Breakthrough CO_2 Free Aluminium Process

CLEANTECH CAPITAL DAY

OSLO • NORWAY

OCTOBER 25TH & 26TH •2022

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arctus

nordic cleantech open
11th EDITION

Competitive Advantages

The advantages of our aluminium process with inert anodes compared to a conventional process with carbon anodes;

- **Zero** CO_2 emission only O_2
- 20% less energy and flexible power
- 50% less space, see figures.
- 40% less investment cost
- 30% less operation cost

CO_2

Aluminium smelter with a carbon plant

O_2

ARCTUS smelter with no carbon plant

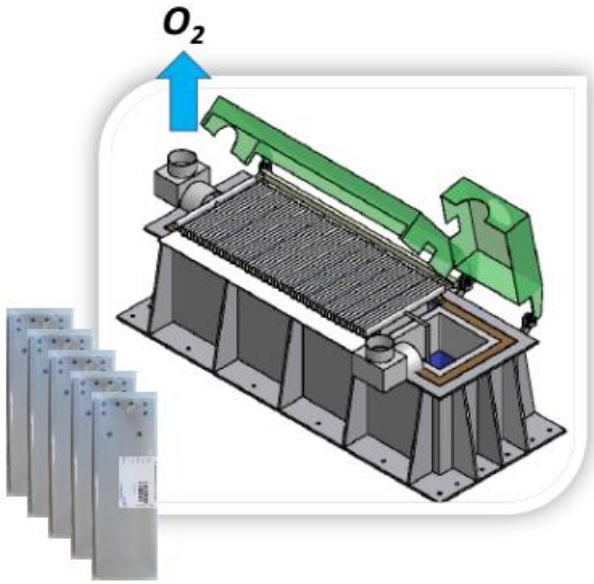
The Problem – CO_2 Emission

In year 2022 some 67 million tons of primary aluminium will be produced in 211 smelters worldwide emitting 135 million tonnes of CO_2

