ASCEND ELEMENTS

JANUARY 2024

The Road to Net Zero

Summary of life cycle assessment for NMC 622 CAM products made from recycled lithium-ion batteries via the Hydro-to-Cathode® process.

Report based on an independent life cycle assessment (LCA) performed by Minviro in accordance with ISO 14067:2018 standard. The study was independently reviewed and verified.

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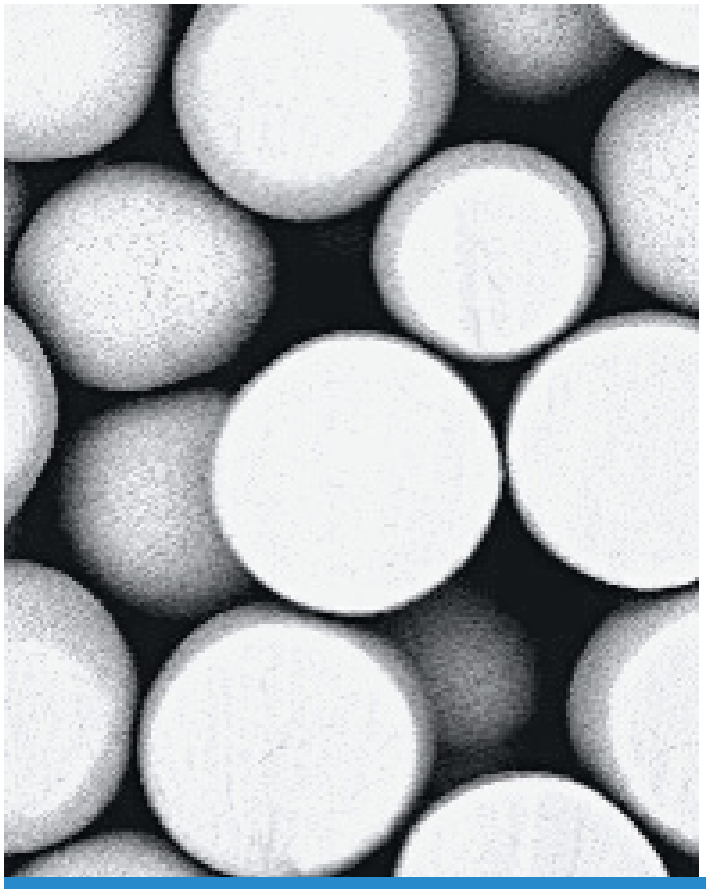


About Ascend Elements

Based in Westborough, Mass., Ascend Elements is a leading provider of sustainable, engineered EV battery materials. From battery recycling to commercial-scale production of lithium-ion precursor cathode active material (pCAM) and cathode active materials (CAM), Ascend Elements is revolutionizing the production of sustainable lithium-ion battery materials.

Its Hydro-to-Cathode® direct precursor synthesis technology produces new pCAM and CAM from spent lithium-ion cells more efficiently than traditional methods, resulting in reduced cost, improved performance, and lower GHG emissions. With fewer batteries going to landfill and a cleaner manufacturing process, Ascend Elements is taking the lithium-ion battery industry to a higher level of sustainability.

