Analysis of modern, small to medium powertrains with a Focus on their sustainability and environmental impacts

Brian Grace

TUS

Aim of the Project

- Provide an understanding of the current modern powertrains in use. (ICE) (HEV) (EV).
- Analysis of their environmental impacts from production point of view.
- Compare and Contrast similar model vehicles from and ownership point of view, through surveys/case studies/interviews.
- Research the impact these vehicles have at the end of their life.
- Future of the transport industry based on findings.

Project Objectives

1. Thorough literature review to explore information surrounding modern powertrains currently in use.
2. Analysis of the environmental impacts of each from a production point of view.
3. Compare and contrast similar models from an ownership point of view through surveys/case studies/ interviews.
4. Research the impact these powertrains have at the end of their life.
5. Future of transport industry based on findings.

Project Overveiw

- Provide an understanding of Internal Combustion Vehicles, Electric Vehicles, and Hybrid Electric Vehicles.
- Comparison of ownership costs through questionnaires/surveys
- Interview industries that have recently implemented EV fleets
- Data and information presented to illustrate findings surrounding ownership of these powertrains.

Literature Review

- **ICE:** Prevalent due to long history; facing bans due to environmental concerns.
- **HEVs**: Combine ICE technology with electrical power for sustainability and emissions reduction.
- **EVs**: Powered solely by electricity; recent interest due to environmental concerns; concerns surrounding lithium-ion battery production impact

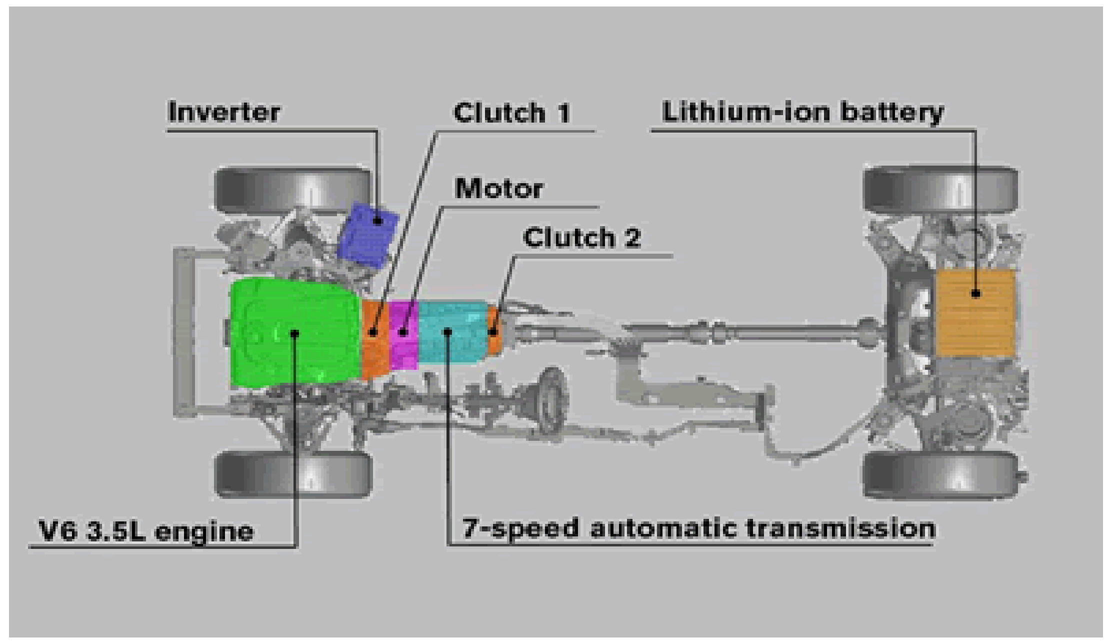
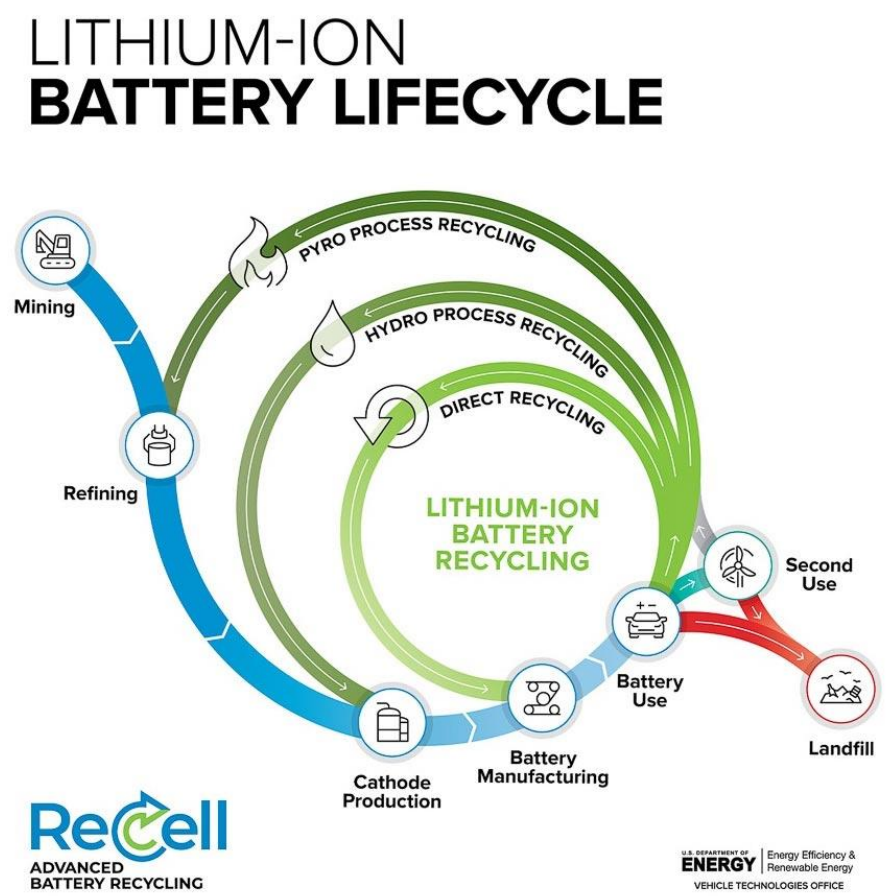


