

# Second Life Lithium-Ion Energy Storage Systems

# higherwire

Energy Solutions, Elevated



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Trevor Warren  
Founder and CEO

# About Us



**Trevor Warren**  
Founder and CEO



**Jordan Causer**  
President



**Felix Webber**  
Manufacturing Engineer



**HIGHERWIRE MISSION:** To create innovative technologies that maximize the useful life of power and energy storage systems.

# The Problem

1

Lithium-ion batteries are often disposed of prematurely, leaving significant energy unused

2

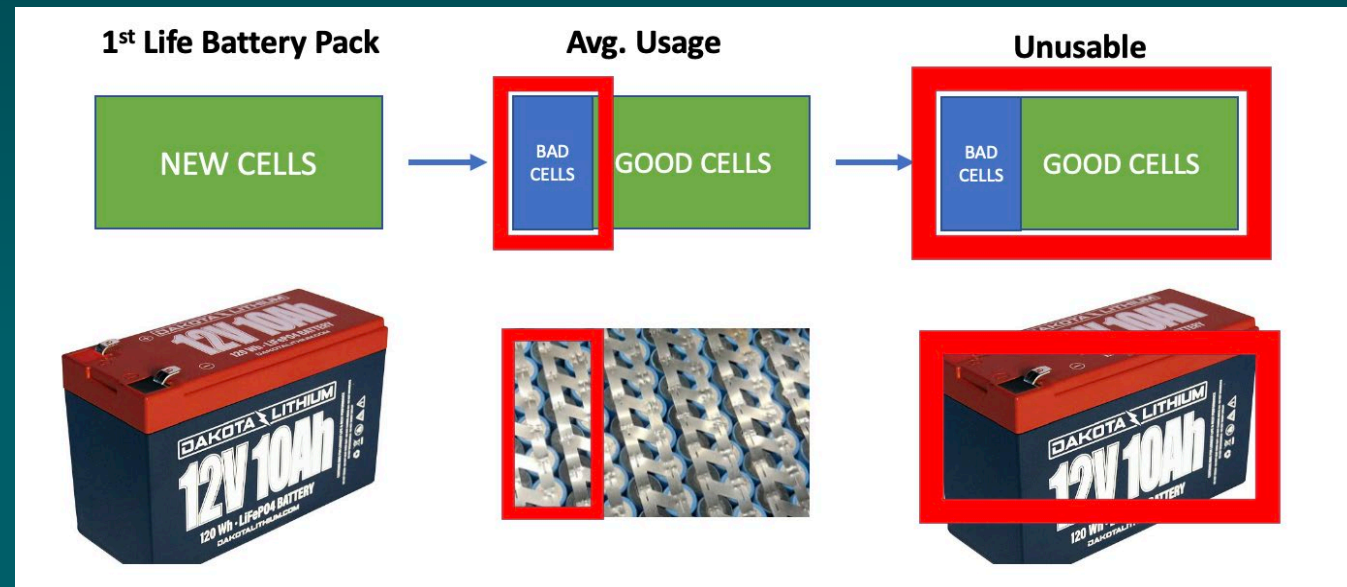
This inefficiency increases demand on the global supply chain and drives up costs

