Assessing the Alleged Benefits of EVs

Exposing the Electric Vehicle Fantasy – Part 2

Robert Lyman 12/20/20

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Cover photo - original source unknown, seems a common sight in Alberta.
https://www.reddit.com/r/Edmonton/comments/5i5dxt/at_least_he_has_a_sense_of_humor_tesla_model_s/

Assessing the Alleged Benefits of EV's

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EXECUTIVE SUMMARY

There is a widespread perception that passenger and commercial vehicles fueled by gasoline and diesel fuel are "dirty" and that electric vehicles are "clean". This perception has served to rationalize a wide range of government policies, programs, regulations, and subsidies that have discouraged and disadvantaged the use of internal combustion engines and promoted the sale of electric vehicles and the installation of electric refueling infrastructure at taxpayers' expense.

Yet, if one examines the truth behind these claims, one finds that, on a life cycle basis, the production and use of electric vehicles have many adverse environmental effects.

A single electric car battery weighing 1,000 pounds typically contains about 25 pounds of lithium, 30 pounds of cobalt, 60 pounds of nickel, 110 pounds of graphite, 90 pounds of copper, and 400 pounds of steel, aluminum, and various plastic components. Extracting the key minerals (lithium, cobalt, nickel, graphite, and copper) for each battery requires mining about 90,000 pounds of ore. Removing overburden to extract these ores means digging and moving between 200,000 and 1,500,000 pounds of earth, a rough average of 500,000 pounds per battery. Moreover, the energy equivalent of 100 barrels of oil is used in the processes to fabricate a single battery that can store the equivalent of one barrel of oil.

A peer-reviewed life-cycle study comparing conventional and electric vehicles served to assess a wide range of environmental impacts.

"To begin with, about half the lifetime carbon dioxide emissions from an electric car comes from the energy used to produce the car, especially in the mining and processing of the raw materials needed for the battery. This compares unfavourably with the manufacture of a gasoline-powered car which accounts for 17% of the car's lifetime carbon dioxide emissions. When a new EV appears in the show-room, it has already been responsible for 30,000 pounds of carbon dioxide emissions. The equivalent amount for manufacturing a conventional car: 14,000 pounds…

Once on the road, the carbon dioxide emissions of EVs depend on the power-generation fuel used to recharge the battery. If it comes mostly from coal-fired power plants, it will lead to about 15 ounces of carbon dioxide for every mile it is driven – three ounces more than a similar gasoline powered car."

This is a far cry from “zero emissions”.

A recent United Nations Report warned that the raw materials used in EV batteries are highly concentrated in a small number of countries where environmental, labour and safety regulations are weak or non-existent. “Artisanal” cobalt production in the Democratic Republic of the Congo now supplies two-thirds of the global output of the mineral. Many of the mines employ child labour in extremely dangerous tasks.

“Up to 40,000 children are estimated to be working in extremely dangerous conditions, with inadequate safety equipment, for very little money in the mines in Southern Katanga. The children are exposed to multiple physical risks and psychological violations and abuse, only to earn a meager income to support their families.”

There are other adverse environmental consequences at the end of the battery fuel cycle. It is difficult to recycle batteries from EVs. They pose great challenges because of their weight and complexity. It also is difficult to recover commercially useful material from spent batteries.

In short, the clean and green image of EVs stands in stark contrast to the realities of manufacturing batteries, powering them from the grid and disposing of them at the end of their useful lives.

About the Author

ROBERT LYMAN *is an economist with 27 years’ experience as an analyst, policy advisor and manager in the Canadian federal government, primarily in the areas of energy, transportation, and environmental policy. He was also a diplomat for 10 years. Subsequently he has worked as a private consultant conducting policy research and analysis on energy and transportation issues as a principal for Entrans Policy Research Group. He is a frequent contributor of articles and reports for Friends of Science, a Calgary-based independent organization concerned about climate change-related issues. He resides in Ottawa, Canada. Full bio.*

Assessing the Alleged Benefits of EV's

Exposing the Electric Vehicle Fantasy – Part 2

In part 1 of this series, I provided information not generally available from the media concerning the costs of electric vehicles (EV's), both to consumers and to the broader economy. In this article, I will explore the facts with respect to the alleged environmental and other benefits of EV's.

The widespread perception, frequently reinforced by articles in the media and by government statements, is that passenger and commercial vehicles fueled by gasoline and diesel fuel are "dirty" and that electric vehicles are "clean". This perception has served to rationalize a wide range of government policies, programs, regulations, and subsidies that have discouraged and disadvantaged the use of internal combustion engines and promoted the sale of electric vehicles and the installation of electric refueling infrastructure at taxpayers' expense.

Yet, if one examines the truth behind these claims, one finds that, on a life cycle basis, the production and use of electric vehicles have many adverse environmental effects.

