



WHITE PAPER

Driving the circular economy: Batteries, EVs, and the importance of connected data

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Executive summary:

Electrification is transforming the transportation, industrial, and utility markets. Batteries, electric vehicles (EVs), and the power grid must communicate to minimize disruptions throughout their circular economy. This paper will focus on the data infrastructure needs of the battery and EV life cycle as they transform related industries, from metals and mining to battery recycling. As more EVs hit the roads, an information supply chain among these adjacent industries will make data more valuable than ever.

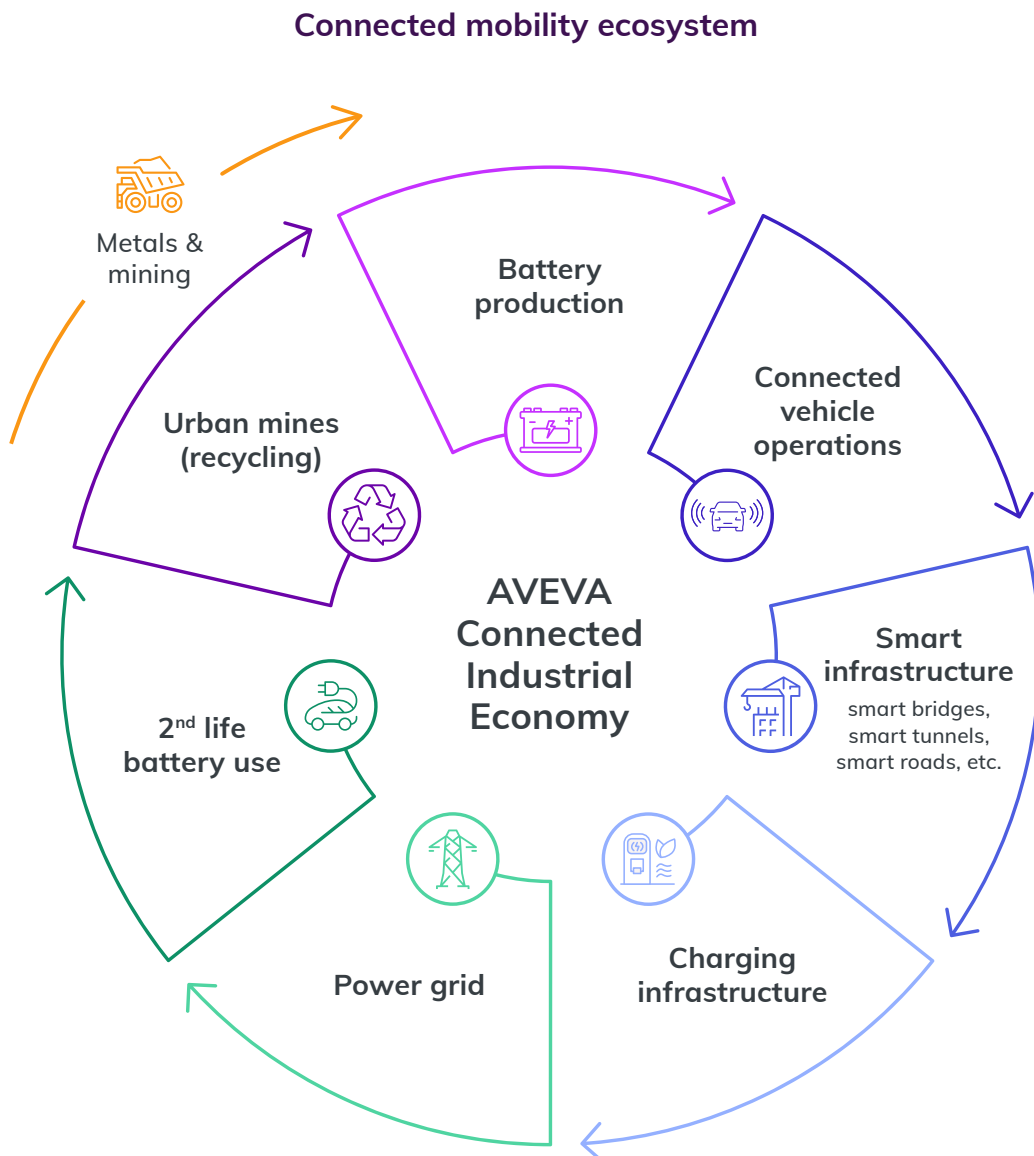
The push for a sustainable future

What used to be a secondary concern for enterprises is now a growing area of focus: sustainability. As it continues to play a larger role in how people live and work, sustainability is also of increasing concern to stakeholders, investors, employees, and communities. The advent of electrification as sustainable energy and electric vehicles (EVs) as an extension of its reach creates challenges and opportunities for an entire ecosystem of adjacent industries and players. From mining and battery manufacturing to EVs, charging infrastructure, second-life batteries and even brand loyalty, real-time data sharing within this ecosystem will be critical to success throughout the value chain.