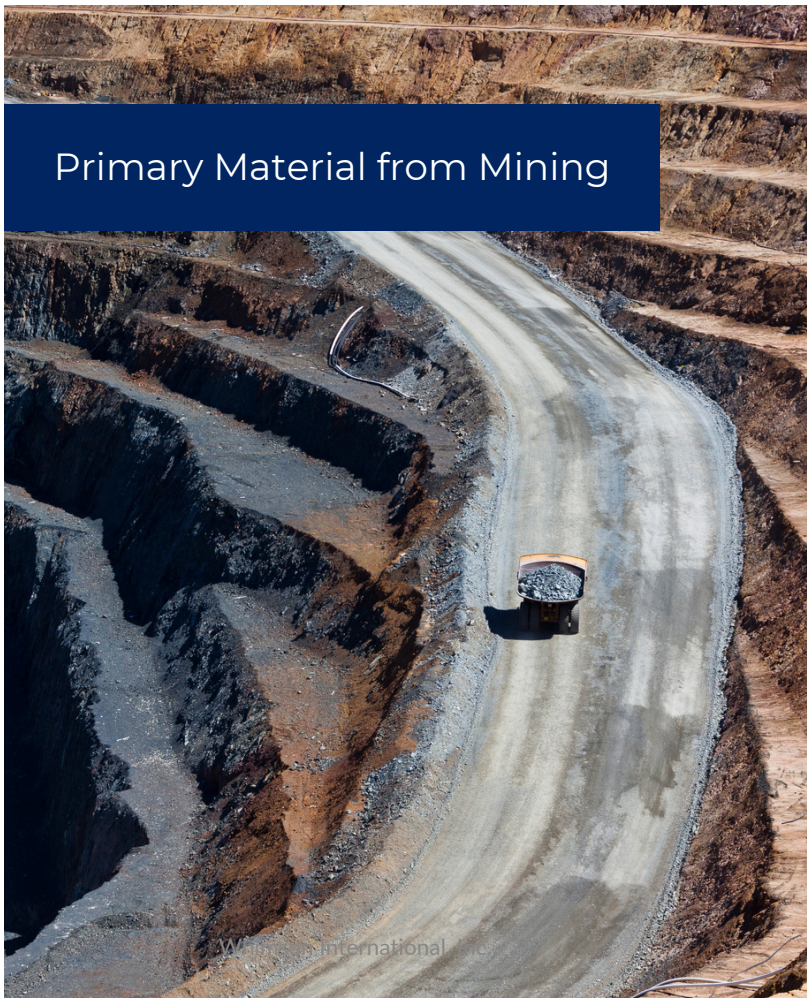
Accelerate to Net Zero

Our mission is to elevate the value of recycled elements and engineer sustainable materials for the clean energy transition. We will accelerate to net zero and beyond.

To that end, we developed an ultra-efficient way to manufacture high-performance cathode active material (CAM) and cathode precursor (pCAM) made by recycling lithium-ion batteries.

By using end-of-life lithium-ion batteries and manufacturing scrap as feedstock, we avoid the carbon emissions associated with the production of primary materials from mining. That's just one of the ways we can decarbonize new materials.

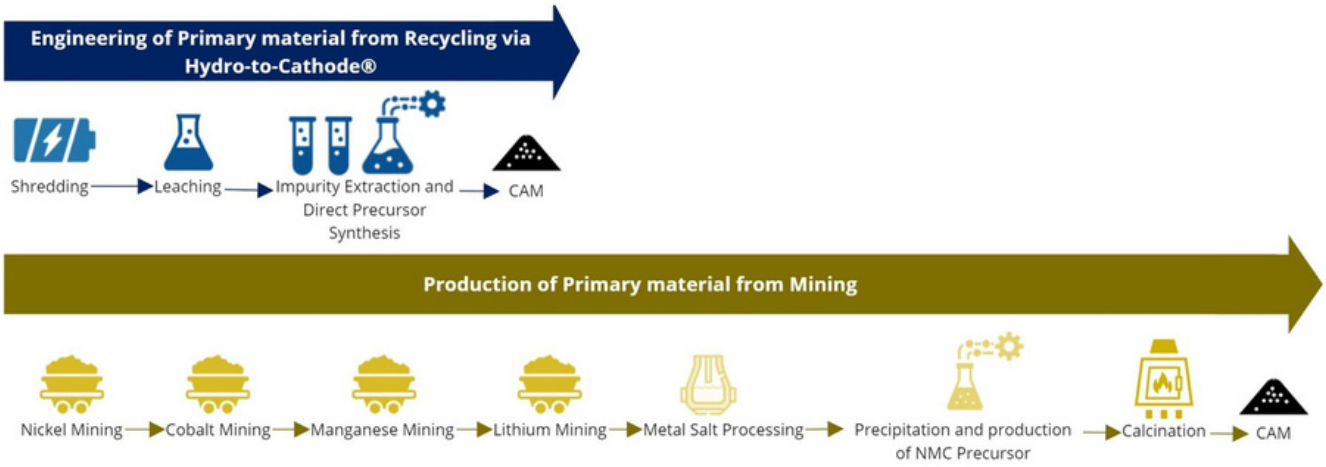
We aspire to deliver zero-carbon products to electric vehicle OEMs and battery manufacturers by **2035.**



