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White Paper: Electric Vehicles vs. Internal Combustion Engine Vehicles. CM Dilley, PhD

Executive Summary

The automotive industry is undergoing a significant transformation as the world transitions towards more sustainable transportation solutions. One of the most notable shifts is the growing adoption of electric vehicles (EVs) alongside traditional internal combustion engine vehicles (ICEVs). This white paper aims to provide an in-depth analysis of the key differences between EVs and ICEVs, focusing on various aspects such as environmental impact, performance, cost of ownership, and infrastructure.

Introduction

The automotive sector plays a pivotal role in addressing climate change and reducing greenhouse gas emissions. Electric vehicles and internal combustion engine vehicles are the two primary options available today, each with its distinct characteristics and implications. Understanding the differences between these two types of vehicles is crucial for consumers, policymakers, and industry stakeholders.

Environmental Impact

Electric Vehicles (EVs)

Zero Emissions: EVs produce no tailpipe emissions, significantly reducing air pollution and contributing to improved air quality.

Lower Carbon Footprint: The environmental impact of EVs depends on the source of electricity, but they typically have a lower overall carbon footprint compared to ICEVs.

Regenerative Braking: EVs can capture and store energy during braking, increasing energy efficiency and reducing wear on brake components.

Internal Combustion Engine Vehicles (ICEVs)

Tailpipe Emissions: ICEVs emit harmful pollutants such as carbon dioxide (CO₂), nitrogen oxides (NO_x), and particulate matter, contributing to air pollution and climate change.

Higher Carbon Footprint: ICEVs have a higher carbon footprint due to their reliance on fossil fuels for propulsion.

Waste Heat: ICEVs dissipate energy as waste heat, making them less energy-efficient than EVs.

Performance

Electric Vehicles (EVs)

Instant Torque: EVs deliver instant torque from the moment they start, resulting in rapid acceleration and a smooth driving experience.

Lower Center of Gravity: EVs typically have a lower center of gravity due to their battery placement, enhancing stability and handling.

Quiet Operation: EVs are quieter than ICEVs, reducing noise pollution in urban environments.

Internal Combustion Engine Vehicles (ICEVs)

Torque Curve: ICEVs often have a torque curve that requires higher RPMs for peak performance, leading to a different driving experience.

Noise and Vibration: ICEVs produce more noise and vibration during operation, affecting cabin comfort and overall driving experience.

Transmission Complexity: Many ICEVs require multi-speed transmissions to optimize power delivery, adding mechanical complexity.

Cost of Ownership

Electric Vehicles (EVs)

Lower Fueling Costs: Electricity is generally cheaper than gasoline or diesel, resulting in lower operating costs.

Reduced Maintenance: EVs have fewer moving parts, reducing maintenance requirements and costs.

Incentives: Many governments offer incentives, such as tax credits and rebates, to encourage EV adoption.

Internal Combustion Engine Vehicles (ICEVs)

Fuel Costs: ICEVs have higher fuel costs due to the price of gasoline or diesel.

Maintenance: ICEVs require more frequent maintenance due to complex internal combustion engines.

Resale Value: Resale values of ICEVs may decline faster as EV adoption increases.

Infrastructure and Range

Electric Vehicles (EVs)

Charging Infrastructure: EV charging infrastructure is expanding but is not as widespread as gasoline stations in most regions.

Range Anxiety: EVs have limited driving ranges compared to ICEVs, which can be a concern for long-distance travel.

Internal Combustion Engine Vehicles (ICEVs)

Fueling Infrastructure: Gasoline and diesel fueling stations are widely available, reducing concerns about refueling access.

Longer Range: ICEVs typically offer longer driving ranges on a single tank of fuel.

Conclusion

The shift from internal combustion engine vehicles to electric vehicles represents a fundamental change in the automotive industry. While both have their advantages and drawbacks, EVs are gaining prominence due to their environmental benefits, superior performance, and increasingly competitive cost of ownership. However, the transition to EVs also necessitates improvements in charging infrastructure and addressing range concerns.

Ultimately, the choice between an electric vehicle and an internal combustion engine vehicle depends on individual preferences, driving habits, and local infrastructure. The automotive industry is evolving rapidly, and stakeholders should stay informed about the latest developments to make informed decisions regarding their transportation needs.