AVOIDING A ROAD TO NOWHERE

The Push for Electric Vehicles and their Impact on Environmental Pollution and Slave & Child Labour

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The History

Automobiles date back to the 17th century when Ferdinand Verbiest, a Jesuit missionary in China, built a steam-powered vehicle as a toy for the Kangxi Emperor[1]. In 1832, Robert Anderson developed the first electric carriage in Britain, 53 years before the first gasoline automobile was developed by a German engineer, and 171 years before Tesla launched the first electric car[2]. Automobile production started in 1888 and since then, internal combustion engine (ICE) vehicles have been commercialized and adopted by the mass, while the popularity of electric vehicles has declined. Just like many of mankind's achievements, ICE vehicle production and prevalent usage comes at the expense of the environment. Greenhouse gas emissions from the transportation industry are estimated at approximately 14% of the global total[3].

The EV Surge

Over the past decades, several alternatives have been proposed to replace ICE vehicles. Electric vehicles (EV) are the prevalent and ostensibly most feasible solution for reducing greenhouse gas emissions and mitigating environmental impact. Currently, global adoption of EV is estimated at around 2% and is expected to reach 10% to 12.5% by 2025[4]. Drivers of this surge include policy support, advances in technology resulting in falling costs, and overwhelming positive responses from automakers towards electrification. Governments around the world have adopted measures to encourage or require EV deployment in the form of research funding support, infrastructure investment and production incentives to owners' tax advantage, while automakers are investing at least $90 billion in EV assembly and battery technology[5].

The Consumer View

The recent Ipsos Automotive Navigator survey across 10 countries shows that consumers generally view electric vehicles as 'green'. They see EVs as environmentally friendly (43%), and this is their key potential benefit. Sure enough, several other research sources confirm this belief by comparing ICE and EV greenhouse gas emissions, with ICE emerging as some 20% higher[6], even after the higher emissions associated with EV manufacture are taken into consideration. Nevertheless, most studies fail to recognize the impact of the entire EV value chain from production to disposal. In fact, German researchers at the Institute for Economic Research find that EV will barely help to cut CO2 emission in Germany, and in the best case the CO2 emissions associated with battery EV are actually slightly higher than those of a diesel engine[7].

> **So, are EV really as "green" as policy makers, manufacturers & consumers portray them to be?**

