

Q2: Is electric vehicles (EV) paving the way to a greener future?

Introduction

Electric vehicles are getting more common due to the development of battery technologies that enable electric vehicles to have a longer range, as well as government policies in different parts of the world. They are considered one of the tools to help achieve the target of net-zero carbon emissions by 2050, as they have the benefits of a supposedly better power generation efficiency at the power plant and the possibility of using renewable energy sources. Lithium-ion batteries are the enabling technology to power the electric vehicle industry, and cobalt is sometimes viewed as a key element in Li-ion batteries because of the stability it provides. Cobalt is a byproduct of copper and nickel mining and is now mostly supplied by the Democratic Republic of the Congo. The mines in Congo have been accused of using child labor and not providing a sufficiently safe working environment to miners. Another source of cobalt is from recycling cobalt-containing batteries. Similar to cobalt mining in Congo, battery recycling is also hazardous. As a result, cobalt batteries and electric vehicles are questioned for their sustainability and exploitation of African labor. Nowadays, cobalt-free batteries are an option in electric vehicles which addresses some of the concerns. (Lawrence, 2022) In this article, the electrical vehicle industry and cobalt supply cycle are analyzed from the different aspects of the issue.

Economics

The electric vehicle industry is continuously supporting the economy in less developed and lower-income countries. In terms of microeconomics, by adopting electric vehicles, private users and companies are reducing their operating costs compared to traditional fossil-powered vehicles. According to the research conducted by the World Bank (The World Bank, 2022), the average savings over the life cycle of using an electric vehicle is US\$5000 in maintenance and US\$10000 in cost of energy, benefiting from the simpler mechanical designs and better energy efficiency. In terms of macroeconomics, the simpler mechanical design also supports the democratizing of car manufacturing as electric vehicles can be manufactured with fewer technological requirements

such as the supply of internal combustion engines. The socioeconomic impact that electric vehicles are creating is that it promotes inclusive mobility by reducing the dependence on fossil fuels, subsequently improving the energy security of the lower income countries. Inclusive mobility helps access opportunities and boosts the economic and living standards in these countries. The cobalt industry is also impacting the world's economy. The cobalt supply cycle has shown significant growth in this decade and is predicted to grow continuously in the future. This is due to the demand for batteries for electric vehicles and appliances. The job opportunities in cobalt mining, refining, and recycling are supporting the economy in less developed countries, hence, the cobalt industry is also criticized for exploiting workers. The miners in Congo are not provided with adequate safety equipment and are underpaid for the dangerous and extended working hours. It is the responsibility that the more developed countries using cobalt should ensure the source is ethical and reasonably compensated but then that the cost of cobalt applications including electric vehicles will be further increased, diminishing the benefits of cost saving. Overall, the electric vehicle and cobalt industries are motivating the world's economy and improving the lives of lower-income countries.

Environmental

The prime reason for switching to electric vehicles is the environmental benefits it provides, notably easing global warming. The power supply of electric vehicles is from the electric grid of any local power company. Generally, the power-generating efficiency is larger at a large-scale powerplant compared to a small internal combustion engine used in fossil-powered vehicles. Because of the reduced fuel burnt, the overall greenhouse gas emission is reduced. The use of electric vehicles also favors the transition to sustainable energy sources as they are usually output in the form of electrical energy, further reducing carbon emissions and helping ease global warming. Besides the effect of easing global warming, electric vehicles also provide other environmental benefits such as reduced noise pollution and suspended particles, improving the living quality of urban residents. Despite the environmental benefits, electrical vehicles' sustainability is sometimes questioned, when considering the whole manufacturing cycle. As electric vehicles are powered electrically, whether there is a reduction in carbon footprint depends on the power grid. Nearly two-thirds of the world's electricity is still fossil generated and the

progress in the transition to renewable sources is slow. The cobalt-containing batteries used in electric vehicles also create other environmental concerns. When cobalt battery is disposed of, there is a risk of cobalt metal leakage, polluting the soil and water near the disposal site. This leads to health concerns as cobalt is harmful to humans. Another concern is the fire hazard cobalt batteries create. When the battery is damaged or deformed, the barrier between the cathode and anode is disabled and causes violent thermal runaways. For battery recycling workers it is a hazard and has caused injuries and loss of properties in the past. For environmental and ethical issues, and to reduce the dependence on cobalt supply, cobalt-free batteries are used by some manufacturers nowadays. For example, nearly half of the new Tesla is using cobalt-free iron phosphate batteries. However, the common issue of producing energy-dense batteries is that mining of raw materials including lithium, nickel, and cobalt causes soil and water degradation, destruction of habitats, and damages biodiversity. Therefore, for the electric vehicle and batteries industry to be sustainable, battery recycling is a key component, as to reduce the need for mining new raw materials. Overall, electric vehicles can help ease the pressing issue of global warming by reducing the carbon footprint of transportation, outweighing the damage it causes to the environment.