Conventional aluminium smelter with horizontal carbon anodes

The Solution - CO_2 Free Aluminium

Our carbon neutral process emits no **CO_2** only **O_2**



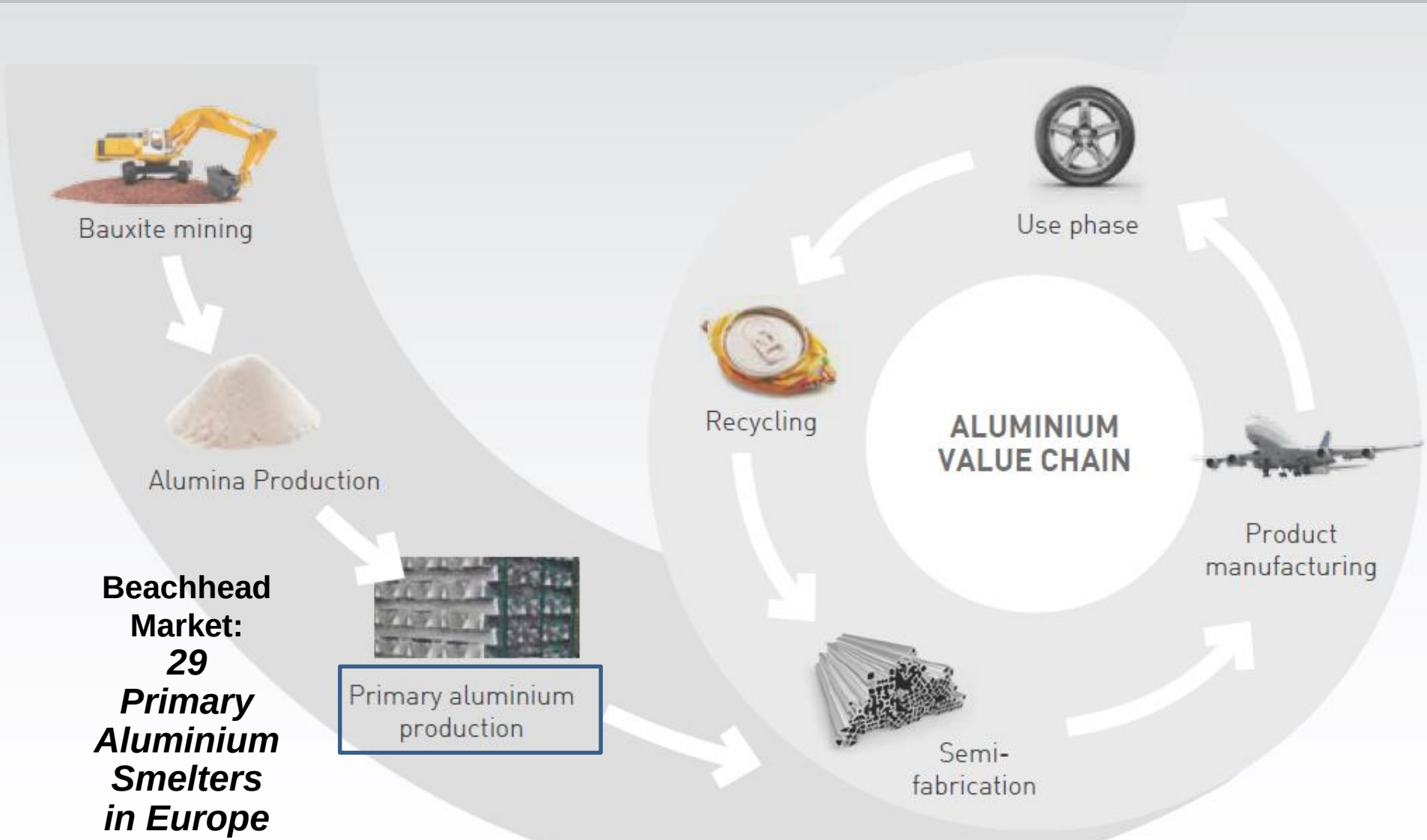
Alumina	⇒	Aluminium + Oxygen
$2\ Al_2O_3$	**⇒**	**$4\ Al + 3\ O_2$**

Products:
Production cells
with vertical inert metallic
anodes, ceramic cathodes
and control systems
for
aluminium production

Time Schedule:

- 2018 Proof of concept
- 2020 Continuous production in laboratory
- 2023 Pilot Plant
- 2025 Demonstration Plant
- 2028 Start conversion of the first aluminium smelter

The Market



Beachhead Market:
29 Primary Aluminium Smelters in Europe

Key Financials

The business and market potential for our carbon free process is great due to the interest to reduce industrial CO_2 emission!

Estimated sales in 2030-2040 in Europe of Process cells, etc. for conversion of eight (8) old smelters:

- Four (4) smelters by Trimet Aluminium
- Four (4) more smelters in Europe like in Iceland, Norway, Sweden and Germany.

Estimated total revenues in the period 2030 – 2040: €4,5 billion

Business Proposals

Arctus Aluminium has successfully raised funds of € 7.5 millions for R&D and pilot plant operation in 2022-2024.

The State of North Rhein Westphalia via progress.nrw

Co-funded by the European Union

Arctus and Trimet will apply in 2024 to the EU Innovation Fund for >€ 15.0 millions for commercial demonstration of our innovative carbon free technology 2025 – 2028.

