

Environmental Aspects of Energy Storage

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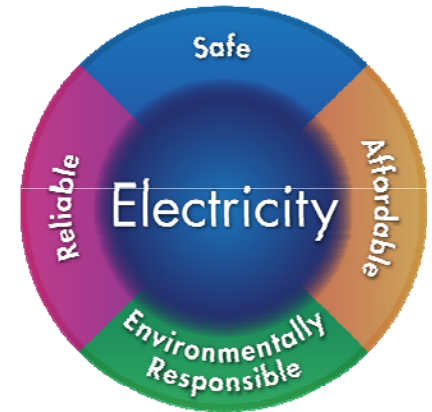


EPRI Energy Storage Program Mission

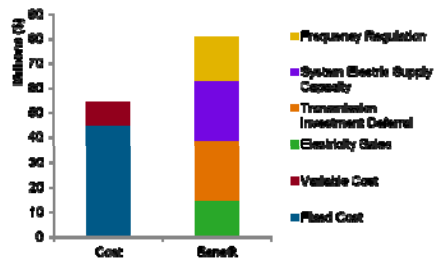
Advance integration and use of safe, reliable, cost-effective and environmentally responsible energy storage

- Technology evaluation and testing
- Techno-economic analysis methods and tools
- Grid integration and control
- Safety and environmental impacts
- Industry collaboration and common approach development

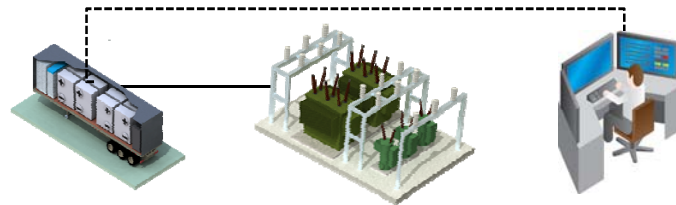
EPRI Guiding Vision



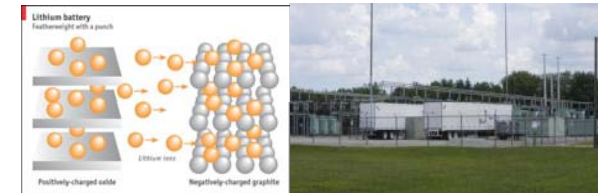
Storage Valuation



Storage Integration



Evaluation and Demonstration



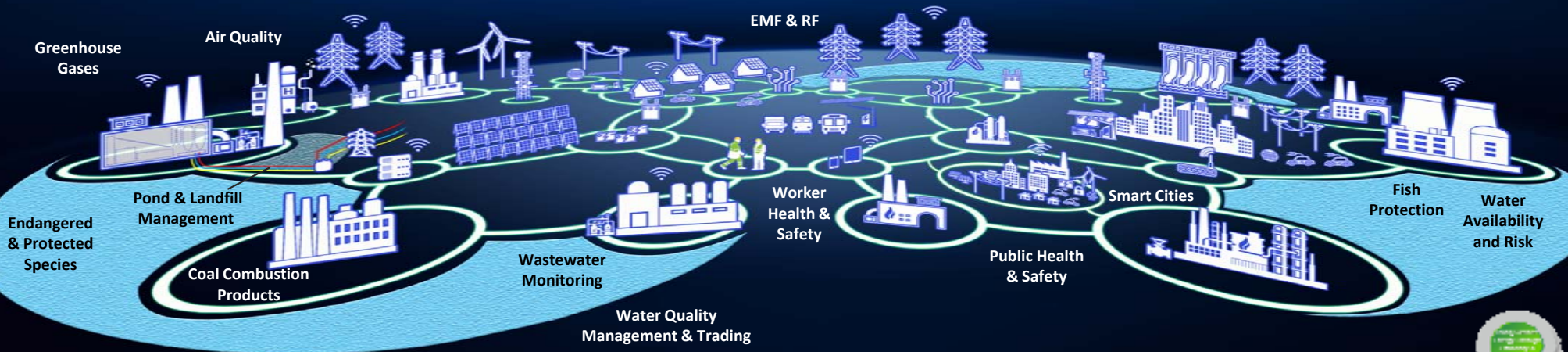
Environmental Aspects of Coal Generation

Environmental Aspects of Renewables & Distributed Energy Resources

Environmental Aspects of Transmission & Distribution

Environmental Aspects of Natural Gas

Environmental Aspects of Nuclear Generation



Site Decommissioning & Liabilities



Strategic Analysis, Safety & Sustainability

Energy & Environmental Analysis

Energy Sustainability

Workforce Health & Safety

Energy & Environment Research

Water

Air

CCP Mgmt.

