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LEVERAGING ARTIFICAL INTELLIGENCE TO ACCELERATE BATTERY CIRCULARITY

BUSINESS WHITE PAPER

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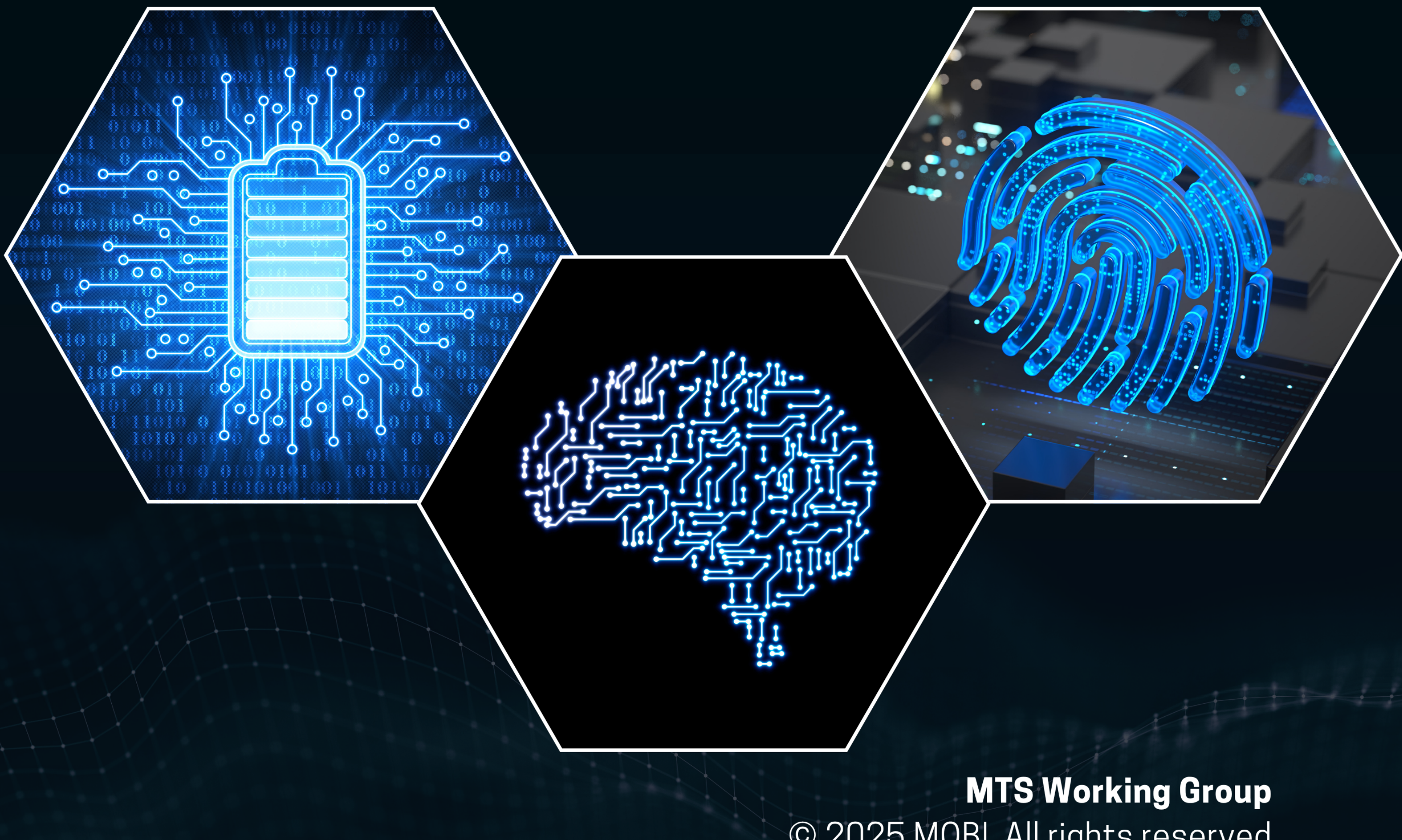

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EXECUTIVE SUMMARY

Enhancing circularity in the battery supply chain can have extraordinary impacts on the sector's sustainability and resiliency. AI is a valuable tool to drive positive changes for battery circularity.

Battery circularity helps reduce environmental impact, conserve critical minerals, and improve economic sustainability. It reduces dependence on geopolitically sensitive regions for raw materials, making supply chains more resilient. At the same time, it creates net new jobs in recycling, remanufacturing, and second-life applications fostering a more sustainable and profitable industry. Artificial Intelligence (AI) is already a widely used tool for process improvement and optimization and recent developments can be applied to improve battery circularity and create net new revenue opportunities for the stakeholders in the battery value chain. This white paper explores challenges in current battery circularity, opportunities AI provides, and strategies for using AI to overcome those challenges.

LIST OF ACRONYMS

ACC II	:	Advanced Clean Cars II
AI	:	Artificial Intelligence
BMS	:	Battery Management System
BP	:	Battery Passport
EOL	:	End-of-life
EV	:	Electric Vehicle
FCV	:	Fuel Cell Vehicle
IRA	:	Inflation Reduction Act
LCA	:	Life Cycle Analysis
LLM	:	Large Language Model
ML	:	Machine Learning
PHEVs	:	Plug-In Hybrid Electric Vehicles
ROI	:	Return on Investment
SMEs	:	Small and Medium Enterprises
SOC	:	State of Charge
SOH	:	State of Health
WEF	:	World Economic Forum

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GLOSSARY OF TERMS

This section contains the definitions of all technical and specific terms used throughout this document.