Investors: Arctus is looking for strategic business partners to accelerate the development and to commercialize our technology with **investment of € 1.0 million to start with.**

Team

Arctus Aluminium Management Team and Founders

Jon Hjaltalin Magnusson
President, CEO & Co-Founder

Rolf M.G. Falkenberg
Chairman of the Board of Directors & Co-Founder

Dr. Lennart Billfalk
R&D Director

Olafur Orn Jonsson
Commercial Director & Co-Founder

Industrial Partner in 2022 – 4 pers:

trimet

Trimet Aluminium, Germany

R & D Partners in 2022 – 22 pers:

IceTec

PLANSEE

access

SWERIM

Háskólinn í Reykjavík Reykjavik University

Universität des Saarlandes

RWTH Aachen University

KAN-NAK

Questions and Answers

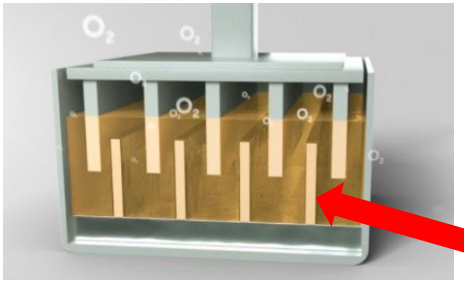
I will be pleased to answer your questions and look forward to be invited for discussions

Competition

Corporations Developing Vertical Inert Anodes and Cathodes

Report December 2021 by World Economic Forum and the Energy Transmission Commission

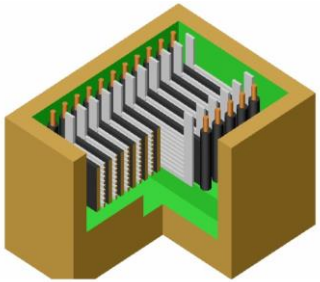
- ELYSIS (Alcoa and Rio Tinto Alcan)
  Declare available in 2024.



?

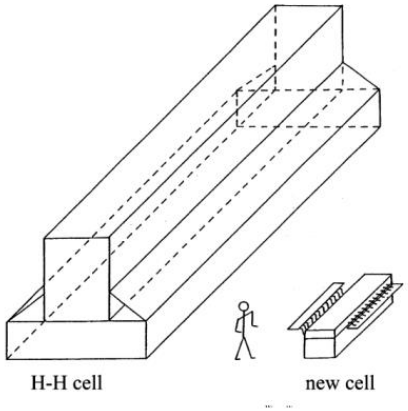
- ARCTUS ALUMINIUM
  Declare available in 2030.

- RUSAL
  Declare available in 2030.



Q & A Comparison in Size

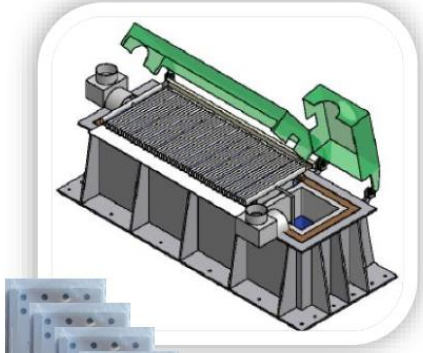
Comparision in Size of Hall Héroult Cells and Arctus Cells 8 :1



Hall Héroult 170 kA Cell
8 x 4 x 4 m = 128 m3
produce
1,200 kg Al per day

Horizontal prebaked carbon anodes in the HH cells.

