

FUTURE IN LITHIUM

The development of the battery industry will significantly increase lithium consumption. Central Ostrobothnia is home to a cluster of mines, research and industry of international significance, one which has set its sights on a substantial production of battery chemicals.

Raw materials

Lithium spodumene.

Chemical processing

Production of bulk chemicals and special chemicals.

Product applications

Researching and developing battery cells.

Reuse and recycling

Recycling batteries.

Work across the entire value chain

In the lithium cluster focusing on lithium ores and their concentration, launched by the Central Ostrobothnia Federation of Municipalities, R&D is carried out across the entire spectrum of the value chain, as indicated in the illustration above.

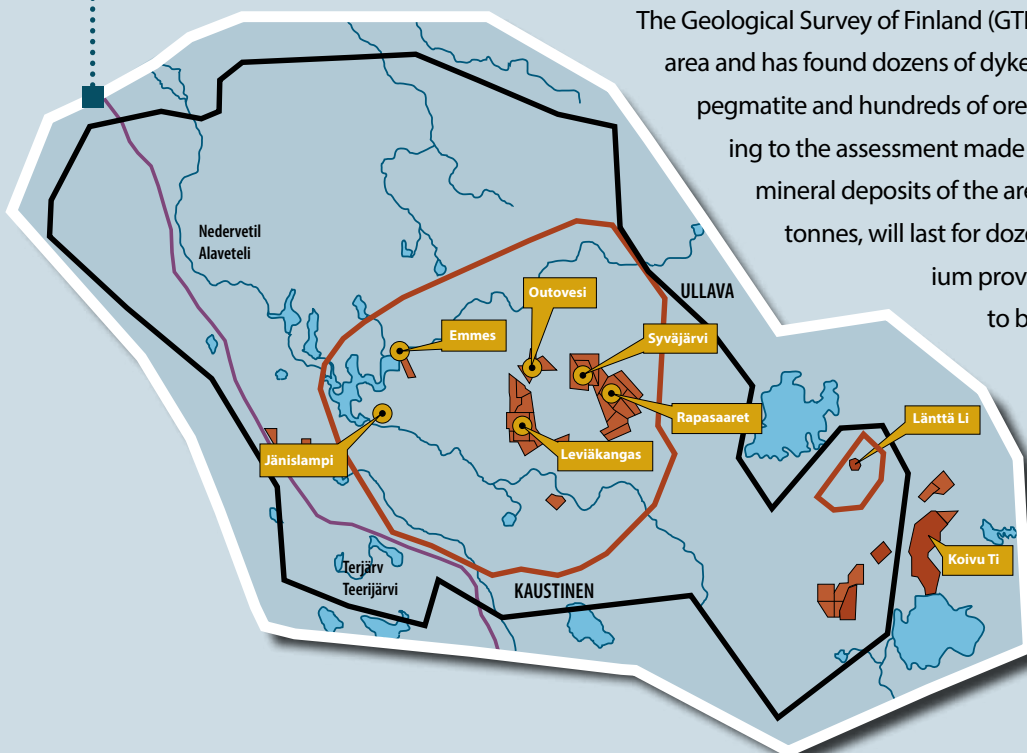
This work has resulted in significant developmental steps. The factor underlying the results is a shared view held by the industry, research institutes and business developers regarding the opportunities available to the cluster and its focus areas.

Lithium is the most important element in the battery chemicals used in Li-ion batteries. Demand for Li-ion batteries is rapidly growing in portable electronics, power tools and electric vehicles.

The most significant deposits of lithium spodumene in Europe

The lithium spodumene deposits in Central Ostrobothnia are the most significant in Europe. The first observations indicating the presence of a lithium-containing mineral, spodumene ($\text{LiAlSi}_2\text{O}_6$), in the bedrock of Kaustinen, were made in 1959 by Arvo Puumala, a farmer living in the village of Nikula.

The Geological Survey of Finland (GTK) has examined the area and has found dozens of dykes of spodumene pegmatite and hundreds of ore boulders. According to the assessment made by GTK, the known mineral deposits of the area, around 12 million tonnes, will last for dozens of years. The lithium province has also proved to be more extensive than was previously known, which means that new lithium deposits may still be found.



Industry invests and carries out R&D

The lithium cluster comprises around a dozen companies, their operations ranging from the exploration of ore to recycling of battery chemicals.

A green mine

The mining company Keliber Oy has numerous exploration permits and one mining concession within the lithium province. The company aims to launch mining operations and to start production of lithium carbonate by the end of 2019. The competitive edge of the company is based on the production of extremely pure lithium carbonate.

Keliber has collaborated with the Geological Survey of Finland in the exploration of the ore deposits, in the concentration of ore and, with the Kokkola University Consortium Chydenius, in clarifying the characteristic of spodumene. The concentration process of transforming spodumene into lithium carbonate was developed in collaboration with Outotec.

Keliber's future investments in the lithium production, will amount to a total of EUR 170–200 million. The number of permanent direct jobs during the initial phase will be around 120–130.

The global lithium market is experiencing strong growth

The consumption of lithium has exhibited a remarkable growth over the past few years. The growth in consumption is a result of a growth in the demand in the battery industry. Based on a forecast published by Deutsche Bank, the fact that electric vehicles will become more commonplace and renewable energy more widely stored, the demand for lithium will triple over the next ten years.





