Forum: Special Conference On Environment (SPC-3)
Issue: Addressing the environmental consequences caused by increasing demand and production of electric vehicles
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Introduction

The Flocken Electrowagen, regarded as the first proper electric car, was built by German inventor Andreas Flocken in 1885, only 3 years after Benz patented the Benz Patent Motorwagen. In the earlier days of the automobile, the electric automobile enjoyed greater popularity as the internal combustion (IC) car, with the numbers in the early 1900s showing that electric cars made up almost twice the amount of gasoline-powered cars (38 and 22% respectively) while the rest was steam powered vehicles (Britannica).

Because of their very high-efficiency motors, electric vehicles (EVs) were quickly adapted to various avenues of transportation early on, including the automobile. From the 1890s until the 1910s is regarded as the golden age of electric vehicles. Back then they were less noisy, didn't have the disturbing smell and vibration associated with gasoline cars, and could be used by women. Over time, however, their lack of range, long charging time, and lacking infrastructure caused them to lose popularity in favor of the IC car.

Although for most of the 20th century, the electric automobile was not relevant in the car market, the 2010s witnessed a revival of the EV, with demand for efficient vehicles and more environmentally conscious car purchasing. Alongside this, with calls to reduce the usage of internal combustion vehicles due to their contribution to global warming, electric automobiles, whose usage causes less damage to the environment, have enjoyed increasing popularity, and thus, demand. While their usage is safer in terms of health and they are less polluting compared to internal combustion engines because of their extremely low tailpipe emissions, their production process sometimes has a greater environmental footprint than that of internal combustion cars.

Definition of Key Terms

Internal Combustion Engine (ICE): The internal combustion engine is the one predominantly used in automobiles today. It is a heat engine wherein fuel is ignited and combusted within a combustion chamber inside an engine; the heat and pressure generated by this process are applied usually to pistons which are used to move whatever the engine is attached to.

Tailpipe Emissions: Gases discharged from the tailpipe of a vehicle. While EVs generate little to no tailpipe emissions, exhaust gas from the tailpipe emissions of IC cars results in around 50,000 premature deaths yearly (Caiazzo et. al)

Lithium-Ion Battery: A type of rechargeable battery that uses the reversible intercalation (to insert among the layers of a substance) of Li^+ ions into electrically conductive solids to store energy.

Electric Vehicles (EVs): A vehicle that uses one or more electric motors for propulsion. Most EVs use rechargeable Lithium-ion batteries to store electricity.

Hybrid Vehicles: Hybrid electric vehicles are powered by an internal combustion engine and one or more electric motors, which use energy stored in batteries. (Department of Energy)

Background Information

History of Electric Vehicles

After the development of the first electric motor in 1827, small model electric cars started being designed and built. The first mass-produced electric vehicles in America started being produced around 1900-1902. At the beginning of the car age, the EC was more popular than internal combustion cars, with electric cars making up 38% of total automobiles and IC cars making up 22%. The advantages electric cars enjoyed over IC cars were numerous and can be listed, non-exhaustively: less noise, less vibration, less smell, lack of a need for manual starters which allowed women to be able to use the car, better use in cities where cars were generally used in, and more. Although the EC enjoyed these critical advantages, it had major flaws that eventually led to its fall from relevance towards the end of the 1910s. These issues were the problems of charging and range. Charging stations were few and far between while charging times were very high, which led to inconvenience. As for the range, it did not present a problem in the early 1900s when car usage was more restricted to urban areas, however, as cars became more widespread and car

infrastructure improved, demand for long-range cars increased, which alongside the great success of General Motors and Ford Motors IC vehicles, pushed to electric cars into irrelevance.

After around 60 years of not being produced at any major scale, the energy crises of the 70s and 80s brought renewed interest, research, and development into EVs due to their high efficiency. However, this development was constrained mostly to experimental vehicles and concept cars. (Britannica) Although public interest in fuel-efficient electric vehicles waned over the 1990s, development continued with advancements in technology, and in 1999, the Honda Insight and Toyota Prius went on sale in the market, the first hybrid vehicles to do so since 1917 (cleantechnica).