Artificial Intelligence: Artificial Intelligence means a discipline that includes techniques and models to identify relationships between variables, classify data, and predict future outcomes.

Machine Learning: Machine Learning means models to identify the relationships in the data, classify them, and improve future outcomes by learning from output.

Battery Passport: Battery Passport means electronic record for each battery placed on the market....it is a "a structured collection of product-related data with a predefined scope and agreed data ownership and access rights conveyed through a unique identifier." The battery passport shall "electronically register, process and share product-related information amongst supply chain businesses, authorities, and consumers.

Battery Circularity: Battery Circularity refers to a system where end-of-life electric vehicle batteries are reused, repurposed, or recycled to create new batteries, minimizing reliance on virgin materials and reducing environmental impact.

OBJECTIVE OF THIS DOCUMENT

The objectives of this white paper are to answer the following questions:

- What are the challenges in battery circularity?
- What are the benefits of deploying AI in battery circularity?
- What role is AI currently playing in battery circularity?
- What kind of gaps can the AI fill to improve battery circularity?
- What kind of AI-infused products and services can be developed by the stakeholder?
- What are the barriers and challenges to AI adoption in battery circularity?
- How can members collaborate to improve AI's use in battery circularity?

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DEFINING BATTERY CIRCULARITY

Definitions

Battery circularity focuses on keeping battery materials in use for as long as possible, rather than discarding them after a single use.

Battery circularity, as discussed by the World Economic Forum (WEF), refers to a system where end-of-life (EOL) electric vehicle (EV) batteries are reused, repurposed, or recycled to create new batteries, minimizing reliance on virgin materials and reducing environmental impact.[1] Battery circularity focuses on keeping battery materials in use for as long as possible, rather than discarding them after a single use. Focusing on battery circularity can help to reduce reliance on raw materials, enhance supply chain resilience, reduce emissions, and provide economic opportunities by creating new jobs in battery recycling and repurposing.

Current Challenges

The World Economic Forum has identified several hurdles to achieving battery circularity. Chief among them are lack of value chain transparency, data access issues, and high investment costs for recycling and reuse.

The WEF report mentions several current challenges to achieving battery circularity (WEF, 2025). Some of these are listed below, along with how AI can play a role in meeting these challenges:

Lack of transparency across the full value chain: The current EV battery value chain is both geographically concentrated and dispersed. This often obscures the environmental and social impacts of EV batteries from materials sourcing and manufacturing to end-of-life, preventing the mitigation of—and accountability for—these impacts. Without visibility into all these factors, buyers have less ability to differentiate and procure lower-impact batteries, hindering due diligence efforts, and producers have less incentive to reduce their impacts.

WEF recommends widespread implementation of traceability activities with standardized data tracking and disclosure frameworks (WEF, 2025). One of AI's core capabilities is to unlock relationships between complementary and competing factors that affect the EV battery value chain. Unlocking these complex relationships can be easily done by using AI, which requires global data standardization.

Battery design data access: The current battery design prioritizes first-life performance and safety. Combined with limited access to Battery Management System (BMS) data, this hinders capacity for battery repairs along with second-life uses and recycling. The use of AI models to prolong first-life performance is well documented.[2] Such studies involve sophisticated equipment to extract data from the batteries. Battery makers and EV manufacturers can work to make this data easily accessible for value chain members to easily train AI models to extract this data without requiring sophisticated equipment.

Challenging economics of recycling and second life: The investments required

[1] Powering the Future: Overcoming Battery Supply Chain Challenges with Circularity, World Economic Forum, January 2025.

[2] Antony Jose, S., Cook, C. A. D., Palacios, J., Seo, H., Torres Ramirez, C. E., Wu, J., & Menezes, P. L. (2024). Recent Advancements in Artificial Intelligence in Battery Recycling. Batteries, 10(12), 440. https://doi.org/10.3390/batteries10120440.

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for new recycling infrastructure are staggering[3], and the supply chain involved in moving recycled material to the secondary market is complex.

Regulatory Landscape

The European Union's landmark battery regulations are a key driver for safer, cleaner, more efficient battery supply chain processes. One of the critical enablers of battery circularity highlighted in these regulations is the battery passport.

The EU Batteries Regulation will ensure that, in the future, batteries have a low carbon footprint, use minimal harmful substances, require fewer raw materials from non-EU countries, and are collected, reused, and recycled to a high degree in Europe. This will support the shift to a circular economy and increase the security of supply for raw materials and energy. One of the key enablers for battery traceability in the EU regulation is the battery passport.[4] It is clear from the regulation's requirements that the battery supply chain will produce battery life cycle data at an unprecedented level and that stakeholders must share such data to provide traceability from raw material mining to end-of-life. Enforcement agencies can use AI tools for compliance activities. At the same time, companies can use AI to scour through a treasure trove of battery data to create new products and services for more efficient traceability.

