



NAATBatt North American Lithium-ion Battery Supply Chain Database Documentation and User Guide

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 - Phase I September 2021
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- DB Detailed Documentation

Objectives/Tasks for Phase I – September 2021

- Task 1: Create a database of every company doing business within identified Segments* that (a) has a manufacturing facility, or (b) employs at least 10 persons, (c) located in North America
- Task 2: Add list of companies engaged in (1) li-ion battery modeling tools and services (2) service and repair Li-ion systems in transportation and stationary applications, and (3) Lithium-ion battery R&D.
- Task 3: Collect the following information for each company as applicable (1) Installed battery capacity (in GW) or material production capability (in tons/year, (2) Other metrics based on the company's business, (3)Plans for future capacity, (4) Types of chemistries and processes, and (5) Future expansion for transportation and stationary sectors

*Segments refer to Materials, Cell, Module/Packs, and End-of-Life (equipment, process)

Phase II - Improving and Expanding the Database

- Realizing this should be ongoing effort, NAATBatt funded NREL in May to initiate Phase II
 - LIB market is competitive and evolving fast
 - Some information (e.g., production capacity) is not always publicly available and companies may not want to share this
 - New companies and facilities will be constantly coming on-line
 - Impact of the Bipartisan Infrastructure Bill and DOE FOA for developing battery supply chain
- Phase II August 29th 2022 Release:
 - Added workforce and production capacity, where publicly available
 - Added new (> 75) entries, including those that emailed to be added
 - Corrected information based on feedback on last version
 - Added Maps Instructions worksheet
 - Improved Search function to include searching on Product (Facility Type for EOL) and State, updated notes and included NAATBatt membership in records retrieved
- We ask you to send comments, corrections and additional information concerning the Database through <u>LIB.SupplyChain@nrel.gov</u>
- NREL/NAATBATT intend to update the information in the database every 6 months after.

Database Background and Summary

Data Sources

Public Search

- Internet search
- ✓ Business directories in in all U.S. states and Canadian territories
- Technical and marketing conferences in battery materials, cells, systems, manufacturing, end-of life.
- ✓ Literature Search
- ✓ Government-supported efforts (AMR Reviews, STTR/SBIR database)
- Private Searches
- ✓ Bloomberg New Energy Finance (BNEF)
- ✓ Thomas databases (<u>https://business.thomasnet.com/about</u>)
- Zauba (for trade data <u>https://www.zauba.com/</u>)
- ✓ Market reports
- Commercial databases
- **V**Questionnaire
 - Emailed to all NAATBatt members and other identified companies
- VInterviews with Stakeholders

Trade show info, Internet, Market data firms and reports

Questionnaires

Direct

Sall

Questionnaires and Interviews

Questionnaire Status

- Sent to all current NAATBatt members
- Sent to approximately 600 others
- Received > 150 responses
- Research on responses required
- Interviews
 - Contacted companies with missing or confusing data

NREL Li-Ion Supply Chain Questionnaire for NAATBatt

NAATBatt has commissioned the National Renewable Energy Laboratory (NREL) to collect data on the lithium ion battery (LIB) supply chain in North America. The purpose is to identify gaps in the supply chain and provide data to decision makers to aid in strengthening it for both electric vehicles and stationary applications.

Please complete this very short questionnaire for each facility in North America that is a part of the LIB supply chain. Filling out this questionnaire will ensure that your company is represented accurately in the database. Your specific data will not be shared with others.

Please submit responses by July 28th, 2021

Thank you.

Ahmad Pesaran, NREL

* Required

1. Company Name *

Your answer

2. Is this company North American Owned, a Joint Venture between companies in North American and outside, or a Subsidiary of a non-North American entity?

O North American Owned

Joint Venture between companies in North America and outside

Subsidiary of a non-North American entity

Other:

Current Database Statistics

Supply Chain Segment	U	S	Can	Canada		ner	Tot	tal
	Companies	Facilities	Companies	Facilities	Companies	Facilities	Companies	Facilities
Raw Material Manufacturing	15	18	16	23	3	4	34	45
Battery Grade Component Manufacturing	44	58	10	11	5	5	59	74
Other Battery Components and Materials Manufacturing	33	41	1	1	1	1	35	43
Electrode and Cells Manufacturing	58	67	10	10	6	9	73	86
Modules and Packs Manufacturing	98	115	10	10	3	8	111	133
End of Life/Recycling	44	59	7	7	0	0	51	66
Equipment Manufacturing	44	46	2	2	3	3	49	51
R&D	68	76	7	7	6	6	81	<i>89</i>
Service and Repair	61	63	4	0	1	5	66	68
Modeling	19	19	2	2	0	1	21	22
Distributors	6	6	1	1	0	0	7	7
Totals	490	568	70	74	28	42	587	684