Hydro-to-Cathode®

Compared to Mining

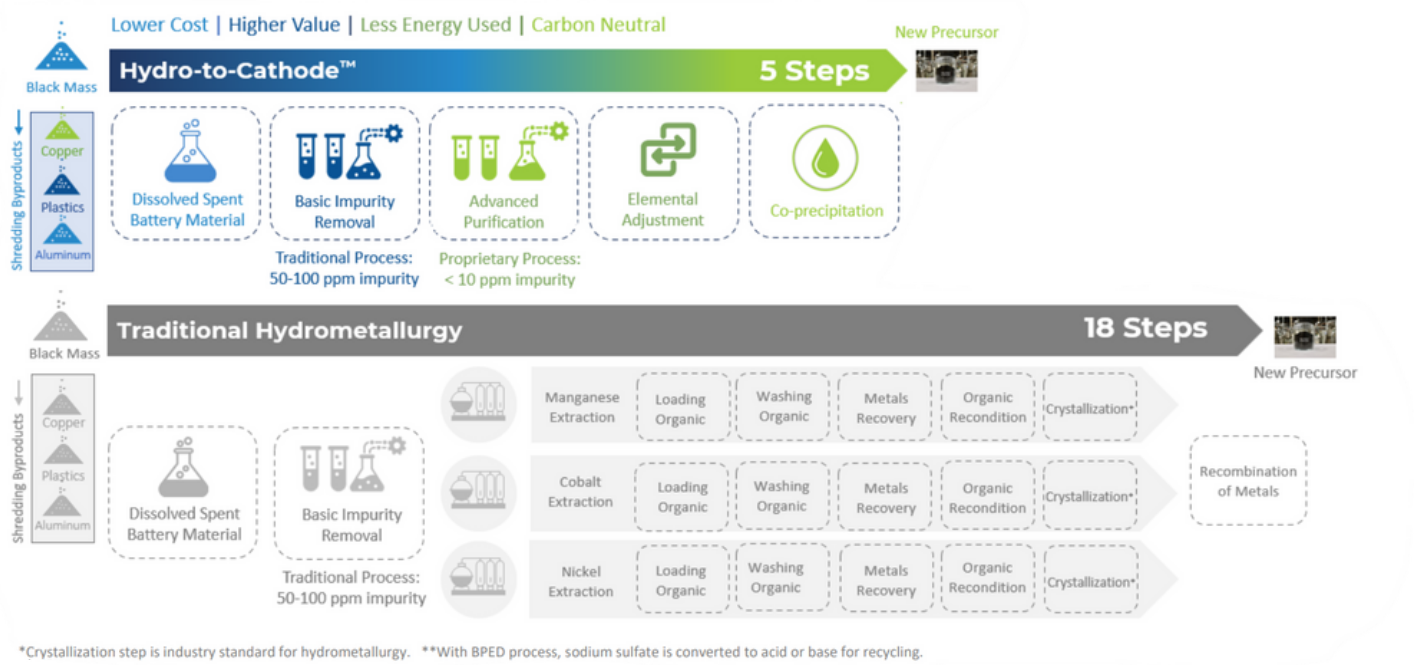
By using recycled battery materials in our Hydro-to-Cathode® process, we avoid the carbon emissions associated with the production of primary materials from mining.



Compared to Traditional Hydrometallurgy

Beyond the use of recycled battery materials as feedstock, our Hydro-to-Cathode® direct precursor synthesis technology also eliminates up to 15 energy intensive steps in the traditional hydrometallurgical recycling and cathode manufacturing process. See page 6.

Instead of extracting the critical battery metals (nickel, cobalt and manganese) one by one, we extract impurities like aluminum, copper, plastics and graphite. This leaves the nickel, cobalt and manganese in an aqueous solution and ready for elemental ratio adjustment before cathode precursor synthesis. There's no need to recombine the metals to form new cathode particles.



During the elemental adjustment step, we can specify what type of pCAM or CAM we want to produce. For example, one customer might want NMC 622 pCAM and another might want NMC 532 CAM. We can even customize the particle size, crystallinity, porosity and morphology of the cathode microstructure.

Our ultra-efficient process naturally delivers significant reductions in carbon emissions -- approximately 49% lower compared to producing primary materials from mining -- but we have identified additional steps to further decarbonize the process.