Section 30D of the Internal Revenue Code, as amended by the Inflation Reduction Act (IRA) of 2022, provides a federal tax credit for qualifying new clean vehicles, including EVs, plug-in hybrid electric vehicles (PHEVs), and fuel cell vehicles (FCVs).[5] The purpose of this credit is to encourage domestic EV adoption and promote supply chain resilience by incentivizing U.S. production and critical mineral sourcing. Among other requirements, to be eligible for the credits, the vehicles must be manufactured in the U.S., Canada, or Mexico by a qualified manufacturer and must meet battery component and critical mineral sourcing requirements. Without going into details, the regulation requires that the value of critical minerals and critical components extracted/processed/manufactured in the U.S. or in countries with which it has free trade agreements must exceed a certain value specified by the tax authorities. This means the qualified manufacturers must provide evidence of mineral and material sourcing to estimate such value to be eligible for tax credits.

Regulations in other regions of the world are also increasingly concerned with battery circularity and the promotion of electric vehicle usage.

The Advanced Clean Cars II (ACC II) regulations take California's already growing EV market and augments them to meet more aggressive tailpipe emissions standards and ramp up to 100% ZEVs.[6] ACC II requires all new EVs from model year 2026 to have proper labels about the batteries, including a website for the general public to query battery data such as manufacturing information, state of health (SOH), and more. Unlike the EU Batteries Regulation, the ACC II regulation does not include comprehensive traceability requirements.

[3] Key Challenges of Large-Scale Battery Recycling and How to Resolve Them, https://www.batteryrecyclersofamerica.com/key-challenges-of-large-scale-battery-recycling-and-how-to-resolve-them/?srsltid=AfmBOoqnSThHCQQ71ombs2G-83jtX-TFjkMnV9_vKRdlPRkdW2-XPJbH, Accessed April 14, 2025.

[4] Battery passport is an "electronic record for each battery placed on the market….it is a "a structured collection of product-related data with a predefined scope and agreed data ownership and access rights conveyed through a unique identifier." The battery passport shall "electronically register, process and share product-related information amongst supply chain businesses, authorities, and consumers."

[5] Section 30D New Clean Vehicle Credit, Federal Register, https://www.federalregister.gov/documents/2023/04/17/2023-06822/section-30d-new-clean-vehicle-credit, Accessed April 02, 2025.

[6] https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii

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ARTIFICIAL INTELLIGENCE: A GENTLE INTRODUCTION

Definition of Artificial Intelligence

AI is a discipline that includes techniques and models to identify relationships between variables, classify data, and predict future outcomes. Machine Learning (ML) includes models to identify the relationships in the data, classify them, and improve future outcomes by learning from output.

2024 Nobel Prize winner and 2018 Turing Award winner Geoffrey Hinton defined AI as a "...new form of intelligence that is fundamentally different from human intelligence." Andrew Ng (Stanford University, Google Brain) defined AI as "the ability of machines to perform tasks that would normally require human intelligence."

AI is a discipline that includes techniques and models to identify relationships between variables, classify data, and predict future outcomes. Machine Learning (ML) includes models to identify the relationships in the data, classify them, and improve future outcomes by learning from output. It involves searching for useful representations of input data, within a predefined space of possibilities, using guidance from a feedback signal. ML is a subfield of AI, and its use has grown exponentially driven by the availability of faster hardware and larger datasets. ML models can be classified as supervised, unsupervised, and reinforcement learning:

ML models can be classified as supervised, unsupervised, and reinforcement learning.

Supervised Learning: Supervised ML is a type of ML where an algorithm learns from labeled training data to make predictions or classify new data. It works by mapping input variables (X) to an output variable (Y) based on examples provided during training. There are two broad categories of supervised learning: regression and classification. Regression is used to predict the value of a dependent variable given a set of independent variables. Classification is used to find distinct classes of values.

Unsupervised Learning: Unsupervised ML is a type of ML where the algorithm learns patterns and structures from unlabeled data without predefined categories or outcomes. The goal is to find hidden patterns, groupings, or structures in the data. Clustering, dimensionality reduction, anomaly detection, etc. are different types of unsupervised learning.

Reinforcement Learning: Reinforcement ML is a type of ML where an agent learns to make decisions by interacting with an environment and receiving rewards or penalties based on its actions. The goal is to maximize cumulative rewards over time.

Strengths and Capabilities of AI

ML can be used to organize large data sets, make predictions based on data, and more.

Machine learning techniques are widely used to:

» Classify, cluster, and annotate high-dimension data with many attributes
» Detects gaps and anomalies in a data stream or large datasets
» Prediction of future state
» Planning and decision making

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ROLES AI CAN PLAY IN BATTERY CIRCULARITY

There is massive potential for the use of AI in the battery supply chain, examples of which are described inexhaustively herein.

AI's potential role in battery circularity can be described by its four capabilities:

- **High-dimensional data analysis**
  - Find clusters of batteries with common defects, such as faster SOH degradation.
  - Identifying issues in the battery supply chain that may include hundreds of variables.
- **Automated detection of anomalies**
  - Discovering broken battery passport links.
  - Discovering fake battery passports.
- **Predictions**
  - Predicting which batteries will become hazardous (expected life of batteries) and need to be collected for repurposing/remanufacturing/recycling.
  - Predicting remaining capacity and SOH of the batteries.
  - Predicting which batteries are suitable for second-life applications.
- **Decision Making**
  - Optimizing identification of used vs. waste batteries by analyzing their passport history as well as physical/chemical damages.

