Datacenter Energy Storage Recycling and the Future of Sustainability

9/13/2022

Cirba Solutions

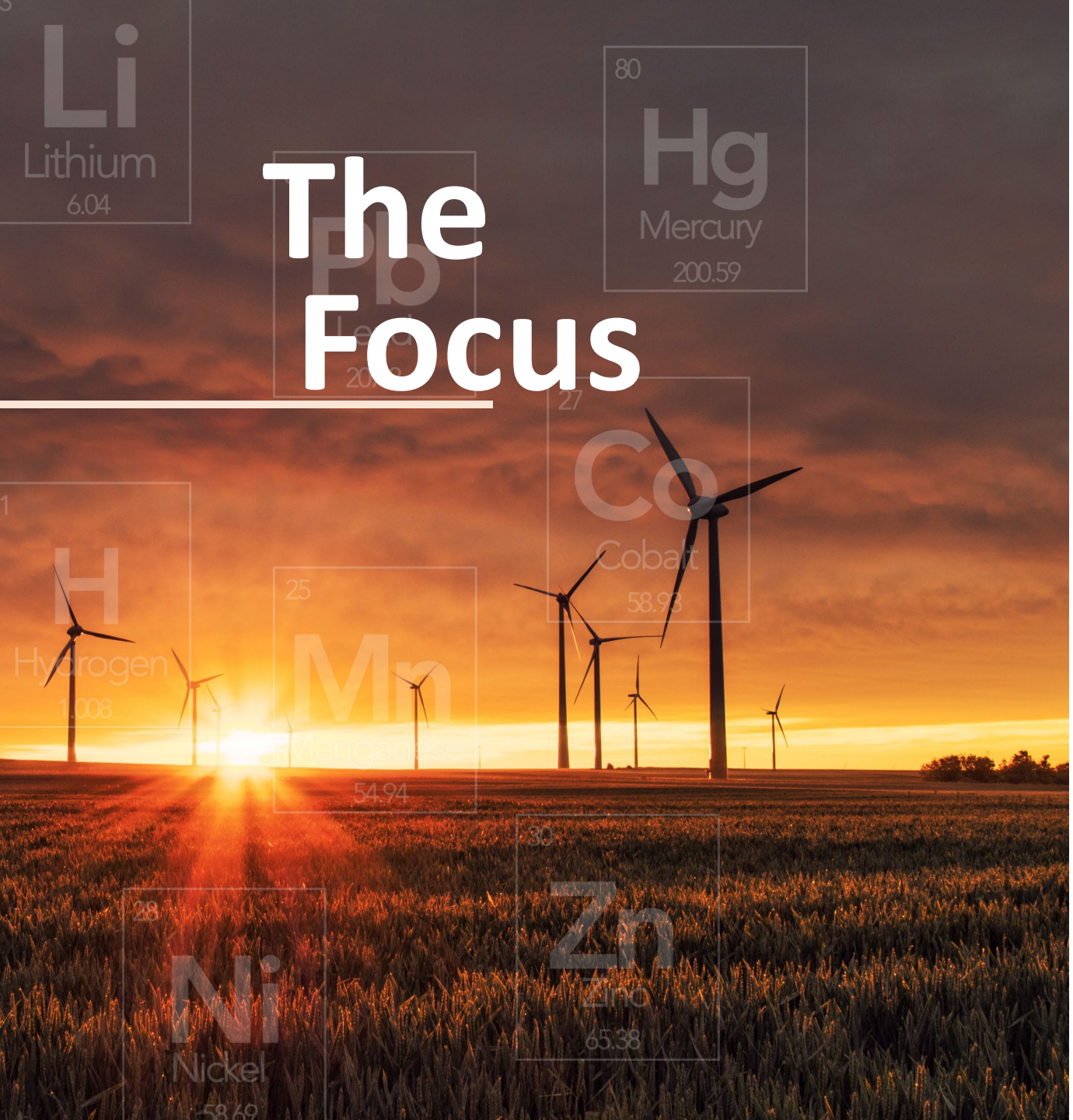
DISCUSSION WITH

Battery expert

Eric Hill

Director of Business Development

Over the last 15 years, Eric has worked in various roles from startup companies to large organizations in different levels of product development, program management, vendor management, operational management, and business development throughout his career. He has experience working with lithium-ion, lead-acid, nickel-cadmium, nickel-metal-hydride chemistries from manufacturing, deployment, to circular sustainability. Eric has a B.S. in Finance from LSU-Shreveport and is Pragmatic Marketing Certified.



