World Materials Forum
Peter Carlsson, CEO Northvolt
Enabling the Future of Energy

Northvolt was founded with the mission to build the world's greenest battery and enable the transition to a decarbonized society and industry.

Unique vertical integration done at scale

European leadership with European roots

Industry leading technology and industrialization platform

World’s greenest battery

These levers set Northvolt apart from the rest of the battery manufacturing industry and form the pillars of Northvolt’s sustainable competitive advantage.
Key milestones on Northvolt’s journey

Northvolt is consistently delivering on its business plan towards becoming a European leader in the battery space.

**Significant achievements in the last 9 months**
Solidifying Northvolt’s business plan, de-risking the execution path and laying a strong foundation for future growth.

**March 2021**
- Secured USD 14 bn order from VW Group for Skellefteå expansion

**February 2021**
- Environmental permit secured for Northvolt Ett expansion to 60 GWh
- First cell from Northvolt Labs
- Hydrovolt battery recycling JV announced in Norway
- Northvolt ESS Expansion announced
- Fluence GWh-scale energy storage supply agreement signed
- CUBERG

**December 2020**
- Approved for ~EUR 200 m in grants to expand Northvolt Labs & a new German factory
- Environmental permit secured for Northvolt Ett expansion to 60 GWh
- December 2020

**July 2020**
- USD 16 bn Debt Financing signed
- June 2019
- USD 1 bn Equity funding closed for Northvolt Ett
- Summer 2019
- Battery cell Assemblies delivered to key customers
- January 2020
- First cell from Northvolt Labs

**October 2016**
- Northvolt was founded to enable the European transition to a decarbonized future

**Spring 2018**
- Key partnership investments secured & EB support to begin Northvolt Labs construction

Northvolt AB, Strictly Confidential
Northvolt project overview

Northvolt Ett
- USD 1.6bn debt financing fully unlocked
- >1,400 contractors on site daily
- 50% of project completed in March 2021
- Anode and cathode coating, slurry mixing being installed
- US 1 and DS1 structurally complete
- First cathode active material calcination equipment installed
- 4,200 equipment containers delivered to site
- Environmental permit secured to 60GWh
- Northvolt Ett Expansion design and groundworks started
- First cells in Q4 2021

Northvolt Labs
- Northvolt Labs and R&D facilities fully operational
- Cathode Materials Lab installed and operational
- 200+ operators in 3 shifts
- 4 ongoing industrialization development programs
- Northvolt Labs 2.0 expansion started
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Revolt
- Revolt Pilot operational since September 2020
- >1,000 kg batteries crushed
- 500 kg black mass recycled
- 94% recovery yield achieved
- Hydrovolt JV construction started
- Revolt Ett construction start in Q2 2021

Systems
- 3,000 modules produced
- 6 GWh+ ESS contract signed, among world's largest contracts
- 45 packs delivered to Epiroc, used in the field
- Northvolt Poland 5GWh/year expansion for ESS launched
Northvolt Ett progress in pictures

Northvolt Ett Phase 1

US1: Fine particle precursor installation

DS1: Cell Assembly Line 1 installation

DS1: Slurry mixing electrical inspection

DS2: Shell near completion

FAI: C&D room installation ongoing
The Northvolt loop

Northvolt’s commitment to sustainability extends throughout the battery supply chain.

Focus is placed on raw material sourcing, production processes, logistics, battery recovery and recycling.
By building a sustainable raw materials supply chain, significant CO₂ reductions can be realized.

Northvolt manufacturing with renewable sourcing of electricity, target to decrease CO₂ with 50%.

Northvolt raw material strategy with sourcing and recycling, target to decrease CO₂ with 75%.

The Goal: 10 kgCO₂e/kWh.

Battery carbon intensity
kgCO₂e / kWh cell

Reference

100 - 150

Cell manufacturing
-50%

Cell manufacturing
-75%

Recycling

Raw material

Northvolt manufacturing with renewable sourcing of electricity, target to decrease CO₂ with 50%.

Northvolt raw material strategy with sourcing and recycling, target to decrease CO₂ with 75%.

The Goal: 10 kgCO₂e/kWh.

Battery carbon intensity
kgCO₂e / kWh cell

Reference

100 - 150

Cell manufacturing
-50%

Cell manufacturing
-75%

Recycling

Raw material

Northvolt manufacturing with renewable sourcing of electricity, target to decrease CO₂ with 50%.

Northvolt raw material strategy with sourcing and recycling, target to decrease CO₂ with 75%.