What is a circular economy framework?

A circular economy is an industry system that is restorative or regenerative by design. It replaces the end-of-life concept with restoration, shifts toward renewable energy use, and aims to eliminate waste through superior design of materials, products, systems, and business models. Transitioning to a circular economy works to eliminate hard-to-abate emissions from many industry verticals. Circularity is considered a critical component for addressing the impacts of climate change.

In the case of EVs and connected mobility, a circular economy framework is key to creating an information infrastructure in which all members of its ecosystem share access to business-critical data in real time.





Mining operations

Growing demand for EVs has created a step change in rare earth mineral demand. But along with it comes the need to look at energy use required for production. Electrification of transport equipment in underground mines is progressing, which also necessitates scheduling not just downtime, but also charging time for equipment. A growing goal to get the most out of the ground with the lowest energy impact makes local mine power supply management even more critical while also creating a greater need for automation.



Electric vehicles

EV manufacturers are essentially becoming power companies. Notably, General Motors recently launched GM Energy, marketing it as an extension of the business that designs “integrated energy solutions” for consumers. Just like power companies, vehicle manufacturers have concerns about their energy supply, where their electrical loads are, and how to perform matching and pricing. While traditional heating and cooling residential loads are driven by time of day, day of the week, and outside temperature, EV power consumption is far less predictable.



Battery manufacturers

The second player in the ecosystem, battery manufacturers, is directly tied to mining and, of course, to EVs themselves. Increasingly, they are locating their operations near mining sites to improve logistics. Beyond access to minerals, battery manufacturers’ main issue is quality—as many as 20% to 30% of batteries are scrapped during production, and costly recalls hamper revenue and reputation. Energy is a key component as manufacturers move from an old model of overloading capacity to maintain range over time to a model that favors a more conservative charging scheme with less degradation.

With the EV industry demanding steep production growth for batteries while demanding less waste and lower environmental impact, battery manufacturers must increase efficiency and monitor energy use, asset health, and in-line quality. Without a robust data infrastructure, this is next to impossible.



Second-life and recycled batteries

The circular economy framework is not sustainable without second-life battery use. The end of an EV battery warranty is generally considered to be at 80% of capacity for initial use purposes. However, the secondary market for batteries must follow the secondary market for EVs. For example, an EV with a new range of 330 miles could still be operating with 264 miles of range. This might happen after 10 years of use, making it likely to see a reliable EV operating well past the 10-year window. There is also a flourishing use for second-life batteries as microgrid storage, receiving and then discharging solar energy to power buildings after the sun goes down.

Approximately 98% of battery materials are recyclable, so even past their second-life use, batteries can be broken down chemically. Recycling and urban mines are still in a startup phase, but it is expected, as mining companies are also sometimes refiners of raw materials, that battery recycling companies will create precursors, closing the material loop by manufacturing battery components with recovered materials.