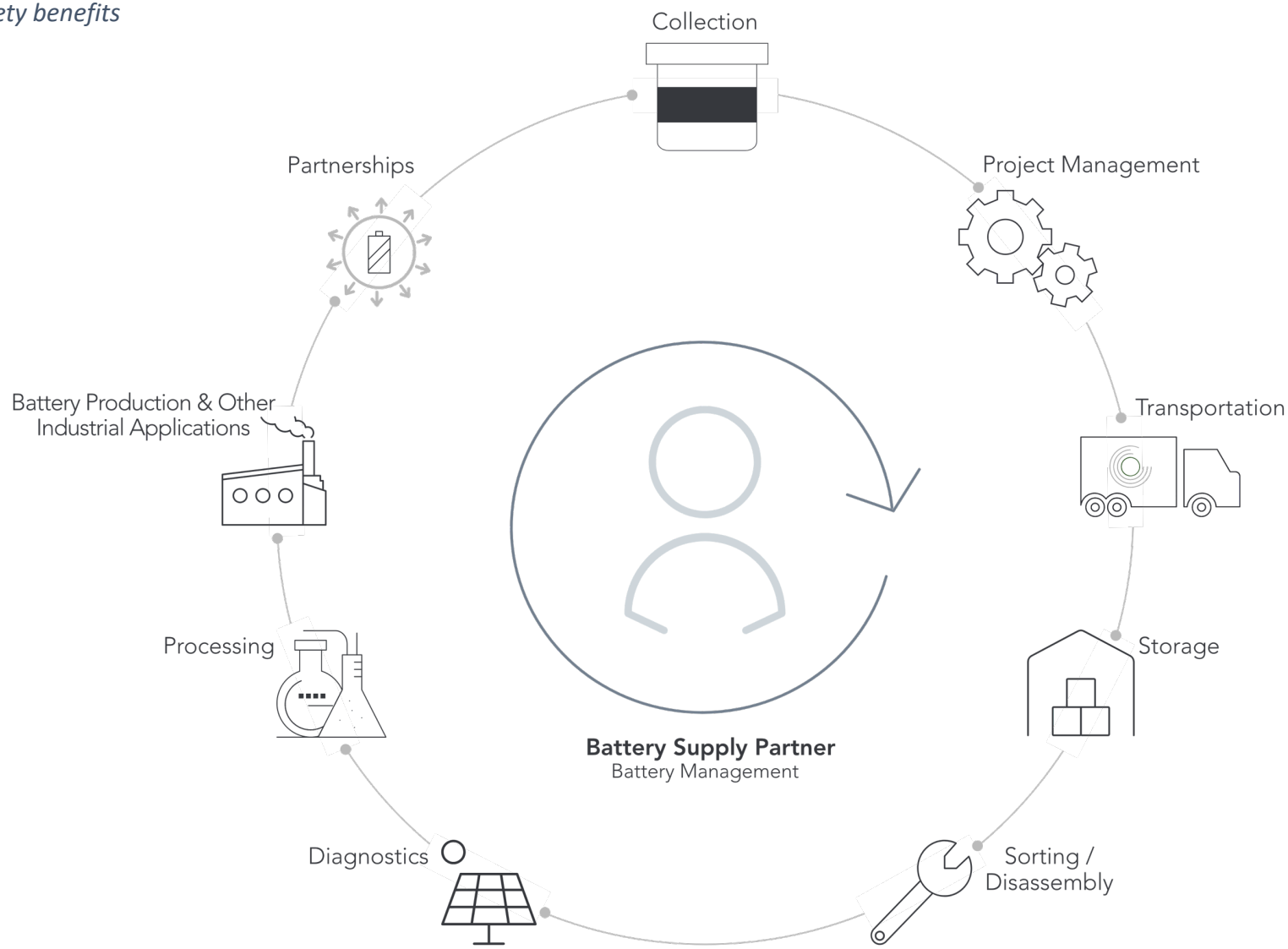
The Focus

1. Why Recycle Batteries?
2. Lead-Acid Recycling Process
3. Lithium-Ion Recycling Process
4. Datacenter Battery Sustainability

Why Recycle Batteries?

Create circularity for environmental, economic, and safety benefits

Empowering an electric future to accelerate human progress.



