THE TOP FIVE THINGS TO KNOW ABOUT ELECTRIC VEHICLE BATTERIES

As electric vehicles (EVs) become more popular, many questions have surfaced regarding their batteries, environmental impact, and ethics. There's no doubt that the increasing demand for EVs will increase the demand for components that make up the vehicles, like batteries. The following talking points address common questions surrounding the impact EV batteries have and identify progress being made in this space. Each talking point is followed with references from studies and articles for those that want to dive deeper.

MINERALS USED IN EV BATTERIES ARE RECYCLABLE, AND THEY'RE USED TO PRODUCE NEW BATTERIES.

Most materials used in EV battery manufacturing, such as copper and aluminum, are widely recycled. This cuts down on the need for new raw materials.

- Copper, for instance, is 8 percent of the battery cell mass in the Chevrolet Bolt (compared to 2 percent for lithium),[1] and 100 percent recyclable while maintaining its valuable engineering qualities such as durability, high conductivity, and efficiency. Additionally, it can continually be used without damaging its engineering qualities.[2]
- While lithium has been more challenging to recycle, the increase in EV adoption creates more demand and spurs more recycling research and development for recycling it. There's already a company in Canada, Li-Cycle, that can recover greater than or equal to 95 percent of lithium-ion batteries materials.[3] Founded in 2016, the company quickly moved from pilot to commercial scale and can now process 5,000 tons of lithium-ion batteries annually at its Ontario, Canada commercial facility and is opening a second commercial facility in New York in 2020.[4]
- Some ways to make lithium-ion battery recycling more economically viable are "better sorting technologies, a method for separating electrode materials, greater process flexibility, design for recycling, and greater manufacturer standardization of batteries."[5]

- In California, where EV adoption is highest in the US, the Lithium-ion Car Battery Recycling Advisory Group formed to stay apprised of lithium-ion recycling technologies and advise the legislature on appropriate policies.[6]
- Recycled materials needed for EV battery manufacturing don't have to come solely from old EV batteries. Redwood Materials, a recycling startup, separates the materials needed for EV batteries from scrap technology they receive from consumers and companies (e.g., phones and small batteries from electronics). The company can recover more than 80 percent of lithium, and 95–98 percent of cobalt, copper, and nickel to be then used for producing new EV batteries. Beyond what is lost in the recycling process, there is no degradation to the atoms. That means the materials can be continuously recycled, reducing the need for mining new materials.[7]

EMISSIONS ASSOCIATED WITH EV BATTERY PRODUCTION ARE DECLINING.

Battery manufacturing has decreased in emissions in the last several years. And we expect the emissions will continue to go down as the production process becomes more efficient and less reliant on fossil fuels to power the plants. It's another reason to invest in solar- and wind-generated electricity.

- Using cleaner electricity in the battery manufacturing process leads to lower emissions attributable to the battery manufacturing process and, therefore, to cleaner batteries. In 2018, the International Council on Clean Transportation (ICCT) reported that the expected decarbonization of electric grids by 30 percent will lower battery manufacturing emissions by 17 percent by 2030. Furthermore, it stated that electricity decarbonization will lead to additional emissions reductions in the fabrication of other vehicle materials, such as aluminum.[8]
- A study by the IVL Swedish Environmental Research Institute stated that greenhouse gas (GHG) emissions from battery production decreased 47–59 percent from 2017 to 2019. *

- They indicated the decreased emissions are from running at full capacity, making battery facilities more efficient. Additionally, they indicated that facilities are incorporating more fossil-free electricity, which is also reducing emissions.[9]
- According to a 2018 ICCT report, lithium-ion batteries retain 75–80 percent of their original capacity after removal from EVs, meaning that their production's initial energy cost could be spread across with more use. The utility-scale, peak-shaving market is increasingly promising for the use of second-life batteries.[10]
- CCT's 2018 report also showed that combining developments in second life for batteries, battery recycling, grid decarbonization, and greater battery energy density lowered EV lifecycle GHG emissions by approximately 41 percent, accounting for a larger EV battery as well.[11]

MANUFACTURING AND RECYCLING BATTERIES WHEN THEY'RE AT THE END OF THEIR USEFULNESS PRODUCES FEWER GREENHOUSE GASES THAN CONVENTIONAL VEHICLES DURING THE SAME TIME PERIODS.