[1]Teun Koetsier, Marco Ceccarelli, editor. 2012. Explorations in the History of Machines and Mechanisms, Proceeding of History of Mechanism and Machine Science. Spring Science & Business Media. [accessed May 2020]. shorturl.at/cOPX6.
[2]Timeline: History of the Electric Car. Washington (DC): U.S. Department of Energy; [accessed May 2020]. https://www.energy.gov/timeline/timeline-history-electric-car.
[3]Greenhouse Gas Emissions. Washington (DC): United States Environmental Protection Agency; [accessed May 2020]. https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data.
[4]Ben Kilbey, Alisdair Bowles, editor. 2019. Global electric-vehicle adoption rate around 10-12.5% by 2025:LME seminar. S&P Global. [accessed May 2020]. https://www.spglobal.com/platts/en/market-insights/latest-news/metals/102819-global-electric-vehicle-adoption-rate-around-10-125-by-2025-lme-seminar.
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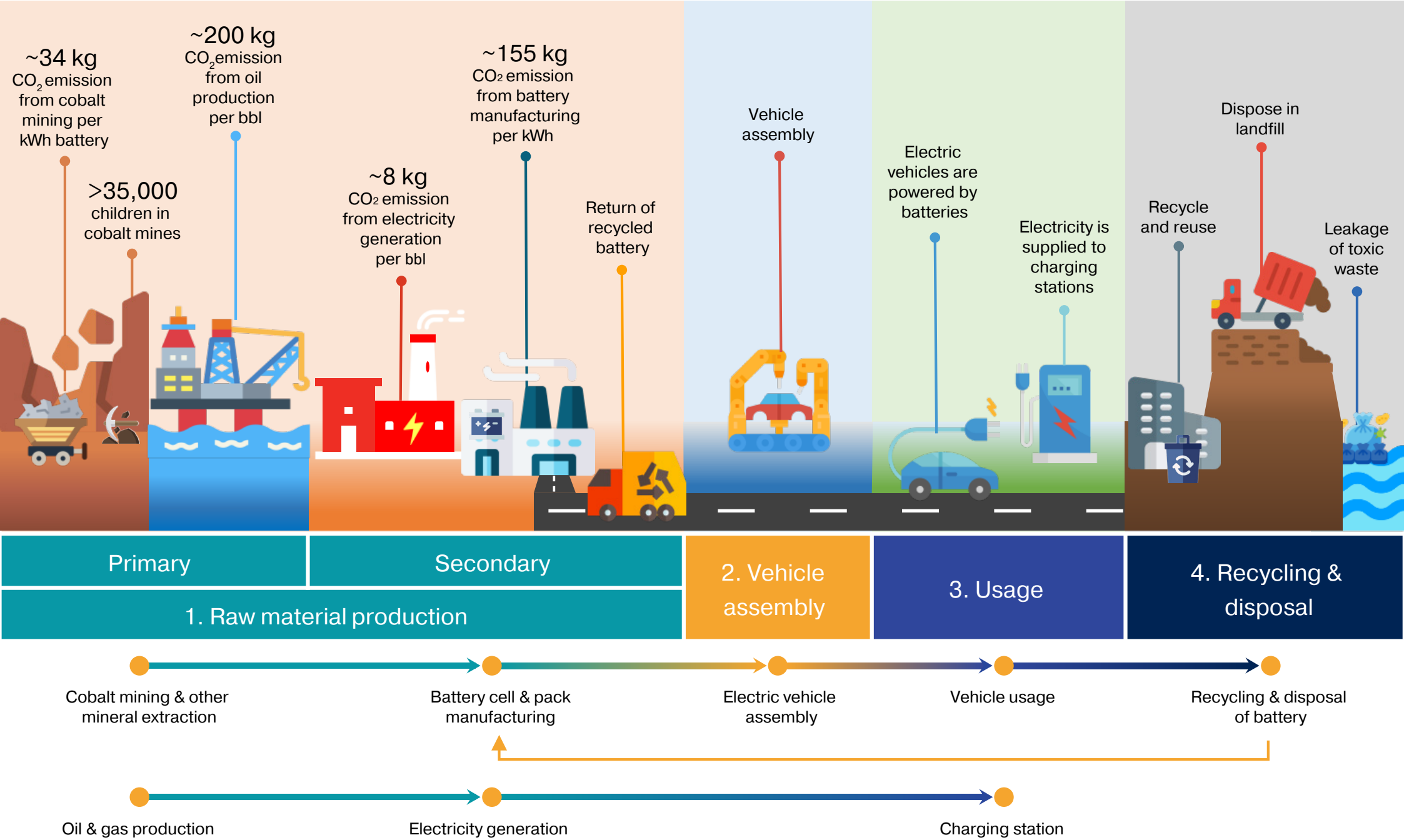
[6]John W. Brennan, Timothy E. Barder, Ph.D. 2016. Battery Electric Vehicle vs. Internal Combustion Engine Vehicles: A United States-Based Comprehensive Assessment. Arthur D. Little. [accessed May 2020]. http://www.adlittle.cn/sites/default/files/viewpoints/ADL_BEVs_vs_ICEVs_FINAL_November_292016.pdf.
[7]Zeke Hausfather. 2019. Factcheck: How electric vehicles help to tackle climate change. CarbonBrief. [accessed May 2020]. https://www.carbonbrief.org/factcheck-how-electric-vehicles-help-to-tackle-climate-change.

Electric Vehicle Value Chain



Current Negatives

Battery development plays a critical role in driving the EV industry. Lithium-ion (Li-ion) batteries are often cited as a power source for EV by key auto makers, given their relatively high unit energy mass and longer life cycle compared to other types of battery. Li-ion batteries are derived from cobalt, which is an essential element in rechargeable batteries. It's estimated that some 50% of cobalt produced globally is found in rechargeable batteries[8].

Cobalt mining does not echo the green image of the downstream industry. Emission of CO2 from global cobalt production is estimated at 1.6 metric megatons[9 10] in 2019 and is set to increase as demand for Li-ion batteries surges. Toxic mining waste pollutes rivers and drinking water, and its dust causes respiratory problems. Local residents' health and well-being are adversely affected, with birth defects, cancer, vision problems and heart disease all linked directly to exposure to mining activities.

Furthermore, cobalt mining often involves child labor, particularly in the Democratic Republic of Congo (DRC), where 60% of global cobalt supply comes from. Young children are forced to work in the mines and perform dangerous tasks without any protective gear, often causing injury and even death. At the end of the life cycle, batteries are disposed of in trash and landfills. Improper battery disposal can lead to release of corrosive liquids and dissolved metals into groundwater and the environment. These liquids are toxic to plants and animals, and eventually, leaked chemicals can seep into our water supply and the ocean.

