



## REDEFINING THE CRITICAL MATERIAL SUPPLY CHAIN

Megan O'Connor, Nth Cycle

Megan O'Connor, Nth Cycle co-founder and CEO and member of Innovation Crossroads Cohort 2, has developed a technology that recycles rare earth metals from permanent magnets and cobalt, nickel, and manganese from lithium-ion batteries at efficiencies greater than 95%, and with margins greater than 70%.

To do this, O'Connor and team have built a low-cost, modular system that can be deployed anywhere these sources of waste are located, saving time and the cost of transportation.

### Accomplishments

Nth Cycle has successfully scaled the nanotube filter technology from the lab bench scale to a fully functional filter module. This module emulates the filter plates used in large-scale filtration units in the wastewater treatment industry today, enabling easy integration of the Nth Cycle tech into existing, off-the-shelf systems.

With efficiencies greater than 95%, Nth Cycle is able to process critical materials four times cheaper, with a 60% reduction in energy use and 75% reduction in greenhouse gas emissions compared to incumbent technologies.

The Nth Cycle team has developed a comprehensive plan and is raising seed round funding to build out the team and fully scale the device for commercial use by the end of 2021.

### The Process

Nth Cycle has combined two traditional techniques used in industry today: membrane filtration and electrowinning. By combining these using carbon filters as electrodes, they can overcome the low efficiencies traditional electrochemical cells see, as well the fouling issues with membrane systems.

This allows for a high throughput system with a small footprint, enabling distributed recycling as a service model. With >95% recoveries and low energy input, this is a very cost-competitive technology for recycling high-value materials.

The Nth Cycle process takes in different components from spent electronics including speakers (permanent magnets) and batteries, producing solid rare earth oxides and battery metal hydroxides for resale to manufacturers.



### COHORT 2

#### Milestones

- Successfully scaled the device from the bench to a pilot filter module and identified an off-the-shelf filtration system to scale in for commercial use
- Recovered rare earth metals from permanent magnets and cobalt, nickel, and manganese from lithium-ion batteries at efficiencies greater than 95%
- Can process these critical materials four times cheaper, with a 60% reduction in energy use and 75% reduction in greenhouse gas emissions compared to incumbent technologies
- Named Forbes 30 Under 30 Energy 2019
- Funding raised: \$364,000

“If you are a founder in the energy space, this is the place for you. The Innovation Crossroads team goes above and beyond for all the entrepreneurs in the program and ORNL has all the resources a young company could ever need for technology development. This program will greatly accelerate your growth.”

Megan O'Connor, Co-founder and CEO, Nth Cycle

## The Challenge

Nth Cycle's greatest obstacle was understanding the fragmented value chain in the lithium-ion battery and permanent magnet industries, and in turn, discovering the end-user for the technology.

“With the resources at Oak Ridge National Laboratory (ORNL) and the research expertise we were able to utilize at the Critical Materials Institute,” O'Connor said. “We were able to fully understand the market and each part of the supply chain. This enabled us to narrow down our product-market fit and understand exactly who our upstream and downstream customers will be.”

## The ORNL Advantage

By working with ORNL through Innovation Crossroads, Nth Cycle has gained access to numerous resources that have enabled the research necessary to develop the company's technology. Additionally, Innovation Crossroads provided the Nth Cycle team with the mentoring and services needed to transition from the lab to industry. ORNL's resources, such as lab space, access to advanced instrumentation, and expertise in technology areas significantly decreased time to market and solved major roadblocks in a short timeframe that would have otherwise taken years.

“Working with a national lab has significantly advanced our company, both on technology development as well as the business development,” O'Connor said. “Coming directly out of academia and being a first-time founder, I knew I needed to learn a lot of information in a very short

amount of time in order to successfully bring this technology to market. The Innovation Crossroads program was absolutely critical to our success.”

## Future Growth

Nth Cycle was founded on the premise that technology can solve some of the world's largest issues. The company is focused on creating a solution to mitigate North America's dependency on foreign supply chains and waste management issues through recycling of lithium-ion batteries and rare earth permanent magnets. The Nth Cycle team believes that technology should solve an issue and not generate an environmental one in return, which is why the company is focused on building a sustainable technology that can save energy and reduce the carbon footprint of these critical materials, truly enabling socially responsible consumer products.

“I'm optimistic that within the next decade Nth Cycle will have successfully commercialized the recycling technology and helped generate a new source of critical materials for North American manufacturers,” O'Connor said. “I want to look back and see the change we helped initiate back in 2017 when we were just a three-person company, with the pipe dream of disrupting the massive electronics and automotive industries, determined to enable a true circular economy.”



## About Innovation Crossroads

Innovation Crossroads is a fellowship program based at Oak Ridge National Laboratory that matches aspiring energy entrepreneurs with the experts, mentors, and networks in technology-related fields to take their world-changing ideas from R&D to the marketplace.

Through an annual call, up to seven entrepreneurs will be selected to transform their ideas into energy, advanced manufacturing, and integrated grid companies with financial support from the U.S. Department of Energy's Advanced Manufacturing Office and the Tennessee Valley Authority. Innovators will receive a fellowship that includes a personal living stipend, benefits, and travel allowance for up to two years, plus substantial funding to use on collaborative research and development at ORNL.

## Contact

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