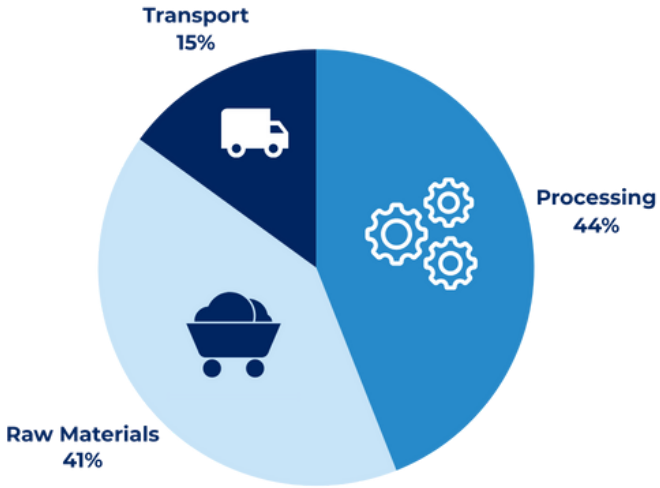
The Levers of Decarbonization

Key Findings of the LCA

The primary levers to further decarbonize the Hydro-to-Cathode® direct precursor synthesis process are:

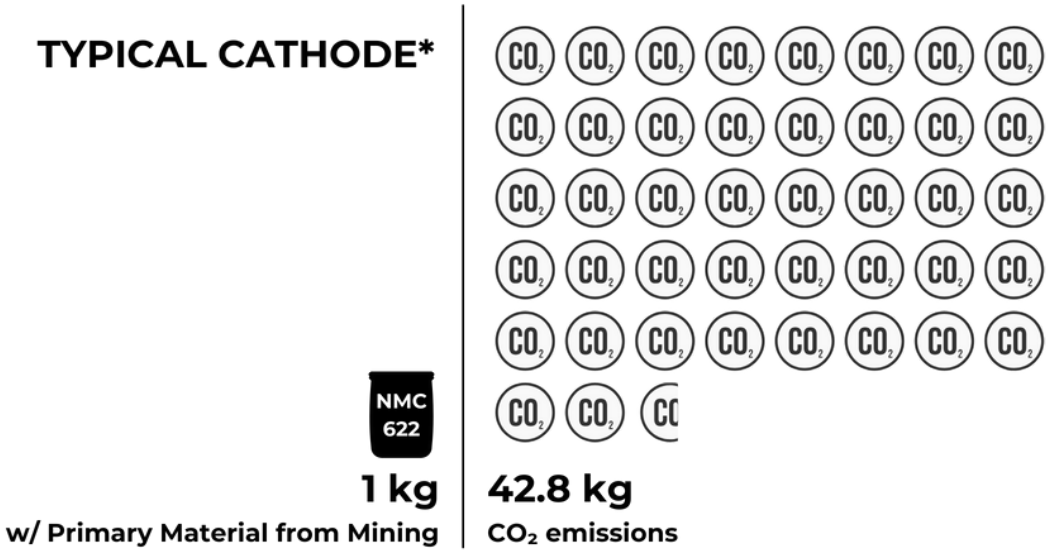
- Use of 100% renewable energy in our recycling and manufacturing facilities,
- Use of rail to transport materials, and
- Use of responsibly sourced lithium carbonate (Li^2CO^3).

By adjusting these levers, we aim to further reduce carbon emissions **up to 90%** compared to production of primary materials from mining. As we move forward on our decarbonization path, the Hydro-to-Cathode® process emits carbon dioxide from:

