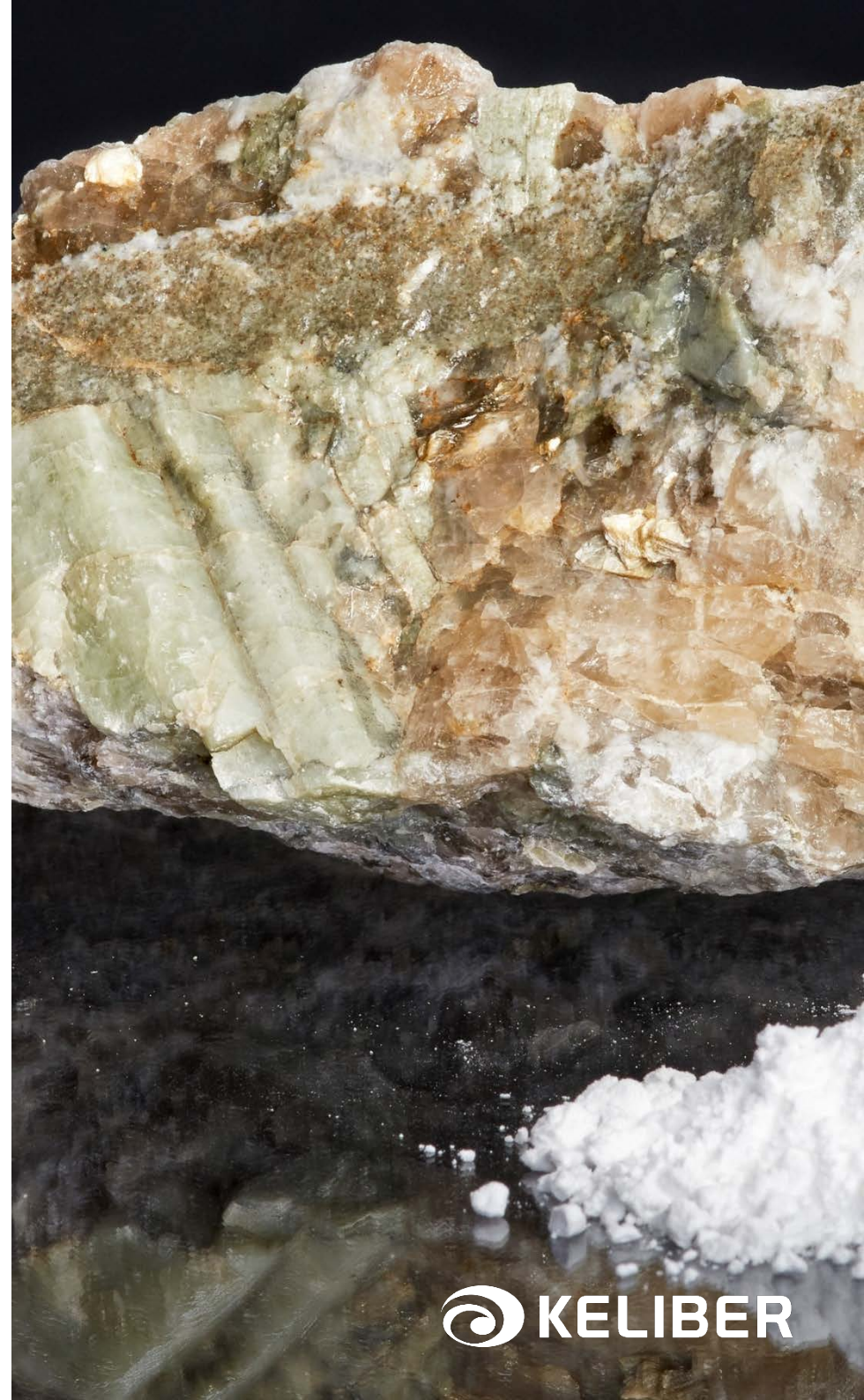
- Optical sorting
- Valuable by-products: Analcime sand and quartz-feldspar sand
- Concentrate grade optimization
- Flexible and environment-friendly soda leaching
- Tailings with no heavy metals nor acid generating minerals