An Inadequate Response

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Despite these efforts, environmentalists and human rights advocates believe companies should do much more to minimize environmental and social impacts. Amnesty International's report[12] uses 4 key criteria to assess corporate levels of action regarding human rights along the cobalt supply chain:

1. Has the company investigated its supply links to DRC and Huayou Cobalt?
2. Does the company have robust policies and systems in place for detecting human rights risks and abuses in its cobalt supply chain?
3. Has the company taken action to identify "choke points" and detect human right risks and abuses?
4. Has the company disclosed information about human rights risks and abuses in its cobalt supply chain?

Two of the seven global leading automakers evaluated in the Amnesty report had made 'moderate' efforts in addressing such issue, while the rest had made minimal effort or taken no action at all. None of the companies included in the study achieved an adequate level of effort in covering all four aspects.

[8]Cobalt in Batteries. United Kingdom: Cobalt Institute; [accessed May 2020]. https://www.cobaltinstitute.org/assets/files/Pages%20PDFs/Infographic-Cobalt-Batteries.pdf.
[9]Shahjadi Hisan Farjana, Nazmul Huda, M.A. Parvez Mahmud. 2019. Life cycle assessment of cobalt extraction process. Journal of Sustainable Mining. [accessed May 2020]; Volume 18, Issue 3. https://www.sciencedirect.com/science/article/pii/S2300396018301836.
[10]Worldwide mine production of cobalt from 2008 to 2019. 2020. Statista. [accessed May 2020]. https://www.statista.com/statistics/339759/global-cobalt-mine-production/
[11]Priscila Barrera. 2020. Top Cobalt Production by Country. Cobalt Investing News. [accessed May 2020]. https://investingnews.com/daily/resource-investing/battery-metals-investing/cobalt-investing/top-cobalt-producing-countries-congo-china-canada-russia-australia/.
[12][Amnesty International] Time to Recharge: Corporate Action and Inaction to Tackle Abuses in the Cobalt Supply Chain. 2017. [accessed May 2020]. https://www.amnesty.org/download/Documents/AFR6273952017ENGLISH.PDF.

Major Countries and Automotive Hubs Committed to Scrapping ICE

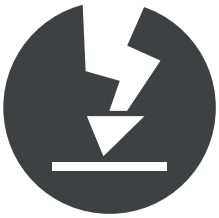
Country	2025-2029	2030-2039	After 2040	Note
China	✓ (Hainan)			China is developing long term plans to phase out ICE, alongside carbon controls. Timeline for the whole country is not confirmed.
United States			✓	United States aims to reduce national vehicle emissions to zero by 2050.
Japan			✓	A Japanese working group, involving the government's ministry of economy, trade and industry (METI) and manufacturers such as Toyota, Honda and Nissan, aims for all new cars sold in Japan to be electric or hybrid by 2050.
India		✓		No new gasoline or diesel vehicles by 2030.
France	✓ (Paris)			Paris pledged to ban diesel engines by 2025, and phased out all ICE cars by 2030. It aims to take greenhouse gas-emitting vehicles off the market by 2040. Stopping sales of petrol and diesel cars will encourage manufacturers to innovate and take the lead in this market.
Italy	✓ (Rome)			Italy will ban diesel vehicles from city centers by 2024.
Germany			✓	A ban on sales of new diesel cars is expected. Germany is considering a ban on all ICE by 2040, in line with Britain and France.
United Kingdom			✓	No sales of conventional petrol and diesel cars and vans by 2040. United Kingdom is aiming to reduce national vehicle emissions to zero by 2050.

Source: Ipsos Strategy3 Analysis

Avoiding a Road to Nowhere: The Way Forward

The pursuit of chemical-free and genuinely sustainable alternatives to Li-ion batteries must continue as the market starts to mature. Rather than spending billions of dollars[13] on battery infrastructure for an outdated technology linked to pollution and modern slavery, governments should allocate some budget to explore more environmentally friendly power sources.

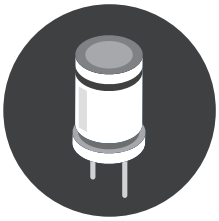
Some alternatives are already being explored to replace the Li-ion batteries used in EV. We have selected four technologies for discussion and comparison based on feasibility in the near future.