The development of the modern, highway-capable EV had a major breakthrough with the founding of Tesla Motors. The Tesla Roadster, which started being sold to customers in 2008 was the first produced EV to have a range of over 320 km and was also the first to be powered by Lithium-Ion batteries. These batteries, still the primary power source of electric vehicles, enjoy a plethora of advantages compared to previous power sources that allowed the EV to become mainstream and competitive with IC cars. Some of these advantages are: “high power-to-weight ratio, high energy efficiency, good high-temperature performance, long life, and low self-discharge.” (Department of Energy). The use of lithium-ion batteries accelerated EV development massively. This, coupled with nascent government subsidies made further advancements in EVs possible. In 2010, the mass production of the Nissan Leaf (max speed 145km/h and top range 161 km) began (cleantechnica). Until 2020, the Leaf was the bestselling EV, when the Tesla Model 3 overtook it.

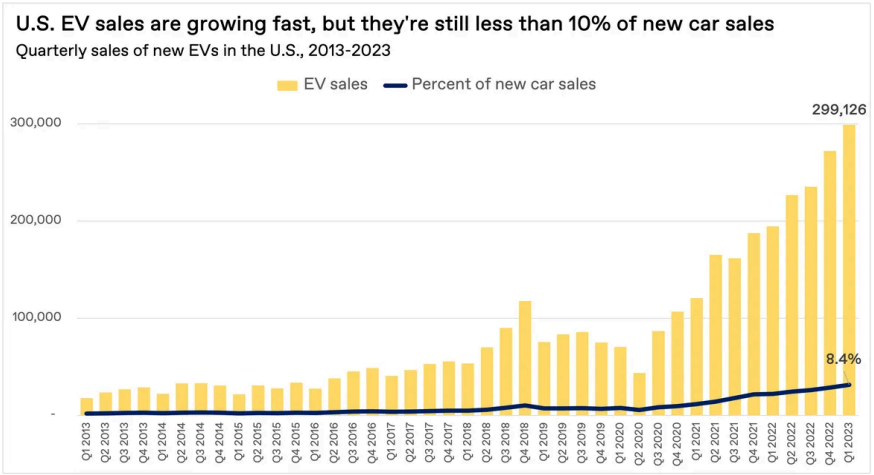

Image by: canarymedia

The Environmental Impact of Electric Vehicle Operation

The operation of EVs damages the environment and people's lives less than IC vehicles. This is because they produce very low, if any, tailpipe emissions. Tailpipe emissions are also the cause of the premature death of thousands of people (newscientist.com) and EV usage helps reduce that. The electric motors used within are also much more efficient than IC motors (Natural Resources Defense Council) with around 85% fuel efficiency, compared to around 40% for IC engines. The low tailpipe emissions alongside the high fuel efficiency means that the carbon footprint for their use is much lower than similarly sized IC vehicles.

EVs also require much fewer moving parts, meaning that repair needs and costs are lower per vehicle (assessed to be 0.06 cents per mile for EVs and 0.10 cents per mile for IC vehicles). This is significant as automobile repair and especially replacement processes are a source of non-negligible harm to the environment due to high energy usage, waste generation such as used oils, plastic and metal scarps, as well as the use of harsh chemicals such as paints and cleaning agents, all of which have significant carbon footprints in their own right.

Although the operation of electric vehicles is less harmful to the environment than similar-sized IC vehicles, the environmental cost of the electricity generated for EVs is still significant, since EVs are only as clean as their power source. Even though the engines are more efficient, if the electricity used for it is produced from fossil fuels, the environmental benefits of EVs become much less. Considering how electricity generated around the world is a mix of sustainable sources, fossil fuels, nuclear energy etc. EV usage still generates greenhouse emissions for usage, though much less than IC cars considering the average US grid (New York Times). The advantage in this situation for EVs is that as the global push for greener energy continues, the grids also get more sustainable, reducing the emissions brought about by EV usage.

The Environmental Impact of the Production of Electric Vehicles

One of the biggest causes of negative environmental impact for EVs is their production process. The lithium-ion batteries required to run the vehicles and rare-earth motors used within have extremely adverse effects on the environment and the changes in this regard are quite significant to achieve truly carbon-free electric vehicles. The chemicals used for lithium extraction, such as sodium hydroxide and sulfuric acid penetrate the soil, poison the environment, lead to

habitat destruction, and threaten species. In fact, although mass production of EVs is still only a decade and a half old, the fallout of lithium mining has been felt very harshly on indigenous species, for example with: "two flamingo species in Chile [being] threatened because of lithium mining." (mining-technology.com). A lot of freshwater also has to be diverted away from local communities and wildlife in particularly arid communities for this mining, further endangering the environment. Alongside this the large quantities of water, on the order of millions of liters per year (apmresearchlab.org), is used is polluted in the mining process, and cannot be used by the local wildlife. Deforestation and the destruction of water habitats (where lithium mining is also done) further add to the environmental weight of lithium mining, to the point where 1 ton of mined lithium emits around 15 tonnes of CO_2.