3

Good batteries can be stepped-down in application load for second life

4

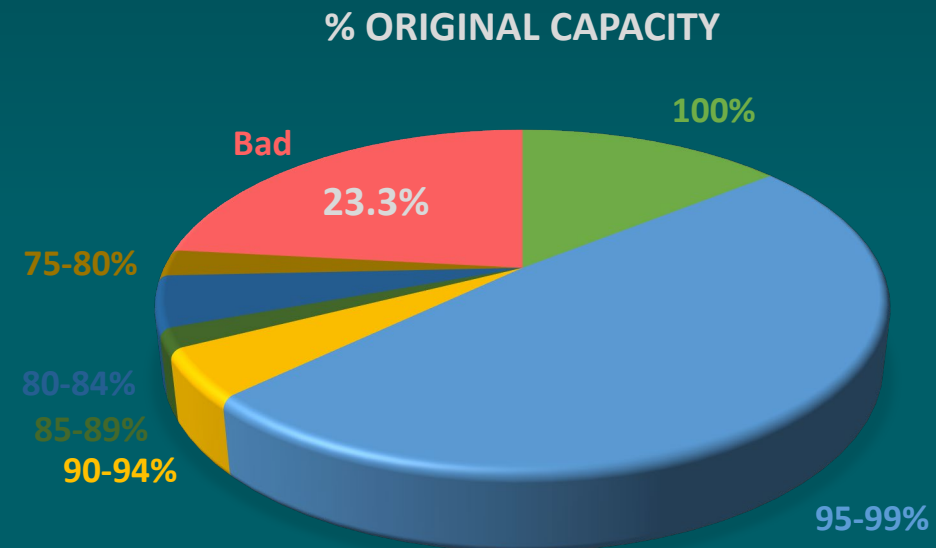
~25% of bad cells drive battery removal



There will be enough spent EV batteries by 2030 to power the entire City of Phoenix for nearly 2 months.

# Our Solution

- Higher Wire processed nearly 2MWh of spent lithium-ion batteries in 2024.
- More than 75% were above 80% rated capacity.
- Our database tracks
  - Original pack data: application, manufacture date, voltage, capacity, etc.
  - Cell data: chemistry, make/model, manufacture date, test data
- We use this to
  - Determine expected yield and value for a given lot
  - Estimate remaining cycle life
- See US patent 2023/0402667 “SYSTEMS AND METHODS FOR PROCESSING AND MANAGING USED LITHIUM-ION BATTERIES”

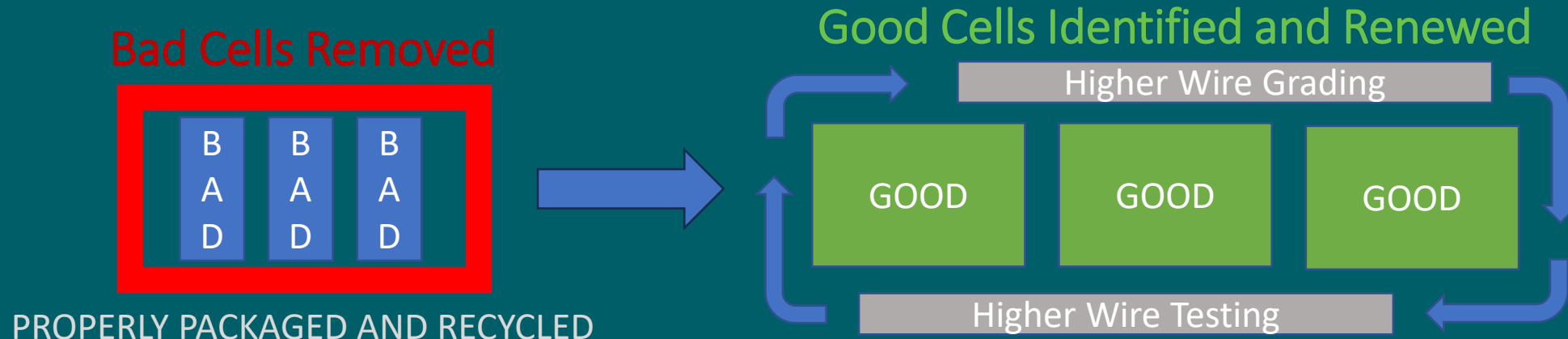


Viability of second use is highest for EV and material handler batteries.

# ReNew Collective



- **Evaluation**: Owners fill out a procurement form to determine suitability
- **Shipping**: Owners package and ship batteries to Higher Wire
- **Testing**: We thoroughly analyze battery/cell performance and grade for reuse
- **Resale or Recycle**: Batteries deemed suitable for reuse are sold. Owners receive a share of revenue. Batteries unsuitable for reuse are recycled.