Graphene-infused Li-ion batteries have advantages over conventional Li-ion - charging speed, capacity and lifecycle. Samsung is expected to release a smartphone powered by a graphene battery in 2020 or 2021 that can be fully charged in less than 30 minutes. However, such technology does not eliminate all environmental and social problems, as cobalt is still used in battery manufacture.

Cobalt-free batteries are under examination as an alternative to Li-ion. One possibility is a lithium iron phosphate (LFP) battery, which is relatively cheap and also less toxic to produce and recycle compared to a Li-ion battery with its cobalt component. However, it has drawbacks in terms of energy density and safety.

Hydrogen fuel cells[14] generate electricity, water and heat from hydrogen and oxygen. They are lighter and take up less volume than Li-ion batteries, while generating the same level of energy. They can also be recharged faster. However, there are disadvantages as the hydrogen extraction process is not environmentally friendly, and storage of the gas in fuel tanks can be extremely hazardous and expensive. Moreover, fuel cells can only operate in a temperature-controlled environment, requiring radiators and cooling channels which add considerable weight to the vehicle.



Supercapacitors & Ultracapacitors[15] store energy electrostatically rather than chemically, unlike a battery. They have advantages over Li-ion batteries in terms of weight, speed of charging and environmental impact, since they do not contain any toxic metals or harmful chemicals. However, they still lag behind Li-ion batteries for energy output, so vehicles can only operate for a shorter duration. Some leading OEMs have started to explore the possibility of supercapacitors to replace Li-ion batteries. For example, Toyota has developed the Yaris Hybrid-R concept car which runs on supercapacitors, while Tesla announced acquisition of Maxwell Technologies, an ultracapacitor manufacturer, in early 2019.

[13][Meticulous Market Research]. 2020. Electric Vehicle Charging Stations Market Worth $38.9 Billion by 2027. [accessed May 2020]. https://www.globenewswire.com/news-release/2020/02/17/1985723/0/en/Electric-Vehicle-Charging-Stations-Market-Worth-38-9-Billion-by-2027-Exclusive-Report-by-Meticulous-Research.html.
[14]Eliott Wertheimer. 2018. Hydrogen Fuel Cells vs Lithium-ion Batteries in Electric Vehicles. [accessed May 2020]. https://www.furosystems.com/news/hydrogen-fuel-cells-vs-lithium-ion-batteries-in-electric-vehicles/.
[15]Christopher McFadden. 2019. Could Ultracapacitors Replace Batteries in Future Electric Vehicles? [accessed May 2020]. https://interestingengineering.com/could-ultracapacitors-replace-batteries-in-future-electric-vehicles.

Avoiding a Road to Nowhere: Action Plan

In the following chart, we set out what we believe are the priority areas that policy makers and the automotive industry players need to further strengthen and start implementing with some sense of urgency if we are to see change that will make it possible for Electric Vehicles to become a genuinely sustainable product. Consumers also have critical role to play in ensuring that any prolific rise in the sale of Electric Vehicles doesn't lead to significant environmental and social problems for future generations.

Industry

- **Due diligence:** Conduct due diligence in respect of the supply chain and carry out supplier audits
- **Disclosure:** Disclose information publicly to keep consumers fully informed
- **Disposal:** Make sure that batteries are recycled and disposed of in a proper manner
- **Development:** Develop cobalt-free batteries, or explore other alternative power sources with minimal negative environmental or social impact

Government

- **Enforcement:** Enforce legal requirements for battery & automakers to conduct due diligence of supply chains, and properly recycle used batteries to ensure they do not harm the environment
- **Ethics:** Ensure that EV manufacturing policies ensure ethical mining, manufacture and recycling
- **Pioneering:** Provide research funding to explore alternative "clean" power sources
- **Future Strategies:** Examine ways of phasing out the ICE industry, ensuring that the entire industry supply chain meets sustainable trading standards.

Consumers

- Check car manufacturer sustainability & ESG performance on websites such as CSR Hub, which offers free access to rankings of companies in different industries, and which provides peer comparison https://www.csrhub.com/

Source: Ipsos Strategy3 Analysis

The Bottom Line

Given the environmental and social impact of the entire value chain of electric vehicles, consumers should think twice as to whether electric vehicles are as "green" as they think. Governments need to go beyond simply addressing climate change issues by encouraging the conversion of ICE vehicles to EV. They also need to think about the associated negative environmental and social impacts throughout the entire value chain. Governments and auto manufacturers should collaborate to mitigate these impacts and develop integrated solutions that drive the 'green' transport industry forward.

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