Professional

There are many professions involved in the electric vehicle and cobalt industry, such as industrial engineers and geologists. Their knowledge and skills allow them to create the technology for electric vehicles and reliable batteries. Being professionals, they are bound by the code of ethics imposed by their professional organization respectively, and their professionalism is demonstrated by their care and responsibility for society. It has been found that there are some morally questionable behaviors in the cobalt industry. The miners in Congo are underpaid and child labor is used in some of the sites. To meet socially acceptable ethical standards, the Cobalt industry adopted an ethical framework as suggested by the trading association named Cobalt Institute. (Cobalt Institute, 2023) The Cobalt Industry Responsible Assessment Framework (CIRAF). CIRAF is a tool for companies to assess whether their cobalt sourcing is humane and from responsible miners. Another method to ensure the ethical mining of cobalt is to purchase through the Congo state-owned business, Entreprise Générale du Cobalt (EGC) which has standards to make sure workers' safety in the mining sites. The different initiatives and ethical framework the

industry employed are to improve the ethical standards of the industry and be socially responsible, reflecting their higher professionalism when producing electric vehicles and batteries.

Legal

There are legal issues surrounding the cobalt mining business in Congo and the battery recycling industry across different nations. In Congo, despite that child labor is prohibited, it can be found in different small-scale excavation sites for cobalt across the country. Their cobalt is being fed into formal sales channels as supervision is difficult for the outside world. The mines are violating the law and committing fraud by not disclosing the use of child labor. For end-users, although there are no liabilities to protect the miners, they are morally bound to make sure ethical sourcing of cobalt. The battery recycling business faces different legal challenges. There are requirements regarding recycling facilities in terms of location and environment. (Bird, Baum, Yu, & Ma, 2022) Some counties such as Japan mandate the recycling of batteries including lithium batteries. In Europe, each battery has a unique identification to help track the whole product cycle, from manufacturing to recycling. Counties that do not have methods to deal with disposing of lithium batteries, may have to look for counties that are willing to handle their waste. This can be challenging as well as some counties like China have banned importing lithium batteries because of the hazard they create. (SMM, 2021) The cobalt and battery recycling industry must carefully navigate its operations within the legal requirement to avoid any criminal offense.

Health and Safety

Being a responsible employer, the health and safety of workers is an important dimension. Electric vehicle manufacturers, cobalt mining companies, and battery recyclers should assess the risk in their workplace and adopt measures to mitigate the hazard. An electric vehicle assembly line is not so different from any large machinery factory where hazards and mitigation are well-established. Meanwhile, the health and safety of workers in cobalt mining and battery recycling is threatened by chemical exposure and chemical fire. Exposure to cobalt is harmful and is found to be correlated to cancers. Therefore, to protect employees working with cobalt, different measures are taken. For example, PPE is provided to staff, the dosage is measured against the threshold limit

value to assess the health risk, and engineering controls include improved ventilation and automation of processes. Chemical fire can be found in battery recycling. As a lithium battery ruptures, the cathode and anode of the battery contact and cause thermal runaways. This causes a fire hazard and is dangerous for workers who manually disassemble batteries. To protect the workers at risk, damaged batteries are not recycled, and PPE is provided to protect employees. Businesses and professionals have a responsibility to provide a safe working environment for their subordinates.

My Suggestions

If I am involved in the electric vehicle industry, I have several suggestions for improving sustainability and reducing the negative impact on the socioeconomic aspect. First, I would consider adopting more cobalt-free batteries if the labor issue of cobalt mining continues. Cobalt must be sourced from ethical mining sites with valid certifications like those from EGC. Additional funding for improving the compensation to miners should be included. These actions can help protect the health and safety of miners. Second, an ethical framework governing the business should be established. The framework can help identify moral issues and acceptable solutions in the company. For example, with a clear ethical framework, the electric vehicle company can identify inhumane mining in Congo and take the required actions to protect workers. Lastly, I suggest investing in continuing technological innovations. New technologies may be able to look for an energy storage solution that is more beneficial compared to cobalt-containing batteries. For instance, cobalt-free batteries are now used by Tesla. Therefore, continuing technological innovation can help improve our current technology and move towards a sustainable future.

Conclusion

To conclude, I believe that electric vehicles are paving the way to a greener future. However, its success in environmental and socioeconomic sustainability depends on the industry's actions to address the concerns ethically and legally.

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