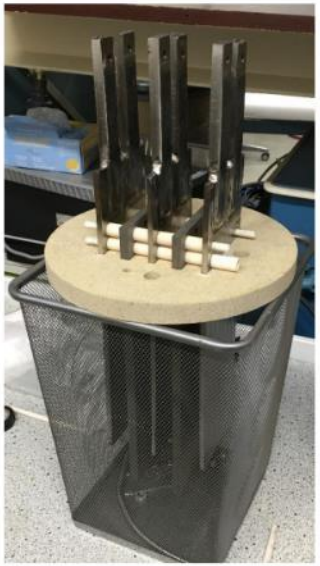
Vertical Electrode Cells



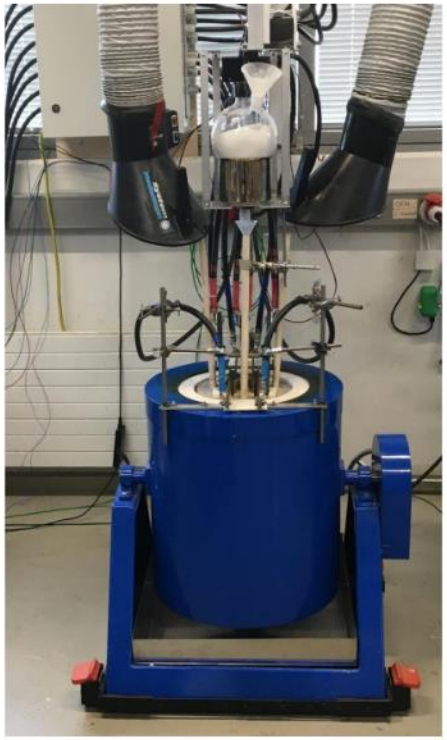
Arctus 170 kA Cell
4 x 2 x 2 m = 16 m3
produce
1,100 kg Al per day

Q &A Proof of Concept

Cathode



Three anodes and two cathodes in the cell



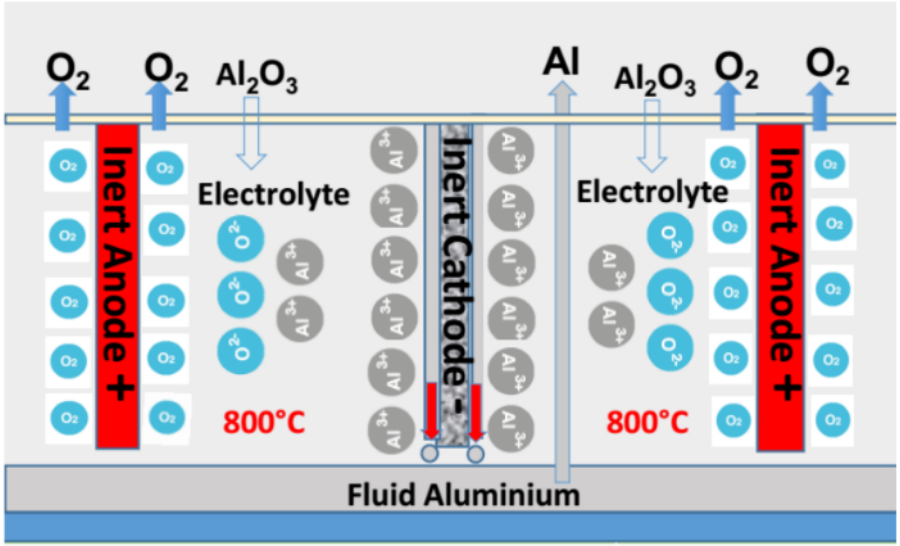
Eletrolytic cell in electric furnace with power cables to the electrodes and alumina feeding device.

The main results:

- 99.8% clean aluminium

Q & A The Process

Arctus´ Aluminium Process



- Alumina (Al_2O_3) is dissolved in the cryolite bath
- Vertical non consumable inert anodes and cathodes
- Oxygen (O_2) is produced at the anode - Oxidation
- Aluminium is produced at the cathode - Reduction and falls to the bottom by gravity and then siphoned.