Recycling and Material Recovery

One of AI's most promising applications lies in its potential to enhance the efficiency and accuracy of sorting processes in battery recycling, a critical challenge in waste management.

One of AI's most promising applications lies in its potential to enhance the efficiency and accuracy of sorting processes in battery recycling, a critical challenge in waste management.[7]

Circu Li-ion's AI-based technology[8] disrupts the otherwise inefficient cycle of battery recycling by employing AI and a comprehensive battery library to diagnose the health of individual battery cells within seconds. This rapid and precise diagnosis allows the company to save usable cells from being shredded, thereby reducing waste and optimizing resource utilization.

AI detection systems utilize visual inspection to assess quality, identify defects, and ensure the correct placement of materials. This technology, already widely used across multiple industries, is now being applied to address the biggest challenge in recycling: effectively sorting recyclables from waste.[9]

[7] What Is AI Visual Inspection for Defect Detection? A Deep Dive. Available online: https://marutitech.com/ai-visual-inspection-for-defect-detection/, Accessed on 19 March 2025.

[8] How a Startup Is Tackling Battery Waste With AI, November 23, 2023, https://eepower.com/tech-insights/how-a-startup-is-tackling-battery-waste-with-ai/#, Accessed on 19 March 2025.

[9] Artificial Intelligence for Recycling: AMP Robotics. Available online: https://www.ellenmacarthurfoundation.org/circular-examples/artificial-intelligence-for-recycling-amp-robotics, Accessed on 19 March 2025.

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AI is used to refine the sorting accuracy, computer vision for battery recognition, material composition analysis, and robotic systems for automated dismantling.

The effectiveness of AI models in battery recycling depends heavily on access to high-quality data for training and inference. This requires more acute data standardization than what is currently practiced.

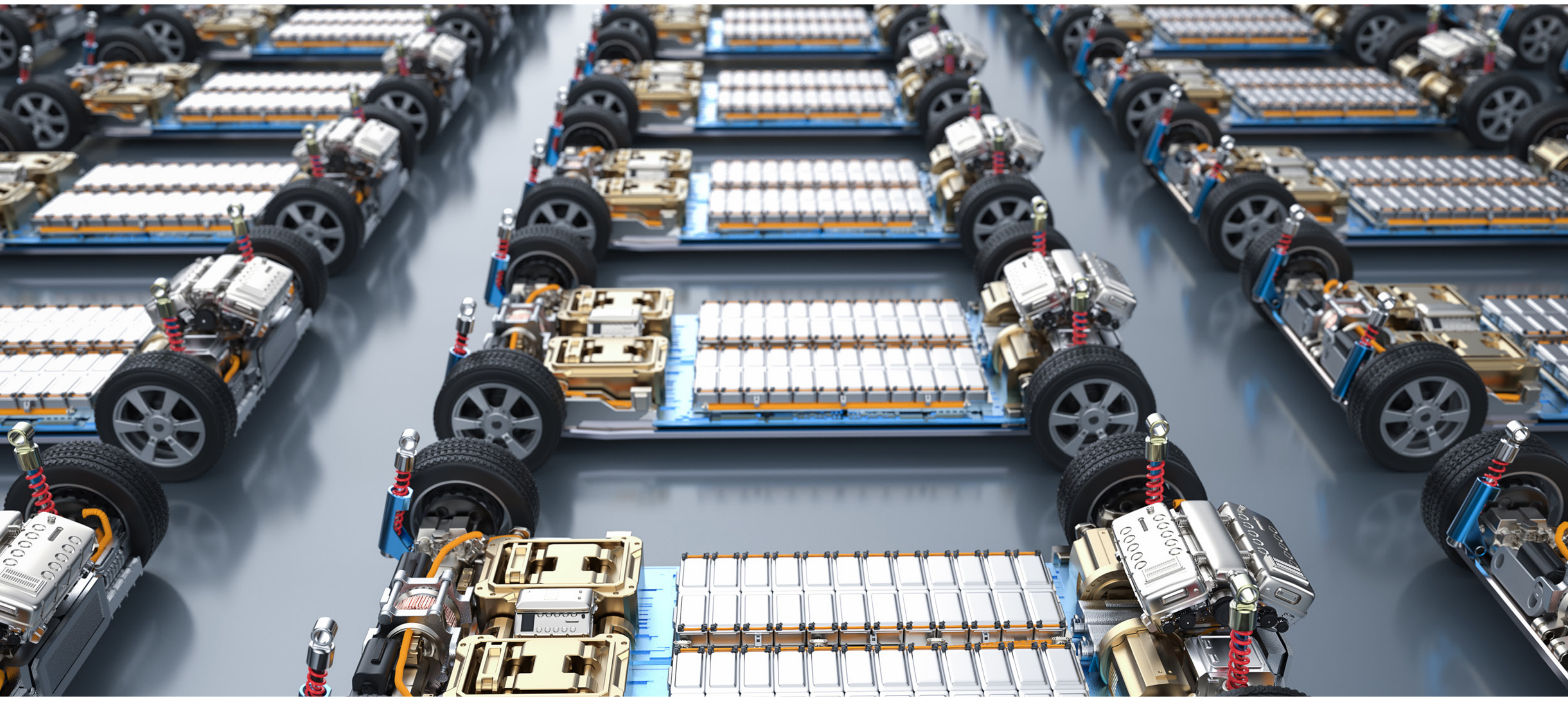
The effectiveness of AI models in battery recycling depends heavily on access to high-quality data for training and inference. However, obtaining comprehensive datasets encompassing various battery types, states of charge, degradation levels, and recycling outcomes is a formidable challenge. Furthermore, the lack of data standardization across different recycling facilities and geographical regions hampers the development of universally applicable AI-driven solutions, making it difficult to create models that can be effectively deployed globally.[10]

