

University of Wales Trinity Saint David

Wales Institute of Science & Art

A PROPOSAL TO THE UK GOVERNMENT ABOUT THE FUTURE OF AUTOMOTIVE SUSTAINABILITY

Automotive Materials and Sustainability (ACHA6012)



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Nathanael Potts (2003504)
Date 04/2023

Contents

Introduction	1
Literature Review	1
1. UK Legislation.....	2
2. Electric Powertrain.....	3
2.1. Electric Vehicle Efficiency/Performance	3
2.2. Electric Vehicle Emissions	4
3. Hydrogen Powertrain.....	4
3.1. Advantages to Hydrogen Fuel Cells	4
3.2. Disadvantages to Hydrogen Fuel Cells.....	4
4. Go Zero Synthetic Fuels	4
4.1. How does this technology work?.....	5
4.2. Why consider it as the future in the Automotive industry?	5
5. The link between the Automotive and Motorsport Industry	5
6. What should the government Consider (Conclusion).....	5
Bibliography	6

Introduction

The United Kingdom Government is coming under increased amounts of pressure to tackle the environmental crisis. One of the main focusses is to reduce the overall emissions of vehicles on the road as the overall greenhouse contribution of emissions from the transport industry is 16.2% across the world. Not long back, the government announced the target of phasing out the number of new vehicles sold in the UK that have tailpipe emissions by 2030, except hybrids, and then hybrids with any form of ICE to be cut by 2035 with only new electric cars being sold in the UK from then onwards. The development of electric vehicles is increasing year on year as the number of sales increase. However the opportunity for new technology being developed that could play a major part in automotive sustainability is huge and something the government should explore more. An example is the new fuel, discussed in this report, designed and manufactured by Patrick Lowes new company. This new fuel will work in a traditional ICE vehicle and is made using carbon captured from the atmosphere meaning the fuel is carbon neutral. With government investment and backing, this fuel could revolutionise the automotive industry. Overall, this report will focus on the current government legislation and how the government could address the future of the automotive industry with the potential of new technology and initiatives being developed.

Literature Review

When looking towards the future of the automotive industry, the sustainability aspect arguably is one of the most talked about topics due to the ongoing global warming issue. Holli describes global warming as the 'rapid increase in the earth's surface temperature on average' over the past century as a resultant of greenhouse gasses emitted by humans burning fossil fuels (Riebeek, 2010). The primary contributing greenhouse gases that's having the biggest effect on global warming are Carbon Dioxide, Methane and Nitrous Oxide as well as fluorinated gases. Whilst the majority of the

greenhouse gases are caused by human activity, some of the gases can be emitted naturally. The every increasing human activities with regards to production and consumption of fossil fuels have increased the concentration of greenhouse gasses. This has led to climate change and global warming effect (Darkwah Williams Kweku, 2017). As the global warming crisis increases, the motivation of industry leading experts wanting to tackle and prevent global warming has increased. In 2020, a study conducted by Hannah Ritchie and Max Roser found that the transport industry alone contributed to approximately 16.2% of all greenhouse gases (Hannah Ritchie, 2020). Of this 16.2%, 11.9% was on road transport. To bring this percentage down and to help slow the global warming process, governments across the world are bringing in legislations to task transport manufactures to produce cleaner working cars as well as the energy they run on, whether that's petrol/diesel, electric or hydrogen.

Zach Stien describes an energy carrier as a 'substance or phenomenon' that contains energy that can be converted into 'useful energy mechanically or electrically' with some of the most common energy carriers being fuels such as gasoline or natural gas (Stein, 2023). Energy carriers are an essential part of an automotive vehicle, storing the energy the vehicle needs before being converted into mechanical propulsion. The automotive industry have been using energy carriers as a source of travel for many years and have highly developed the petrol and diesel combustion engine which has been the most popular energy carrier for decades. Now that global warming and greenhouse gases are heavily influencing the future, other energy carrier types are being developed including electric vehicles and hydrogen vehicles.