# Battery-grade lithium carbonate

9 000 tonnes per year

- Battery grade lithium carbonate ( $\text{Li}_2\text{CO}_3$  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 %  $\text{Li}_2\text{CO}_3$
- Lithium carbonate from Syväjärvi spodumene pegmatite ore test program
  - 99,5 %  $\text{Li}_2\text{CO}_3$





# Potential by-products

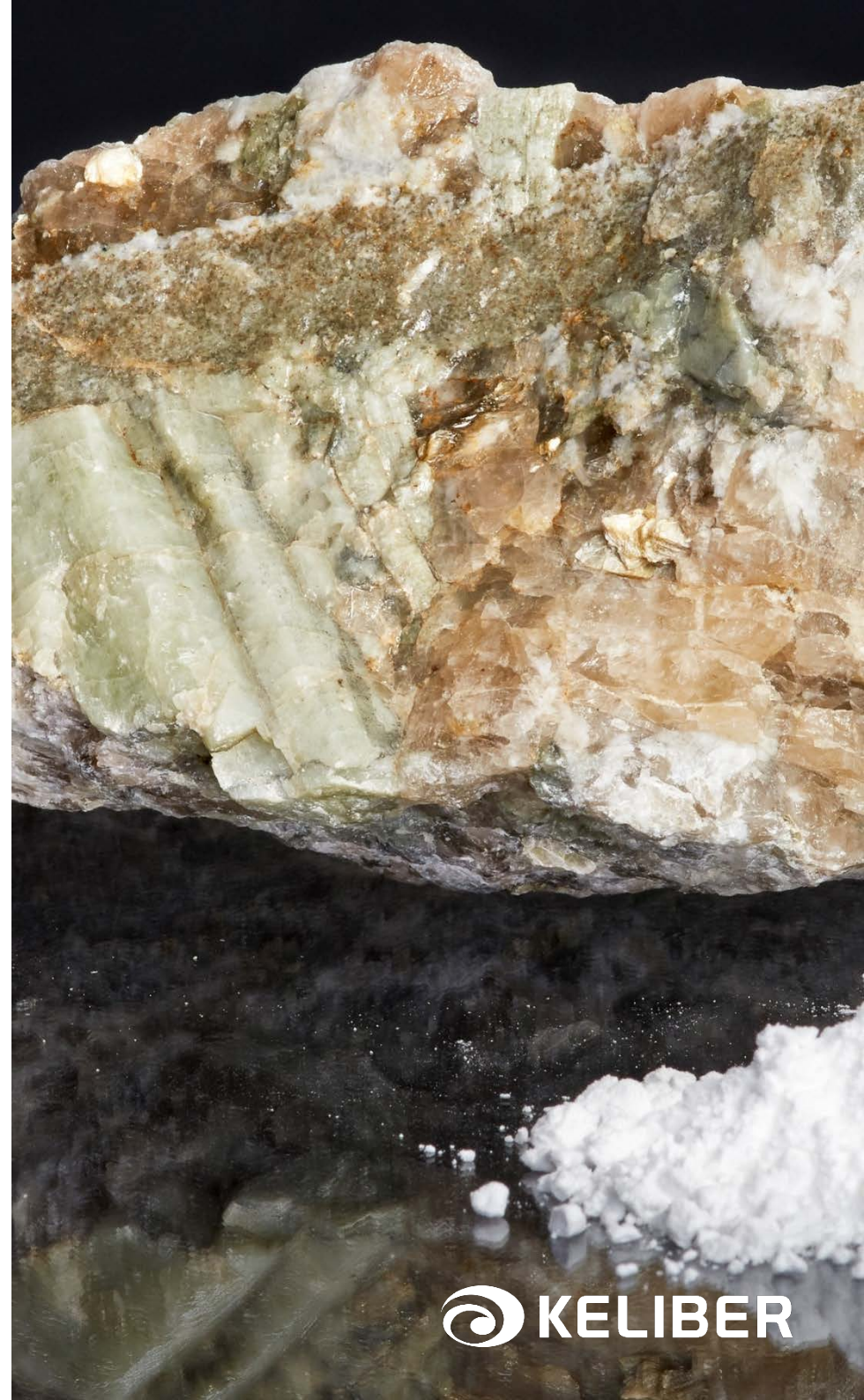
Analcime sand and Quartz-feldspar sand

Analcime is a porous zeolite with a number of potential industrial uses

- an agent in the manufacture of cement, concrete, ceramic tiles and asphalt

Fine-grained quartz feldspar sand

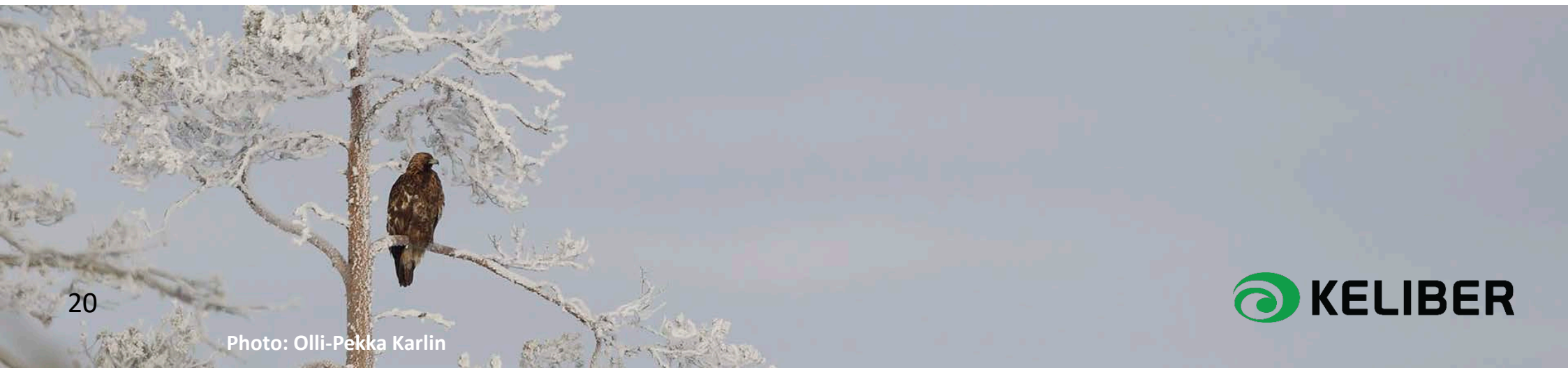
- various uses as a filler, in for instance, asphalt coatings



# 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





An aerial photograph of a mining or construction site. The scene is dominated by a large area of grey gravel and dark earth. Several pieces of heavy machinery are visible, including a red truck, a yellow excavator, and a yellow bulldozer. A dirt road or path runs through the site. The background shows a dense green forest. The text "From a project to production" is overlaid in white on the left side of the image.

# 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
Basic Engineering – Definite Feasibility Study				
Permitting (environmental, mining and other)				
Detailed Engineering				
Construction				
Commissioning and testing				

**Production estimated to start 2020**

# Committed and skillfull management

## Management team

**Pertti Lamberg**



- CEO since 2016
- Chair of the management team

**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, private investors and the Norwegian Nordic Mining ASA

	Total number of shares	Percentage
Nordic Mining ASA	239,044	22.0
Tesi Industrial Management Oy	190,662	17.6
Ab Mine Invest Oy	97,527	9.0
Keskinäinen Eläkevakuutusyhtiö Ilmarinen	70,929	6.5
Thominvest Oy	68,683	6.3
Jorma Takanen	63,123	5.8
Osuuskunta PPO	60,000	5.5
Case Invest Oy	59,547	5.5
Jussi Capital Oy	35,010	3.2
Eero Halonen	20,000	1.8



# Current activity

- Additional process test work to reconfirm positive results in minerals processing tests
- Additional drilling to further increase of the resource base
- 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