T&D

Electrification

OH&S

Integrated Energy Planning

EMF & RF

Why is this Important for a Resilient Grid?

- **Diverse Regulatory Considerations:** Storage increasingly subject to environmental regulations (*e.g. siting, emissions, worker safety, public health, end of life*)
- **Complexity Confounds Integration:** Diversity and rapid evolution of equipment, fuels, markets, and policies complicates safe and environmentally-responsible integration
- **Worker, First Responder and Public Safety:** Increased safety risks for workers, first responders and the public if not properly connected, maintained, and handled
- **Enhanced Public Scrutiny:** Storage located near the public can raise public awareness, increase exposure potential, heighten local scrutiny and environmental justice concerns.



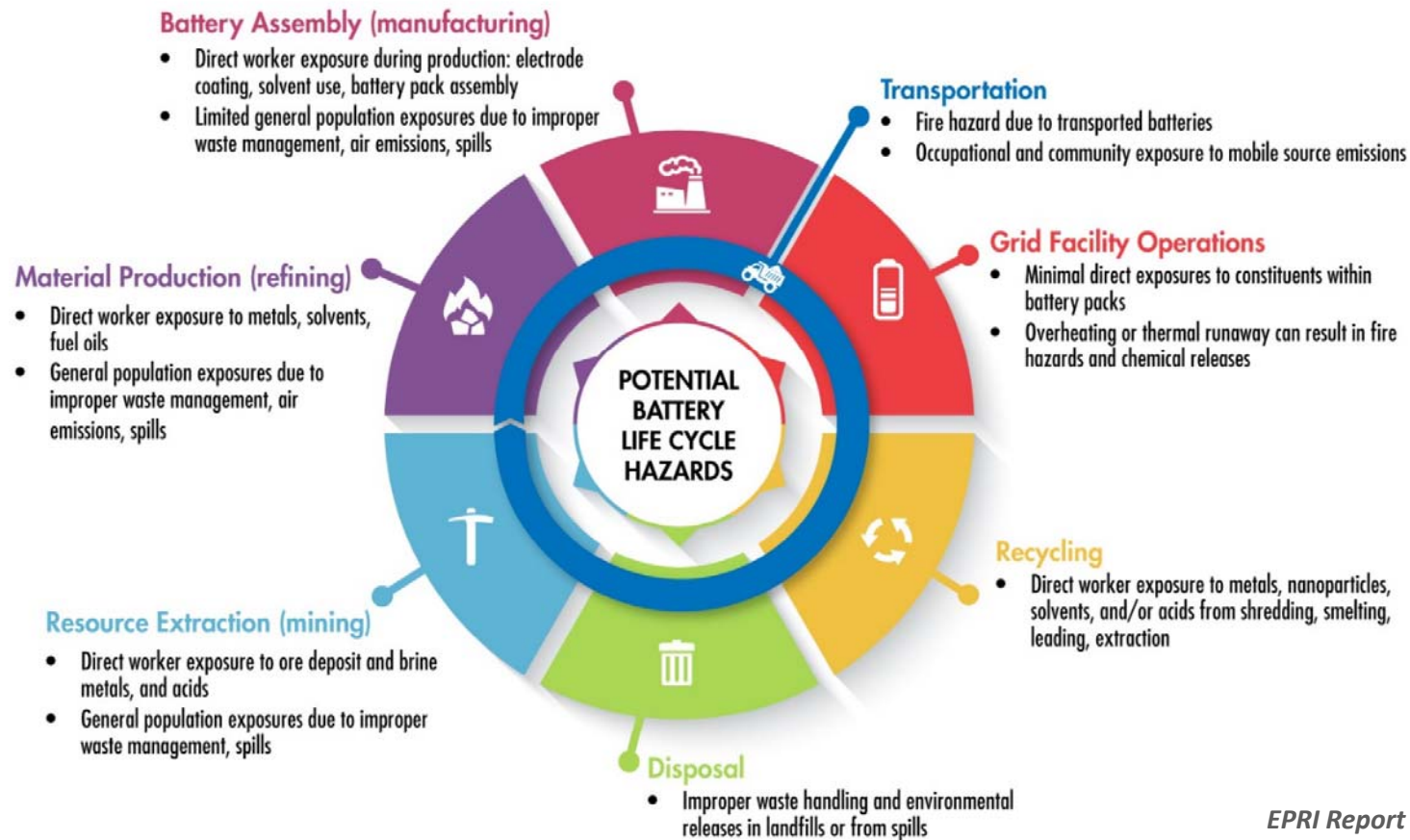
Environmental Aspects of Energy Storage

- Environmental Permitting for Lithium Ion Storage Systems
- Worker & First Responder Safety for Battery Storage; Fire Safety
- Health Risk Assessments
- Critical Review of Lithium Ion Battery Life Cycle Assessments (LCA)
- LCA of Stationary Grid-scale Lithium Ion Batteries
- Emissions Impacts of Energy Storage
- Battery End-of-Life Management
- EMF/RF



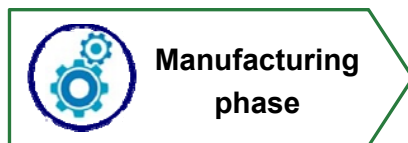
ENVIRONMENTAL ASPECTS OF
RENEWABLES & DISTRIBUTED ENERGY

Research Snapshot: Potential Health Risks Across the Battery Life Cycle



EPRI Report 3002014564

Research Snapshot: Life Cycle Assessment of Stationary Lithium Ion Batteries



