

Lithium-Ion Batteries Recycling Process

**ACT Like a Recycler
But
THINK Like a Chemical Plant**

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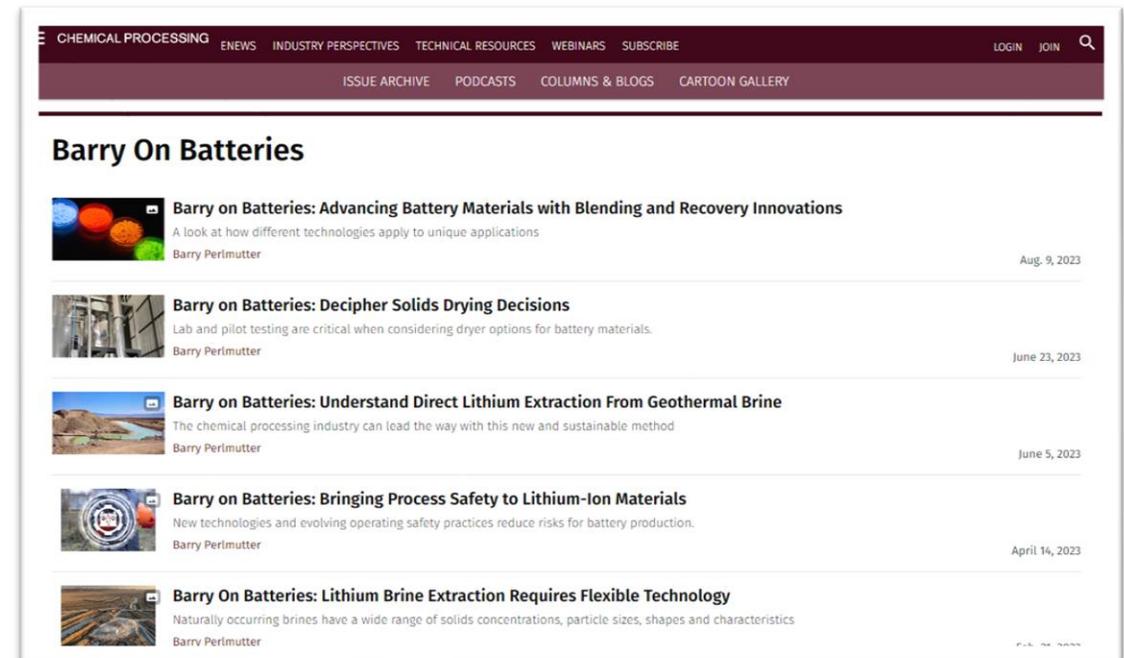
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Overall Experience

- 40 years of international engineering and business marketing experience in the field of solid-liquid separation including filtration, centrifugation, drying, mixing & recycling
- Published & presented worldwide including:
 - Author of [“Solid Liquid Filtration Handbook” \(Elsevier, 2015\)](#)
 - Editor of [“Integration & Optimization of Unit Operations” \(Elsevier, 2022\)](#)
- Professional skills focus on process solutions, innovation strategy, market expansion and business development.

Lithium Market Expertise & Experience

- <https://perlmutterideadevelopment.com/lithium-battery-materials/>
- [Chemical Processing Magazine and Columnist for “Barry on Batteries”](#)
- [International Battery Seminar Conference Presentation](#)



The screenshot shows the 'Barry On Batteries' website. The navigation bar includes 'CHEMICAL PROCESSING', 'NEWS', 'INDUSTRY PERSPECTIVES', 'TECHNICAL RESOURCES', 'WEBINARS', 'SUBSCRIBE', 'LOGIN', and 'JOIN'. Below the navigation bar, the main content area is titled 'Barry On Batteries' and lists five articles:

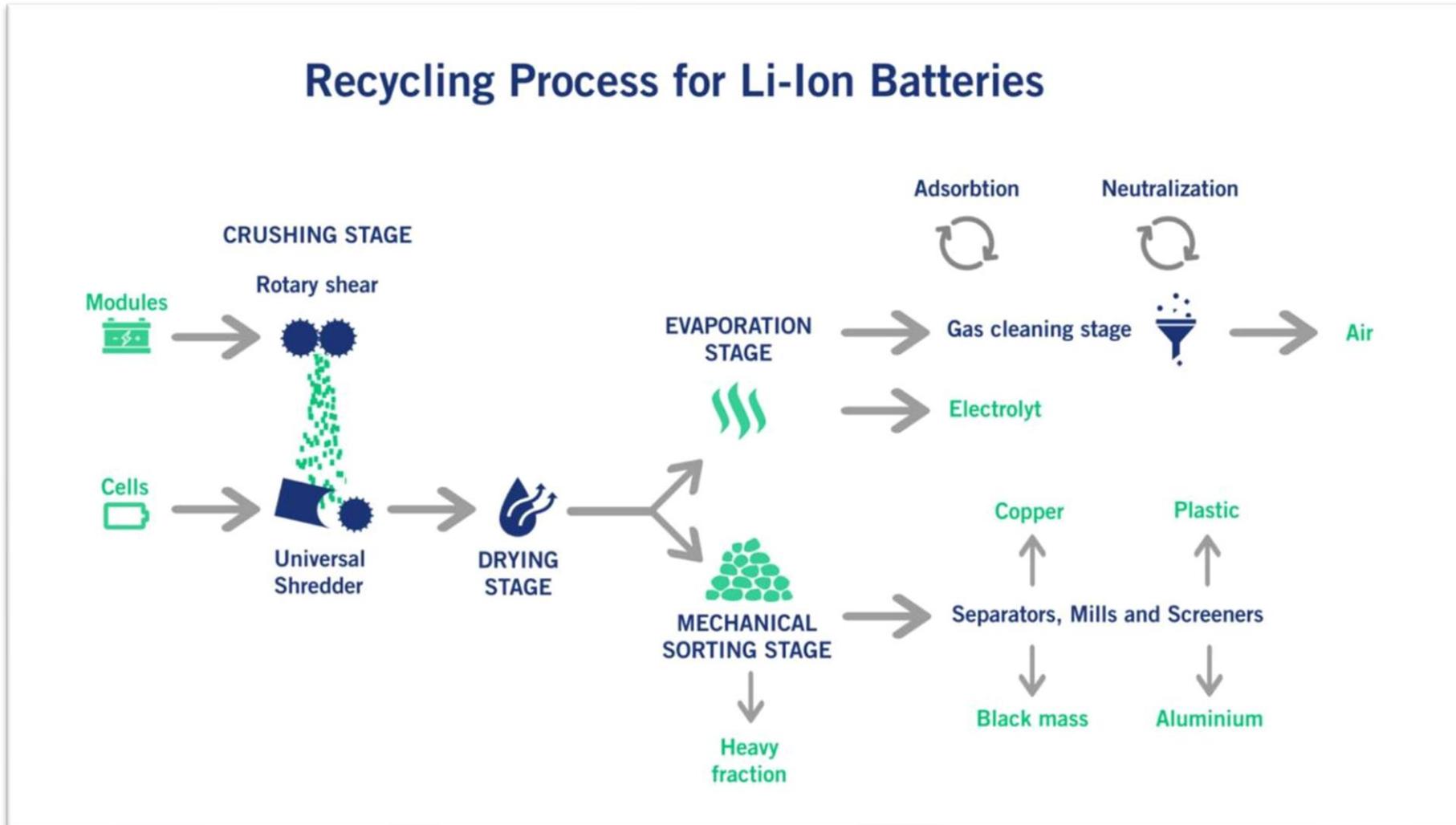
- Barry on Batteries: Advancing Battery Materials with Blending and Recovery Innovations**
A look at how different technologies apply to unique applications.
Barry Perlmutter
Aug. 9, 2023
- Barry on Batteries: Decipher Solids Drying Decisions**
Lab and pilot testing are critical when considering dryer options for battery materials.
Barry Perlmutter
June 23, 2023
- Barry on Batteries: Understand Direct Lithium Extraction From Geothermal Brine**
The chemical processing industry can lead the way with this new and sustainable method.
Barry Perlmutter
June 5, 2023
- Barry on Batteries: Bringing Process Safety to Lithium-Ion Materials**
New technologies and evolving operating safety practices reduce risks for battery production.
Barry Perlmutter
April 14, 2023
- Barry On Batteries: Lithium Brine Extraction Requires Flexible Technology**
Naturally occurring brines have a wide range of solids concentrations, particle sizes, shapes and characteristics.
Barry Perlmutter

Lithium-Ion Batteries Recycling Process For End-of-Life (EOL) Packs, Modules & Cells Production Scrap & Defective Battery Cells Small-Format Consumer Batteries