1. UK Legislation

The UK government has set out a plan to phase out the sales of brand new petrol and diesel cars/vans by 2030, By 2035, the government has said that all brand new cars that are to be sold, must be zero emissions at the tailpipe (UK Government, 2020). This legislation that the government has brought in is to help tackle the environmental impact of the automotive industry. This puts massive pressure on automotive manufacturers to adapt to the new legislation and come up with a solution. The most obvious solution and the solution that the government has leaned towards most is the EV industry. According to MER UK, who have put a 2023 guide to EV funding together which was published on 23rd March 2023, the government has provided funding to vehicle grants and infrastructure £2.5billion (MER UK, 2023).

With this legislation outlawing petrol and diesel engines, the opportunity for fuel development has been effected. Fuels are becoming more and more advanced with the key objective to reduce/eliminate emissions from the tail pipe. If a fuel that could be manufactured and rolled out across the UK, could run in a normal petrol engine, this would mean that the cars already on the road would be made potentially carbon neutral. The number of vehicles licenced in the UK, according to the RAC, is 40.8million (RAC, n.d.). If you could create a fuel that could run in all these vehicles and new ones that is also carbon neutral, then this would be a massive gain in technology, with a positive environmental impact. This technology is already being developed and tested by a company, Go Zero, founded by former Mercedes technical chief Patrick Lowe. This will be covered further in the report.

The UK government released a report in March 2023 discussing the action of zero emission vehicles (ZEV). In the report section 9, the government state that for a car to qualify as a ZEV, the vehicle must not emit any CO₂/any other 'targeted' greenhouse gasses at the exhaust as well as having a minimum range of 120miles according to the WLTP test standard (UK Government, 2023). There

target for new ZEV's sold across the UK is to be 80% of new vehicles by 2030 and 100% of new vehicles by 2035.

2. Electric Powertrain

The most popular and what most people conceive to be the future of the automotive industry is electric vehicles. Electric vehicle have the right to be seen as the future due to the powertrain not emitting any greenhouse gases unlike petrol/diesel. However they still do have an environmental impact when they're being manufactured due to the mining of the lithium and the industrial manufacturing processes that use large amounts of energy which ultimately are emitting greenhouse gases into the environment. One study by Dave Mcquilling states that you would have to drive your electric car over 19,000 miles before the EV becomes carbon neutral (Mcquilling, 2023). This can vary from vehicle manufacture and what energy source is being used to charge the vehicle. In march 2022, the government set out the commitment to spend £1.6billion to expand the UK charging network with aim to have 300,000 charging points by 2030 (UK Government, 2022). However, according to EV chargers in the UK, the UK will need 2.3million charging points to be able to cope with the EV demand. That in total is 700 chargers installed every day until 2030 (EV Chargers, 2021). In February 2023, according to zap map who tracks the amount of charging points across the UK, there are only 38,982 chargers at 23,066 locations (Zap Map, 2023) which is no where near enough that the UK need to stay on projection. The graph below, sourced from Zap Map, shows the amount of chargers increase from 2016 till February 2023.

