EV Batteries 101 The Basics

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In the United States, transportation contributes more climate-warming emissions and air pollution than any other sector. To reduce transportation-related climate pollution and avoid the worst effects of climate change, we must rapidly improve infrastructure for non-motorized ways of moving, and we must transition vehicle transportation to use electricity instead of fossil fuels. We must electrify the way we move.

The good news is that we are making progress -- an increasing number of people are buying electric vehicles (EVs) and many governments and employers are replacing their gas-powered trucks, vans, and buses with ones powered by electricity.

However, to speed up EV adoption, we"ll need to improve the ways we mine, process, and assemble the materials that go into an EV battery. Understanding how an EV battery works can help policymakers make informed decisions, help people choose an EV that best meets their needs, guide investor resources, and equip the private and public sectors with the tools they need to develop efficient and effective technologies.

Most electric vehicles are powered by lithium-ion batteries and regenerative braking, which slows a vehicle down and generates electricity at the same time. The types of EVs that use batteries include:

There are several types of lithium-ion batteries, with lithium nickel manganese cobalt oxide (NMC) and lithium iron phosphate (LFP) batteries being the most common ones used in EVs. Like all batteries, both NMCs and LFPs have their strengths and shortcomings:

Lithium-ion batteries, like all batteries, store energy and convert it to electrical energy when in use. This electricity is produced by the movement of electrons, which are small particles with a negative charge that are found in all atoms.

Chemical reactions within the battery move these electrons from one electrode to another. There are two electrodes in a battery: the anode (a negative electrode) and the cathode (a positive electrode). Electrons start off in the anode and then move to the cathode through an electrolyte medium, which can be either liquid or solid.

To explain this movement, imagine that an electron is a person taking a bus to the grocery store. The anode is the person"s home while the cathode is the grocery store. The electrolyte medium is the bus itself, the tool that gets the person from point A to point B. The food the person buys at the grocery store is the electricity.

Another key component of a battery is the separator, a thin, porous membrane that, as the name implies, separates the anode and cathode electrodes while enabling the lithium ions to move from one to the other. It also prevents short circuiting, which happens when an electric current flows down a wrong or unintended path.

Lithium-ion batteries usually include lithium, cobalt, manganese, nickel, and graphite. There is considerable concern about the effects of mining these minerals on local communities and landscapes. Some mines use child labor, lack safety measures to protect workers, and negatively impact the surrounding environment.

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