

# Energy Storage is Necessary for Grid Resiliency

Pb Battery R&D Center: Hammond, IN

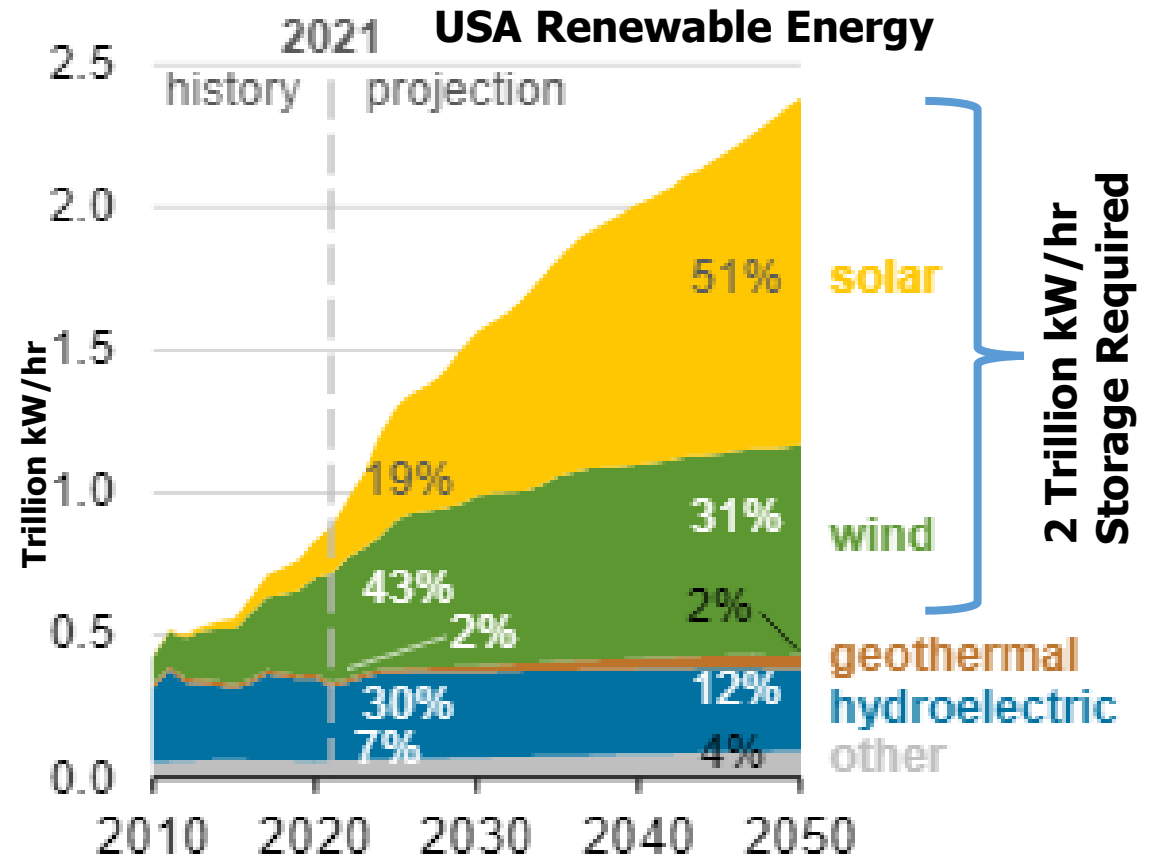
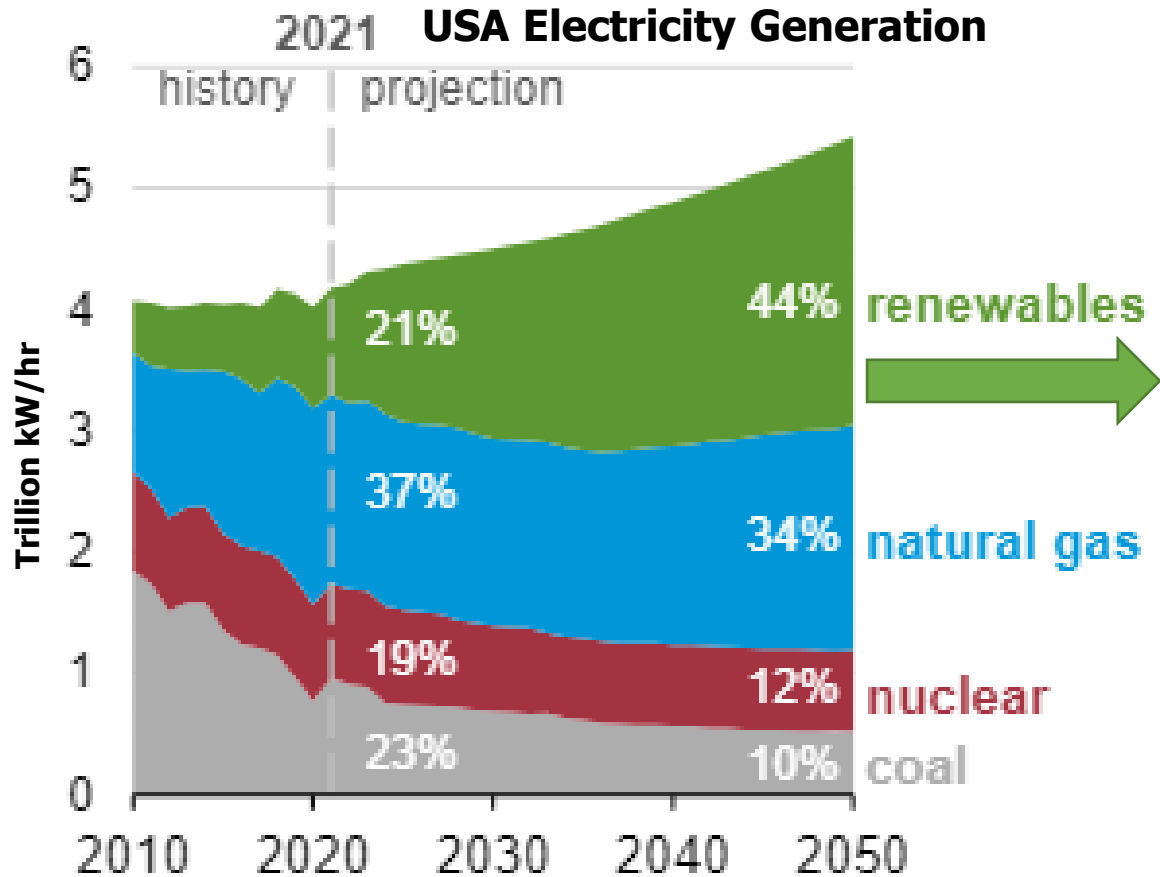