The Goal: 10 kgCO₂e/kWh.
Northvolt’s approach to sustainable raw material supply

- **Target most sustainable feed**
- **Full traceability to mine level**
- **Working closely with counterparts to ensure environmental and social sustainability**
- **Audit all mines, smelters and refineries before contracting**
- **Promoting the European supply chain**
- **Supporting new projects with best-in-class sustainability profile**
- **Circular business model with 50% recycled material in 2030**

**Raw materials sourcing and recycling**
- Raw materials sourced responsibly and locally
- Patented large-scale, vertically integrated recycling process
- Batteries closed loop enabling circular economy

**Northvolt’s long-term emission goal for batteries**
- 10 kg CO₂e/kWh

**Target recycled materials in new batteries by 2030**
- 50%

**Traceability of all raw materials**
- 100%

**Target recycled materials in new batteries by 2030**
- 100%
There is a need to strengthen regional supply chains to meet sharp uptick in lithium demand driven by battery market growth

Battery demand will be the primary driver of the lithium market...

- Li-ion battery demand is accelerating globally with a major push from Automotive OEMs to transition to electric vehicles, driven by looming CO2 fines
- Global lithium demand is as a result expected to grow by c. 10x between 2018 and 2030 to 2.7 million tonnes/year
- A prolonged supply deficit to occur in coming years unless significant additional capacity comes online
- Europe is a key growth market for battery demand, but at present lacks lithium refining capacity
- 10+ additional large scale conversion plants needed to meet European demand in 2030

...and significant additional capacity must come online to fill supply gap

Global lithium demand by use case, ktonnes LCE, base case(1)

<table>
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<th>Year</th>
<th>Battery sector</th>
<th>Other</th>
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<tr>
<td>2018</td>
<td>267</td>
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<tr>
<td>2020</td>
<td>433</td>
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<td>2025</td>
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<tr>
<td>2030</td>
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CAGR % p.a. 2020-2030: 23%

Battery grade lithium compound supply and demand, 2020-2030, ktonnes LCE(2)

In Europe, lithium demand is set to soar but capacity is lacking

2019 lithium feedstock production and processing capacity, ktonne LCE(3)

Source: (1) Roskill, Northvolt adjustments for 2020-2030 figures based on projected Li-ion battery demand by World Economic Forum, Global Battery Alliance, McKinsey analysis; (2) Roskill, Northvolt adjustments for based on projected Li-ion battery demand; (3) Wood Mackenzie, Northvolt analysis.
Revolt enables a fully circular business model

Northvolt’s own recycling program reduces dependence on raw materials and unlocks further CO₂ footprint reduction

Revolt is Europe’s first large scale EV battery recycling plant, with a developed recycling process targeting ~95% recovery of Nickel, Cobalt, Lithium and Manganese

- **Unique process for high-lithium extraction** from black mass versus peers in the market
- Reducing extraction of new primary resources – large reduction in CO₂ emissions
- **De-risking battery materials supply chain** for Northvolt
- Symbiotic relationship with OEMs, providing long-term customer loyalty and mitigating end-of-life risk
- Significant **economic benefit**, capturing large volumes of scrap and waste from active materials production and cell manufacturing, and batteries reaching end-of-life (EOL)

Revolt is well positioned across the entire recycling value chain, with further expansion opportunities across Europe for collection, dismantling and crushing of EOL batteries:

Hydrovolt JV / Revolt expansions → Revolt

Revolt’s sustainability and circularity focus stands to benefit significantly from the new EU Battery Regulation presented in December 2021:

- Mandatory battery **carbon footprint declarations** for all batteries sold in Europe will shift the industry towards sustainability
- Mandatory **recycling efficiencies** with minimum lithium recovery efficiency
- Mandatory **declaration of recycled content** in new batteries, with minimum levels of recycled materials required
- **Retention of spent batteries in Europe**, export of batteries needs proof of recycling facilities with quality and high environmental standards

Northvolt’s green battery

“Dirty” battery

Northvolt AB, Strictly Confidential

Source: Northvolt analysis, Independent third-party consultancy firm
Revolt has developed a unique recycling process