- Discharging
- Dry (inerted) shredding/crushing/granulating
- Black mass vacuum drying with gas treatment, electrolyte recovery and dedusting
- Classifying and sorting of the different fractions

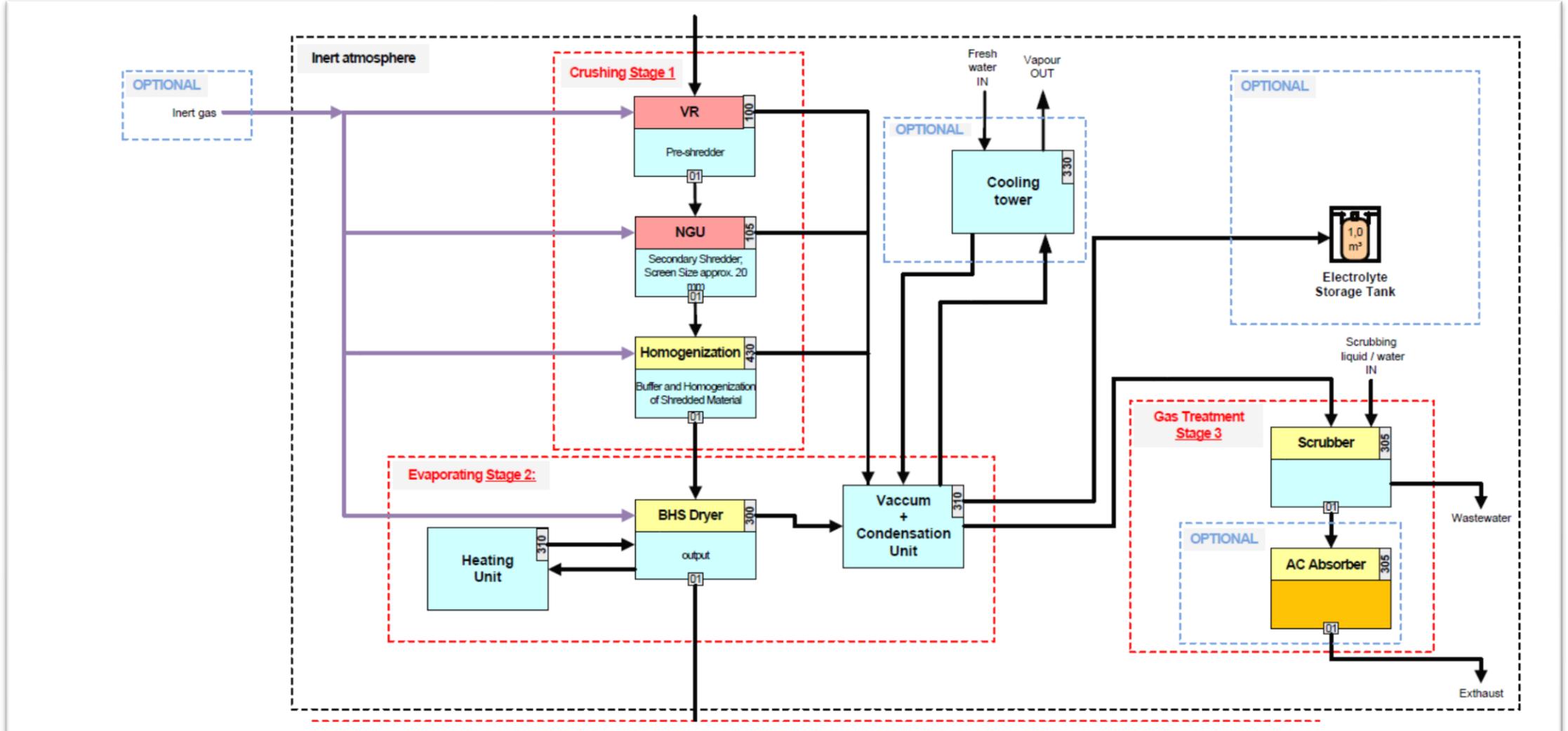
BHS Recycling Solution

Overall Process: Stages 1 - 4



BHS Recycling Solution

Overall Process: Stages 1 - 3



PDE-Stage 1: Preliminary Engineering

PDE-Stage 2: Detailed Engineering

P&IDs, PLC control philosophy and specification, detailed equipment specifications and other documents to allow client to issue purchase orders.

PDE-Stage 3: Project Execution

Assistance is provided, as necessary, to the client engineering teams and/or outside contractors, etc. to enable the project to be completed on-time within budget.