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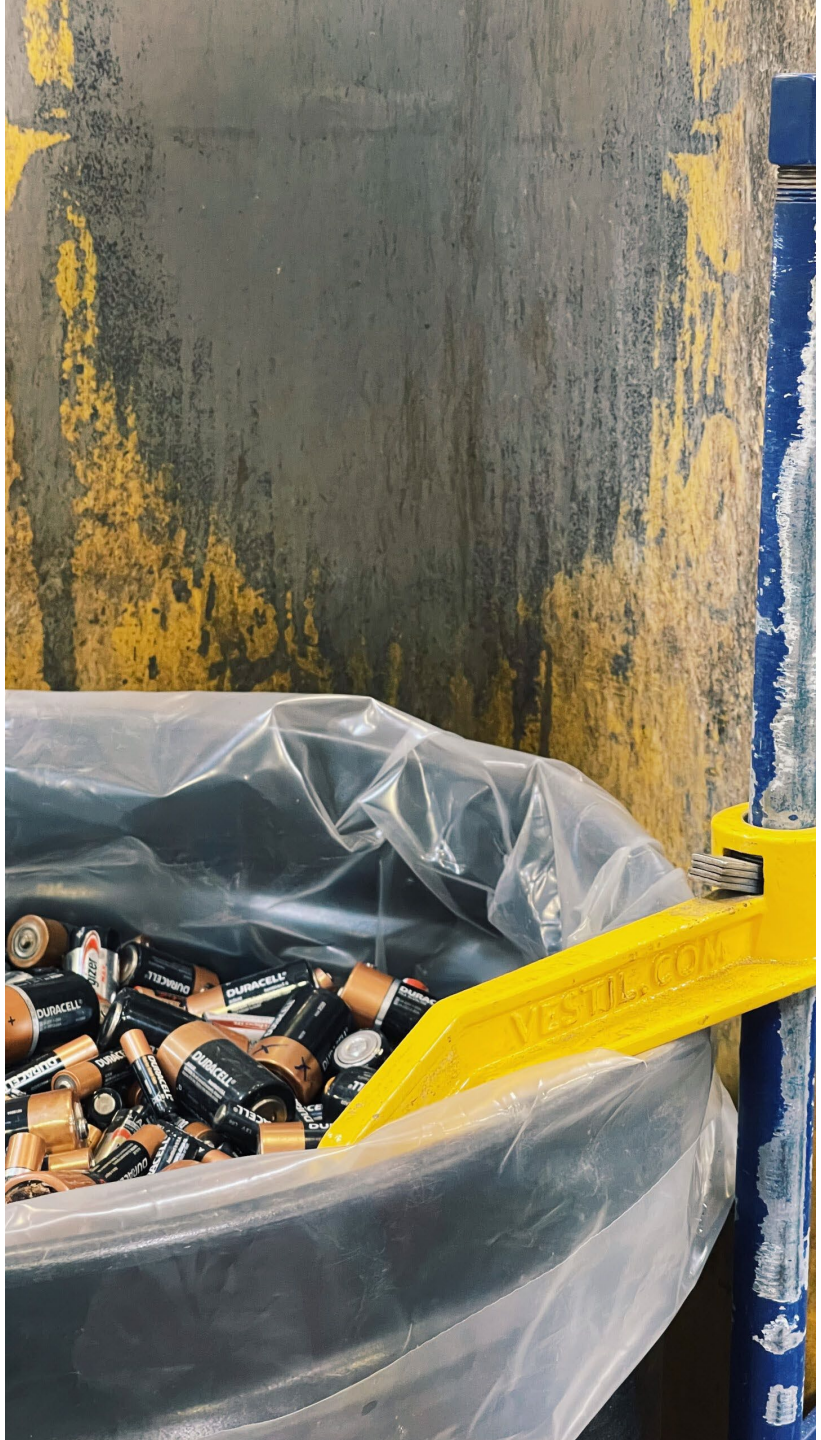
Collecting Batteries Delivers Critical Elements into the Supply Chain

- Turnkey options for compliance and safety-first approach
- Flexible and adaptable based on volumes
- Options for all formats (small or large)
- Onsite training available for customers in packaging and safety
- Program traceability
- Services work together to provide a holistic approach to collection:
  - Warehousing
  - Logistical coordination
  - Product packaging
  - Sorting



Lead Acid Recycling

Batteries Arrive at Cirba Solutions Location

Dissasembly

Battery Breaker
Allowing us to recover various components of the lead acid battery

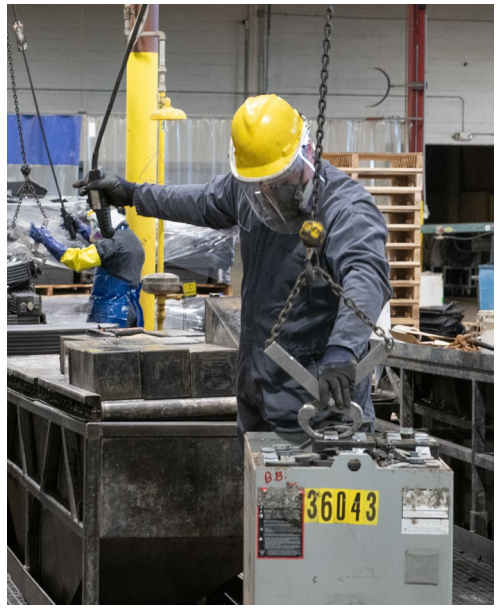
High - Impact Crusher
Seperating the battery components

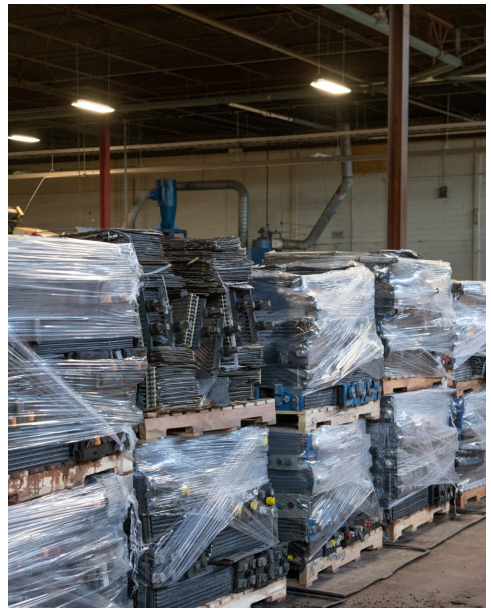
Material Separation Techniques
Battery Components

