



## TECH 2020S11: Recycling of Lithium-ion Batteries

Recycling of Lithium-ion Batteries is one in a series of reports published as part of NexantECA’s 2020 Technoeconomics – Energy & Chemicals (TECH) program.

### Overview

Lithium-ion battery recycling is widely acknowledged as essential for augmenting limited supplies of critical battery metals such as lithium, cobalt and nickel. An expected wave of lithium-ion batteries from widespread adoption of battery-electric vehicles is anticipated to strain existing metal supply chains while also providing immense amounts of waste batteries. In response to this market need, a large number of players and technologies have emerged to process waste batteries into new battery materials.

Despite this widely ascribed importance, high levels of uncertainty pervade the immature sector. Much capacity is currently provided by adjuncts to existing nickel or copper smelting, which coexist with dedicated hydrometallurgical or pyro-hydrometallurgical processes based on mining technology. A wave of capacity expansion has strained feedstock collection, but most battery recycling ventures have been small scale, semi-commercial facilities and the sector has yet to fully consolidate. National and supranational policies have had a strong influence on the development of the recycling sector. Finally, new technology providers are also rising to the challenge of innovation in the sector.

Key strategic questions assessed by this report include:

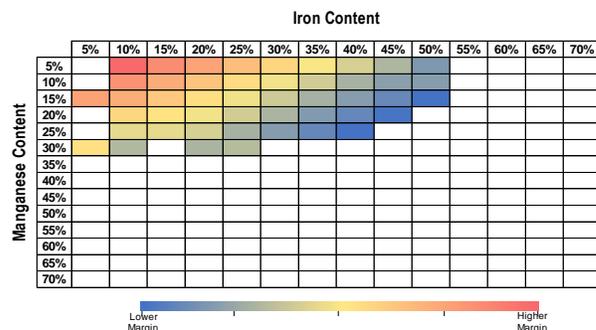
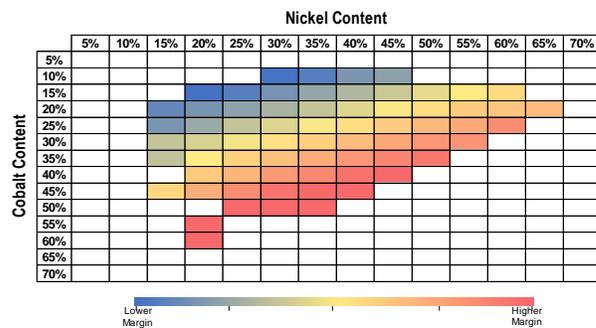
- What are the major technologies used for battery recycling, and how do they differ?
- What are the projected costs of major battery recycling technologies, and how do their differing product slates affect their profitability?
- What is the effect of the cathode chemistry on the economics of battery recycling?
- Will battery recycling ventures operate as profitable metal scrap recovery businesses, or will they depend on regulation to collect waste disposal tipping fees or producer responsibility transfer payments?
- What is the current regulatory and commercial outlook for battery recycling feedstock availability?
- How will future changes in commodities pricing and battery technology affect sector economics?

### Commercial Technologies

This report focuses on the wide variety of available technologies in the sector for metals recovery from waste batteries, including both hydrometallurgical and pyro-hydrometallurgical processes. Coverage of pyro-hydrometallurgical processes includes novel reduction roast processes, reduction roast processing as an adjunct to existing metal smelting, and processes that use pyrometallurgical elements alongside traditional sulfuric acid leaching and precipitation. In addition, the report analyzes new technologies in the battery recycling sector that innovate on the traditional ore processing-based flow.

### Process Economics

This report assesses the economics of a generic hydrometallurgical process and a pyro-hydrometallurgical reduction roast process with ammonium carbonate leach using process flows derived from commercial installations. A Monte Carlo simulation is used to assess the competitiveness of each process depending on feedstock input variation using input models of the 8 most common battery cathode chemistries. Process scenarios cover locations in North America, the EU, and Coastal China, and are assessed on the basis of margin, cost of processing and annual return on investment.



For more information, please contact  
Technology@NexantECA.com or www.NexantECA.com



## TECH 2020S11: Recycling of Lithium-ion Batteries

### Subscribe to TECH

The TECH program (formerly known as PERP) is globally recognized as the industry standard source of process evaluations of existing, new and emerging of interest to the energy and chemical industries.

TECH's comprehensive studies include detailed technology analyses, process economics, as well as commercial overviews and industry trends. Reports typically cover:

- Trends in chemical technology
- Strategic/business overviews
- Process Technology:
- Chemistry
- Process flow diagrams and descriptions of established/conventional, new and emerging processes
- Process economics – comparative costs of production estimates for different technologies across various geographic regions
- Overview of product applications and markets for new as well as established products
- Regional supply and demand balances for product, including capacity tables of plants in each region
- Regulatory and environmental issues where relevant

### Subscription Options

A subscription to TECH comprises:

- PDF reports including detailed technology analyses, process economics, as well as commercial overviews and industry trends
- Cost of production tables in spreadsheet format
- Consultation time with the project team

An annual subscription to TECH includes twenty reports published in a given program year. Reports can also be purchased on an individual basis, including reports from previous program years.



**NexantECA Subscriptions & Reports** provide clients with comprehensive analytics, forecasts and insights for the chemicals, polymers, energy and cleantech industries. Using a combination of business and technical expertise, with deep and broad understanding of markets, technologies and economics, NexantECA provides solutions that our clients have relied upon for over 50 years.

**Technology and Costs** comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

NexantECA serves its clients from over 10 offices located throughout the Americas, Europe, the Middle East, Africa, and Asia.

**Americas**  
Tel: + 914 609 0300  
44 S Broadway, 5<sup>th</sup> Floor  
White Plains  
NY 10601-4425  
USA

**Europe, Middle East & Africa**  
Tel: +44 20 7950 1600  
1 King's Arms Yard  
London EC2R 7AF  
United Kingdom

**Asia Pacific**  
Tel: +662 793 4600  
22nd Floor, Rasa Tower I  
555 Phahonyothin Road  
Kwaeng Chatuchak  
Khet Chatuchak  
Bangkok 10900  
Thailand

Copyright © 2000-2021 NexantECA, the Energy and Chemical Advisory company

**For more information. please contact  
Technology@NexantECA.com or www.NexantECA.com**