Supply Chain Track-and-Trace

ML can enhance supply chain track-and-trace by improving visibility, accuracy, and efficiency across logistics networks. Capabilities include telematics data processing, predicting supply fluctuations, error detection, and more.

Machine learning can enhance supply chain track-and-trace by improving visibility, accuracy, and efficiency across logistics networks. Capabilities of machine learning include:

» Processing data from telematics devices and barcode scanners to track used and waste battery shipments for security and traceability.
» AI-powered cameras identify, classify, and track waste batteries (and those with potential temperature events) at warehouses and transit points.
» Identifying irregular shipment patterns or unauthorized route changes.
» Detecting fake invoices, cargo theft, or unauthorized handling of batteries.
» Predicting supply fluctuations to avoid overstocking or shortages.
» Detecting damaged or mislabeled batteries, as well as incorrect shipments.
» Ensuring batteries meet safety, environmental, and traceability regulations.



[10] Antony Jose, S., Cook, C. A. D., Palacios, J., Seo, H., Torres Ramirez, C. E., Wu, J., & Menezes, P. L. (2024). Recent Advancements in Artificial Intelligence in Battery Recycling. Batteries, 10(12), 440. https://doi.org/10.3390/batteries10120440.

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Economic/Environmental Impact Modeling

ML helps assess and minimize the environmental footprint of batteries through life cycle analysis (LCA), emissions tracking, and waste reduction. Capabilities include emission predictions, compliance analysis, price forecasting, battery health tracking, and more.

ML helps assess and minimize the environmental footprint of batteries through life cycle analysis (LCA), emissions tracking, and waste reduction. Capabilities include:

» Predicting carbon emissions, energy consumption, and pollution at each stage of the battery supply chain.
» Analyzing used battery data to determine which can be repurposed, reused, or recycled.
» Optimizing reverse logistics for collecting and sorting EOL batteries.
» Flagging environmental risks such as deforestation or water usage in battery raw material extraction.
» Ensuring compliance with the EU Battery Regulations and other sustainability policies.
» Optimizing cost efficiency, risk management, and supply chain resilience in battery traceability.
» Predicting future costs of raw materials and battery production based on market trends.
» Simulating supply-demand imbalances to prevent overproduction or shortages.
» Forecasting lithium price volatility, helping manufacturers hedge against price fluctuations.
» Optimizing routes for reduced transportation costs and emissions.
» Minimizing waste in supply chains by tracking battery health in real-time.
» Helping EV manufacturers reduce logistics costs by optimizing battery shipments.
» Detecting counterfeit batteries and regulatory violations using supply chain tracking.
» Predicting battery recall risks, preventing costly failures.
» AI-backed risk analysis helps companies comply with the EU Battery Regulation (2023).

Life Cycle Prediction and Optimization

ML algorithms play a significant role in EV battery management, predicting SOH and the remaining life of batteries[11] [12] , finding ways to extend battery life, optimizing battery design, and recycling.[13] ML can enhance material composition analysis, predict metal recovery, and optimize resource allocation. Likewise, intelligent robotics can automate the dismantling process for increased safety and efficiency.

[11] Gong, J.; Xu, B.; Chen, F.; Zhou, G. Predictive Modeling for Electric Vehicle Battery State of Health: A Comprehensive Literature Review, Energies 2025, 18, 337.
https:// doi.org/10.3390/en18020337.

[12] de la Iglesia, D.H.; Corbacho, C.C.; Dib, J.Z.; Alonso- Secades, V.; López Rivero, A.J., Advanced Machine Learning and Deep Learning Approaches for Estimating the Remaining Life of EV Batteries—A Review. Batteries 2025, 11, 17.
https://doi.org/10.3390/batteries11010017.

[13] Antony Jose, S.; Cook, C.A.D.; Palacios, J.; Seo, H.; Torres Ramirez, C.E.; Wu, J.; Menezes, P.L. Recent Advancements in Artificial Intelligence in Battery Recycling. Batteries 2024, 10, 440.
https://doi.org/10.3390/ batteries10120440.