*Companies are counted more than once if they are active in multiple sections of the supply chain and/or have multiple products

NREL

User Guide

List of Worksheets

Worksheet	Tab Color	Description
Summary Table	White	Dynamic table that summarizes the entries in the database by supply chain segment, country, company and facility
Search	White	Interface that allows the user to search all segments except EOL
EOL Search	White	Interface that allows the user to search the EOL segment
Map Instructions	White	Provides instructions for accessing maps of the data
RawMatl	Green	Data for facilities that extract raw materials
Battery Grade Materials	Brown	Data for facilities that produce battery grade materials
Other Battery Comps Matls	Brown	Data for facilities that produce battery components or other battery materials
Electrodes and Cells	Brown	Data for facilities that manufacture electrodes and cells
ModPack	Blue	Data for facilities that manufacture modules and packs
EOL	Blue	Data for facilities that process batteries at the end of life (EOL)
Equipment	Light Red	Data for companies that develop software or equips or offer equipment services
ServiceRepair	Light Red	Data for companies that offer services such as engineering or testing
RandD	Light Red	Data for Research and development facilities
Modeling	Light Red	Data for companies that develop software or models or offer modeling services
Distributors	Light Red	Data for companies that distribute products in the LIB supply chain
Terms	White	Glossary of important terms

The database also has 1 hidden sheet: Append2 which is a compilation of all segments. This standardizes data output.

Database Summary Table

- First worksheet in the database
- Updates automatically as information is added or deleted
- No user input required or recommended

Supply Chain Segment	U	S	Canada		Other		Total	
	Companies	Facilities	Companies	Facilities	Companies	Facilities	Companies	Facilities
Raw Material Manufacturing	15	18	16	23	3	4	34	45
Battery Grade Component Manufacturing	44	58	10	11	5	5	59	74
Other Battery Components and Materials Manufacturing	33	41	1	1	1	1	35	43
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Search Interfaces – Search and EOL Search Tabs

- Simple Search Interface developed for the Excel version of the DB
 - Search on Full or Partial Company, Product or State/Province Names
 - Search pulls results from all segments <u>except EOL</u>
 - EOL Search pulls results for EOL for Company, Facility Type or State/Province Names
 - Totals number of records retrieved

Directions:	 Select the Search Type (Company, F State) in the yellow box next to Searce Enter the full or partial name of a 	h Type. he											
	selected Search Type in the 2nd yello and hit Enter	w box		No.	of Records:	10							
	Search							Dee	ults				
Select Search (ype dropdown list):	Company	ID	Status*	NAATBatt Member?	Company	Facility Name	Facility City	Facility State or Province	Facility Country	Product or Service Type	Product or Service	Production Capacity	Units
Company	Vale	1048	С	No	Vale Canada Ltd.	Sudbury Basin - Copper Cliff Complex	Copper Cliff	ON	Canada	Cathode raw materials	Co concentrates	1,000	MT contained Co/yr
Note:	If a company is in the EOL sector (e.g. recycling), use the EOL	1049	с	No	Vale Canada Ltd.	Thompson	Thompson	МВ	Canada	Cathode raw materials	Co concentrates	800	MT contained Co/yr
	Search sheet instead	1050	с	No	Vale Canada Ltd.		Happy Valley - Goose Bay	NL	Canada	Cathode raw materials	Co concentrates	2,000	MT contained Co/yr
	*Status	1051	с	No	Vale Canada Ltd.	Sudbury Basin - Copper Cliff Complex	Copper Cliff	ON	Canada	Cathode raw materials	Ni concentrates	66,000	MT contained Ni/yr
	C - Commercial	1052	с	No	Vale Canada Ltd.	Thompson	Thompson	MB	Canada	Cathode raw materials	Ni concentrates	14,800	MT contained Ni/yr
	P - Planned	1053	с	No	Vale Canada Ltd.		Happy Valley - Goose Bay	NL	Canada	Cathode raw materials	Ni concentrates	80,000	MT contained Ni/yr
	PC-SU - Pre-commercial/startup	2083	с	No	Vale Canada Ltd.	Copper Cliff Nickel Refinery (Sudbury)	Sudbury	ON	Canada	Cathode Battery Grade (BG) Materials	Ni pellets, powder or rounds	66,000	MT contained Ni/yr
	UC - Under construction	2084	с	No	Vale Canada Ltd.	Copper Cliff Nickel Refinery (Sudbury)	Sudbury	ON	Canada	Cathode Battery Grade (BG) Materials	Co pellets, powder or rounds	1,400	MT contained Co/yr
		2085	с	No	Vale Canada Ltd.	Long Harbour Processing Plant	Long Harbour	NL	Canada	Cathode Battery Grade (BG) Materials	Ni pellets, powder or rounds	50,000	MT contained Ni/yr
		2086	с	No	Vale Canada Ltd.	Long Harbour Processing Plant	Long Harbour	NL	Canada	Cathode Battery Grade (BG) Materials	Co pellets, powder or rounds	1,700	MT contained Co/yr