The production of lithium batteries after mining is also resource-intensive and generates further CO_2 emissions. With use, the battery's capacity for storage is reduced and it has to be replaced. They have a lifespan of around 8-12 years. (https://www.edfenergy.com/). Although recycling is possible, the lack of it represents another issue as "only 5% of lithium-ion batteries are recycled every year." (apmresearchlab.org). Since lithium-ion batteries are dangerous in landfills, their disposal also requires lots of energy, contributing further to their environmental footprint.

Major Countries and Organizations Involved

CARB: The only U.S. state to be bound by the regulations of an entity outside of the federal government or the EPA is California. CARB, (the California Air Resources Board), has the authority to set regulations alongside the federal government.

The U.S. Environmental Protection Agency (EPA): The EPA is an independent agency, concerned with matters regarding environmental protection. The EPA has adopted many regulations about vehicle pollution and regularly updates the requirements of emissions made by vehicles.

Tesla: As per their own report, by building Gigafactories, Tesla reduces the water and energy usage for the production of each vehicle. Despite this, their environmental footprint seems to be increasing, as seen through their supply chain emissions (30.7 million tons of Carbon Dioxide in 2022). The company's previously hidden supply chain emissions have caused debate on their environmentally-safe branding.

Timeline of Events

1885	The first electric automobile was built.
1910s	The golden age of electric vehicles comes to an end in light of problems relating to range and speed.
1990	Low Emissions Vehicle (LEV) is adopted by CARB, aimed at lowering emissions
1999	Honda Insight and Toyota Prius are for sale in the market.
2008	The Tesla Roadster starts being sold to customers.
2021	Tesla Model 3 hits 500,000 sales, becoming the most sold EV of all time

Relevant UN Resolutions and Other Documents

United Nations Global Technical Regulation on In-vehicle Battery Durability for Electrified Vehicles

Although there are no UN resolutions starkly on the issue of curbing the environmental effects of EVs, there have been attempts made to regulate the production, disposal, and implementation of batteries such as this set of regulations by the United Nations Economic Commission for Europe (UNECE).

UNEP/EA.4/L.4

The decisions proposed rely on four proposed actions; encouraging Member States to adopt uniquely adapted methods to increase innovation in sustainable mobility, proposing the exchange of knowledge regarding sustainable mobility, identifying and financially supporting innovative policies via different approaches, and requesting the Executive Director to promote sustainable mobility through different proposed actions.

Previous Attempts to Solve the Issue

- EPA (the U.S. Environmental Protection Agency), operates ten regional offices, which are accountable for managing the environmental regulations in different territories. EPA has set regulations for emissions made by vehicles, which have recently been updated.
- In 1990, CARB adopted the Low Emissions Vehicle (LEV) program. LEV, which, was initially supposed to run from 1994 to 2003, regulated all vehicles sold in California and aimed to reduce emissions by vehicles. Later on, an amendment to the program was made to lengthen its time from 2004 through 2014, called LEV II. CALP would then go on to adopt a third amendment, LEV III.
- CALP has also had other programs, such as the Alternative Fuel Vehicle Incentive Program. Within this program, CALP financially incentivized the use and production of alternative fuels.

Possible Solutions

Increasing regulation regarding lithium mining should be exercised since a very significant portion of the environmental footprint of lithium-ion battery production is by its mining. These regulations should aim to control the chemicals and concentrations used for the mining processes and be more comprehensive when giving permits and exercise restrictions on the miners to prevent possible damage to the environment.

Research and development initiatives regarding alternative, more eco-friendly energy sources to lithium-ion batteries should be encouraged, while the supply chain emissions of lithium-ion products should be ameliorated. Greater development for the production process of batteries should be encouraged and lower emissions should be prioritized in new developments. New disposal and recycling facilities for batteries should be built and research into making the lifecycle of batteries longer as well as making the disposal and recycling process cheaper and more accessible should be considered.

Greater transparency and accountability need to be ensured for car and battery manufacturers as well as mining corporations, and international organizations, and their resources should be utilized to that end.

In markets where EVs are still in their infancy, more sustainable charging facilities and waste disposal and recycling facilities should be created with the help of the international community and NGOs.

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