NYSERDA Presents:

Battery Energy Storage Systems –
Key Considerations for Local Governments

Webinar #4:
Decommissioning & End-of-Life Considerations

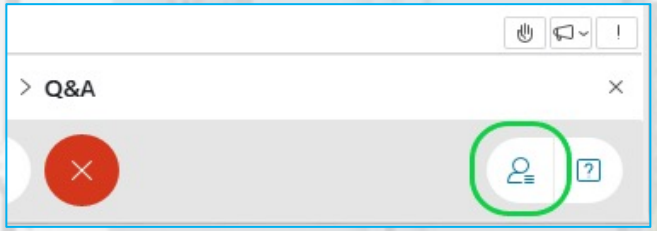
NEW YORK STATE OF OPPORTUNITY. | NYSERDA

June 16, 2021

Meeting Procedures:

- Members of the public are muted upon entry
- Questions and comments may be submitted in writing through the Q&A feature at any time during the event
- The chat feature is disabled
- Today's materials, along with a recording of the webinar, will be posted to www.nyserda.ny.gov/StorageGuidebook
- If technical problems arise, please contact Sal.Graven@nyserda.ny.gov

You'll see  when your microphone is muted



Remaining Webinar:

Wednesday, June 30th: Taxation and Assessments
Featured Speakers: Hodgson Russ LLP

Recordings + materials for previous webinars are available at: www.nyserda.ny.gov/StorageGuidebook, under "Trainings for Local Governments"

Agenda:

- Recap: Energy Storage in NYS
- Brief Intro to BESS Decommissioning
- DNV: Decommissioning Energy Storage Systems
- Li-Cycle: Lithium-Ion Battery Recycling
- Q&A

Guest Speakers:

- **Daniel Pardo**
  Senior Project Manager, DNV
- **Kunal Phalpher**
  Chief Commercial Officer, Li-Cycle

Recap: Energy Storage in NYS

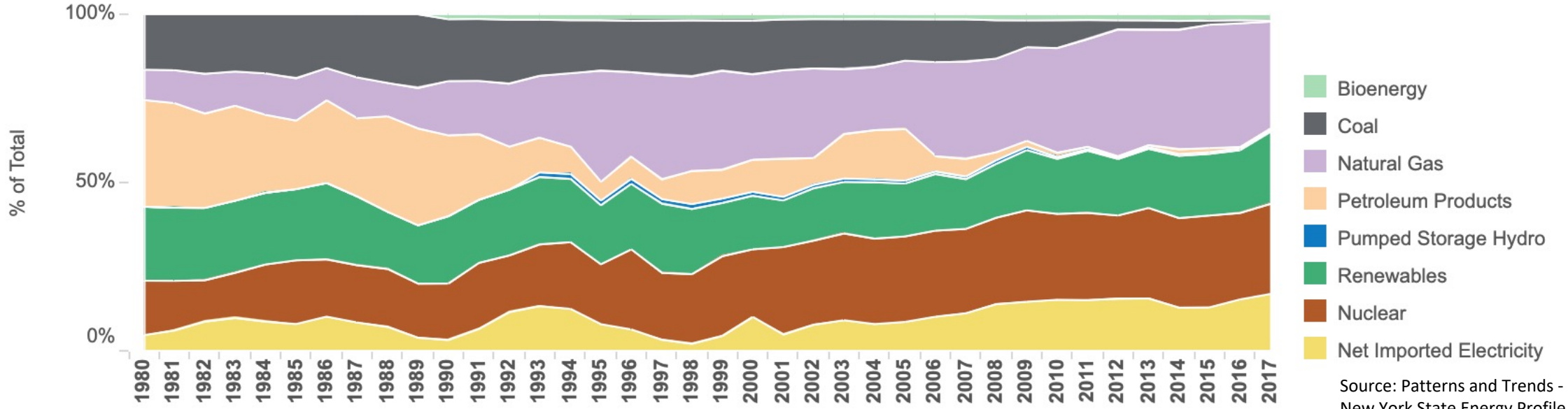
The Climate Leadership and Community Protection Act (Climate Act)

Electricity Sector Goals:

- 70% Renewable Electricity by 2030
- 100% Emissions-Free Grid by 2040

Technology-Specific Goals:

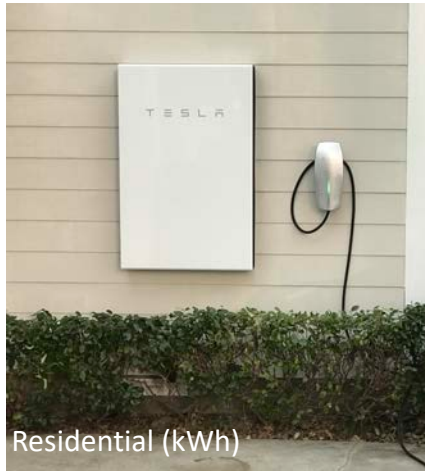
- 6,000 MW Distributed Solar by 2025
- 9,000 MW Offshore Wind by 2035
- **1,500 MW Energy Storage by 2025; 3,000 MW by 2030**



Source: Patterns and Trends - New York State Energy Profile (NYSERDA)

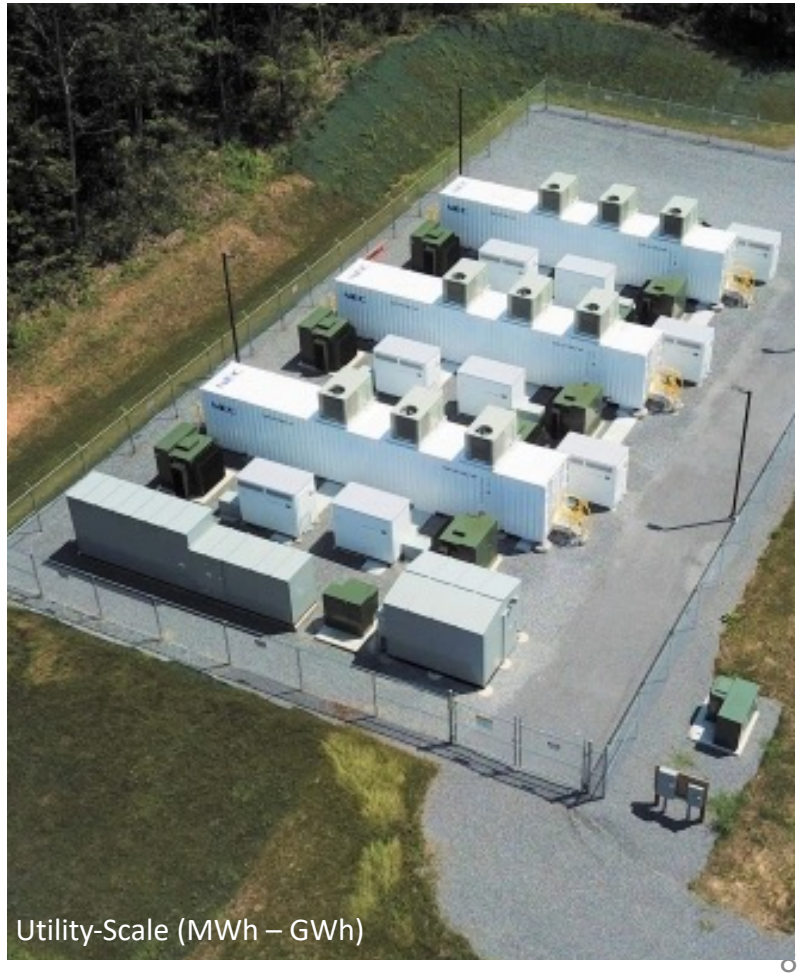
Energy Storage Systems (ESS) 101

- ESS store energy for conversion to electrical energy
- Batteries are the most common and flexible ESS
- Lithium-ion batteries are the prevailing chemistries for ESS
- ESS components include:
  - Cells → Modules → Racks
  - Battery Management System (BMS)
  - Monitoring, Safety, and Balance of System Equipment



Residential (kWh)