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Search Interface Results

- Enter full or partial name in Yellow Box
- Press Enter
- To search again, add another name or partial name
- To clear results, delete name in search box

ID Indicates Worksheet:	6000's – EOL
1000's – Raw Material	7000's – Equipment
2000's – Battery Grade Materials	8000's – Service and Repair
3000's – Other Materials	9000's - R&D
4000's – Electrodes and Cells	10000's- Modeling
5000's – ModPack	11000's - Distributors

irections:	 Select the Search Type (Company, I State) in the yellow box next to Searce Enter the full or partial name of a 	h Type.											
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elect Search ype dropdown list):	Company	ю	Status*	NAATBatt Member?	Company	Facility Name	Facility City	Facility State or Province	Facility Country	Product or Service Type	Product or Service	Production Capacity	Units
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		2085	с	No	Vale Canada Ltd.	Long Harbour Processing Plant	Long Harbour	NL	Canada	Cathode Battery Grade (BG) Materials	Ni pellets, powder or rounds	50,000	MT contained Ni/yr
		2086	с	No	Vale Canada Ltd.	Long Harbour Processing Plant	Long Harbour	NL	Canada	Cathode Battery Grade (BG) Materials	Co pellets, powder or rounds	1,700	MT contained Co/yr

Maps Overview

- 11 maps developed
 - 1 for each supply chain segment
- Built-in capability of Excel
- Each map shows all facilities for that segment
 - Markers are colored by product or product type
 - Details for each site available with roll-over option



Maps Instructions

- Maps can be viewed from any worksheet
 - 1. Go to Insert menu
 - 2. Click on 3D Map
 - 3. Click on Open 3D Maps
 - 4. Launch 3D Maps and a list of available Tours will be shown
 - Select Tour 1

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Maps Instructions cont.



Maps Instructions cont.



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Database Documentation

Supply Chain Segments in the Database

FCAB National Blueprint for Batteries 2021-2030



- Manufacturing Supply Chain
 - Raw Materials
 - Battery Grade Materials
 - Other Battery Components and Materials
 - Electrode and Cell Manufacturing
 - Module/Pack Manufacturing
- EOL Supply Chain
- Other Segment Supply Chains
 - Equipment
 - Service
 - R&D
 - Modeling and Software
 - Distributors

Manufacturing Supply Chain Representation in the Database

- Worksheet tabs and sheets colored by Supply Chain Segment
 - Upstream, Midstream, Downstream
- Raw Matl Raw Material Extraction and Initial Processing
- Battery Grade Materials Refining into Battery Grade Materials
- Other Battery Comps Matls Other Cell Components and Materials
- Electrodes and Cells Electrode and Cell Production
- ModPack Module, Pack and their Components Manufacturing
- EOL End of life processing (e.g., recycling)

Battery Grade Materials

RawMatl

• More complex and covered in its own detailed supply chain

Other Battery Comps Matls

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ModPack

Electrodes and Cells

EOL

Database Metadata*

Database Column	Data Description	Database Column	Data Description
	Commercial, Planned, Under construction,		
Status	Pre-commercial/Startup	Latitude	
Supply Chain Segment	Upstream, Midstream, Downstream, Other	Longitude	
Company		Facility Workforce	Number of employees
NAATBatt Member	Yes/No	Production Capacity	Annual capacity or production
Facility Name		Annual Production Units	Standardized for each segment
Product Type	Drop-down menu depending on segment	HQ Company	
Product	Drop down menu depending on product	HQ Website	
Facility Website		HQ City	
Facility Address		HQ State or Province	
Facility City		HQ Country	
Facility State		QC	Initials of individual who checked data
Facility Country		QC Date	Date of QC
Facility Zip		Sources	Free form - Sources used for entry
Facility Phone		Notes	Free form - Supplementary info