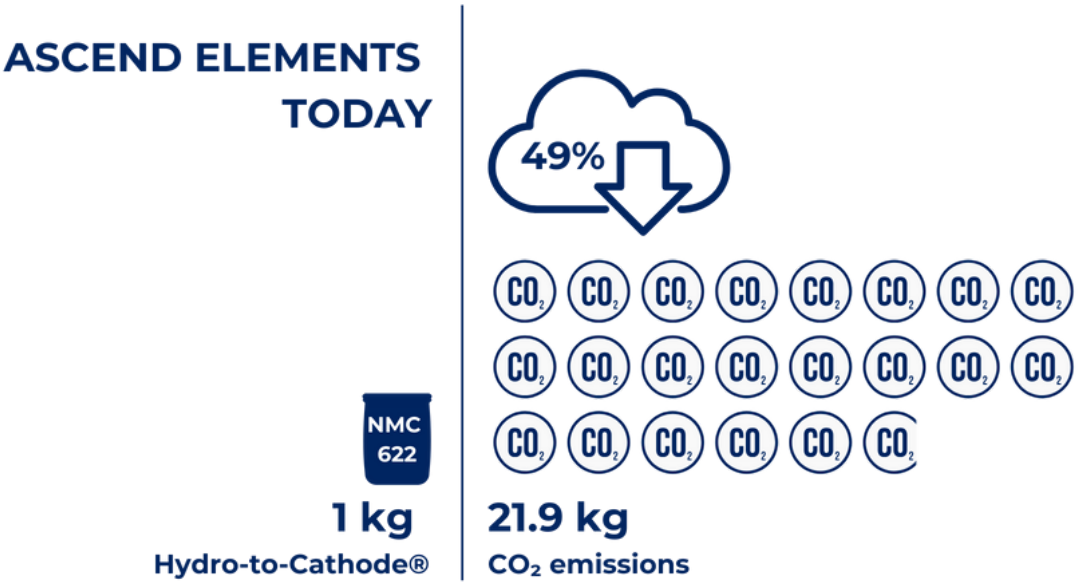


Current Climate Impact

How much carbon is emitted when making 1 kg of NMC 622 cathode? If you assume NMC 622 made with primary material from mining as the typical practice*, then manufacturing 1 kg of cathode generates 42.8 kg of carbon emissions.



With the current Hydro-to-Cathode® process available in 2024, manufacturing 1 kg of cathode generates 21.9 kg of carbon emissions. **That's a 49% reduction!**

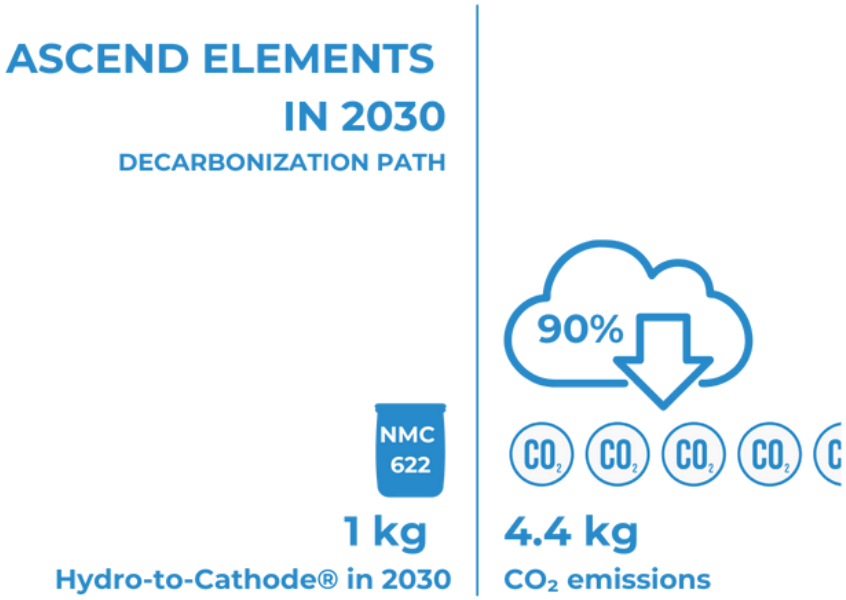


**Industry benchmark based on use of nickel sulfate hexahydrate from Indonesian laterites using nickel matte via RKEF as an intermediate; cobalt sulfate from ore mined in the DRC and refined in China; and manganese sulfate mined in South Africa and refined in China.*

Future Climate Impact

With our planned decarbonization path utilizing 100% renewable energy to power our operations, rail transport and responsibly sourced lithium carbonate (Li^2CO^3), manufacturing 1 kg of NMC 622 cathode will generate just 4.4 kg of carbon emissions.