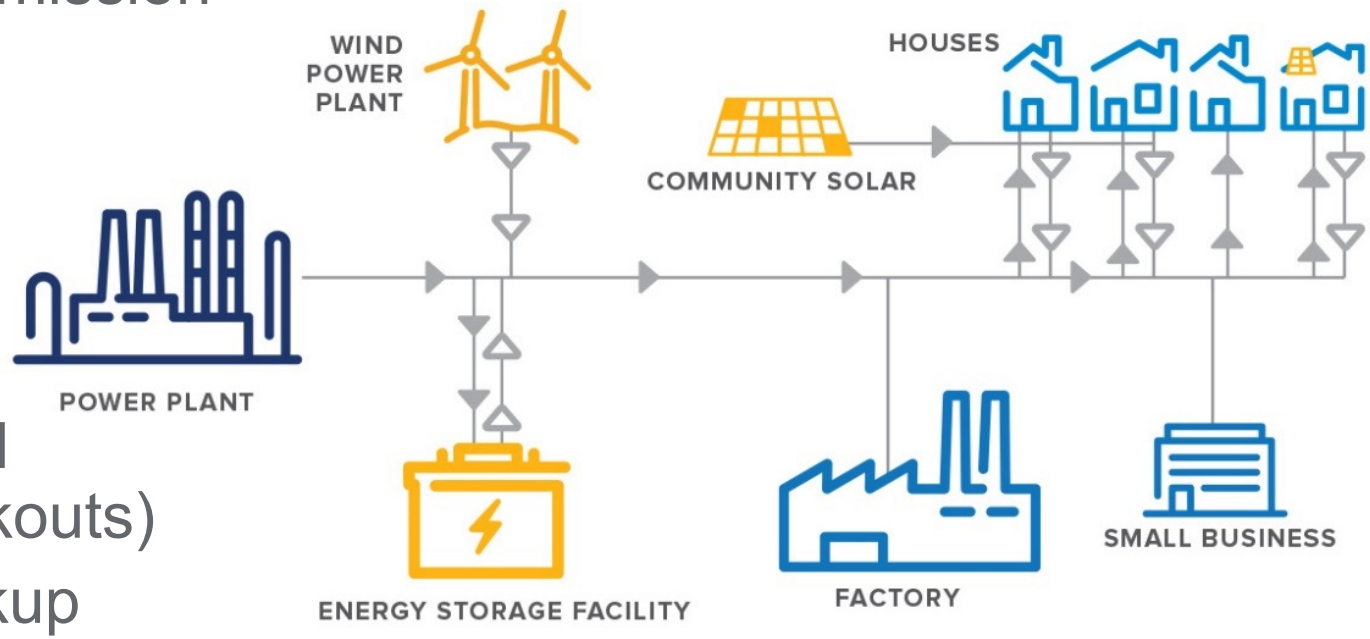
Commercial (kWh - MWh)


Utility-Scale (MWh – GWh)

Use Cases for Energy Storage

Battery Energy Storage Systems can serve a variety of important roles, including these more common uses:

- Defer costly upgrades to transmission and distribution infrastructure
- Provide key grid services
- Support integration of renewable energy generators, including solar and wind
- Alleviate congestion in the grid (reducing brownouts and blackouts)
- Electric bill management, backup power for homes and businesses



NYSERDA Energy Storage Initiative

Provides incentives & technical assistance to support deployment of advanced energy storage technologies

- **Retail Energy Storage Incentives:**
  - For residential through commercial-scale storage projects < 5 megawatts (MW)
  - Incentives vary based on region and megawatt-hour (MWh) block allocation
  - Over $161 million allocated; $16.4 million remaining for residential, commercial projects on Long Island and Con Edison

- **Bulk Energy Storage Incentives:**
  - For storage projects > 5 MW
  - Incentives vary based on project size and year of interconnection
  - Funding is fully allocated

www.nyserda.ny.gov/EnergyStorage

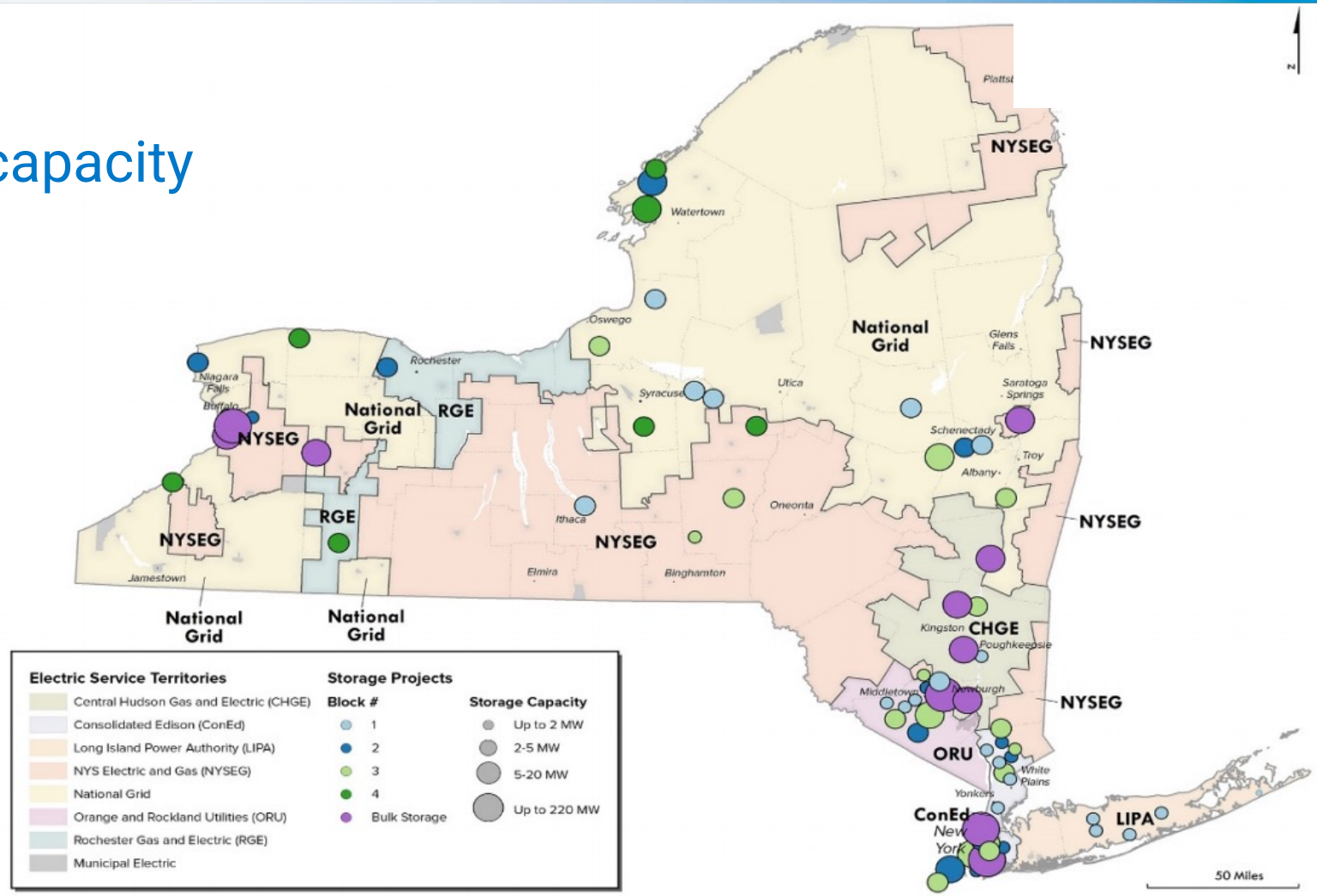
Energy Storage Deployment in NYS

As of April 20, 2021:

- 115.5 MW of installed capacity
- Over 1,100 projects

As of April 30, 2021:

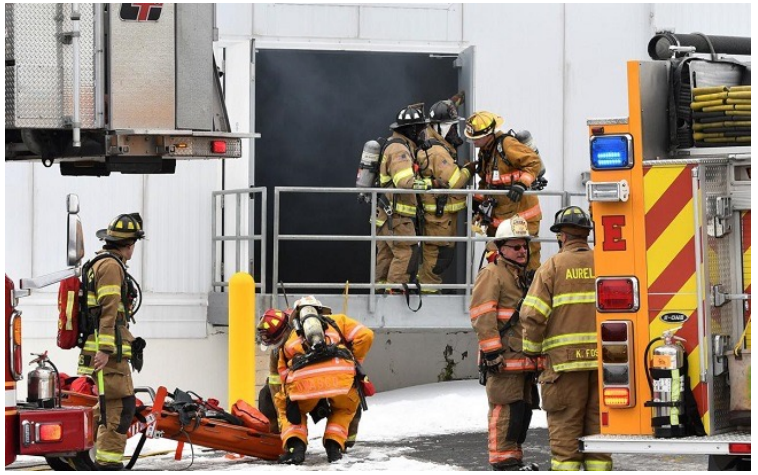
- 1,027 MW contracted, under development
- Over 100 commercial and bulk projects



Fire Safety

Key Takeaways:

- **Codes and Standards:** Requirements have evolved with the technology; significant protections are in place under the 2020 NYS Uniform Code.
- **Fire Testing:** Certain systems are required to complete large-scale fire testing to ensure installation safety.
- **Trainings:** NYS Office of Fire Prevention and Control, NYSERDA, and subject matter experts (SMEs) are partnering to ensure training and information reaches critical audiences.