Fully Recovered Metal Solids

Material Separation Techniques
Battery Components

Fully Recovered Metal Solids





Lithium-Ion Processing

Batteries Arrive at Cirba Solutions Location

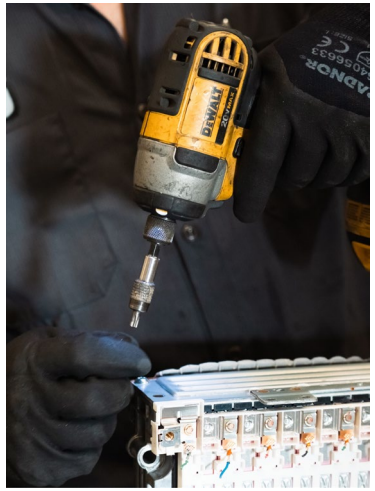
Manual Disassembly
Large Batteries Only

Automatically Crushed

Metal-enriched Liquid is Solitifed
Filtering Technology

Set for Further Metal Purification

Fully Recovered Metal Solids



Lithium-Ion Black Mass

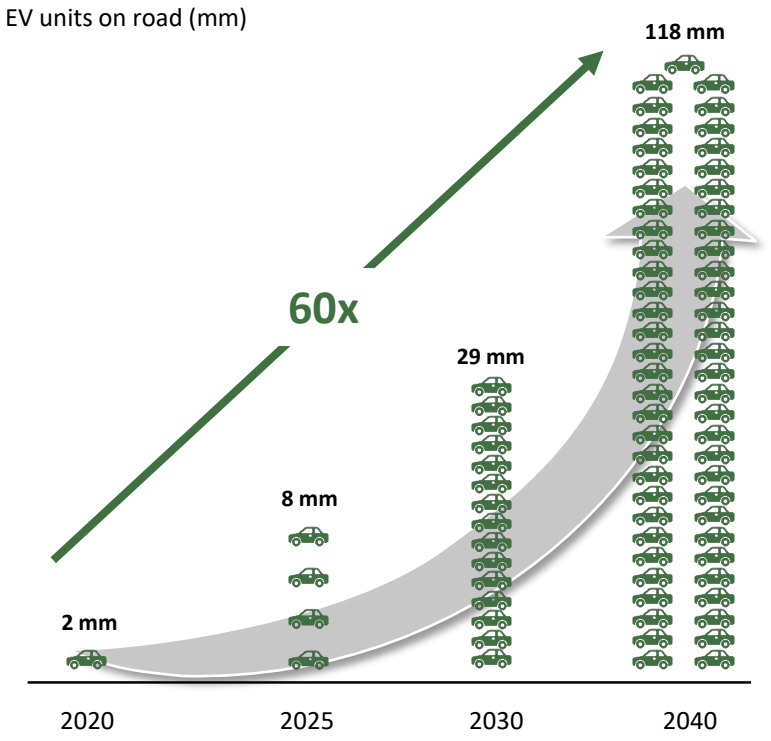
Extracted material from shredding or hydrometallurgical separation

Nickel, Cobalt, Lithium, Manganese can be extracted from mass and used in new Lithium-Ion battery production

Market Dynamics - Electrification Transformation is Here

The acceleration in electric vehicle adoption and investments in battery production will serve as catalysts for Lithium-ion battery recycling service needs