***Lead (Pb) Batteries = Circular Sustainability***

## Electric Grid System Challenges

- **Massive Addition of Renewable Energy**
  - Solar and Wind Intermittency
  - Low-Capacity Factors (25% - 35%)
- **Electric Vehicles Charging Stations**
  - EV Charging is Disruptive
  - Adoption of EV is being Mandated
- **Retiring Fossil Fuel Power Plants**
  - Arbitrage Baseload Power into Peak
- **Transmission Deferral Opportunity**
  - Peak Shaving and Micro Grids

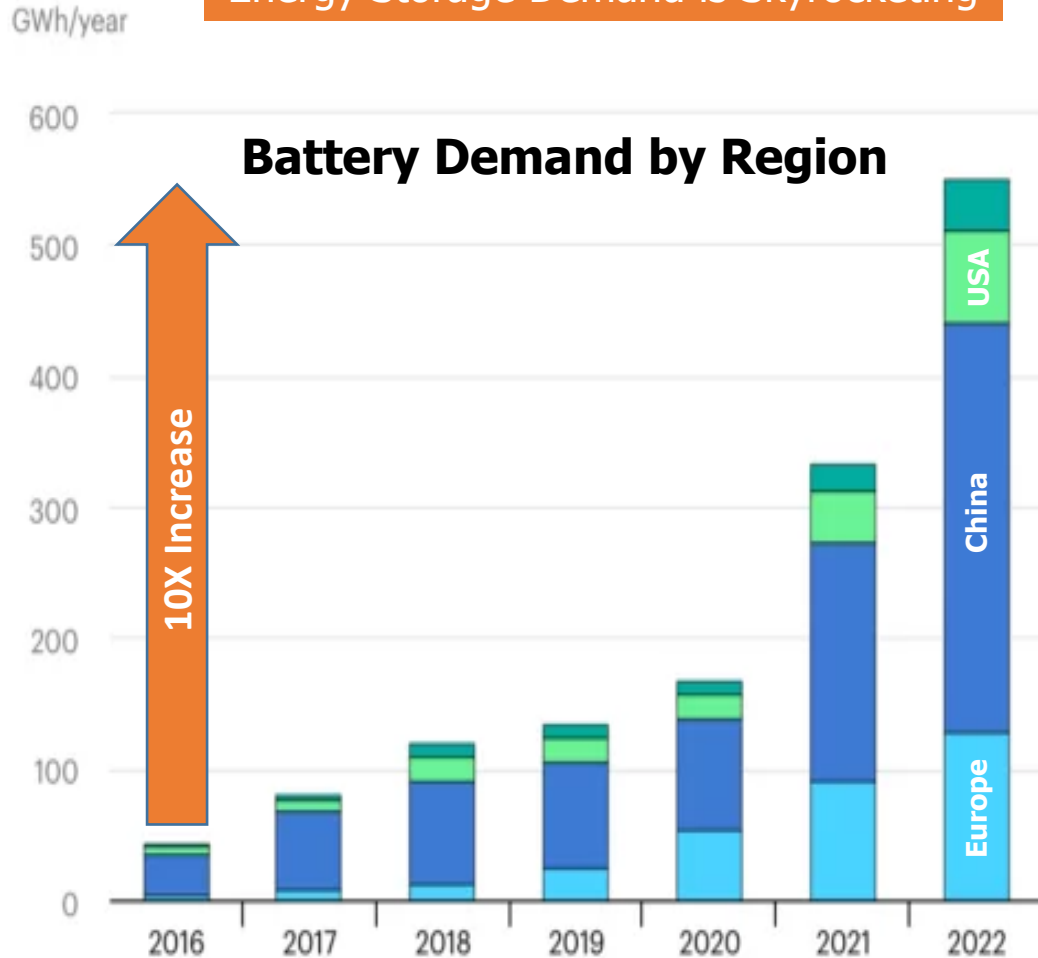
# Renewable Energy is Intermittent: Storage Required