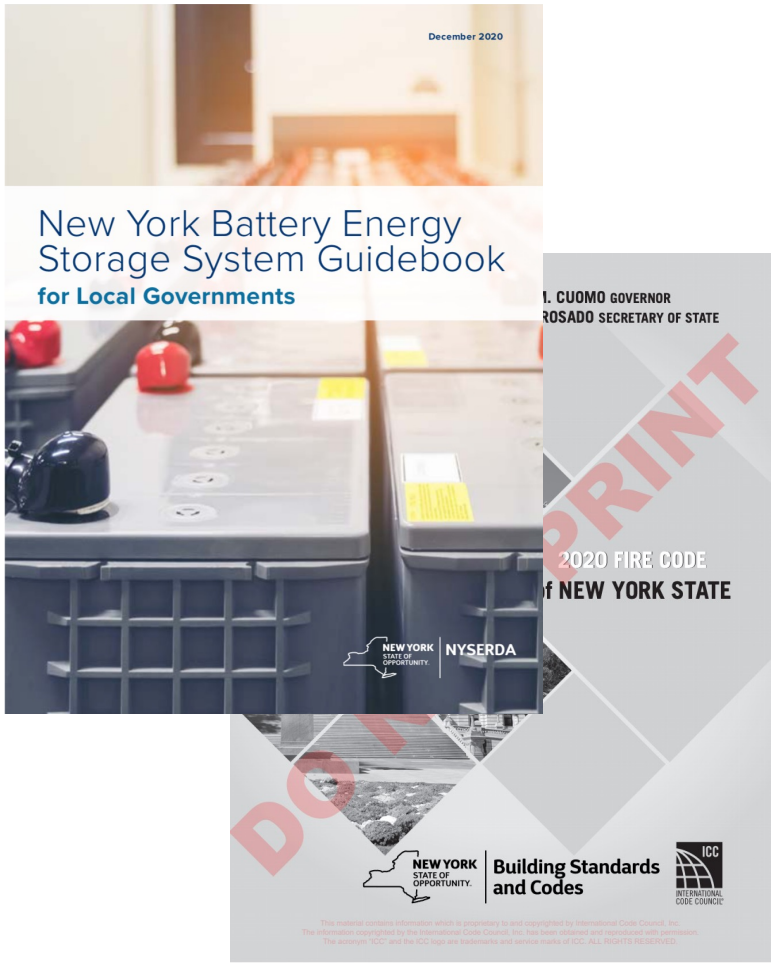
Permitting & Zoning

Key Takeaways:

- Regulatory Framework for Permitting BESS:
  - **BESS co-located with large-scale generators**: Permitted by Office of Renewable Energy Siting
  - **All other projects, regardless of size**: permitted at the local level under SEQR, other local requirements

- NYSERDA Energy Storage Guidebook for Local Governments:
  - Model Permit + Inspection Checklist
  - Model Zoning Law

- 2020 NYS Uniform Codes:
  - NYS Residential Code
  - NYS Fire Code



Introduction to BESS Decommissioning

Introduction to BESS Decommissioning

Defining Decommissioning:

- Shutting down/removing system from service
- Disassembling, removing, and transporting system components
- Disposal, reuse, and/or recycling of components
- Site restoration and remediation

Key Questions to be Answered:

- Under what circumstances is the system being decommissioned?
- Who is responsible for system removal/costs?
- How do you ensure safety during decommissioning?
- Decommissioning a damaged vs. undamaged system?

Introduction to BESS Decommissioning

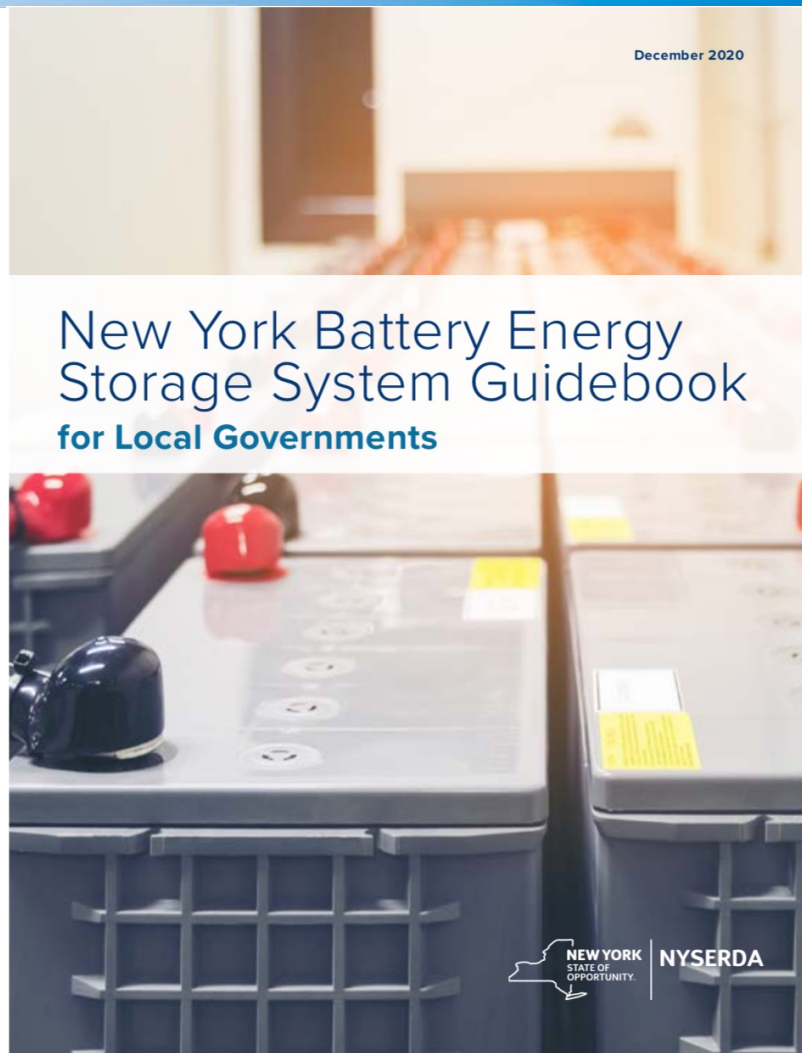
Decommissioning in the NYS Uniform Fire Prevention and Building Code:

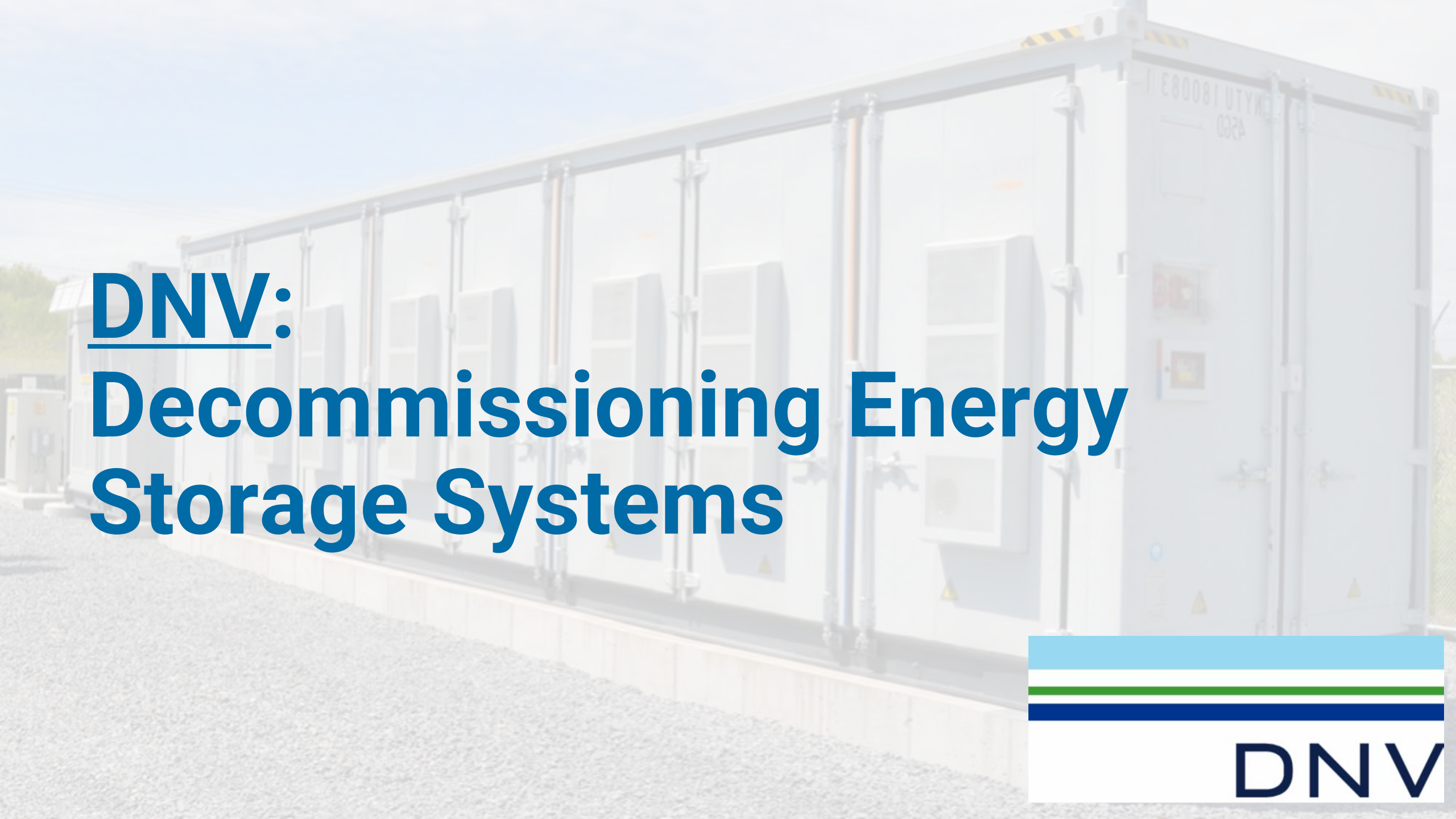
- **Definition: ESS Decommissioning**
  Reflects the staged nature of decommissioning: de-energizing, disassembling, prepping, and removal/disposal.
- **Section 1206.4: Construction Documents**
  Requires a decommissioning plan to be provided alongside the permit application up front.
- **Section 1206.9.3: Decommissioning**
  Outlines requirements for the above-referenced plan; requires a narrative description of decommissioning activities + listing of protocol for removing damaged systems.

Introduction to BESS Decommissioning

Decommissioning in the NYSERDA Model Law:

- **Section 7.G.(1): Decommissioning Plan**
  Outlines substantive requirements for decommissioning plan to be submitted with application.
- **Section 7.G.(2): Decommissioning Fund**
  Details requirements for ensuring the availability of funds to cover decommissioning costs.
- **Section 7.J: Ownership Changes**
  Ensures continuity in decommissioning timelines/activities in the event of a change in project ownership.
- **Section 9: Permit Timeframe and Abandonment**
  Details circumstances which may constitute project abandonment + trigger decommissioning.





DNV: Decommissioning Energy Storage Systems

Decommissioning Energy Storage Systems

Why require a decommissioning plan/cost estimate?

DNV considers decommissioning cost estimates to be an **industry best practice**. A cost estimate should describe how the BESS owner proposes to **dismantle the infrastructure and restore the site to a safe condition** that is suitable for future land use.

Key considerations of a decommissioning plan/cost estimate:

1. Project size (MW) and footprint
2. Enclosure/facility type (containerized, modular/blocks, indoors)
3. Weight of components (including battery banks, inverter skids, racking, etc.)
4. Recycling or disposal alternatives
5. Decommissioning requirements contained in permits and/or regulations

Key Considerations of a Decommissioning Plan

Project Size and Footprint:

- 53 ft. container measures ~L 53’ x W 9’ x H 10’
- Container in top image holds a 10 MW BESS

- A 182.5 MW/730 MWh project (lower left: Moss Landing Energy Storage Facility in CA) might have ~150 containers
- The impact on land can vary significantly.

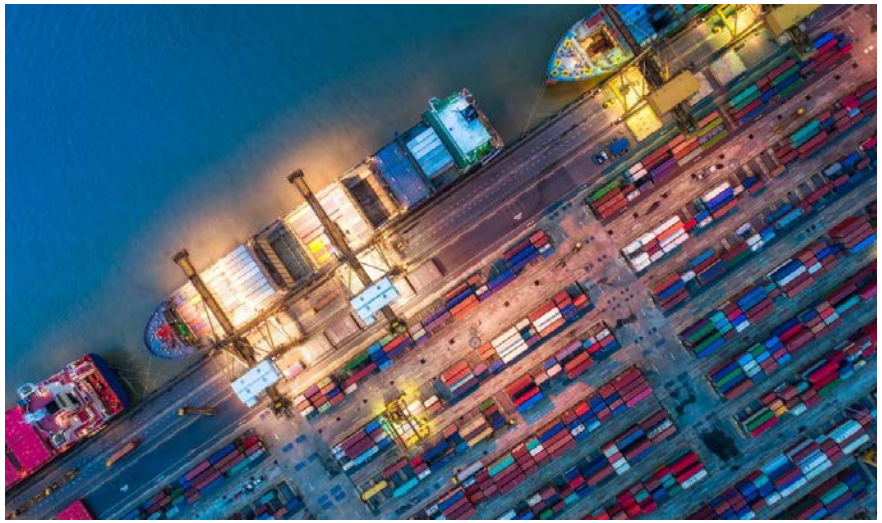
Key Considerations of a Decommissioning Plan

Enclosure/Facility Type:

- Modular/block technology is recent. Most important improvements are related to safety, installation time, O&M efficiency, transportation, etc.
- Indoor vs. outdoor installations
  - Indoor racked BESS require a building. How will the building be used after system decommissioning? Will it remain?

Key Considerations of a Decommissioning Plan

Weight of Components:



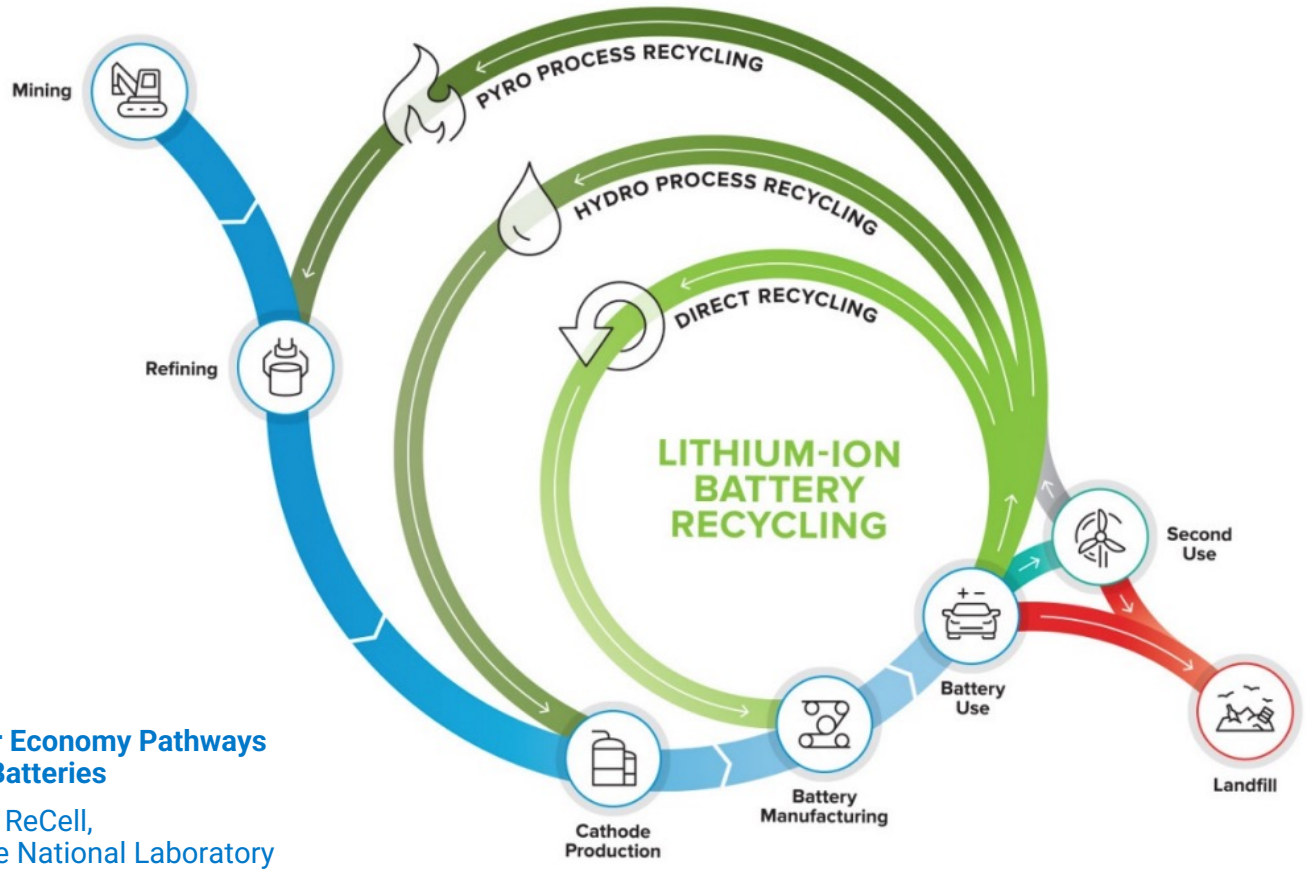
Batteries are heavy!