Wave of EV Demand is Coming Quickly and Expected to Increase ~60x By 2040

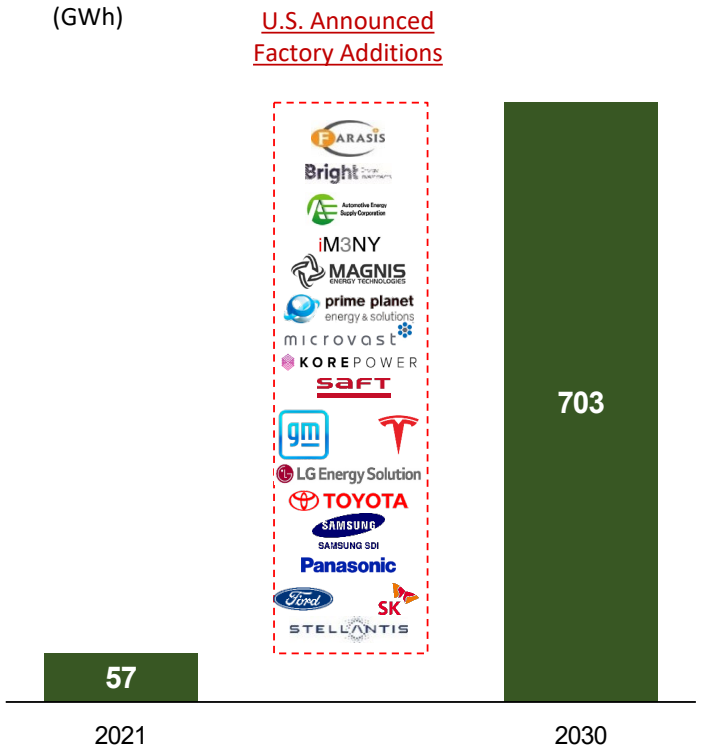


Auto OEMs are Accelerating Their Commitments to a Primarily Electric Future…

>$500bn

Cumulative Investment in EV and Battery Industries

…And Building Out Battery Mega Factories in North America



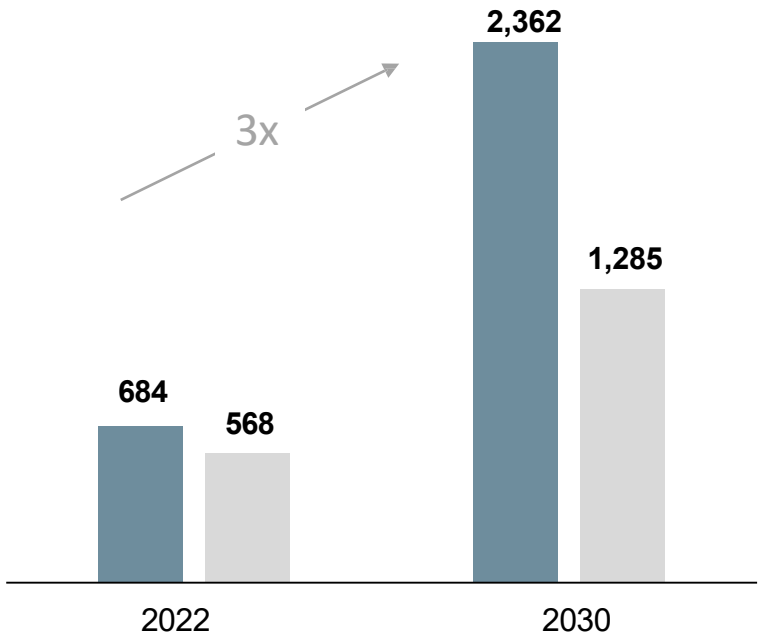
Source: BNEF, Company information, Duke University, Oxford Energy Forum, Reuters.

Material Imbalance for Lithium-Ion Batteries

With demand for new metals projected to outpace supply, recycling provides a viable and more sustainable resource for the lithium-ion supply chain

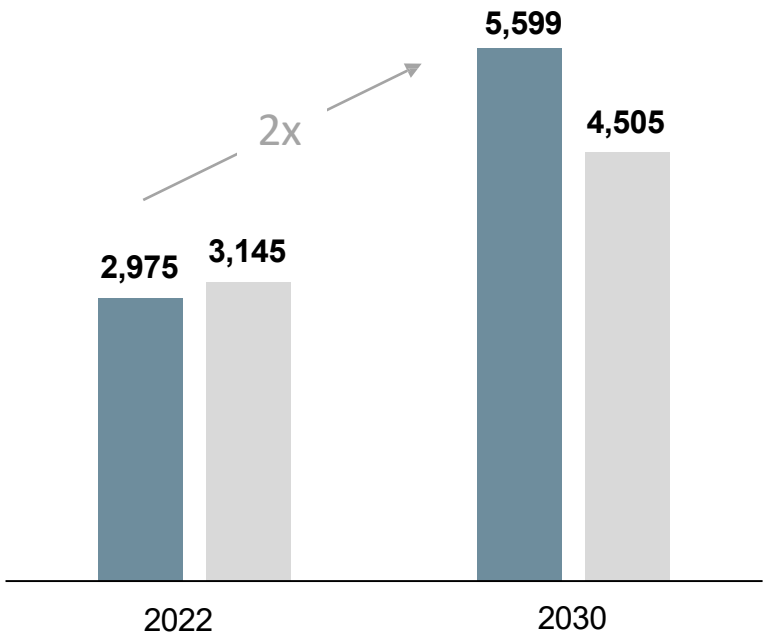
Lithium Supply & Demand Imbalance[1]

Global Mined Lithium Supply and Demand LCE[2]
Metric Tons (000s)