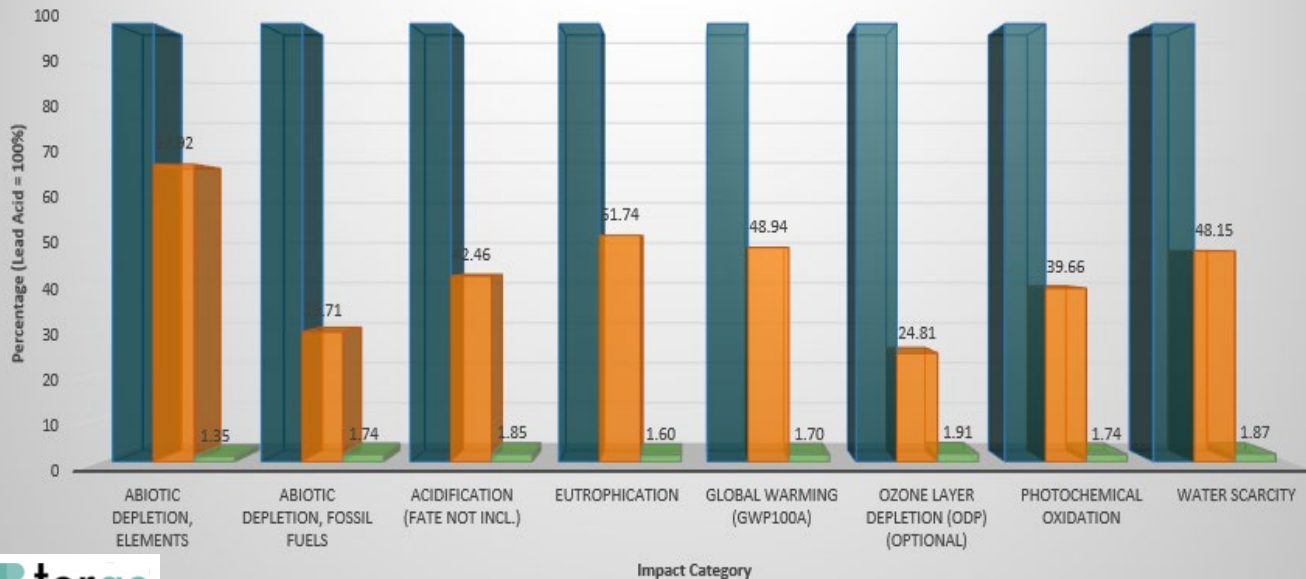


An innovative program that transforms hazardous waste back into positive cash flow for first life battery owners.

# Environmental Benefits

Higher Wire ReNewed LFP vs. Competitors

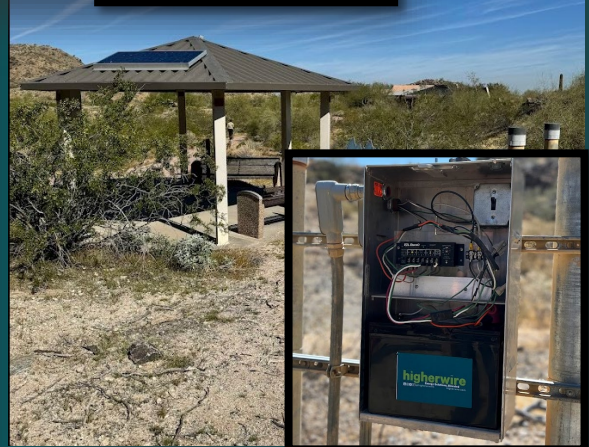
Competitor Lead-Acid 12v FS27    Competitor LFP 12v 100Ah    Higher Wire ReNewed 12v 100Ah



- Up to 98% reduction in manufacturing emissions as compared to new
  - Emissions analysis performed by TerGo
- Full lifecycle analysis to be performed with Argonne National Lab
  - DOE Energy Storage Grand Challenge voucher awardee