Transportation of BESS can require large trucks and cranes, if containerized. Other solutions may require smaller equipment. It's important to understand the equipment assumptions and their cost impact.

Material salvage helps to offset some of the decommissioning cost. Steel, aluminum, and copper content are usually important in a decommissioning study.

Key Considerations of a Decommissioning Plan

Recycling or Disposal Alternatives:



Circular Economy Pathways for EV Batteries

Source: ReCell, Argonne National Laboratory

DNV Decommissioning Study Approach:

Scenario 1: System owner bears the cost of recycling;
Li-ion cost $4,000 to $5,000/ton

Scenario 2: OEM takes the cells at no cost

Key Considerations of a Decommissioning Plan

Decommissioning Requirements in Permits/Regulations:

Local zoning regulations, landowner agreements, and other applicable regulations can address key land use considerations:

- Can the foundations be left? If not, to what depth should they be removed
- Can any buildings remain? (e.g. in agreement with landowner)
- Can the underground collection system be abandoned? (definition of depth)
- Removal of all above-ground facilities and equipment
- Frequency of the decommissioning study update

Key Considerations of a Decommissioning Plan

Resources:

- **Electric Power Research Institute (EPRI):**
  - Recycling and Disposal of Battery-Based Grid Energy Storage Systems (Dec. 2017)
- **Energy Storage Association (ESA):**
  - Energy Storage Corporate Responsibility Initiative: Emergency Response Plan (Sept. 2019)
  - End-of-Life Management of Lithium-Ion Energy Storage Systems (Apr. 2020)
  - Guidelines for End-of-Life and Recycling of Lithium-Ion Battery Energy Storage Systems (Aug. 2020)

Li-Cycle:
Lithium-Ion Battery Recycling

Li-Cycle®

Lithium-ion Battery Recycling

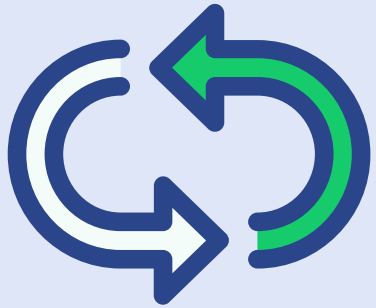
June 16th, 2021

Presented at: NYSERDA Webinar

VISION & MISSION

VISION

To be the most sustainable, vertically integrated, and globally preeminent lithium-ion battery resource recovery company



MISSION

Providing sustainable and safe customer-centric solutions and technology to solve the global end-of-lifecycle lithium-ion battery problems/opportunities

Meeting the rapidly growing demand for critical battery materials

KEY MILESTONES

Milestones reached

2020

Commercial Spoke 1: Kingston, ON (5,000* t/yr)

In May, Li-Cycle's commercial Spoke 1 was commissioned with a capacity to process 5,000 tonnes of lithium-ion batteries per year

2020

Commercial Spoke 2: Rochester, NY (5,000* t/yr)

In December, Li-Cycle opened its commercial Spoke 2 at the Eastman Business Park in Rochester, NY – its first US facility

* tonnages in equivalent battery and battery material feed

Future developments

2022

Commercial Spoke 3: Phoenix, AZ (10,000* t/yr)

Li-Cycle will establish its third commercial Spoke in North America with construction commencing in Q2 2021

2023

Commercial Hub 1: Rochester, NY (60,000* t/yr)

Li-Cycle will commission its first commercial Hub with the ability to process battery materials from 60,000 tonnes of spent batteries

2022+

International Spokes and Hubs: EU / Asia

Li-Cycle will establish several Spokes and Hubs with partners internationally through joint ventures

Awards

BIG INNOVATION 2021

2021 GLOBAL CLEANTECH100 COMPANY Produced by Cleantech Group

2020 GLOBAL CLEANTECH100

SOLARIMPULSE EFFICIENT SOLUTIONS OUR CHALLENGE 1000

WORLD CIRCULAR ECONOMY FORUM

BusinessGreen Leaders Awards 2020

INTEGRATED BUSINESS POLICY

Li-Cycle's committed to providing end products from lithium-ion battery resource recovery, in a manner that ensures the following:

- A safe and healthy workplace for all employees and stakeholders
- Minimal environmental impact with zero wastewater, no direct emissions & no landfill
- Integration of Quality, Health & Safety and Environmental considerations as well as Socially Responsible recycling practices into our management system
- Meeting our commitments to customer specific requirements and expectations
- The continual improvement of our processes

Li-Cycle's Mississauga & Kingston locations have been certified for ISO 9001, 14001, 45001 and R2 standards

ISO 9001:2015 CERTIFIED

ISO 14001:2015 CERTIFIED

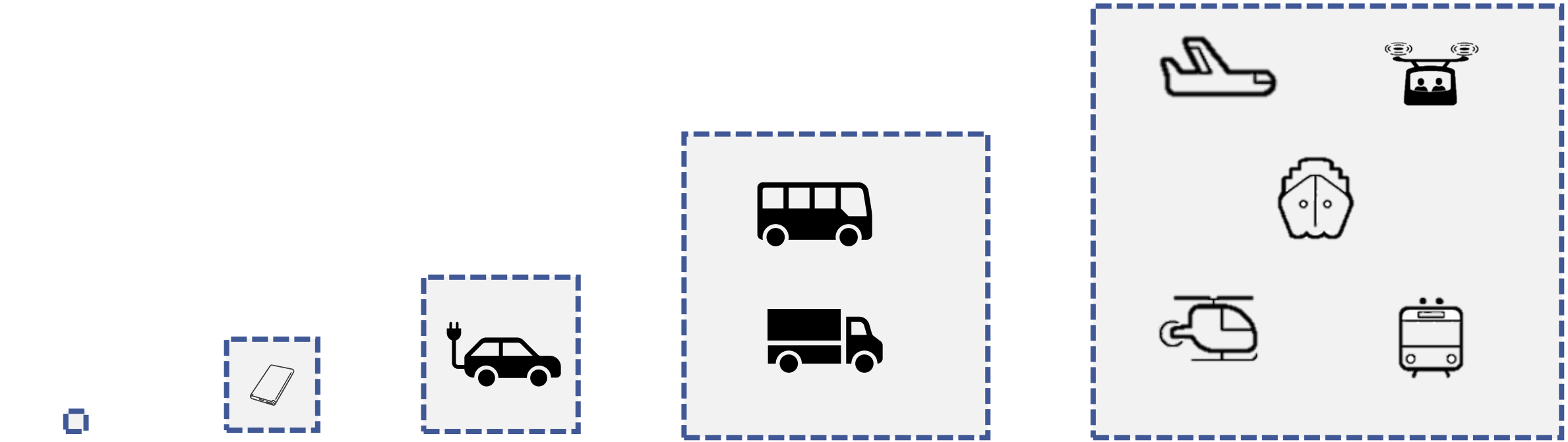
ISO 45001:2018 CERTIFIED

R2 2013 Responsible™ Recycling

EXPONENTIAL LI-ION BATTERY DEMAND GROWTH

Lithium-ion battery demand globally has risen dramatically over the last 10 years, and is only beginning