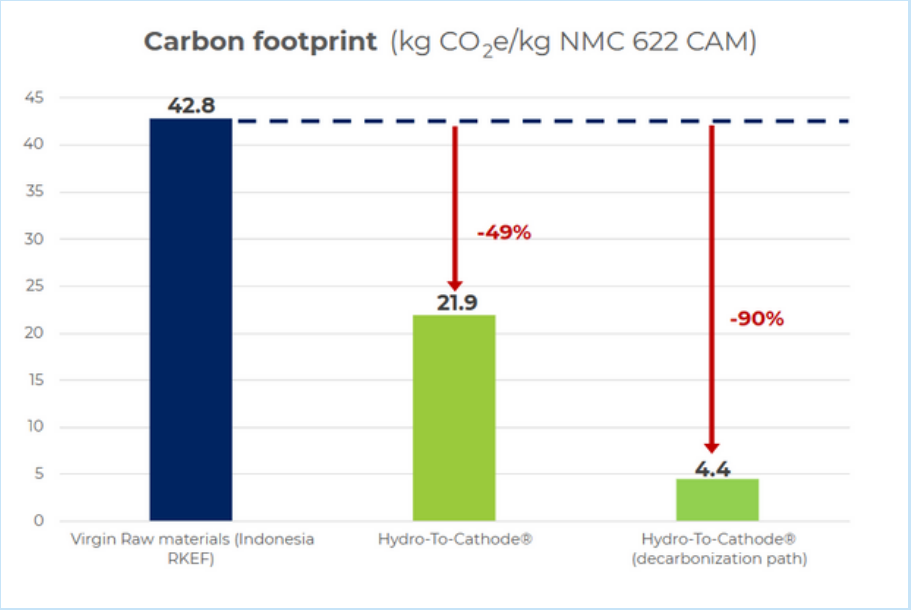
That's a **90% reduction** over the current industry benchmark.



Typical Practice

Indonesia's expanding battery supply chain makes Indonesian nickel sulfate a likely source for most CAM producers in the near future, but it has a carbon-intensive value chain.

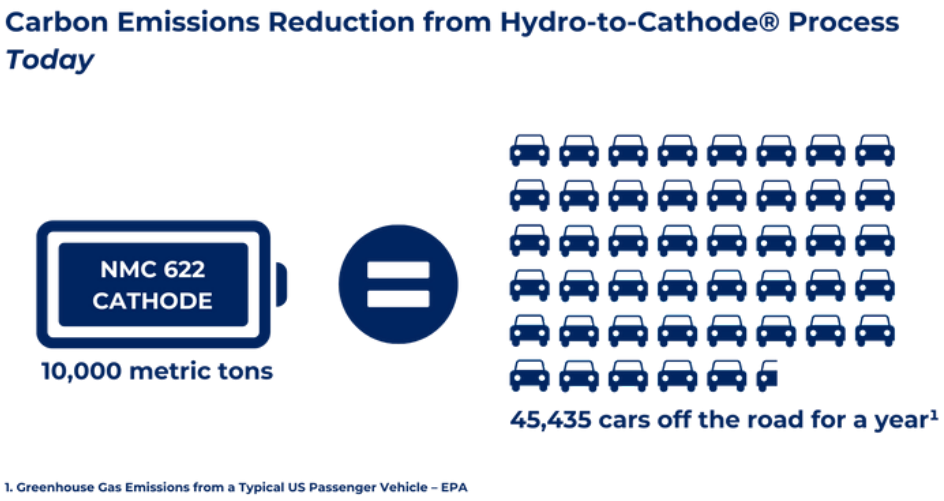
As a result, the Hydro-to-Cathode® process offers significant carbon footprint reductions *today* and in the *future*.