Remarks	<ul style="list-style-type: none"> • Many peer-reviewed studies • Many examine chemistry differences • Lack of primary data is a major challenge • Wide variation in estimated impacts 	<ul style="list-style-type: none"> • Depends on storage effects on grid operations (e.g. avoided emissions from fossil generators) • Very few studies in U.S. 	<ul style="list-style-type: none"> • Mostly unaddressed by existing LCA studies • Relevant EOL pathways: <ul style="list-style-type: none"> • disposal (landfilling) • recycling
EPRI perspective	<ul style="list-style-type: none"> • Need for a roundtable to resolve methodology and data issues 	<ul style="list-style-type: none"> • Need for critical methodology for dispatch in presence vs. absence of storage 	<ul style="list-style-type: none"> • Are EOL impacts an important contributor to total impacts?

Renewables & Battery End-of-Life Strategic Initiative

Emerging Issue

- New classes of wastes - PV Modules, Batteries, Wind Turbine Blades
- Growing issue:
~10-fold increase by 2050
- Diverse stakeholders



Photo Credit: Battery Resources

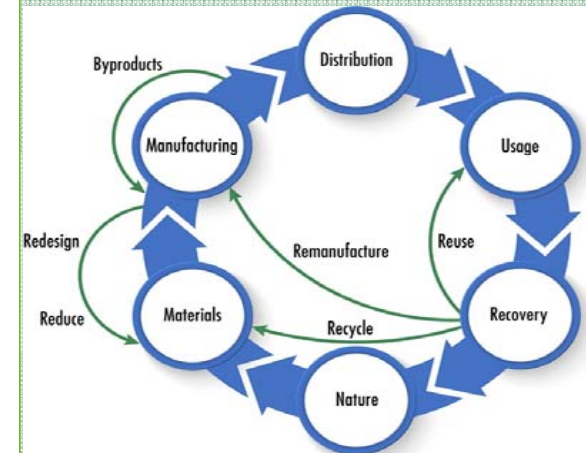
Proactive Strategies

- Identify issues and manage risk
- Align industry resources
- Expand external collaborative opportunities
- Inform public policy



Environmental Stewardship

- Minimize disposal
- Maximize recycling/reuse
- Sustainable raw materials
- Circular economy





Together...Shaping the Future of Electricity