Global demand depicted below with accurate relative scale



2010
4 GWh/yr

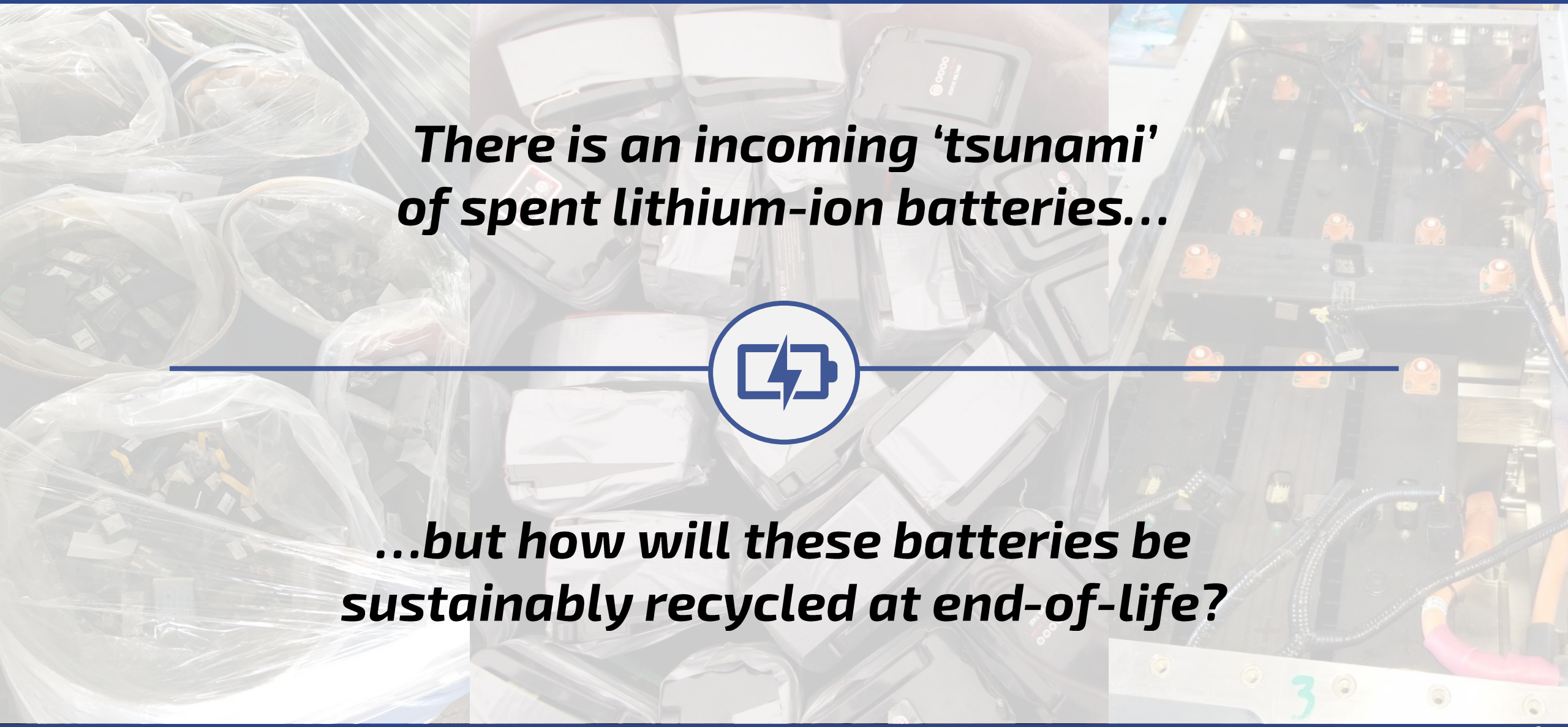
2016
80 GWh/yr

2020
250 GWh/yr

2025
940 GWh/yr

2030
2,300 GWh/yr

THE MISSING SUPPLY CHAIN STEP

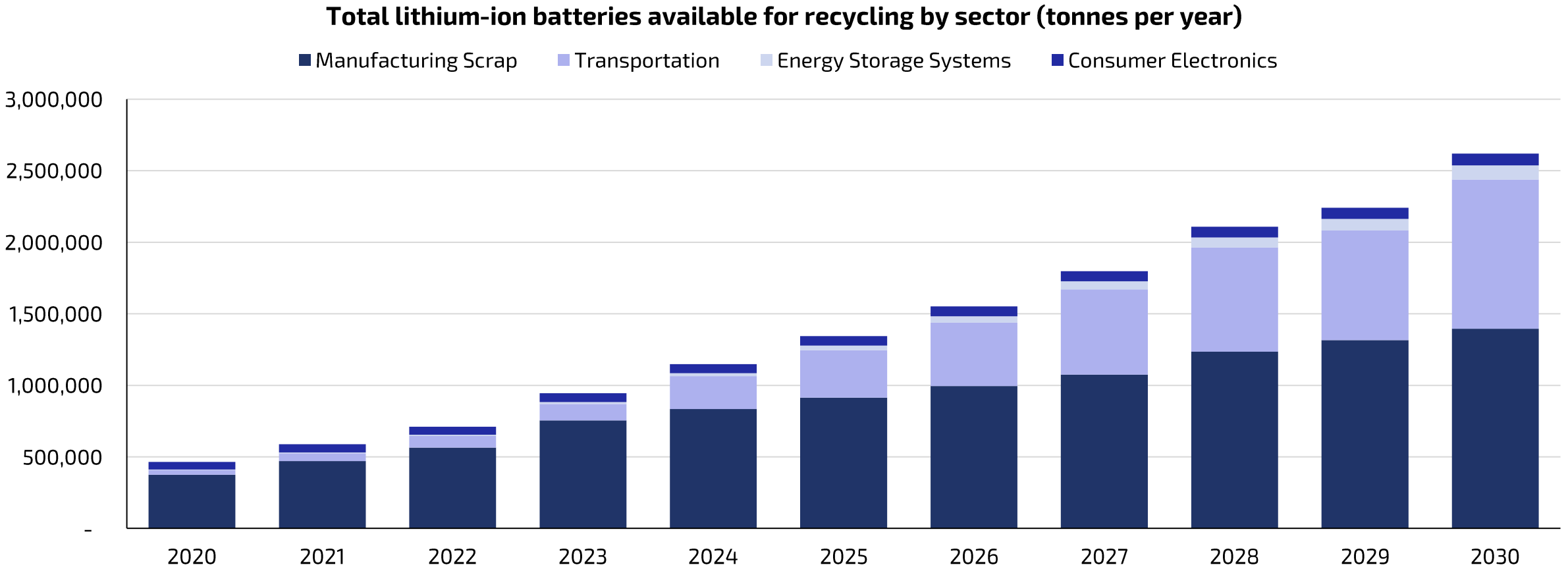


There is an incoming 'tsunami' of spent lithium-ion batteries...

...but how will these batteries be sustainably recycled at end-of-life?

EXPONENTIAL LI-ION BATTERY DEMAND GROWTH

The global lithium-ion battery recycling industry could have >2.5 million tonnes available for recycling by 2030



PROVEN LI-CYCLE TECHNOLOGY

Li-Cycle's patented Spoke & Hub Technologies recover up to 95% of all Li-ion battery materials — extracting high-grade materials for battery reproduction, at a cost lower than mined and refined material

Spoke

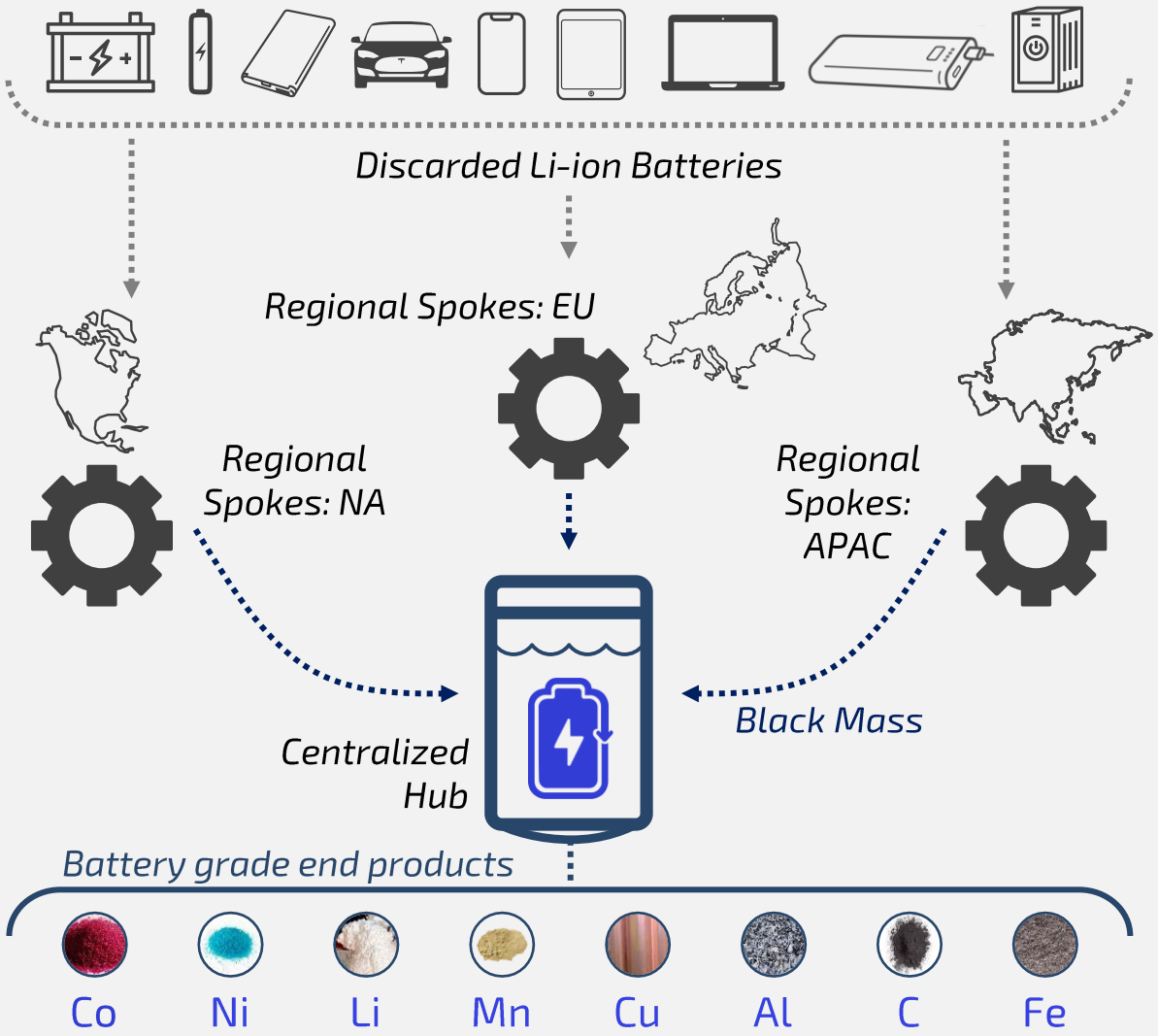
Input: All Li-ion batteries at any state of charge, without manual sorting