*EOL has slightly different metadata

Status Abbreviations:

C – Commercial

P – Planned

UC – Under Construction

PC-SU – Pre-commercial/start-up

Manufacturing Supply Chain (not EOL) Classification

- Facility meta-data tag
 - Modeled on Segment
 Spreadsheet Groups
- Product Type Drop Down
 - Class of products from each step in supply chain
- Product Drop Down
 - Depends upon selection in Product Type

Company	NAATBatt Member	- Facility Name	Product Type	Product
Vale Canada Ltd.	No	Sudbury Basin	Cathode raw materials	Co concentrates
Vale Canada Ltd.	Νο	Thompson	Cathode raw materials	Co concentrates
Vule culture Etal	110	mompson	cutioue ruw materials	co concentrates
Vale Canada Ltd.	No	Voisey Bay	Cathode raw materials	Co concentrates
Moa JV	No	Moa Bay mine	Cathode raw materials	Co concentrates
Moa JV	No	Moa Bay mine	Cathode raw materials	NI concentrates
Glencore	Yes	Raglan Mine	athode raw materials	Ni concentrates

EOL Supply Chain Classification

- Facility meta-data tag
 - Modeled on Segment
 Spreadsheet Groups
- Facility Type Drop Down
 - Boxes from supply chain diagram
- Feedstock and Product Drop Downs
 - Specific materials listed
- Feedstock Chemistry, if available



Raw Materials

RawMatl Spreadsheet ٠

Vale Canada Ltd Sudbury Basin

Monde Graphite (Planned)

Company

Glencore

Albemarle

Nouveau

Mining and extraction of cathode a ٠ materials and initial processing (e.g concentrating) of those materials

Facililty

Raglan Mine

Advanced

Silver Peak Phase I

Materials Plant

Other component raw materials are ٠

RAW

QC

		N	RAW MAT	ERIALS SUPPLY CHAIN
			Product Type	Product
			Anode raw	Brine
	<u> </u>	•••• <i>/</i>	materials (crude)	Li carbonate - crude
ode and anode	Raw Mat	terials Production		Graphite ore/ concentrates
g (e.g.,	UPSTR	EAM		Spodumene
rials	D Mining	g and extraction of		Other
		ials including lithium,		
als are not included	cobalt	t, nickel, and graphite		
			Cathode raw	Brine
AW MATERIALS			materials (crude)	Co concentrates
Location Prod	luct Type	Product		Co ore
Copper Cliff, Cathod	<i>,</i> .		·	Li carbonate - crude
ON materia		Co concentrates		Li clay
Rouyn- Cathode				Li concentrates/salts
,		Ni concentrates		Mn concentrates
, .				Mn ore
Silver Peak, Cathod		Li concentrates/		Ni concentrates
NV materia	ls	salts		Ni ore
				Spodumene
Becancour, Anode	aw	Graphite ore/		Other
QC materia	ls	concentrate		

Battery Grade Materials

- Processing to:
 - Anode Active Materials
 - Anode Battery Grade (BG) materials,
 - Cathode Active Materials (CAM)
 - Cathode Battery Grade (BG) Materials
 - precursor Cathode Active Materials (pCAM)
- Everything from concentrated raw materials to finished electrodes or cells





MIDSTREAM

 Additional processing for battery-grade materials

Cathode/anode powder production

Battery Grade Materials - Groupings

BATTEI	RY GRADE MATERIALS
Product Type	Product
Cathode Battery Grade	Co oxide
(BG) Materials	Co pellets, powder or rounds
	Co sulfate
	Li carbonate - BG
	Li hydroxide - BG
	Mn sulfate
	Ni pellets, powder or rounds
	Ni sulfate
	Other
precursor Cathode Active	LCO unlithiated hydroxide
Material (pCAM)	LFP unlithiated hydroxide
	LMO unlitiated hydroxide
	NCA unlithiated hydroxide
	NMC unlithiated hydroxide
	NMCA unlithiated hydroxide
	Other/ Unknown pCAM