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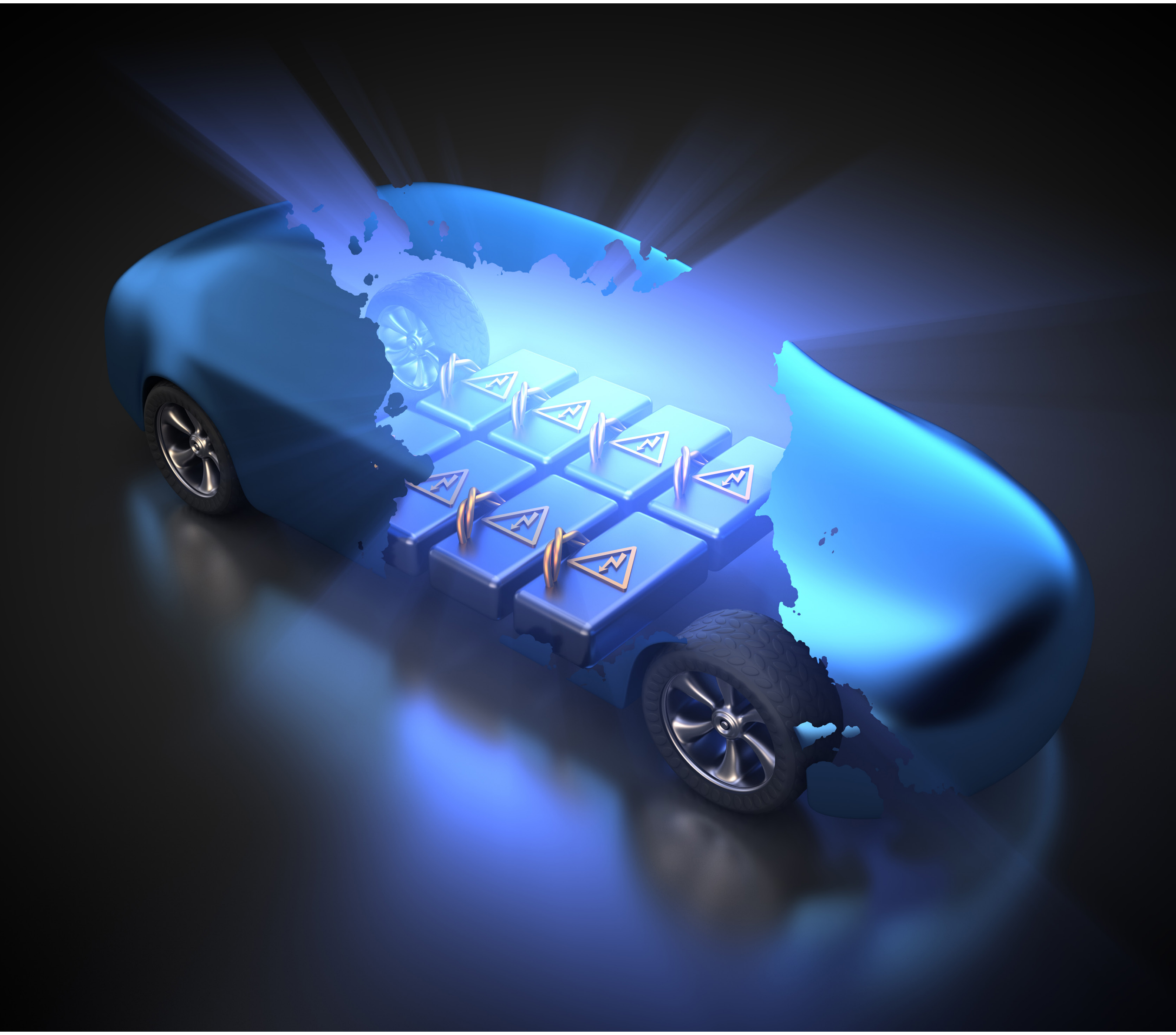
ML can help businesses comply with regulations like the EU's Digital Product Passport by analyzing product information for compliance risks and ensuring accurate documentation.

Battery Passport Management

Machine learning can use data from passports of multiple batteries and even other associated products to improve product lifecycle management and sustainability. ML can identify patterns, predict risks, and optimize processes, ultimately leading to more sustainable and efficient practices. ML can be used to analyze the validity and accuracy of the data in the passport by correlating it with proprietary and non-proprietary data. ML can personalize product information and recommendations based on individual consumer preferences, aligning sustainability with specific needs. ML can help businesses comply with regulations like the EU's Digital Product Passport by analyzing product information for compliance risks and ensuring accurate documentation.



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INTEGRATION OF AI WITH WEB3

Definition of Web3

Web3 is a broad term used to describe a more interconnected, user-controlled, trust-rich web, capable of enabling better data tracking, processing, and verification across complex value chains.

Web3 is about trust and cross-industry interoperability — seamless interconnection and cooperation among diverse systems, organizations, and industries, with trusted identities and verifiable transactions. Web3's essence lies in the ability to create a decentralized network where data ownership and control are democratized, unlike the centralized structures of traditional blockchain and cryptocurrency systems.

Strength and Capabilities of Web3

Web3 provides the foundation for a standardized method of verifying identities and claims, crucial in establishing digital trust and ensuring seamless interoperability across various enterprise environments. This paves the way for a future where digital interactions are more secure, transparent, and user-driven.