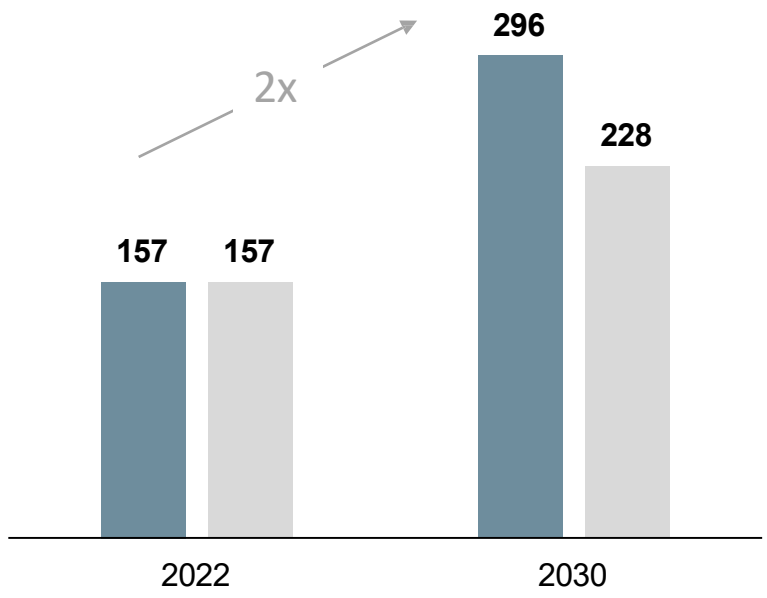
Nickel Supply and Demand Imbalance

Global Mined Nickel Supply and Demand
Metric Tons (000s)



Cobalt Supply & Demand Imbalance

Global Mined Cobalt Supply and Demand
Metric Tons (000s)



Demand Supply

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Source: Benchmark Mineral Intelligence, Canaccord Genuity, UBS, INSG, Glencore.

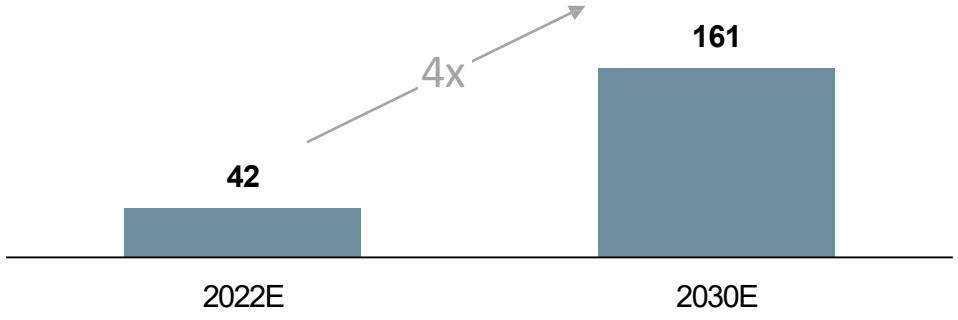
1. Includes operational and highly probable supply.
2. Lithium Carbonate Equivalent.

Close the Materials Supply Gap

As the battery transformation accelerates, the availability of end-of-life batteries and battery manufacturing scrap are a fast-growing and viable sources of reusable materials.

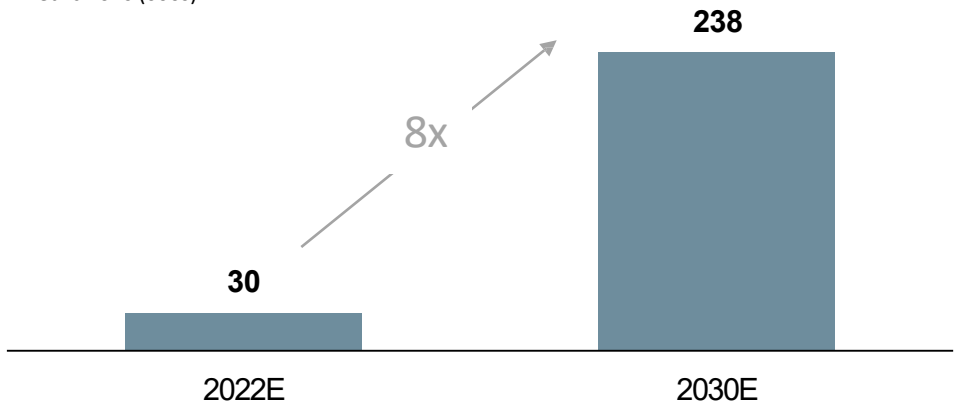
Availability of End-of-Life Batteries for Recycling

North American Li-Ion Batteries
Metric Tons (000s)



Availability of Battery Scrap for Recycling

North American Li-Ion Batteries
Metric Tons (000s)



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Source: Benchmark Intelligence Forecasts, Circular Energy Storage.