### Pilot
Revolt Pilot operational in Västerås

### Phase 1
- Primarily delivered through partnerships
- Revolt Ett in Skellefteå, Sweden – 4 GWh capacity

### Phase 2
- Regional discharge and dismantling hubs across Europe
- Capacity expansion of Revolt Ett

### Comments
- Conventional li-ion battery recycling processes struggle to achieve battery grade purity in a cost-effective way
- Revolt has developed a unique recycling process over the past two years, with a patented hydromet processing stage
- Process developed for optimal recovery of valuable materials, resulting in a unique recovery rate exceeding 95% of all materials
- Revolt process will be the first of industrial scale to also recycle lithium in Europe
- To improve efficiency, the process has been further adapted to deliver directly to an adjacent precursor production (e.g. Northvolt)
- Battery grade NMC-sulphates are delivered in a solution, avoiding the crystallization and dissolution process steps

### Diagram
- **Input**
  - Customer cells, NV scrap cells
  - Pack Modules

- **Discharge**
- **Dismantling**
- **Crushing and sorting**
  - Production scrap (from electrode and coater)
- **Hydromet**
  - Black mass
  - Production scrap (from up-stream and slurry)
- **Nortvolt Ett Upstream**
  - NiSO₄, CoSO₄, MnSO₄, LiOH

- **Output**
  - Cables, Al, Fe, Plastics, Electronics
  - Al, Cu, Electrolyte
  - Graphite, Al, Cu, Fe
  - NISO₄, CoSO₄, MnSO₄, LiOH

- **Leach Filter**
- **SX Cu**
- **Fe/Al**
- **IX**
- **Li/Na**
- **NMC**
- **Cr**
- **Cr**
Competitive advantage

- Strong collaboration with car importers to phase out gate fee
- Tight collaboration with OEM’s to secure volumes long term
- Logic recycling route
- Selective agreements
- Multi channel partnerships on public tenders
- Battery grade recycling integrated in material production
Revolt Ett 4 GWH progress

Building viewed from the south side. SOP 2023
Development roadmap to next generations of battery technology

Northvolt is building on technology improvements in staged phases

Current Northvolt products

- NCM 811 Ni=83% Graphite
- NCM Ni>88% Si+Graphite
- Solid State Technology

Gen 2 products

- Solid State Technology
- Li-Metal Anode Technology
- 100% Si Anode Technology
- NCM Ni>92% Si+Graphite

Gen 3 products

- Solid State Technology
- Li-Metal Anode Technology
- 100% Si Anode Technology
- Non-Co Ni=96% Si+Graphite

Gen 4 products

- Solid State Technology
- Li-Metal Anode Technology
- 100% Si Anode Technology
- Non-Co Ni=96% Si+Graphite

Note: (1) Northvolt estimation of technology roadmap for industrialization of battery cells.
Acquisition of Cuberg accelerates Northvolt’s development roadmap

In March 2021, Northvolt acquired Cuberg to enable the next generation of battery technology

Comparison of Cuberg and conventional battery cell technology

**Conventional Li-ion cell**
- Energy density: ~600 Wh/L
- Cathode: NMC 811
- Anode: Graphite or Si/C (10% less)
- Electrolyte: Liquid, carbonated base

**Cuberg cell**
- Energy density: 1,000 Wh/L
- Cathode: NMC 811
- Anode: Li metal (no copper foil)
- Electrolyte: Liquid, LiFSI-based

Cuberg will become Northvolt’s advanced R&D center based in Silicon Valley, focusing on future generations of battery technology by leveraging Northvolt’s industrialization expertise

- Cuberg was **founded in 2015** and has in a short timeframe developed a high-performance cell design together with an innovative development process based on machine learning
- Cuberg has developed a high-energy density battery thanks to the combination of lithium metal anode and a unique high-performance electrolyte, delivering up to 70% increase in energy density over conventional Li-ion technology
- Cuberg’s products are designed for high energy and high safety, and have a scalable technology compatible with mass production process of traditional Li-ion batteries
- Current sales to high-end aviation customers and VTOL players, with potential to expand into new segment

**High-performance cell design**
- Proprietary, liquid non-flammable electrolyte
- Lithium metal anode
- Scalable Li-ion production process

**Innovative development process**
- Data science-driven R&D
- Machine learning-enabled iteration and testing
- High throughput validation

Source: Northvolt analysis, Cuberg
Lithium-metal market remains at a nascent stage

Chloride the only (current) commercially viable precursor to metal, and lithium metal is not yet a liquid market

Traditional Routes to Li metal foil

- **Brine**
  - Li2CO3
  - LiCl
- **Spodumene**
  - Li2SO4
  - LiCl

Refined lithium Metal

Metal approx. 1.5% of lithium market in 2019 in terms of LCE

Market must expand exponentially to meet future demand
Thank you