Trillions of kW/hrs will be required to support the USA Energy Infrastructure

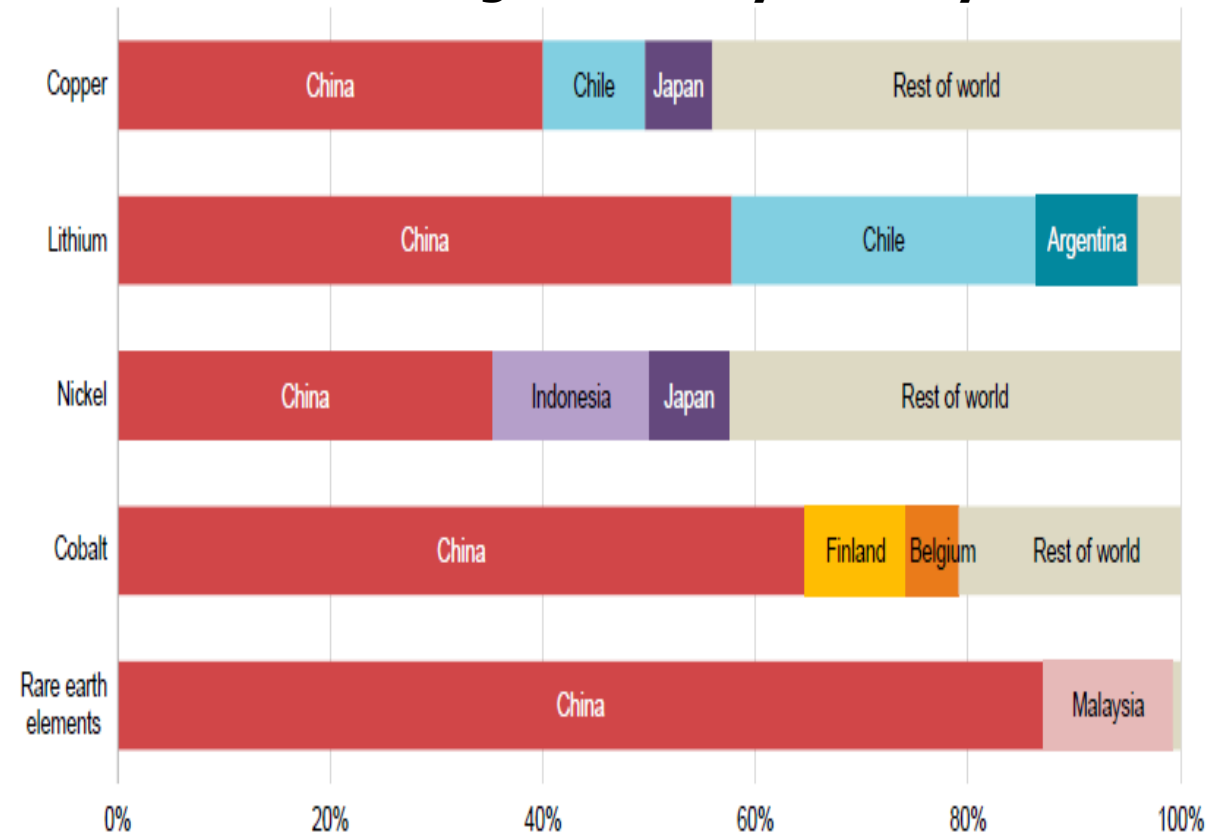
# Li-Ion Demand Skyrocketing with Resources at Risk