Data Center Battery Sustainability Trends

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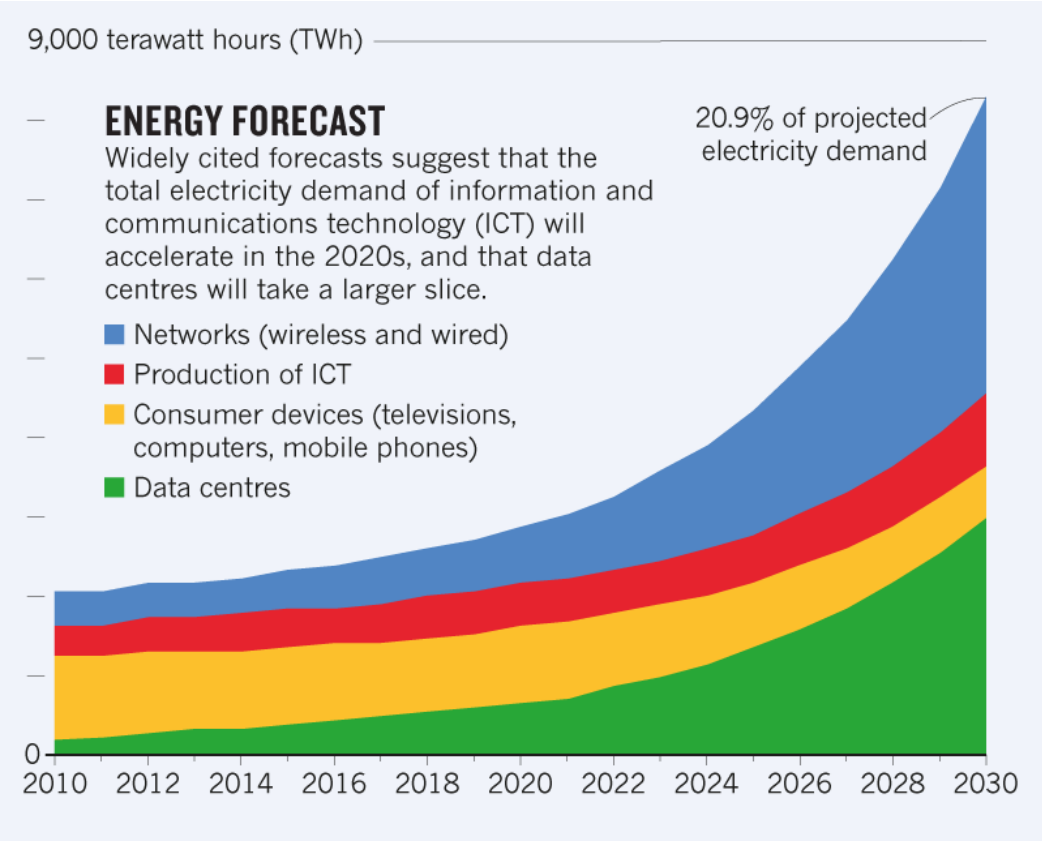
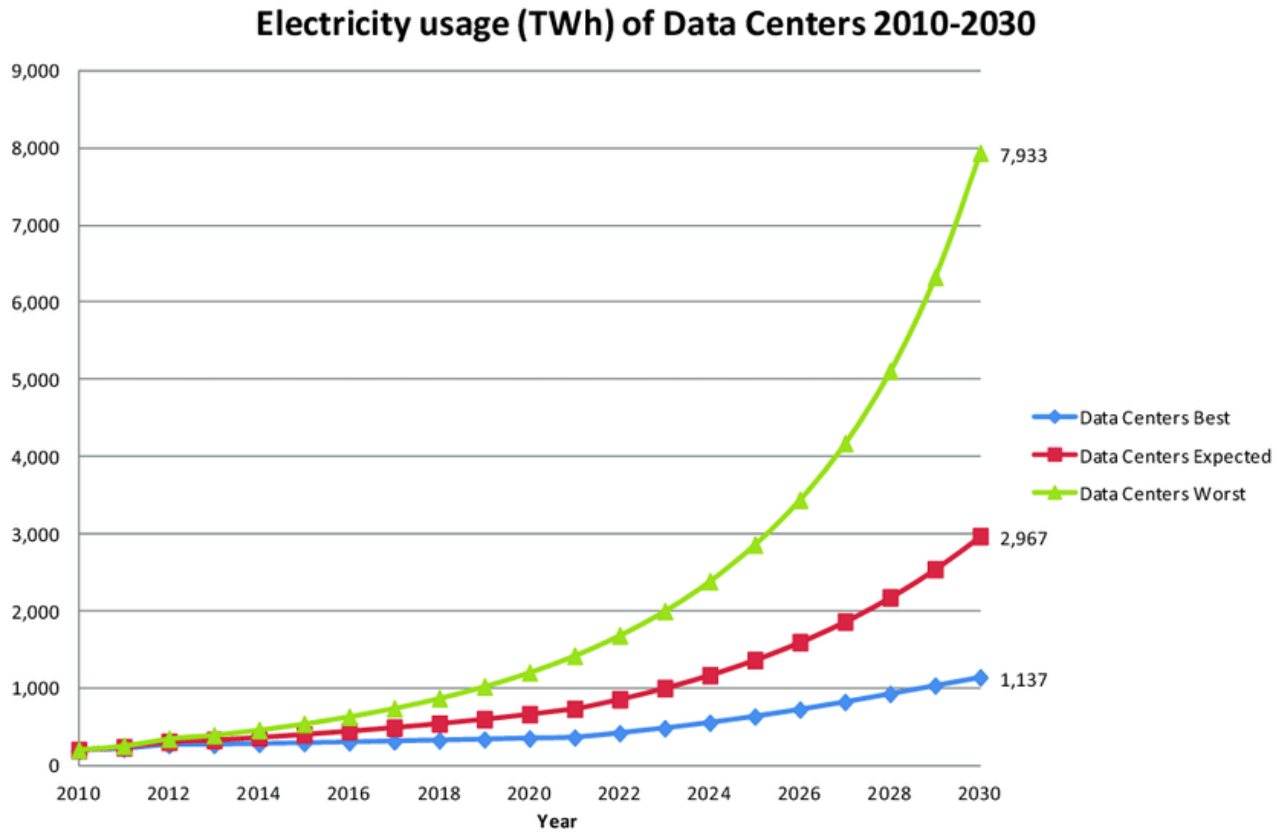
Data Center Power Consumption On The Rise