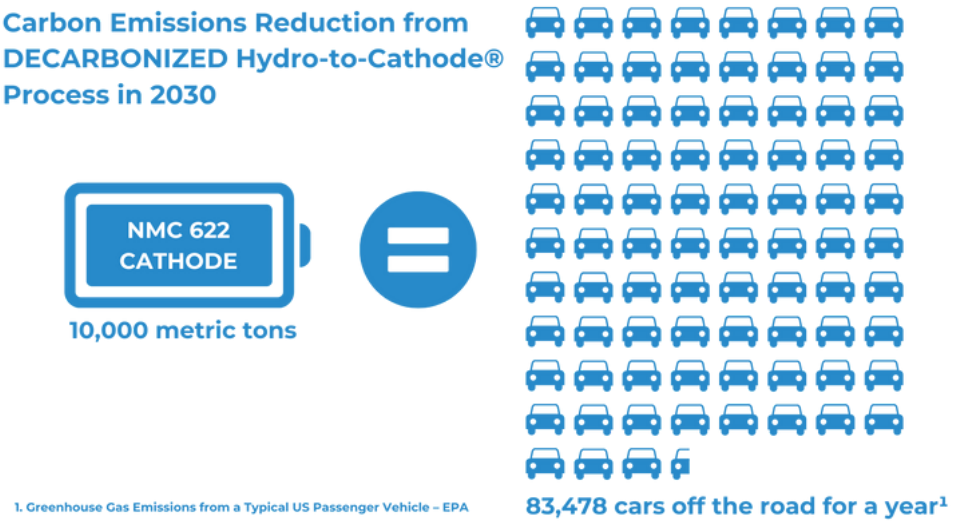
ICE Vehicle Equivalency

To put the climate impact in perspective, the carbon emissions reduction from the current Hydro-to-Cathode® process can be compared to taking a certain number of internal combustion engine (ICE) vehicles off the road for one year.

For example, if we manufacture 10,000 metric tons of NMC 622 (or material for about 125,000 EVs) using the current Hydro-to-Cathode® process, the emissions reduction would be equal to taking 45,435 ICE vehicles off the road for a year.

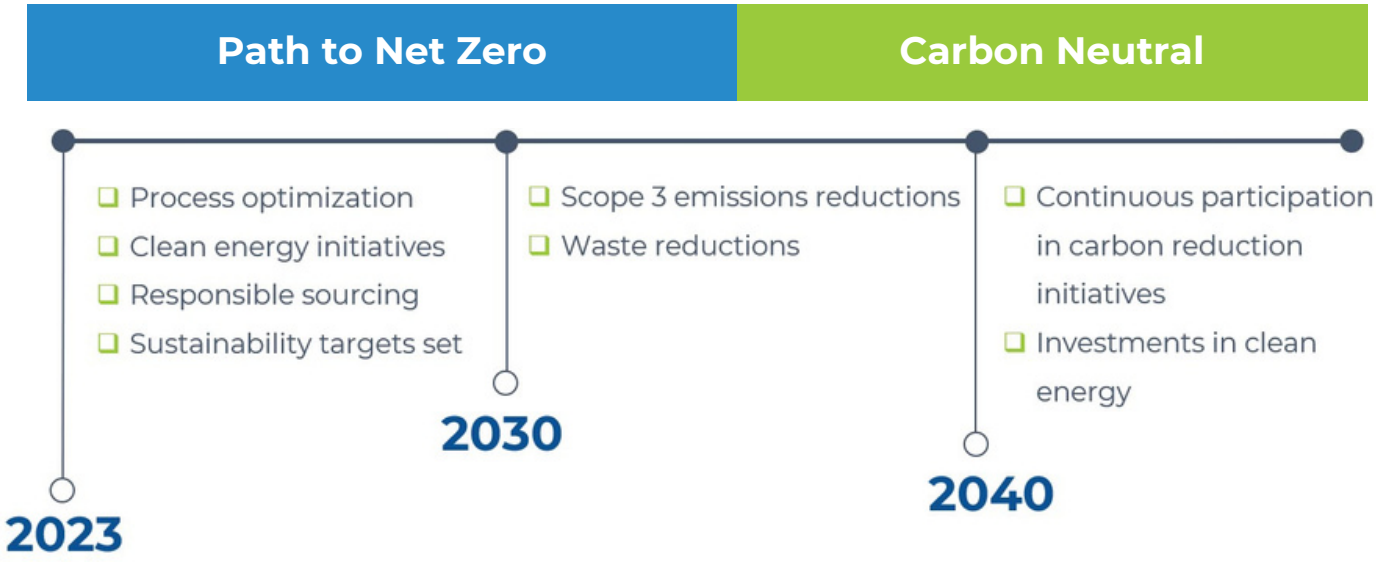


However, using the decarbonized future process, manufacturing the same amount of NMC 622 would be equal to taking 83,478 ICE vehicles off the road for a year.



Decarbonization Road Map

As an organization, Ascend Elements is working to become carbon neutral by **2035**. This will require a wide variety of actions, including clean energy investments, Scope 3 emissions reductions, and more rigorous supplier standards.



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This report is adapted from an independent life cycle assessment performed by Minviro in accordance with ISO 14067:2018, ISO 14040:2006 and ISO 14044:2006. The LCA was reviewed and verified by a board of experts.