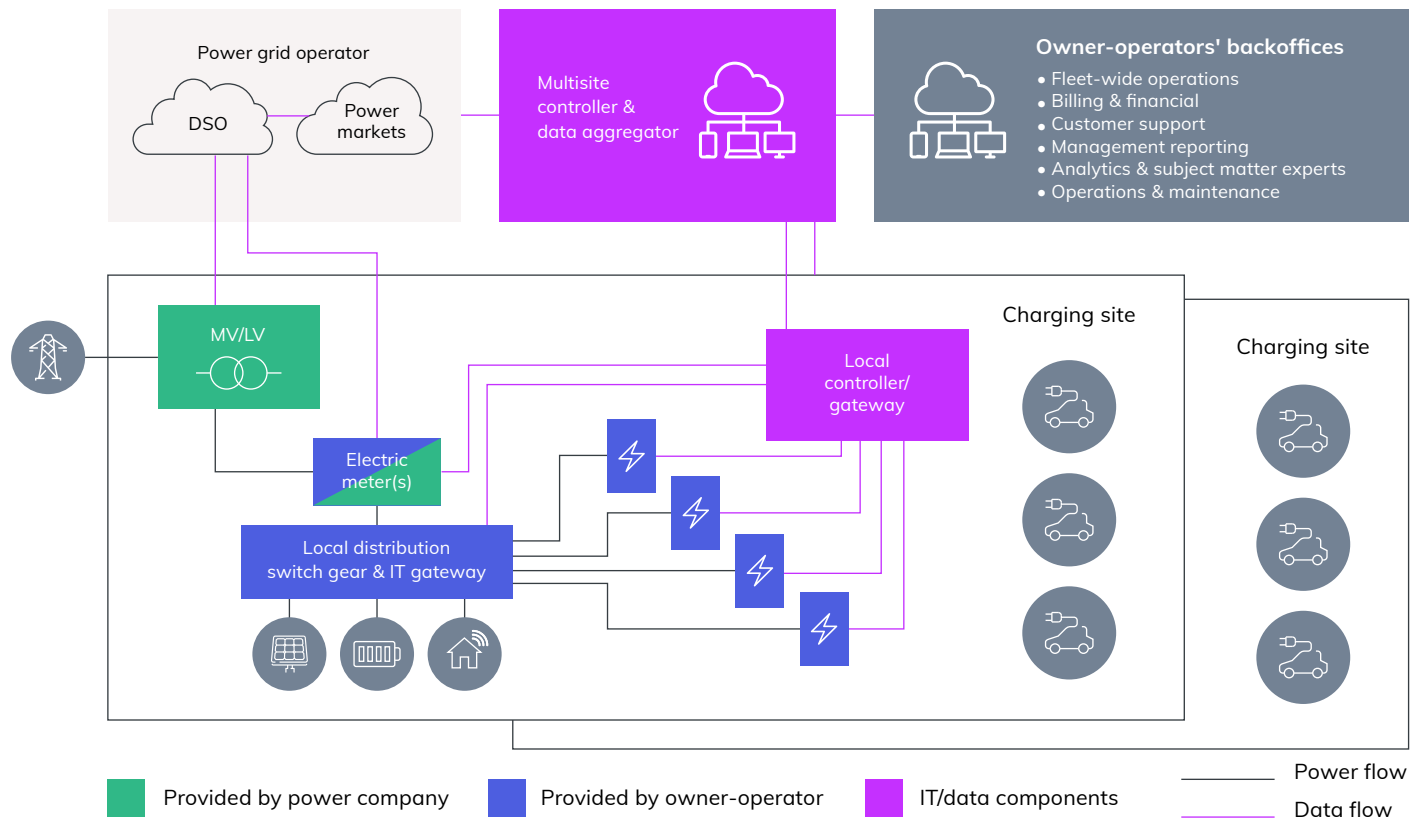


Charging infrastructure

In a connected infrastructure, the role of charge point operators (CPOs) is also critical to EV manufacturers, consumers, and the power grid. The CPO is a public charging site connected to a utility company, typically with a set of stations perhaps using solar power and storage. Managing these complex networks while attempting to innovate offerings and maintain the highest degree of customer satisfaction is next to impossible without a robust data infrastructure, led by a

cloud-based data hub for information coordination and a unified view of the situational awareness.

This connected infrastructure not only addresses practical concerns, such as supply and load in real time, but also extends to AI-driven analytics to predict issues like battery or equipment failure across entire fleets. Companies can also use it for portfolio management to monitor financial health.



Power grid dynamics

The conventional power grid is evolving into what is known as a “prosumer”—both a producer and consumer of energy tied to the grid. Because EVs are behind the meter, they present challenges for the grid and opportunities to improve them. Whether EVs use V1G managed charging or deliver power back to the grid via V2x, the need to manage a much wider set of assets