Alumina ⇒ Aluminium + Oxygen

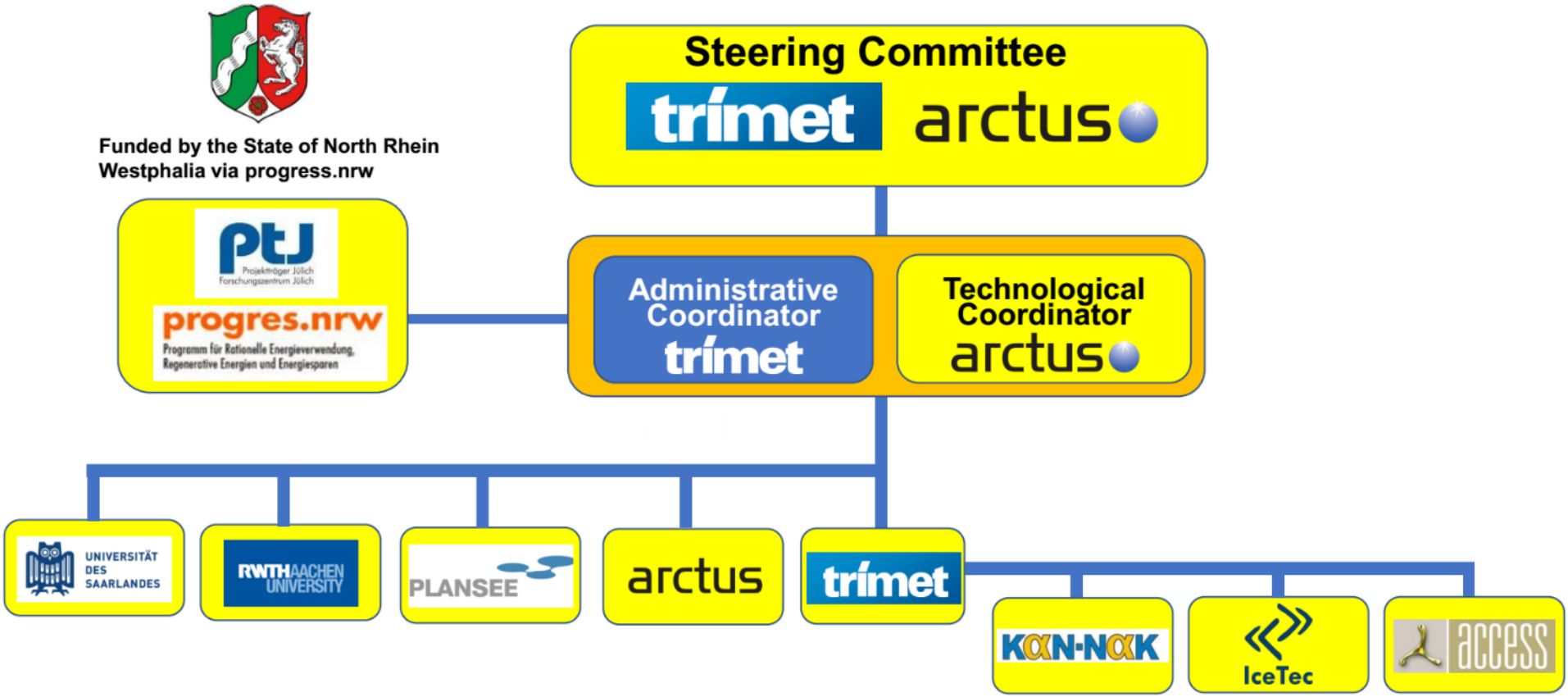
$$Al_2O_3 \Rightarrow 4\,Al + 3\,O_2$$

- Vertical inert anodes and cathodes
- We use both sides of the anodes and cathodes for current between them.
- Short anode-cathode distance 2-3 cm
- Low temperature electrolyte only 800°C fo dissolution of alumina
- 20% energy saving