Cataloguing the "Dirt" on Electric Vehicles

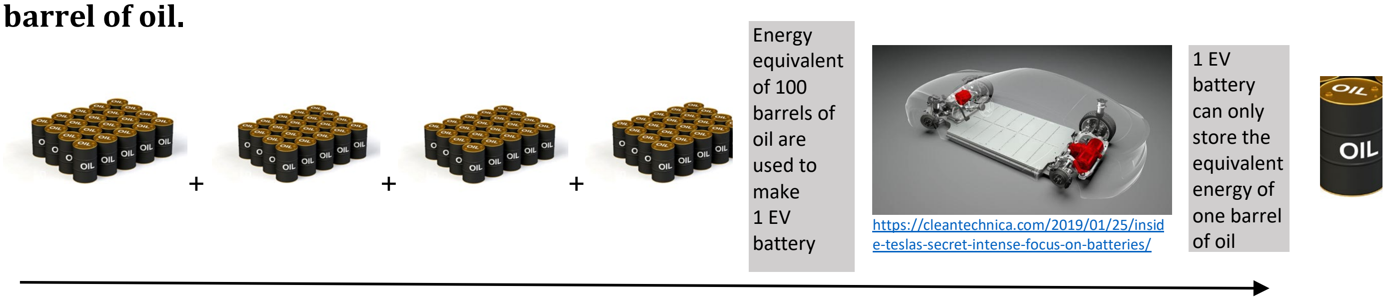
The most important component of the EV is the lithium-ion rechargeable battery. A single electric car battery weighing 1,000 pounds typically contains about 25 pounds of lithium, 30 pounds of cobalt, 60 pounds of nickel, 110 pounds of graphite, 90 pounds of copper, and 400 pounds of steel, aluminum, and various plastic components. [1] Extracting the key minerals (lithium, Cobalt, nickel, graphite, and copper) for each battery requires mining about 90,000 pounds of ore. Removing overburden to extract these ores means digging and moving between 200,000 and 1,500,000 pounds of earth, a rough average of 500,000 pounds per battery. Mark Mills, an engineering professor at Northwestern University in the United States, adds to this.

"It bears noting that this total material footprint does not include the large quantities of materials and chemicals used to process and refine all the various ores. Nor have we counted other materials used when compared with a conventional car, such as replacing steel with aluminum to offset the weight penalty of the battery, or the supply chain for rare earth elements used in electric motors (e.g. neodymium, dysprosium). Also excluded from this tally:

[1] Mark Mills, *Mines, Minerals, and "Green" Energy: A Reality Check*, Manhattan Institute. July 9, 2020

the related, but non-battery, electric systems in an EV use some 300% more overall copper used compared with a conventional automobile. [2]

Professor Mills makes other important points about the energy required to manufacture batteries. Oil, natural gas, and coal are needed to produce the concrete, steel, plastic, and purified minerals to build EVs. **The energy equivalent of 100 barrels of oil is used in the processes to fabricate a single EV battery that can store the equivalent energy of one barrel of oil.**



The energy equivalent of 100 barrels of oil is used in the processes to fabricate a single battery that can store the equivalent energy of one barrel of oil.

Michael Kelly is Emeritus Professor of Technology at Cambridge University in the United Kingdom. He has written extensively about feasibility of meeting the United Kingdom's goal of banning all sales of internal combustion vehicles by 2030.[3] According to him, if the UK replaces all of its vehicle fleet with EVs, assuming they use the most resource-frugal next-generation batteries, it would need the following materials: about twice the annual global production of cobalt; three-quarters of the world's production of lithium carbonate; nearly the entire world production of neodymium; and more than half the world's production of copper in 2018. If the whole world used only EVs, the vast increases in the needed supply of the raw materials listed would go far beyond known global reserves.

Comparing Lifecycle Environmental Impacts

According to the narrative promoted by those who claim human emissions are causing catastrophic climate change, switching the entire vehicle fleet to EVs is an imperative.

However, what if the alleged advantages of EVs in emitting lower carbon dioxide emissions were overstated?

A peer-reviewed life-cycle study comparing conventional and electric vehicles served to assess a wide range of environmental impacts.[4] Tilak Doshi, the Senior Research Fellow at

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[2] Mark Mills, ibid

[3] Michael Kelly. *Electrifying the UK and the want of engineering*. The Global Warming Policy Foundation, 2020

[4] Troy Hawkins et.al *Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles.* Journal of Industrial Ecology

the Middle East Institute, National University of Singapore, summarizes this paper's analysis of the greenhouse gas emissions by type of vehicle thus:

"To begin with, about half the lifetime carbon dioxide emissions from an electric car comes from the energy used to produce the car, especially in the mining and processing of the raw materials needed for the battery. This compares unfavourably with the manufacture of a gasoline-powered car which accounts for 17% of the car's lifetime carbon dioxide emissions. When a new EV appears in the show-room, it has already been responsible for 30,000 pounds of carbon dioxide emissions. The equivalent amount for manufacturing a conventional car: 14,000 pounds…