Combination of AI and Web3 Capabilities

AI by itself is not inherently trustworthy. Web3 can be used to ensure that the data used in AI models are trustworthy by ensuring every data is digitally signed.

AI is an unprecedented tool to discover relationships between variables and predict the new state of the battery supply chain. However, it requires depth and spread of reliable and trustworthy data to ensure the AI results are credible. Web3 can be used to ensure that the data used in AI models are trustworthy by ensuring every data is digitally signed.

Stakeholders in the battery supply chain can use AI as a tool to detect anomalies and predict conditions in the chain, allowing for appropriate planning to increase operational efficiency and drive circularity. Training AI models for detection, prediction, and decision-making requires quality data which, in the case of battery traceability, will include proprietary ones that originate from multiple stakeholders in the value chain.

To extract value from shared data, companies will increasingly turn to protocols such as multi-party computation or zero-knowledge proofs, which allow them to analyze data from multiple parties without any entity revealing its data to others.

Web3 can be leveraged to provide assurances that the data used in the AI models came from known and trusted sources. This is of equal importance to having the quality and quantity of data for training the AI models. However, such information pooling will have to contend with regulations and company policies that constrain the ability of data to move across jurisdictions, or otherwise limit data sharing to protect consumer privacy. To extract value from shared data while working within these limitations, companies will increasingly turn to protocols such as multi-party computation or zero-knowledge proofs, which allow them to conduct analysis or computation on data from multiple parties without any entity revealing its data to others.[14]

[14] How the combination of AI and Web3 could reinvent business, February 09, 2024, https://www.ey.com/en_gl/innovation-realized/how-the-combination-of-ai-and-web3-could-reinvent-business

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CHALLENGES IN DEPLOYING AI FOR BATTERY CIRCULARITY

Uncertain return on investments

The return on investment (ROI) of enterprise-scale AI deployment is often difficult to predict. The AI needs to be trained on high-quality data arranged in a standardized format.

- The effectiveness of AI deployments at enterprises, typically measured by the return on investment (ROI) is often difficult to predict. The effectiveness of AI models and their ability to predict future outcomes is known only after testing them on available data, which may or may not be adequate in scale, depth, and quality. Not being able to ensure positive ROI hinders the investment in AI deployment.
- One of the biggest predictors of ROI is the quality of training data. The quality of data is not known before training the models. Data scientists use various feature engineering methods to “clean” the data. At companies that do not have highly structured, standardized, linked, and cleaned data, the feature engineering to obtain the clean data can be cumbersome and expensive.
- Another point here is that the recycling and end-of-life business models are not yet profitable, especially without government incentives or carbon credits. This seems to limit the work in the R&D phase.

Sharing proprietary data outside organizational walls

The availability of battery circularity-related data is limited, with complicated ownership and business contracts that manage the use of data, which limits the availability of training data. This makes it difficult to build models.

- AI practitioners have long talked about using federated learning techniques to increase the scale and size of training data. In this technique, an entity “sends” ML models to data sources where the models are run and results are sent back to the entity. This technique protects the proprietary data rights of companies that do not want to share their enterprise data. There are two fundamental flaws in this technique: (1) the selection of the right ML models without sample data from the sources is questionable, and (2) the entity that receives the results does not know the quality of the data from where the models are being run.
- The availability of battery circularity-related data is limited, with complicated ownership and business contracts that manage the use of data, which limits the availability of training data. This makes it difficult to build models.
- Even if the data is available from multiple sources, there is a lack of standardized battery data across the entire value chain. This results in costly data acquisition, cleaning, and pre-training AI models.

Separating hype from reality

Due to decreases in computing costs and open-source collaborations, more startups are building with AI. Investments in AI are projected to reach $200B in 2025, according to Goldman Sachs and Stanford Institute for Human-Centered Artificial Intelligence.

- Well-resourced companies and researchers in the mobility and supply chain space have been using AI to improve manufacturing processes and use automated machines to perform tasks such as warehouse stacking, delivery route optimization, automated driving, and more. In the last five years, the AI space has shifted “for the better”—i.e., small companies and startups now have access to AI tools like large language models. Due to decreases in computing costs and open-source collaborations, more and more startups

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are building groundbreaking discoveries using AI. Along with it, investments in AI are projected to reach $200 Billion in 2025 according to Goldman Sachs and Stanford Institute for Human-Centered Artificial Intelligence.[15]

» Due to increasing investments and recent developments in multimodal large language models (LLMs), companies are under pressure to join the bandwagon of investments in research and development as well as building AI-infused products, sometimes without a clear return on investment. The AI hype is real — but so are the opportunities.

Quickly evolving AI landscape

» An AI model built to identify unlinked or "broken" battery passports may need data from multiple companies who issued passports for the same battery. Without proper data-sharing agreements between these companies, it would be difficult to find why the passports are not linked together.