https://www.akcp.com/blog/the-real-amount-of-energy-a-data-center-use/



Andrae, Anders & Edler, Tomas. (2015). On Global Electricity Usage of Communication Technology: Trends to 2030. Challenges. 6. 117-157. 10.3390/challe6010117.

DATACENTERS

The Future of Battery Sustainability

Key Trends:

Designing to integrate energy efficiency powered by batteries and find new renewable sources of energy
- Air containment cooling and liquid cooling (immersion included)
- Higher efficiency UPS systems – transformer-less or modular
- Sustainable electronic component design
- Higher power usage awareness and future forecasting

Exploring storage increases to support demand response – reduce grid and diesel generator dependency
- DERs and Microgrids – generate power where its used
- Reduced footprint, higher energy density, higher power transfers

Alternative chemistries being actively deployed and further explored – fuel cells/flow/nickel-zinc/sodium-ion

Li-Ion and lead-acid meets challenges today (by region and applications) but hurdles like cost, availability, safety exist

Establishing circular plans for complete energy storage support is vital to keep supply chain moving along

https://www.techtarget.com/searchdatacenter/feature/The-global-state-of-data-center-sustainability

https://www.sdxcentral.com/articles/analysis/sustainability-fuels-data-center-physical-infrastructure-growth/2022/08/

Long Duration Storage

Using grid-interactive UPS systems to discharge energy both high power and high energy will reduce fossil fuel dependency on generation and backup

Li-Ion for long duration backup

- Use energy when needed to support increases in demand
- Energy arbitrage to use power at lower cost rates (tiered kWh rate scales only)
- Voltage frequency regulation to prevent equipment shutdown from sags and spikes
- Long duration backup when grid connectivity goes down
- Large-scale deployments being trialed now to curtail fossil-fuel generation and backup

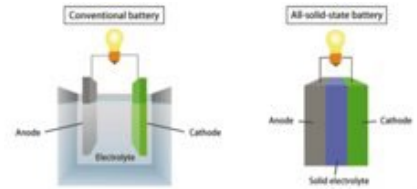
Microsoft Dublin Datacenter

https://www.energy-storage.news/microsoft-data-centre-tries-out-grid-interactive-ups-battery-storage/

Technology Advancements

Development of new Li-Ion technologies + improvement to existing chemistry is key to advancing sustainability

Keeping batteries deployed longer and using power more efficiently

Li-Ion Solid State	Lithium Sulfur	Lithium Air	Sodium Ion
			
Turning liquid electrolyte into a solid electrolyte Solid state is being primarily developed for the electric vehicle market (EV) due to its increase safety and energy density.	Using more abundant materials combined with the ability to provide even higher energy. Very limited cycle life and lower than expected energy throughput efficiency makes this still a laboratory experiment	Concepts behind zinc-air and fuel cells, lithium-air chemistry uses a catalyst for oxygen reduction with an electrolyte and lithium. The driver behind this chemistry is the potential of greater energy density but much lower cycle life. The chemistry is still under development in research laboratories.	Similar approach with lithium-sulfur by using abundant raw materials like sodium Being able to discharge fully and potentially ship without hazardous restrictions This chemistry could prove to be a direct alternative to existing lithium-ion as we know it today.

Providing Customers, a Proven Circular Battery Management & Supply Chain Partner

Full Scale Service Offerings, Customizable Solutions.

Customers can leverage any or all services for a custom solution that is fully traceable with a trusted team.

- Expanded processing capabilities for all battery types – Lithium, Lead, Nickel, etc.
- Battery recycling program & project management
- On-Site services
- Storage & warehousing
- Battery-Centric logistics
- State-of-Health testing & battery diagnostics
- Material recovery and upgrading
- Second life solutions
- Close-Looped approach, from battery collection to innovative recycled cathode materials for battery manufacturing. cathode production for manufacturing.
- Battery safety training
- Consultation for battery management, storage and testing

Renewing resources for a sustainable future

9-13-2022

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