Energy Storage Demand is Skyrocketing



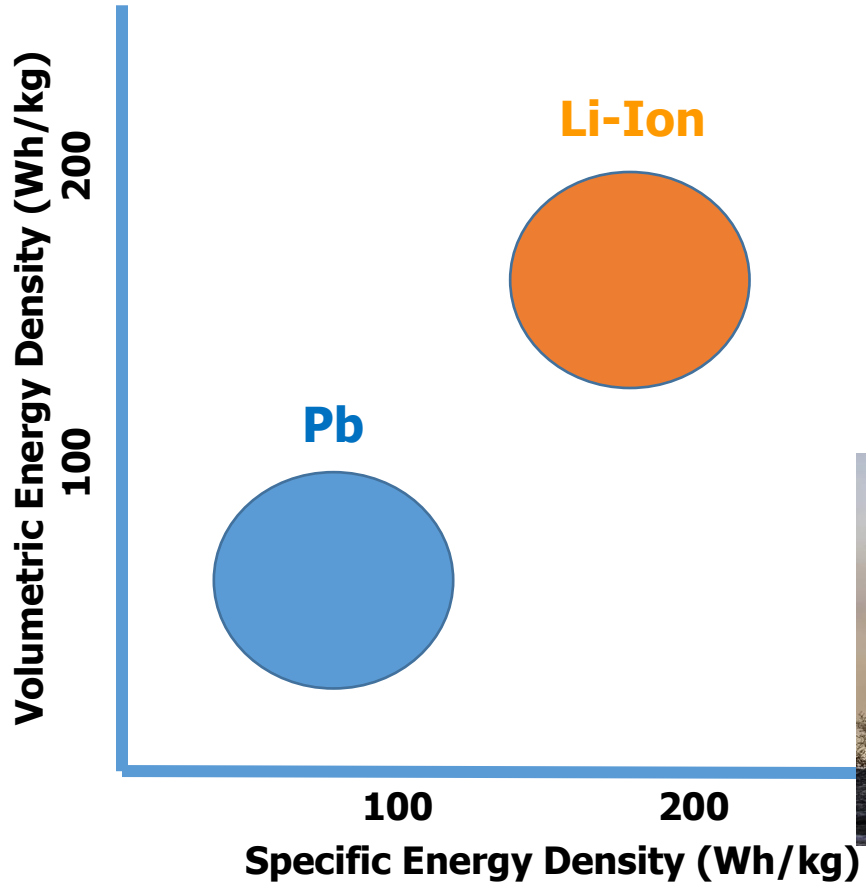
China Controls the Li-Ion Supply Chain

### Li-Ion Battery Processing Volume by Country



# Horses for Courses: Save Li-Ion for Mobile Applications

## Energy Density



Li-Ion = Thoroughbred



Energy Density Not Relevant For Stationary



Pb = Work Horse

Li-Ion Batteries

Mobile Applications

Phones & Electric Vehicles



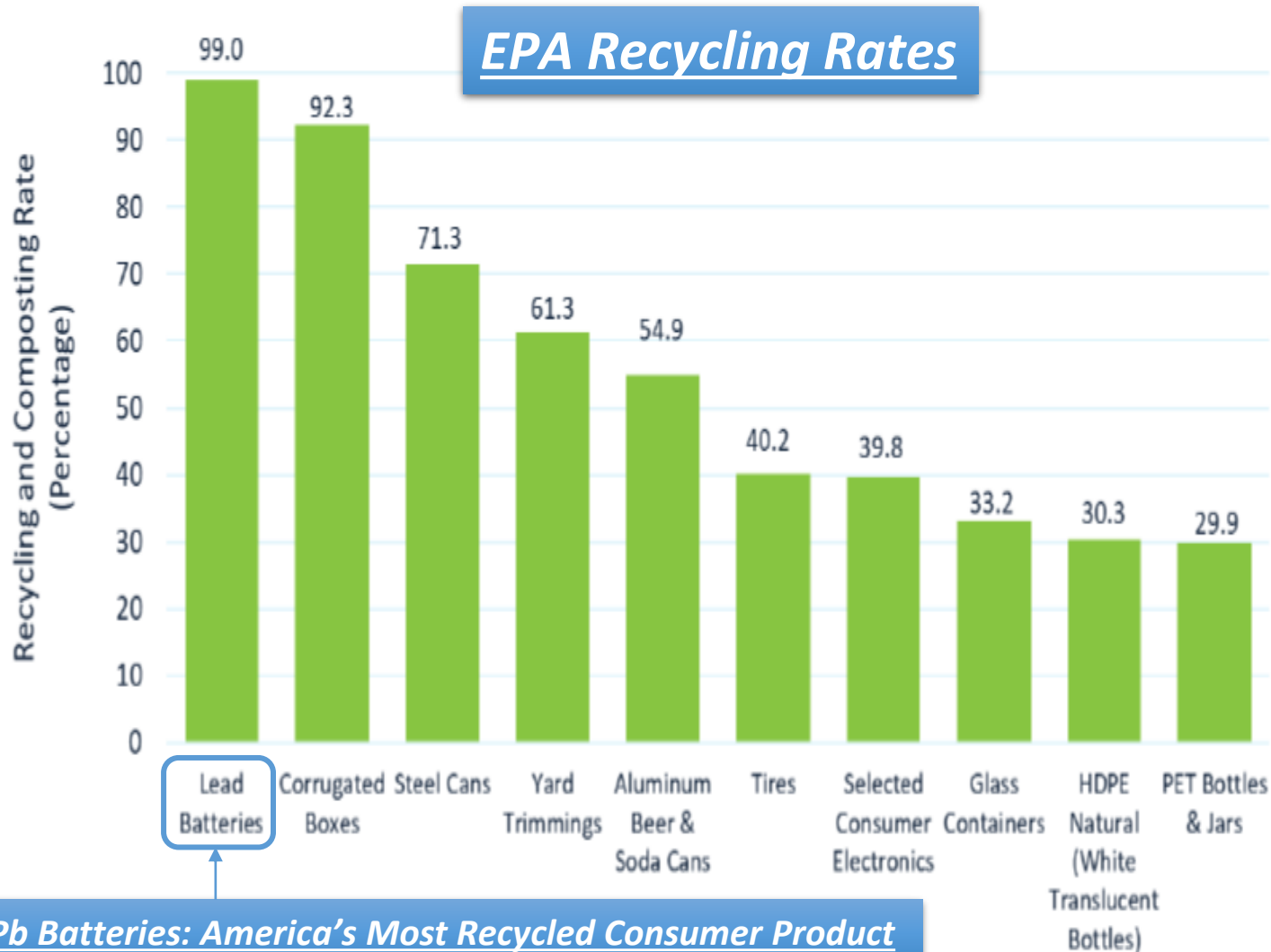
Pb Batteries

Stationary Applications

Cell Towers, Renewable Energy



# Pb Batteries: Circular Recyclability is Infinite Sustainability



## Infinite Sustainability

Stationary Applications  
Must Have an  
Inexhaustible Supply

- **Pb = Circular Recyclability**
  - Old Batteries = New Batteries
- **Domestically Sourced**
  - \$38B/year economy
- **Immediate Availability**
  - Infrastructure in Place
- **Li-Ion is One and Done**
  - Always Virgin Material



# Pb Batteries are Key to Providing Grid Resiliency

## Most Important Requirements

	Lead (Pb)	Li-ion
<b>Sustainability</b>	99% Circular	Zero Reuse
<b>Environmental Impact</b>	Zero Landfill	96% Landfill
<b>Raw Material Availability</b>	USA Circular Recycle	China
<b>Manufacturing Infrastructure</b>	USA	China
<b>Safety</b>	Proven Passive	Thermal Runaway
<b>Energy Density</b>	Moderate	High

- **Sustainability, not Energy Density, is Key**
  - Ideal technologies are those that have Infinite Life
  - Pb Batteries have Circular Sustainability
- **Li Ion is Great Technology, but:**
  - Demand will far exceed supply
  - China controls the critical supply chain
  - Safety issues on large systems: Thermal Runaway
- **Horses for Courses**
  - Save Li Ion for Mobile Applications
- **Pb is Well Understood and Appropriately Regulated**
  - Domestic Infrastructure is in Place
  - Pb Batteries are Critical to our National Security