EV manufacturing has needed more energy during manufacturing than conventional cars and trucks. Even taking that into account, EVs produce far less GHGs during their lifetime than conventional cars and trucks.

- Lifecycle analysis conducted by the Great Plains Institute in 2017, using Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies Model, revealed that EVs offer significant GHG reductions compared to internal combustion engines, which was largely due to increased renewable energy added to the electricity grid. EVs charged in Xcel Energy's service territory showed a reduction of 65 percent GHG emissions while EVs charged in the Midwest Independent Transmission System Operator North Region's service territory showed a reduction of 53 percent GHG emissions. Vehicle and battery manufacturing was included as a component in the overall analysis.[12]
- According to a 2018 ICCT report, EV manufacturing requires more energy upfront than conventional vehicles because of battery production, but EVs travel farther on a given amount of energy and account for fewer emissions during the fuel production and the vehicle use phases. Additionally, they produce zero tailpipe emissions during the use phase when operating on the electric motor.[13]
- Evidence identified by ICCT suggests that each EV ends up only using its original battery since battery degradation is not a typical problem even among EVs with high travel activity.[14]

**Calculated from data in the report where data expressed GHG emissions as carbon dioxide equivalents (CO2-eq) per kilowatt-hour (kWh) of battery storage. 2019 data showed 61-106kg CO2-eq/kWh whereas 2017 data showed 150-200kg CO2eq/kWh.*

A LOT OF TECHNOLOGY, INCLUDING YOUR CELL PHONE AND COMPUTER, USES LITHIUM-ION BATTERIES.

Ensuring ethical and environmentally-friendly processes is a challenge for every industry that uses lithium-ion batteries. EVs are no exception. The industry is identifying ways to ensure the environmental footprint is small and respectful.

- Lithium-ion batteries power a range of devices, such as cell phones, laptops, power drills, and electric lawn equipment.[15]
- Traditional hybrids like the Toyota Prius use lithium-ion technology.
- Second-use applications for which battery performance is less critical provide a reuse option for EV batteries, as well as a possible stream of revenue that would offset the costs of recycling. Some secondary use applications for lithium-ion batteries include utility support of distribution grids, residential and commercial electric power management, power grid stabilization, and renewable energy system firming.[16]
- All devices powered by lithium-ion, not just EVs, require more research to improve battery chemistries and recycling to reduce their impact on the environment.

THE EV INDUSTRY IS LOOKING FOR OPTIONS OTHER THAN COBALT AND NICKEL TO ADDRESS HUMAN RIGHTS CONCERNS ASSOCIATED WITH COBALT MINING.

There are numerous allegations of human rights violations associated with cobalt mining in the Democratic Republic of Congo. As a result of the serious human harm from unsafe mining practices, many companies are turning away from using cobalt in EV batteries.

- Ten auto companies, including Toyota, Honda, and Ford, formed the Drive Sustainability campaign in 2017 to identify and address ethical and human rights issues surrounding mining practices for raw materials used in EVs.[17]
- As a result of a 2019 lawsuit filed against EV manufacturer Tesla and other tech companies for human rights violations associated with cobalt mining in the Democratic Republic of Congo,[18] Tesla announced it would develop cobalt-free cathodes. [19]
- General Motors made changes to the battery cell chemistry in its 2020 Chevrolet Bolt that increased its range; however, it hasn't stated what the new battery chemistry looks like.[20]
- In 2019, the Georgia Institute of Technology developed a solid-state battery using iron fluoride and plastic polymers, reducing the need for cobalt and nickel.[21] Other companies, including Ionic Materials, have also developed solid-state batteries and have indicated the technology is safer than traditional lithium-ion batteries.[22]

ENDNOTES

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Facilitated by the Great Plains Institute, Drive Electric Minnesota is a partnership of electric vehicle (EV) champions, including automakers and auto dealers, utilities, charging companies, environmental groups, and state and local government. The coalition paves the way for the deployment of EVs and charging infrastructure through public-private partnerships, financial incentives, education, technical support, and public policy. Learn more at http://www.driveelectricmn.org/