BATTER	RY GRADE MATERIALS
Product Type	Product
Anode Active Material	Li metal
	Natural graphite
	Silicon composites
	Synthetic graphite
	Other
Anode Battery Grade (BG)	Li metal - Battery grade (BG)
Materials	Natural graphite - Battery grade (BG)
	Silicon
	Spherical graphite
	Synthetic graphite - Battery grade (BG)
	Other
Cathode Active Material	LCO
(CAM)	LFP
	LMO
	NCA
	NMC
	NMCA
	Other/ Unknown



Materials Processing

MIDSTREAM

 Additional processing for battery-grade materials

Cathode/anode powder production

BATTERY GRADE MATERIALSCompanyFacililtyLocationProduct TypeProductToda AdvancedToda AmericaCathode ActiveProductMaterialsBattle Sarnia PlantSarnia, ONMaterial (CAM)NMCPyrotek SanbornAnode BatteryGrade (BG)Synthetic

Battery Grade Materials - Examples

	Pyrotek Sanborn		Anode Battery	
	Battery		Grade (BG)	Synthetic
Pyrotek	Component Plant	Sanborn, NY	Materials	graphite
	Boleo	Santa	Cathode Battery	
Boleo Copper	Copper/Cobalt	Rosalia, Baja	Grade (BG)	
Project	Mine	California Sur	Materials	Co oxide
			Cathode Battery	Ni pellets,
			Grade (BG)	powder or
Sherritt Int'l	Fort Saskatchewan	FS, AB	Materials	rounds



Electrolyte production

Other Cell Components and Materials Manufacturing

- Other Battery Comps Matls Spreadsheet
- Cell components and materials except anode active material, cathode active material (CAM)

OTHER BATTERY COMPONENTS AND MATERIALS						
Company	any Facility Location Product Type Product					
	Daikin Decatur					
	Battery Material					
Daikin America	Plant	Decatur, AL	Electrode materials	Additives		
				Liquid		
Soulbrain MI	Northville Plant	Norville, MI	Electrolyte (liquid)	electrolyte		
Huntsman						
Petrochemical						
LLC	Conroe Plant	Conroe, TX	Electrolyte (liquid)	Solvents		
	Entek Separator					
Entek	Plant	Entek, OR	Separators	Separators		

	ONENTS AND MATERIALS
Product Type	Product
Cell components	Tabs
	Tapes
	Other
Current collectors	Aluminum
	Copper
	Other
Electrode materials	Additives
	Adhesives
	Binders
	Other
Electrolyte (liquid)	Additives
	Li salts
	Liquid electrolyte
	Polymers
	Solvents
	Other
Electrolyte (solid)	Ceramic
	Oxides
	Polymers
	Sulfides
	Other
Separators	Separators

Electrode and Cell Manufacturing

- Electrodes and Cells Spreadsheet
- Cell Production
 - Based on cathode chemistry
 - Anodes are generally not specified except LTO or silicon

	ECTRODE AND CELL SUPPLY CHAIN	
Product Type	Chemistry/Electrode	Notes
Coated electrode rolls	Anode	
Cylindrical cells Cylindrical cells Prismatic (metal can) cells Prismatic (pouch) cells	Cathode Cathode Control Contro	Can be paired with any of thes anodes: Li metal LTO Natural graphite Silicon composite Synthetic graphite Other; LTO chemistries can be paired with any of the cathodes Anode type, if known, is specified in notes

ELECTRODE AND CELL MANUFACTURING							
Company Facililty Location Product Type Prod							
Tesla	Tesla Gigafactory	Sparks, NV	Cylindrical cells	NCA			
	LG Chem Michigan		Prismatic (pouch)				
LG Chem	Plant	Holland, MI	cells	NMC			
	Ener1 Battery						
Manufacturing		Indianapolis,	Prismatic (metal				
EnerDel	Plant	IN	can) cells	NMC			

Cell Manufac

 Electrode and cell manufact

Module/Pack Supply Chain

- Mod/Pack Spreadsheet
 - Manufacturing of Modules, Packs and their non-cell components
 - Product details in Notes



MODULE/PACK SUPPLY CHAIN			
Product Type	Product		
Cell Assemblies/ Groupings	Modules/ Arrays		
	Pack		
	Rack/ Cabinets		
Non-cell Components	BMS		
	Control Systems		
	Electrical Systems		
	Packaging Systems		
	Safety Systems		
	Thermal Systems		
	Other		