The Team for a Pilot Plant at Trimet

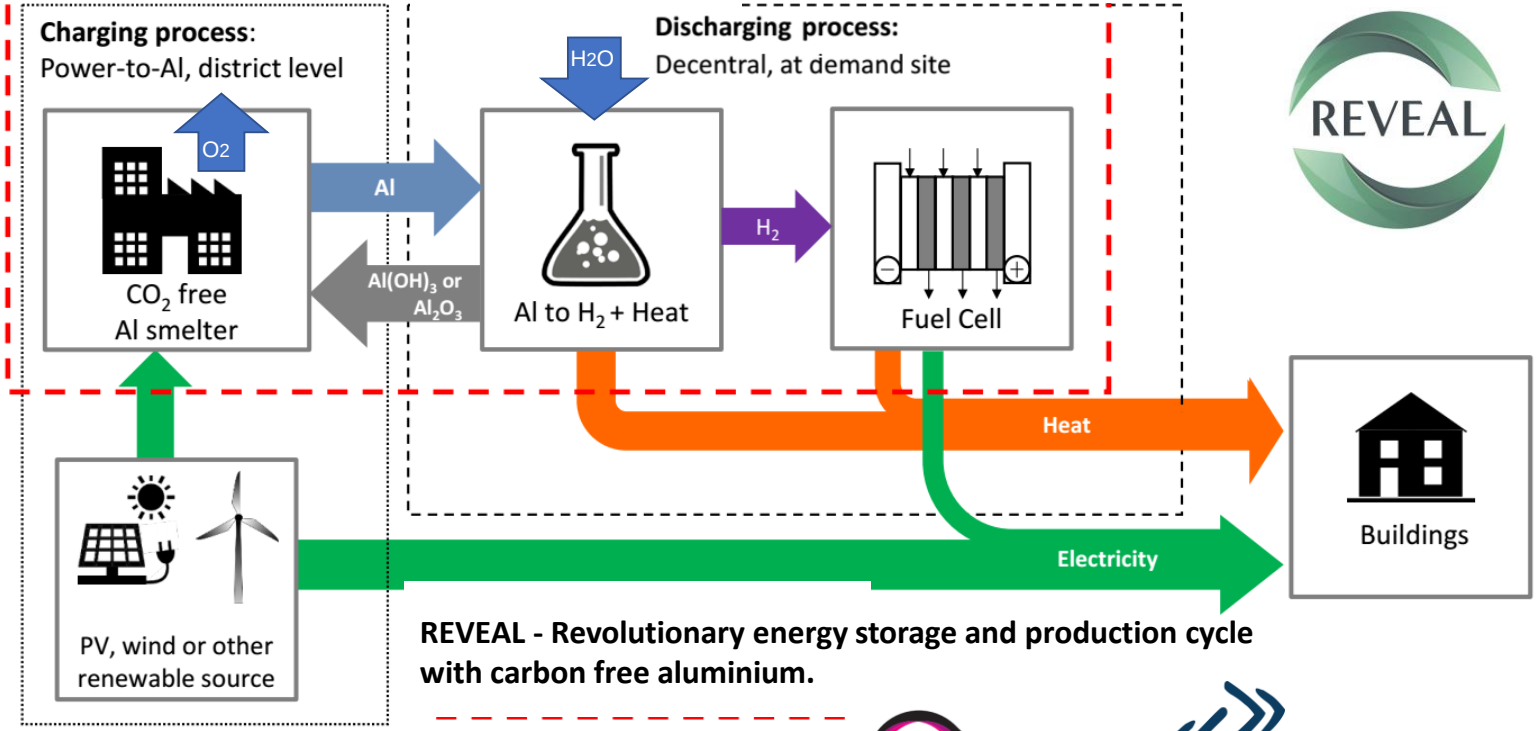
Project Organization and Partners 2022-2024

Funded € 5.5 million
partly by NRW



Interesting Application - REVEAL

New ways of storing renewable energy - REVEAL project supported by Horizon Europe and the Government of Switzerland



REVEAL - Revolutionary energy storage and production cycle with carbon free aluminium.

KEMIJSKI INŠTITUT SINTEF ratiotherm Smart Energy Systems EH GROUP Engineering AG OST Ostschweizer Fachhochschule IceTec arctus

Co-funded by the European Union's Horizon Europe Programme Grant Agreement 101069492.

The Swiss contribution is supported by the Swiss State Secretariate for Education, Research and Innovation (SERI) under

Totals fund 2022-2025
€ 3.5 million

www.reveal-storage.eu

Further Information

Advisian
Worley Group

20TH Annual Petcoke Conference, Anaheim, California, USA
25 - 26 February 2022

Breakthrough CO_2 Emission Free Aluminium Production

For further information you are welcome to send Jon a mail; jhm@arctus.is