PDE-Stage 4: Commissioning and Startup

Supervision is provided to oversee vendors for cold and hot commissioning, startup, training and other on-site activities.

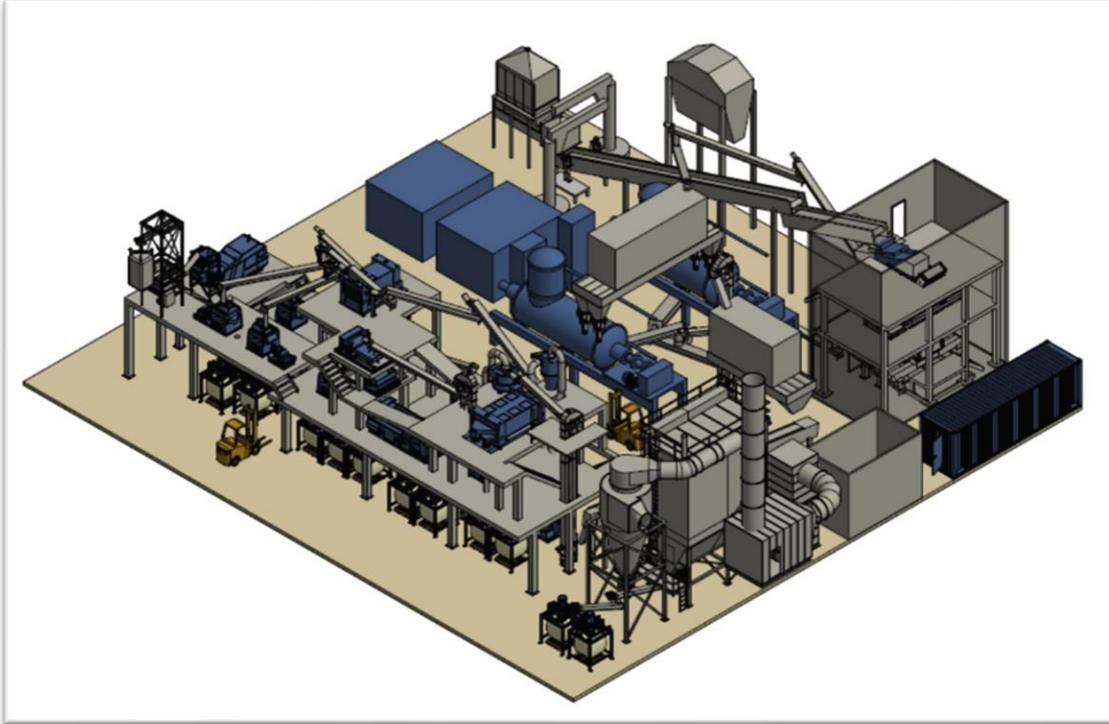
PDE-Stage 5: Support

Guidance is provided for on-going operation, optimization and other recycling plant activities along with assistance with vendor support.

1. PDE-Stage 1 Scope of Work:

- a. Process Description**
- b. General sizing approach including number of pieces of equipment such as one granulator and one dryer or two lines or another ideas/approaches.**
- c. Preliminary Block Flowsheet (PFD) including Discharging, Crushing/Shredding, Drying with vacuum/condensation, Gas treatment and Sorting**
- d. Final PFD**
- e. Equipment description and general specifications / information**
- f. Utility consumption and motor lists**
- g. Emissions**
 - 1. Exhaust gas flows**
 - 2. Exhaust dust flows**
 - 3. General discussion and range of emissions**
 - 4. Brine renewal/disposal based upon the battery quality and other factors**
- h. Building footprint sketch including height requirements (Outside dimensions only, building layout details are part of PDE-Stage 2)**
- i. Equipment cost estimate +/- 20%**
- j. PDE-Stage 2 engineering cost estimate**

BHS Recycling Solution



Client	Capacity	Description of Feed Stock
A	4 tons/hour	Production scrap, EV & Consumer batteries
B	50 kg/hour	Production scrap, EV batteries
C	4 tons/hour	Production scrap, EV batteries
D	2 tons/hour	Production scrap, EV batteries
E	2 x 2 tons/hour	Production scrap, EV & Consumer batteries
F	1 – 2 tons/hour	Consumer batteries
G	50 kg/hour	Consumer batteries
H	4 tons/hour	EV batteries, Consumer batteries
I	100 kg/Hour	EV batteries

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