	MODULES, PACKS AND THEIR COMPONENTS					
Company Facililty Location Product Type Pro						
Storage Battery		Fort Wayne,	Non-cell			
Systems LLC	Fort Wayne	IN	Components	Thermal systems		
Saft America,			Non-cell	Electrical		
Inc	Valdosta	Valdosta, GA	Components	systems		
Xalt Energy MI	Xalt Energy Battery		Cell Assemblies/			
LLC	Park	Midland, MI	Groupings	Packs		



DOWNSTREAM

Pack manufacturing

End-of-life recycling and reuse

EOL Facility Types and Feedstocks/Products

- Facilities are represented by:
 - Facility Type
 - Chemistry
 - Feedstock
 - Product

EOL FACILITIES

4R's - Repair, Remanufacture, Refurbish and/or

Repurpose

Battery material refining

Battery recycling - hydro/ pyro/ direct

Collection and Logistics

Collection, Disassembling and/or Storage

(Universal Waste Handlers)

Shredding and screening (Physical processing)

Other

EOL Feedstock/Product

Battery grade lithium carbonate Battery grade lithium hydroxide Battery grade lithium intermediates Battery grade metal sulfates Black Mass Cathode Precursor Rejected cells and/or components **Consumer Electronics** EOL Battery EV/HEV/PHEV Mixed metal intermediates - alloy/ salts/ sulfates/ mattes Other Crude Products Second Life Battery Sorted EOL Battery Other



End-of-Life Recycling and Reuse

DOWNSTREAM

Pack manufacturing

End-of-life recycling and reuse

Example EOL Supply Chain Classifications

f-life recycling and reuse	END OF LIFE (EOL)				
	Facility	Location	Facility Type	Feedstock	Product
					Battery grade metal
	Battery Resourcers	Worcester, MA	Battery recycling - hydro/ pyro/ direct	Rejected cells and/or components	sulfates
			Collection, Sorting, Storage and/or		
	Battery Solutions	Mesa, AZ	Discharging (Universal Waste Handlers)	EOL Battery	Sorted Battery
					Mixed metal
					intermediates - alloy/
	Clean Earth Inc.	Melbourne, FL	Battery recycling - hydro/ pyro/ direct	EOL Battery	salts/ sulfates/ mattes
					Mixed metal
					intermediates - alloy/
	INMETCO	Elwood City, PA	Battery recycling - hydro/ pyro/ direct	EOL Battery	salts/ sulfates/ mattes
	Li-Cycle Commercial		Shredding and screening (Physical		
	Spoke 1	Kingston, ON	processing)	EOL Battery	Black mass
Detrieu					
Retriev	Li-Cycle Commercial Hub				Battery grade metal
has	1 (under construction)	Rochester, NY	Battery recycling - hydro/ pyro/ direct	Black mass	sulfates
several	Retriev Technologies,		Shredding and screening (Physical		
types of	Inc.	Lancaster, OH	processing)	EOL Battery	Black mass
facilities	Retriev Technologies,				
Tacilities	Inc.	Trail, BC	Battery recycling - hydro/ pyro/ direct	EOL Battery	Cathode Precursor
1	Retriev Technologies,				
	Inc.	Trail, BC		Rejected cells and/or components	Cathode Precursor
\			Collection, Sorting, Storage and/or		
•	Retriev Technologies,		Rendering Safe (Universal Waste		
	Inc.	Baltimore, OH	Handlers)	EOL Battery	Sorted Battery
Spiers offers			4R's - Repair, Remanufacture,		
both 4R's and	Spiers New Technologies	Oklahoma City, OK	Refurbish and/or Repurpose	EOL Battery	Second Life Battery
Pre-			Shredding and screening (Physical		
processing	Spiers New Technologies	Oklahoma City, OK	processing)	EOL Battery	Black mass
P1000000118	*UW Handling - Universal Waste H	andling, which is a common facili	ty type encompassing Collection, Logistics, Storage, So	rting and/or Discharging	

Equipment Supply Chain

- Equipment Spreadsheet
- Companies that <u>manufacture</u> equipment for the LIB supply chain
- Manufacturing, Testing and Service Equipment