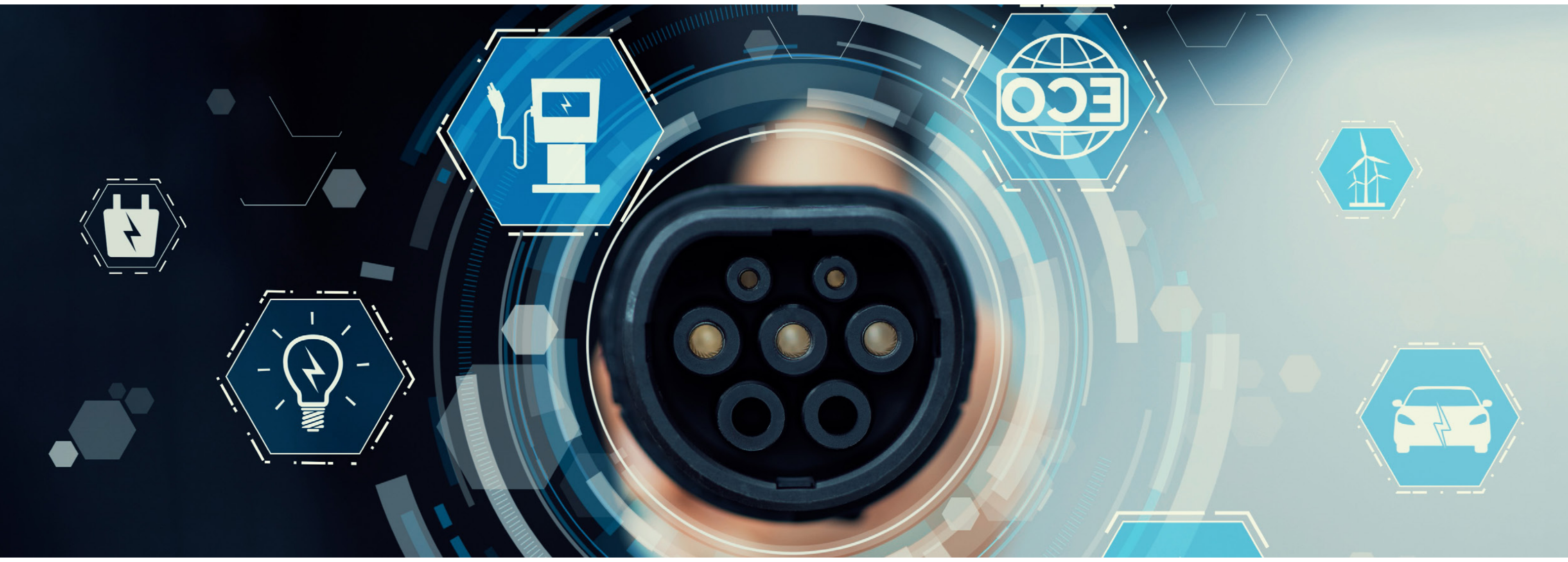
» Small and medium-sized companies in the battery value chain do not have adequate resources to train models. Hence, they must provide the data to third-party companies with the resources.

Non-linear characteristics of battery usage

The general data required for battery aging is quite complicated and relies on a lot of non-linear data like temperature, driver behaviors, and usage patterns, which can pose challenges to AI without physics-based models.

» In EVs, the BMS is responsible for battery-pack sensing, battery-state estimation, and diagnosis, along with ensuring energy-efficient control of the EV battery pack. Battery pack state of charge (SOC) and SOH estimation using empirical models are challenged by nonlinear battery characteristics within each cell and inconsistencies in performance between them (Ahmed et al, 2021). Hence, researchers are exploring the use of ML.

» The general data required for battery aging is quite complicated and relies on a lot of non-linear data like temperature, driver behaviors, and usage patterns which can pose challenges to AI without physics-based models.



[15] AI investment forecast to approach $200 billion globally by 2025, August 1, 2023, https://www.goldmansachs.com/insights/articles/ai-investment-forecast-to-approach-200-billion-globally-by-2025.

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OVERCOMING ADOPTION CHALLENGES

Multi-jurisdictional investments and industry collaboration among battery value chain members will be required to deploy satisfying AI-driven processes at scale.

Investments

Investments play a crucial role in developing new AI models for battery circularity by funding research, infrastructure, and implementation. Investments by the government and through collaborative efforts will allow engineers to find more efficient AI models to predict battery lifespan, assess quality for reuse, and suggest sustainable materials. It will also help companies to collect large datasets across the diverse value chain. AI tools must be accessible to small businesses through platforms and cloud services. These small businesses form a significant part of the battery value chain. Funding helps small and medium enterprises (SMEs) integrate AI without heavy upfront costs.

Industry Collaboration

The battery value chain is multi-jurisdictional and involves multiple entities. Value chain members must collaborate to create battery circularity data standards, form partnerships to share data, and implement projects that utilize AI to enhance it. They can also provide pooled funding for open-source projects for AI adoption in recycling and second-life applications.

The success of these investments and collaborations hinges on universal data standardization and digitization of processes.

Data Standardization

Using industry collaboration with standards organization, the industry must develop standardized definitions of terminologies, data attributes, and schemas that describe various aspects of battery traceability. Such standards will allow the stakeholders to easily share data in a standardized format which will significantly reduce the cost of training AI models.

Digitization of Processes

Digitization of processes involved in battery traceability across all value chain members along with standardized input and output data creates a tremendous amount of data available for training AI models. Understandably, this is a tall order given the large number of SMEs involved in battery traceability. SMEs may not have easy access to digital systems and software applications.

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