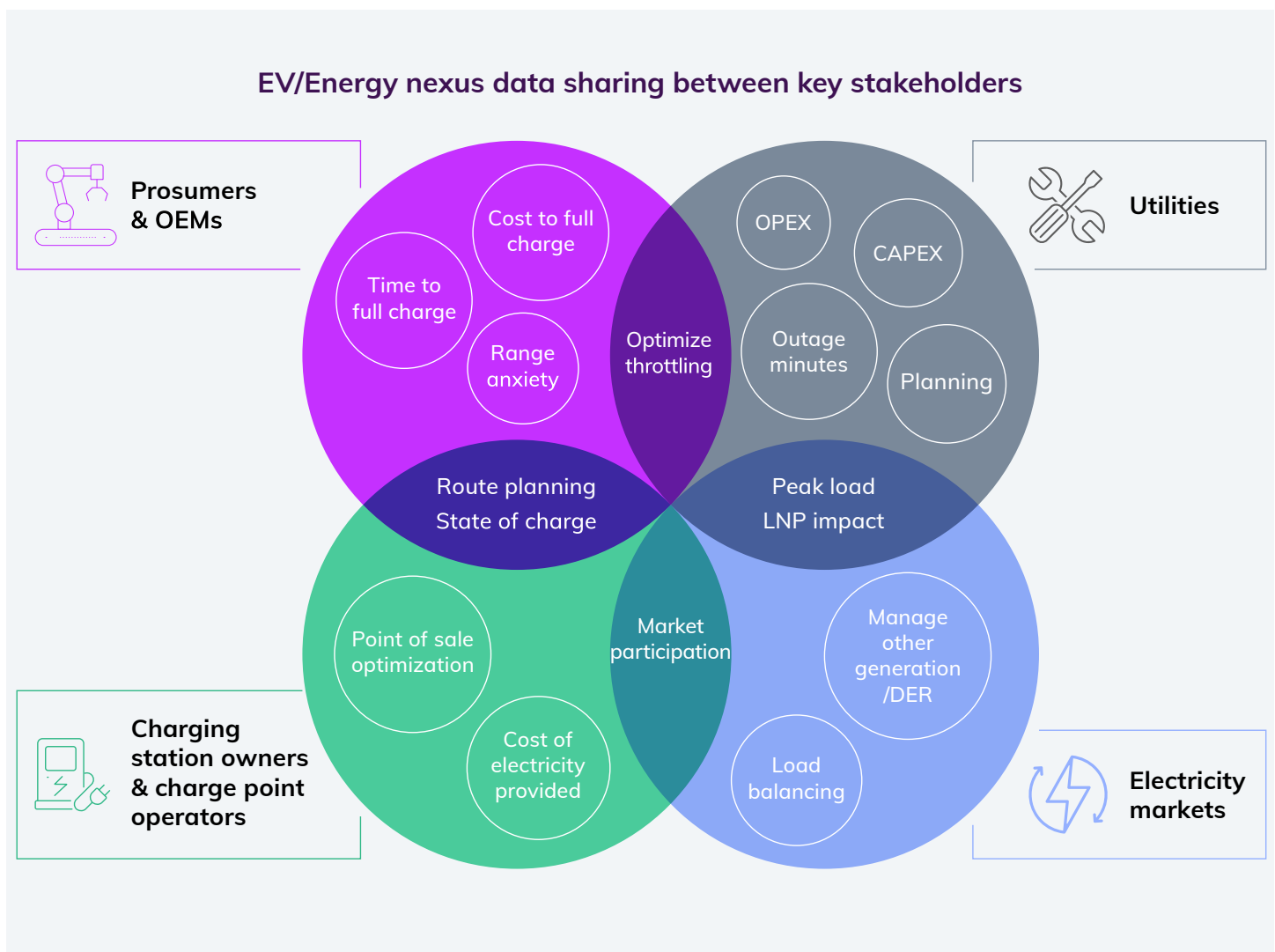
will arise for power utilities as EV use continues to grow. Data sharing between prosumers, utilities and aggregators is crucial to mitigating issues such as the “cul-de-sac problem,” referring to the stress on the power grid from EV owners coming home and charging vehicles at a peak time.

The circular ecosystem at work

This framework represents so much more than the life cycle of a battery. It's of great importance to the future of energy because electrification and EVs in particular put a concerning amount of demand on the grid, from operations and reliability to decarbonization and economics. As mandates for EV use expand, so does the need for a secure data-sharing infrastructure among vehicle manufacturers and all their adjacent market segments—all of whom benefit from this information exchange.

EV manufacturers should receive battery production and end-of-line testing data in real time, since they know exactly what the energy demands of each vehicle are. When drivers are en route to a CPO, EV manufacturers could alert them of impending energy load using their navigational data, helping ensure reliability and consumer loyalty.

When data is shared with the grid, it can supply power and predict peak loads. When batteries are recycled, that data can be shared ahead with the battery producer, so it can better plan demand for feedstocks ... and the cycle continues. Each adjacency forms a data community.



Data as a new currency

Each player in the ecosystem is interested in data specific to its expertise, but there is also significant crossover in what information is relevant to whom. Data needs to be centralized and shared to optimize the ecosystem over time. Moving forward, this data will become more and more valuable. The stakes are high. EV manufacturers want to improve user experience and decrease range anxiety. Utilities want to ensure they have a clear picture of supply and demand and meet their reliability metrics. This common data is far too complex, however, to share, extract, and analyze efficiently with spreadsheets. It must reside in a real-time hub with hybrid cloud architecture for ease of access, flexibility, and cost.

Conclusion

No matter what innovations await in the EV space, this circular economy framework will continue to exist. While today's challenge is breaking down siloes and connecting data communities throughout its ecosystem, tomorrow's is optimizing it. EV sales are projected to increase exponentially year on year, exacerbating existing constraints while introducing and compounding new burdens. These issues can be broken down through secure data sharing among and across the EV infrastructure.

Data infrastructure must be easy to implement and adapt at a moment's notice—adjusting to the breakneck speed at which the market is advancing to address new needs and increasing competition. Although the EV market is new, this concept is not. It is not a question whether some of these changes will come to be, but when.

About the author

In his current role on the Connected Mobility team, John is responsible for leading the vision of the electric transportation sector of AVEVA's global market. He works with customers in every segment of the circular battery economy, helping transform their companies' digital infrastructure to support a decarbonized world.



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