EQUIPMENT					
Company	Location	Product Type	Product		
Arbin Instruments	College Station, TX	Testing Equipment	Cell tester		
Midtronics	Willowbrook, IL	Service Equipment	Module Balancing		
Digatron Power		Manufacturing	Vacuum Pumps and		
Electronics	Shelton, CT	Equipment	Systems		
Digatron Power		Manufacturing			
Electronics	Shelton, CT	Equipment	Winder		

EQUIPMEN	T SUPPLY CHAIN
Product Type	Product
Manufacturing Equipment	Calendering
	Coaters
	Electrolyte Fill
	Formation / Aging
	Laser cutters
	Mixers
	Ovens / vacuum drying
	Pneumatic / punch press
	Process Controls
	Slitters
	Stacking / Folding
	Vacuum pumps and systems
	Welders
	Winders
	Other
Testing Equipment	Cell testing
	EV/HEV/PHEV Battery Testers
	Mod/Pack Tester
	Other
Service Equipment	EV/HEV/PHEV battery Service
	Module Balancing
	Rescue Charging
	Other

	SERVICES SUPPLY CHAIN	
Services Supply Chain	Product Type	Product
	Battery Maintenance	
Services Worksheet	Consulting	
	Engineering	
 Companies that provide services to other companies in 	Equipment Service and Repair	
the supply chain – e.g.,	Logistics	Free form
	Packaging	
Testing and Certification	Process Development	entries
Utilities	Testing and/or Certification	
• Classified into broad service types with free form entries	Toll Manufacturing	
for specific services	Utilities	
for specific services	Other	
	Services listed as "Product" a	nd "Product Type"
SERVICES	for consistency in database	

SERVICES			
Company	Location	Product Type	Product
		Testing and/or	
NSL Analytical Services	Cleveland, OH	Certification	Battery Materials Testing
Polaris Battery Labs	Beaverton, OH	Toll manufacturing	Toll manufacturing of electrodes and cells
Wood Mackenzie Power			
and Renewables	Calgary, AB	Consulting	Market analysis, strategic consulting
			Cell, pack, module, ESS,e-mobility and other
		Testing and/or	battery-powered products testing and
CSA Group	Toronto, ON	Certification	certification for North America standards

Research and Development Supply Chain

- R&D Spreadsheet
- Classified by broad R&D Area
- Free form details for each entry

RESEARCH & DEVELOPMENT			
Product Type	Product		
Battery Development			
Manufacturing/ Process			
Development			
Materials	Free form entries		
Recycling	Free form entries		
Safety			
Other			

R&D listed as "Product" and "Product Type" for consistency in database

R&D			
Company	Location	R&D Area	R&D Description
		Manufacturing/ Process	
A123 Systems	Waltham, MA	Development	Cell chemistry and manufacturing
	East Greenwich,		
EaglePicher Technologies	RI	Battery Development	Medical devices
Jet Propulsion Lab (JPL)	Pasadena, CA	Battery Development	Space-rated Li-ion batteries
NEI Corporation	Somerset, NJ	Materials	Electrode and electrolyte materials

Modeling and Software Supply Chain

- Modeling Spreadsheet
- Modeling (Simulation) or
 Other Software (Design) Tools
- Free form details on the tools

MODELING AND SOFTWARE SUPPLY CHAIN			
Product Type	Product		
Hardware			
Hardware and Software System			
Modeling Services	Free form entries		
Software			
Software and Service			

MODELING AND SOFTWARE			
Company	Location	Product Type	Product
Battery Design LLC	Pleasanton, CA	Software	Battery Design Studio
Bloomy	Windsor, CT	Modeling	Battery Simulator 12000
NREL	Golden, CO	Software	САЕВАТ
			Battery and Electrochemistry Simulation Tool
Fraunhover	Plymouth, Ml	Modeling	(BEST)

Distributors Supply Chain

- Distributor Spreadsheet
- Classified by Supply Chain Area

DISTRIBUTORS SUPPLY CHAIN		
Product Type	Product	
Raw Materials		
Electrodes and Precursors		
Cells	Free form entries	
Modules and Packs	Free form entries	
Equipment		
Other		

		DISTRIBUTORS	
Company	Location	Product Type	Product
Targray Technology			
International	Kirkland, QC	Battery Components	Liquid electrolyte
Targray Technology			
International	Kirkland, QC	Battery Components	Tabs
Targray Technology			
International	Kirkland, QC	Electrode and Precursors	Cathode Powder
Targray Technology			
International	Kirkland, QC	Cells	NMC