Once on the road, the carbon dioxide emissions of EVs depend on the power-generation fuel used to recharge the battery. If it comes mostly from coal-fired power plants, it will lead to about 15 ounces of carbon dioxide for every mile it is driven – three ounces more than a similar gasoline powered car. For every 50,000 miles driven, the difference amounts to 4.45 metric tons of extra CO2 emitted by the EV. Even without reference to the source of electricity used for battery charging, if an EV is driven 50,000 over its lifetime, the huge initial emissions from its manufacture means that the EV will actually have put more carbon dioxide in the atmosphere than a similar-size gasoline-powered car driven the same number of miles. Even if the EV is driven for 90,000 miles and the battery is charged by cleaner natural gas-fueled power stations, it will cause just 24% carbon dioxide emissions than a gasoline-powered car."

This is a far cry from "zero emissions".

The paper acknowledges that EVs offer advantages in terms of powertrain efficiency, maintenance requirements, and tailpipe emissions of air contaminants. It goes on to assess different vehicle propulsion technologies in term of a range of possible environmental effects on a life cycle basis. Of note for those who worry about the adverse effects of increased EV production and use are their findings concerning human toxicity potential. The study authors estimate that this potential is higher for EVs compared to internal combustion engines (ICEV) in both the production and use phases. Specifically, they estimate that the different EV options have180% to 290% higher human toxicity potential compared to ICEV alternatives. [5]

The principal materials used in lithium ion batteries are cobalt, lithium, manganese, and graphite. Current global production of these minerals is concentrated in only a few countries – the Democratic Republic of the Congo in the case of cobalt (66% of global production); Australia (60% of production) and Chile (19% of production) in the case of lithium; South Africa (30% of production) and Australia (17% of production) in the case of manganese; and China (68 % of production) in the case of natural graphite.

[5] Troy Hawkins et.al., ibid

A recent United Nations Report[6] [7] warned that the raw materials used in EV batteries are highly concentrated in a small number of countries where environmental, labour and safety regulations are weak or non-existent. "Artisanal" cobalt production in the Democratic Republic of the Congo now supplies two-thirds of the global output of the mineral. Many of the mines employ child labour in extremely dangerous tasks.

"Up to 40,000 children are estimated to be working in extremely dangerous conditions, with inadequate safety equipment, for very little money in the mines in Southern Katanga. The children are exposed to multiple physical risks and psychological violations and abuse, only to earn a meager income to support their families."

Source: *https://industryeurope.com/sectors/metals-mining/5-tech-giants-sued-over-use-of-child-labour/*

Lithium mining also presents social and environmental risks. Again, to quote the UNCTAD report:

"For example, indigenous communities that have lived in the Andean region of Chile, Bolivia and Argentina for centuries must contend with miners for access to communal land and

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[6] Tilak Doshi. *The Dirty Secrets of "Clean" Electric Vehicles*, Forbes, August 4, 2020

[7] *Commodities at a Glance: special issue on strategic battery raw materials*; United Nations Conference on Trade and Development, 2019

water. The mining industry depends on a large amount of groundwater in one of the driest desert regions in the world to pump out brines from drilled wells. Some estimates show that approximately 1.9 million litres of water is needed to produce a tonne of lithium. In Chile's Salar de Atacama, lithium and other mining activities consumed 65 percent of the region's water. That is having a big impact on local farmers – who grow quinoa and herd llamas – in an area where some communities already must get water driven in from elsewhere."

Disposal

There are other adverse environmental consequences from the battery fuel cycle, notably at the end. It is difficult to recycle batteries from EVs. They pose great challenges because of their weight and complexity. It also is difficult to recover commercially useful material from spent batteries.

In short, the clean and green image of EVs stands in stark contrast to the realities of manufacturing batteries, powering them from the grid and disposing of them at the end of their useful lives.

Conclusion

In part 1 of this series, I explained how the costs of electric vehicles were far higher than those claimed by their advocates. In this part, I have indicated that the alleged benefits of EVs are debatable. The carbon dioxide emissions reductions associated with EVs depend on the sources of power generation used to recharge the vehicles, and there are serious unresolved environmental and social effects of the mining of minerals needed for battery manufacture. This is not the story that the public is told, but it should be. In Part 3, I will address the claims that sales of EVS will soon replace a large share of the world's vehicle fleet and have significant impacts of oil consumption and related emissions.

About Friends of Science Society

Friends of Science Society is an independent group of earth, atmospheric and solar scientists, engineers, and citizens that is celebrating its 18th year of offering climate science insights. After a thorough review of a broad spectrum of literature on climate change, Friends of Science Society has concluded that the sun is the main driver of climate change, not carbon dioxide (CO2).

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