Illustration of a Hybrid Electric Vehicle Powertrain

Environmental impacts:

- **Production:** highlights raw material extraction (lithium, rare earth metals), need for more sustainable mining practices.
- **Disposal:** Brief examination of lithium-ion battery disposal, covering Direct, Hydrometallurgical, Pyrometallurgical processes.



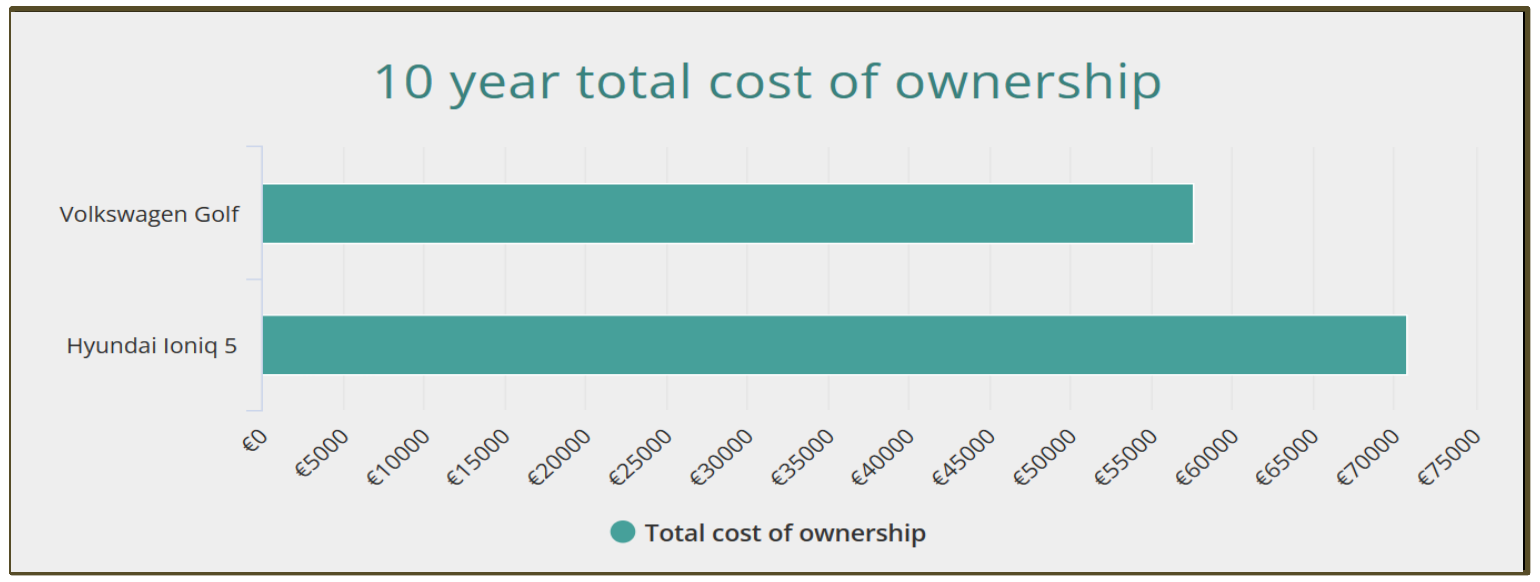
Analysis

Ownership Analysis: EVs/HEVs

- Age distribution: 40-70 years
- **Recent Adoption:** most owners purchased their vehicle in the past 3 years.
- **Annual Mileage:** 10,000 – 30,000 km, 18,000km used as guide for ownership cost analysis.
- **88% benefit** from cheaper tariffs/rates during certain hours

Ownership analysis: Non-EV Owners

- **Fuel**: 86% Diesel
- Annual Mileage: 10,000-20,000km for 36% of owners.
- **Consideration:** 87% stated no to considering an EV/Equivalent.
- **Reasons:** lack of charging infrastructure, affordability, uncertainties on battery lifespan, resale value, technology.



Extraction of raw lithium, 100k metric tons 2021, creates 540,000 of lithium carbonate equivalent needed for production, estimate of 3 million Lithium Carbonate Equivalent for 2025,

Country	Metric Tonnes (MT)
Australia	55,000 MT
Chile	26,000 MT
China	14,000 MT
Argentina	6,200 MT
Brazil	1,900 MT
Zimbabwe	1,200 MT
Portugal	900 MT
United States of America	900 MT

Findings

Findings from dissertation:

- EVs offer zero tailpipe emissions/reduced noise pollution, concerns surrounding production impacts on the environment.
- HEVs aim for sustainable transportation, combining two technologies.
- Environmental impacts of powertrain production, partially raw material extraction, highlights need for sustainable mining practices.
- Overall, Analysis provides a comprehensive overview of modern powertrains and their environmental implications , setting a foundation for further discussions and analysis.

References

-Interviewees that participated in questionnaires/surveys.

-Participants that were interviewed for analysis purposes.

-TUS Library/Science Direct/Google Scholar/ for sourcing past journals on related topics for creation of the literature review.