End products: Black mass, shredded Cu/Al, mixed plastics

Hub

Input: Black mass

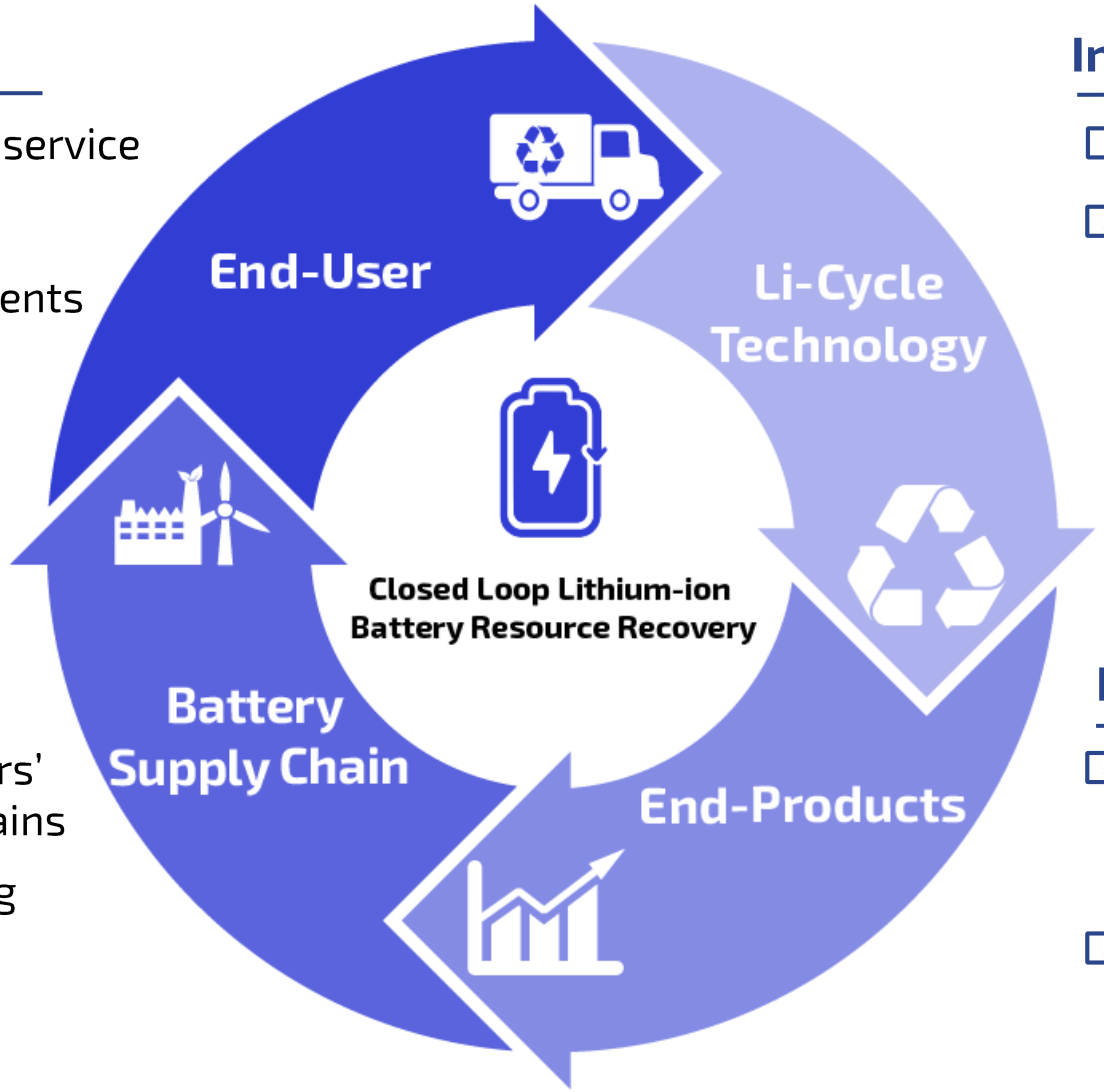
End products: Battery grade end products, including Co, Ni, Li, Mn, Cu Al, C, Fe



LI-CYCLE CAPABILITIES

Addressing the recycling gap

- Holistic logistics coordination service
- Handle damaged batteries
- Advise on packaging requirements
- Manage battery replacement campaigns



Industry-leading recovery rates

- Up to 95% recycling efficiency
- Safe and sustainable process

Closing the loop

- Close the loop in our customers' lithium-ion battery supply chains
- Strategic advantage vs. mining and refining primary supply

High value end-product sales

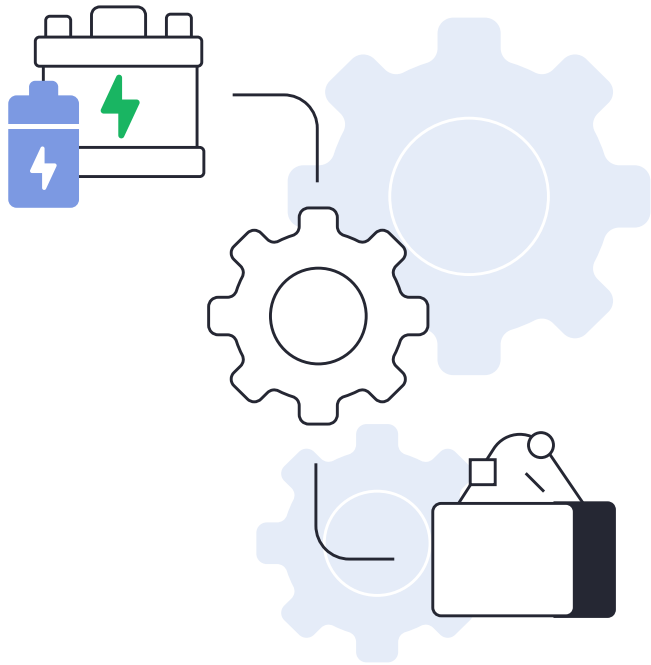
- Produce battery-grade end-products for re-use in battery or other technical applications
- Produce by-products reusable in the general economy

SPOKE TECHNOLOGY OVERVIEW: KEY COMPETITIVE ADVANTAGES

MECHANICAL SAFE SIZE REDUCTION

Spoke

- Ability to accept all lithium-ion batteries – regardless of chemistry, form factor, and prior application. Lithium-ion battery-type agnostic
- No need to separate different battery chemistries
- Processing of full modules, fully charged
- All intermediate products return to the economy
- No wastewater production
- Low air emissions. No fluorine air emissions
- Future processing of full packs
- Solid state battery processing (R&D)



SPOKE 1: KINGSTON, ONTARIO

NA Commercial Spoke 1

Location: Kingston, Ontario, Canada
Operational since: Q3 2019. New site since Q3 2020
Capacity: 5,000 tonnes of LIBs/year