THE LITHIUM SPODUMENE DEPOSITS IN CENTRAL OSTROBOTHNIA ARE THE MOST SIGNIFICANT IN EUROPE. KELIBER HAS COLLABORATED WITH THE GEOLOGICAL SURVEY OF FINLAND IN THE EXPLORATION OF THE ORE DEPOSITS, IN THE CONCENTRATION OF ORE AND, WITH THE KOKKOLA UNIVERSITY CONSORTIUM CHYDENIUS, IN CLARIFYING THE CHARACTERISTIC OF SPODUMENE.

R&D generates results

Public funding has played a key role in the development of the lithium cluster to its current position. The activities of the Central Ostrobothnia Federation of Municipalities, alongside Kokkolanseudun Kehitys Ltd KOSEK and Kaustisen seutukunta, has been key to achieving the current results.

Funding has also been allocated to exploration in the lithium province, research environment and development projects. All in all, public funding funnelled into the cluster amounted to EUR 20–25 million between 2009–2016, which figure also includes business development projects. The Central Ostrobothnia Federation of Municipalities has played a key role in funding.

In addition to this, EUR 15–20 million has been invested in research into lithium and other battery chemicals in Central Ostrobothnia on an annual basis. The target is to keep the funding allocated to research at the same level.

A competence cluster for process chemistry is an important part of the cluster

The research team in applied chemistry at the Kokkola University Consortium, part of the University of Oulu, employs 25 persons. Over the past few years, the research team has completed 15–20 research projects in collaboration with enterprises operating in the area. Such research has comprised projects carried out in collaboration with several enterprises, including non-public research projects commissioned by enterprises, or carried out jointly with other research institutes.

Research resources allocated to the team over the past three years have amounted to EUR 3–4 million, which figure does not include investments for research infrastructure. Research carried out by the research team in applied chemistry focuses on the entire spectrum of the lithium values chain, ranging from spodumene deposits in the province to the characteristics of end products such as battery chemicals and catalysts and their production, and to the recycling of these materials.

Research is related to the chemical processes of mining, the characteristics and processing of minerals, and raw materials suitable for battery chemicals. Involved in research collaboration are research institutes and enterprises operating in the field with national and international significance.

Projects developing new lithium chemicals that have undergone a further refinement process are under way in collaboration with the Kokkola University Consortium Chydenius, the Centria University of Applied Sciences, the University of Oulu, and partner enterprises. Furthermore, under several joint investment projects, laboratory premises have been developed to better suit research into lithium chemicals.



The lithium cluster also has a well-functioning infrastructure and logistics

Kokkola Industrial Park (KIP) is the most significant chemical cluster in Northern Europe, comprising several first-rate enterprises in the chemistry and metal industry. 15 industrial operators and more than 70 enterprises representing the service sector are operating in the area. The value of exports originating in this major industrial area amount to EUR 1.1 billion on an annual basis, with the enterprises operating there providing direct employment to 2,200 people.

A total of 70 hectares of zoned plots in KIP's area are available to the heavy chemical industry. In addition, the service companies operating in the area make available to enterprises utilities, a sewer system, corrugated bridges, railways, fire-fighting services and security service. Finland's third largest general port, with a waterway depth of 13 metres, is located in the immediate vicinity of the industrial area.



R&D lays the foundation for success



Freeport Cobalt is part of Freeport-McMoRan Copper & Gold, the world's largest copper producer. The company's Kokkola plant employs around 450 people.

Freeport Cobalt specialises in the production of cobalt-based chemicals used in lithium-ion batteries. The company operates in the global market, basing its successful business on continued R&D. Research collaboration with the Kokkola University Consortium Chydenius has played a key role in the development of the company's projects.

Freeport Cobalt took an investment decision to expand its production in three phases between 2012 and 2015. During the first phase, completed in spring 2013, new premises for the production of battery chemicals were constructed – three new production lines for the production of cobalt-based chemicals required in the production of lithium batteries. This new production facility provides employment to approximately 38 employees. The investments in this phase amounted to EUR 36 million, with possible follow-up investments totalling around EUR 20 million.

Educational system capable of rapid reaction

Thanks to the educational pathways provided by the educational institutes in Kokkola, they can train new employees for enterprises ranging from people holding vocational qualifications in chemical technology to experts at a doctoral level.

The educational system reacts flexibly and rapidly to labour training needs, both at the different levels of education and in different sectors. In addition to chemical and process technology, the educational organisations train professionals for the logistical, IT and commercial sectors.

Reuse and recycling

The focus on reuse and recycling is in putting to good use industrial by-products and metallic by-products generated by the recycling of batteries. Significant enterprises include Boliden and Freeport Cobalt. Under the leadership of the Centria University of Applied Sciences and the Kokkola University Consortium Chydenius, an extensive research project, entitled "Recovery of metals from industrial by-products and production flows and their reuse", has been utilised.

An important area is also the recovery of battery chemicals contained in alkaline batteries through a hydro-metallurgical process. Akkuser, in collaboration with the Kokkola University Consortium Chydenius, among others, conducts research at enterprises in this field.



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Leverage from
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