# Applications

- Solar lighting
- Mobile power
- Emergency backup



80.6  
kWh



### Installed Capacity

More than a standard-range Tesla

281  
kg



### Critical Minerals Saved

Reducing strain on the global supply chain

13.5  
MT



### Manufacturing CO2e Avoided

96% lower carbon footprint compared to new batteries  
Data from TerGo

1.9  
MT



### Annual CO2e Savings

From solar generation as compared to grid emissions  
Data from EPA eGRID

1.6  
months



### CO2e Break-Even

CO2e savings reached break-even with manufacturing emissions in under 2 months

# Case Study: City of Phoenix

- Higher Wire ReNewed batteries installed at five locations
  - Solar lighting
  - Emergency backup
- Zero battery failures during period of performance
  - Lowest measured SOC was ~50% overnight
- Only **250 kg** of manufacturing CO2e emissions vs. **13,750 kg** for lead acid
- EPA estimates that the Arizona grid generates an average of **0.32 kg CO2e/kWh**
- Our batteries reached carbon negative after **less than two months** in operation



# Community Engagement

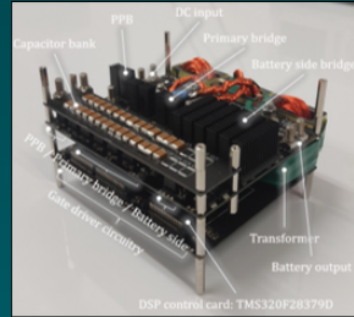
- Partnership with Purpose Focused, a Navajo-owned 501(c)(3)
  - “Solar Warriors” PV training and certification program
  - Classroom training at Dine’ College campuses in Arizona
  - Hands-on training at Higher Wire location – more than 20 students/graduates to date
  - Development hardware to be assembled, installed and tested by Solar Warriors
- Partnership with White Mountain Economic Development
  - DOE Make It grant program
  - Renewable energy workforce development program in conjunction with Northern Pioneer College in St. John’s, AZ.



# Product Ecosystem



**DE-SC0024126**  
**Awaiting Phase II**  
 Battery management system  
 with independent cell control  
 Low 3.2 Vdc input  
 Up to 360 Vdc output



Licensing



Solar PV and grid ready  
 Compact, all-in-one ESS  
 Fewer wiring connections  
 Enhanced safety and reliability

System Design +  
 Integration



**Batteries**

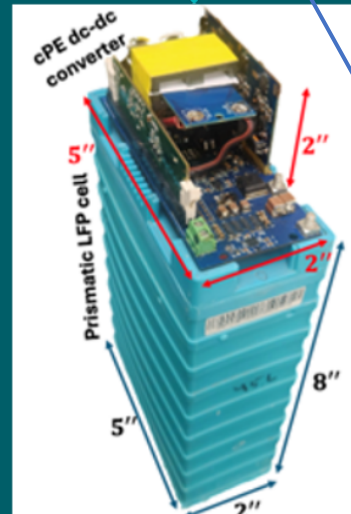
**DC-DC Converter**

**AC-DC Converter**

**All-In-One ESS**

Sales

High-quality battery cells fully  
 tested and built by Higher Wire

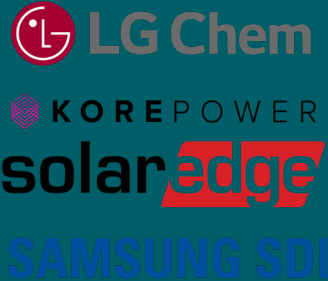


Fully integrated DC-AC-DC  
 converter with MPPT charger.  
 120/240Vac output  
**DE-SC0022600**  
**Current Phase II**

Future work will  
 integrate DC-DC  
 converter into AC-  
 DC system



ESS Manufacturer



Licensing

Activity

Cash Flow

**higherwire**  
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Thank you