Feed conveyor at NA Spoke 1

Automated materials handling circuits

Automated solution handling circuits

SPOKE 2: ROCHESTER, NEW YORK

NA Commercial Spoke 2

Location: Rochester, New York, USA
Operational since: Commissioning Q4 2020
Capacity: 5,000 tonnes of LIBs/year

Feed Conveyor and Shredder End

Modular Plant – Shredder Onwards

Modular Plant – Product Outlets

HUB TECHNOLOGY OVERVIEW: KEY COMPETITIVE ADVANTAGES

HYDROMETALLURGICAL PROCESSING

Hub

- Hydrometallurgy → 'wet' chemistry
- Low temperature operation (<230 deg. F / <110 deg. C)
- Recovery of battery-grade lithium carbonate
  - It has been traditionally very difficult for other technologies to recover lithium – both in terms of recovery and in terms of producing a battery-grade end-product
- Recovery of battery-grade cobalt sulphate and nickel sulphate
- Minimal solid waste for disposal
- Closed-loop recirculation of water with zero liquid discharge (ZLD) bleed treatment
- Low impact air emissions. No fluorine air emissions

LI-CYCLE COMMERCIAL HUB PRELIMINARY RENDERINGS

LI-CYCLE HUB WILL PRODUCE HIGH PURITY BATTERY MATERIALS

Lithium Carbonate

Nickel Sulphate

Cobalt Sulphate

Li-Cycle Hub End Products – Key Differentiators

- Li-Cycle reproduces battery grade and high purity materials
- Li-Cycle end products are “future proofed” – providing the building blocks of batteries that are not at risk of technological obsolescence (unlike the production of active battery materials, e.g., cathode)

THE MOST SUSTAINABLE AND ECONOMIC SOLUTION

	Li-Cycle Spoke & Hub Technologies	Smelting or thermal pre-treatment + refining	Cathode-to-cathode
Recycling efficiency rate[1]	Up to 95%	≤ 50%	30% (cathode proportion only)
Battery chemistry & charge agnostic	✓	✗	✗
Non-thermal, zero impact air emissions	✓	✗	✗
No landfill waste or wastewater	✓	✗	✗
Minimal human operating risk	✓	✗	✗
"Future proofed"	✓	✗	✗

Source:
(1) Recycling Efficiency Rate (RER) is defined as [(The mass exiting the process and returning to the economy / The battery material mass entering the process) x 100%]


Li-Cycle®

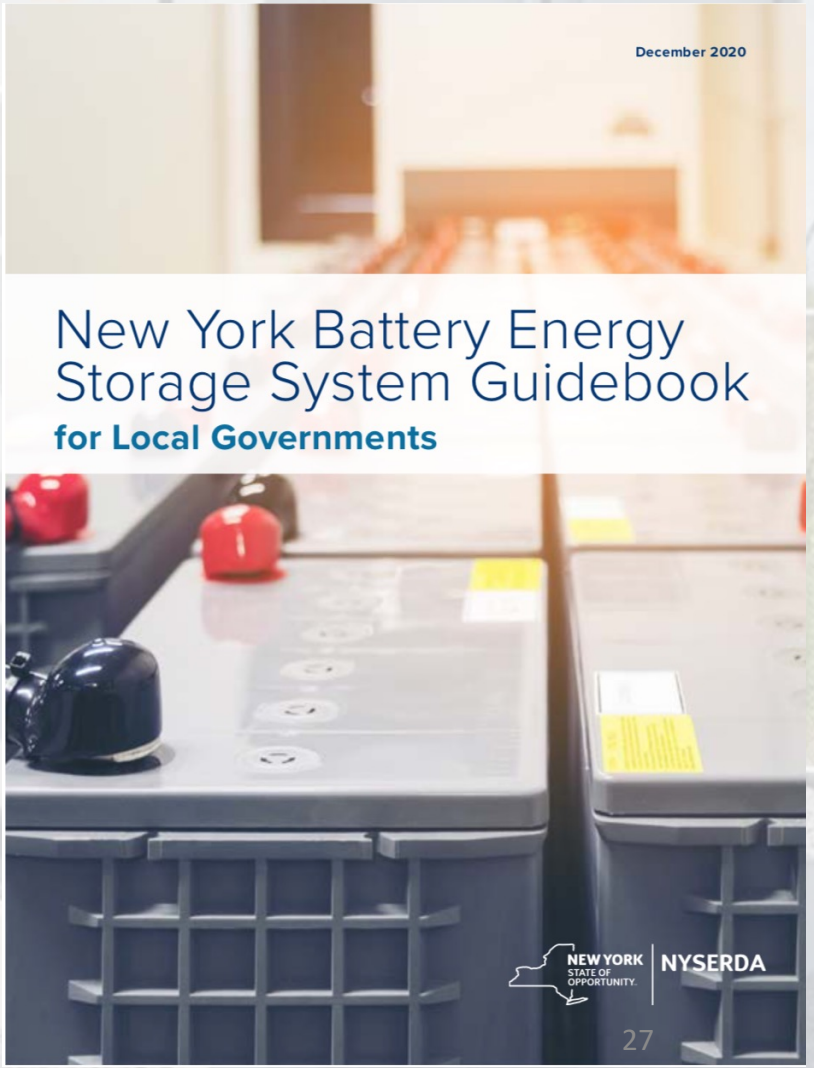
NYSERDA Resources for Local Governments

NY Battery Energy Storage System Guidebook:

- Model Zoning Law
- Model Permit + Inspection Checklist
- 2020 NYS Uniform Code References

NYSERDA Clean Energy Siting Team

- Work one-on-one with municipal boards & local officials to provide free technical assistance
- Offer free accredited trainings for code enforcement officials or planning/zoning board members



Q&A

Helpful links:

- **Energy Storage Guidebook for Local Governments**
- **NYSERDA Energy Storage Program**

For additional assistance, reach out to cleanenergyhelp@nyserda.ny.gov

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Final Webinar in Series:

Taxation & Assessments

(Wednesday, June 30th)

Questions?
Email cleanenergyhelp@nyserda.ny.gov

NYSERDA Webinar Series

Battery Energy Storage Systems: Key Considerations for Local Governments

NYSERDA is pleased to host a series of webinars intended to equip local governments across New York State – including municipal board members, first responders, code enforcement officers, and other community stakeholders – with the knowledge and resources required to ensure responsible battery energy storage system development.

This webinar series, featuring presentations from NYSERDA staff as well as external subject matter experts, will cover a range of key topics related to battery energy storage systems which are particularly important for communities and local governments.

Events in this series will be held biweekly on Wednesdays from 5:30 p.m. to 6:45 p.m. ET.

Register for each session of interest using the registration links.

Questions? Email NYSERDA's Clean Energy Siting Team: cleanenergyhelp@nyserda.ny.gov

Battery Energy Storage Systems 101

Date: Wednesday, May 5, 2021

Featured Speakers: Dr. Stanley Whittingham, 2019 Nobel Laureate for Chemistry; Distinguished Professor of Chemistry, SUNY Binghamton

Gain an introduction to key concepts and technologies associated with battery energy storage systems, as well as an overview of relevant New York State (NYS) goals, policies and programs.

REGISTER HERE

Fire Safety

Date: Wednesday, May 19, 2021

Featured Speakers: NYS Office of Fire Prevention and Control (OFPC), Energy Safety Response Group (ESRG)

Learn about key fire safety considerations for battery energy storage systems, including a discussion of best practices for first responders, as well as a review of important regulations found in the 2020 NYS Uniform Fire Prevention and Building Code.

REGISTER HERE

Zoning and Permitting

Date: Wednesday, June 2, 2021

Featured Speakers: NYSERDA Clean Energy Siting Team

Dive into the valuable resources available to local governments in NYSERDA's Battery Energy Storage System Guidebook. These tools are designed to assist municipalities in implementing zoning, permitting, and inspection processes for battery energy storage installations.

REGISTER HERE

Decommissioning and End-of-Life Considerations

Date: Wednesday, June 16, 2021

Featured Speakers: DNV and Li-Cycle

Explore best practices for the treatment of battery energy storage systems at the end of their useful life – including system recycling and disposal – as well as an introduction to decommissioning plans for energy storage installations.

REGISTER HERE

Taxation and Assessments

Date: Wednesday, June 30, 2021

Featured Speaker: Hodgson Russ, LLP

Learn about New York State and local tax treatment of battery energy storage systems, including information regarding assessments and payments-in-lieu-of-taxes (PILOT) agreements.

REGISTER HERE