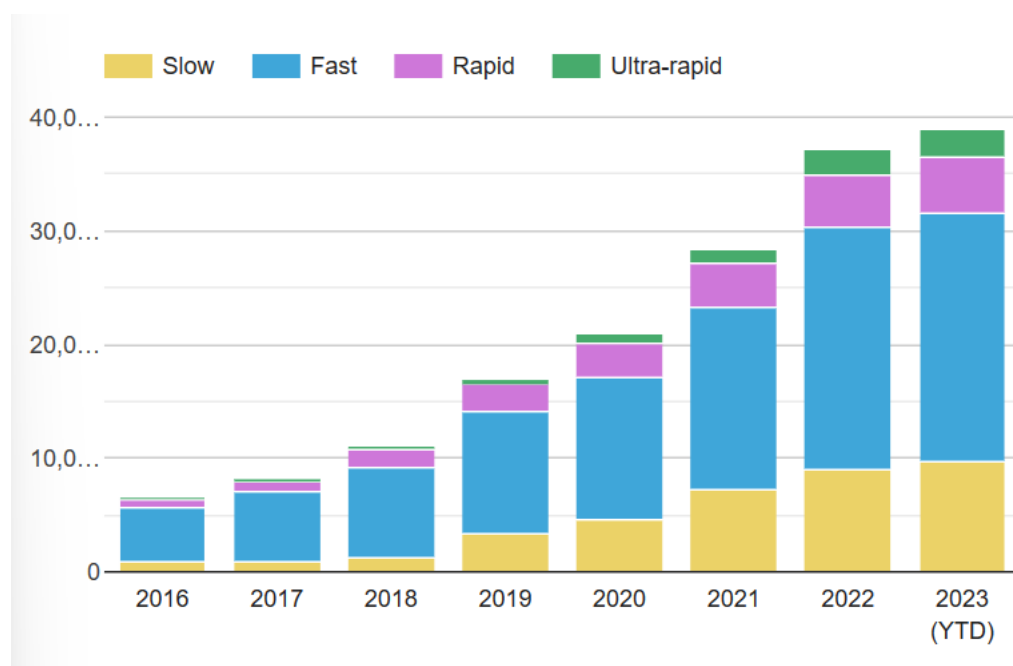


Figure 1 - Number of public charging points from 2016 till February 2023 (Zap Map, 2023)

2.1. Electric Vehicle Efficiency/Performance

Electric Vehicles can convert up 90% of its electrical energy into useful work compared to a combustion engine that has an efficiency of up to approximately 37% (Martin Weiss, 2020). This efficiency comparison makes EV's look like the obvious choice as the future. While the efficiency is better, the range of the cars don't quite match the current range of combustion engine cars. While this is in the now and the range will be improved with further development, the fact that they cant quite match the combustion cars on range is a draw back.

2.2. Electric Vehicle Emissions

While electric vehicle companies state the an EV is completely green and doesn't emit any pollutants while on the road, which is true, the manufacturing process of EV's are another story which is often brushed over. The material extraction from mining the raw materials required for an EV has a higher impact on energy consumption compared to a traditional ICE vehicle due to the specific treatment of the materials used, especially for batteries (Simone Franzo, 2021). During manufacture, Franzo estimated that the energy consumption to manufacture the batteries and vehicle can be anywhere around 40%-70% higher than the energy consumption during manufacture of an internal combustion engine.

3. Hydrogen Powertrain

Another energy carrier that's been around for a number years is hydrogen fuel cells. Even though the hydrogen fuel cell cars have taken a more gradual development path and still quite a small part of the automotive world in the UK, there are still two hydrogen fuel cell cars on the road in the UK: the Toyota Mirai and the Hyundai NEXO (Kristan, 2022). Hydrogen powered cars work by the chemical reaction of hydrogen and oxygen creating electricity which is then converted into mechanical work (BMW, 2019).

3.1. Advantages to Hydrogen Fuel Cells

Hydrogen fuel cells have been designed to reduce the emissions at the tailpipe which they do due to the fuel cell using hydrogen and oxygen which ultimately creates water (H₂O). Using hydrogen and oxygen, the fuel cell creates electricity which means that the car is technically electric. This means that the car creates very little noise compared to a regular car engine.

Another advantage is that the hydrogen fuel cells are more efficient when generating the electricity. (Perry, 2022) says that the hydrogen fuel cells are between 40% and 60% efficient when creating electricity compared to a normal combustion engine which has around 37%. The refuelling of the car is also much quicker than charging an electric car which can take anywhere between 20minutes to 8 hours depending on the charging speed. Perry also says that it takes around 3-5minutes to refuel a hydrogen car.

3.2. Disadvantages to Hydrogen Fuel Cells

The main issue to hydrogen fuel cells is currently the infrastructure in the UK. Currently there is only a handful of places where you can refuel a hydrogen powered cars in the UK (RAC, 2020). It is reckoned that is currently only 12 around the UK with the majority of those being in London. This also means that the running costs are relatively high. The RAC say that the cost of a hydrogen car travelling 100km is £11.40 whereas an equivalent diesel would cost £6.72 to cover the same distance (RAC, 2020).

4. Go Zero Synthetic Fuels

Go Zero, founded by Patrick Lowe in 2020, set the aim of creating a fuel that could replace the normal fuel that goes into your cars engine and is carbon neutral. This would mean that you would be able to run your car as normal with no contribution to global warming. While this technology is still being developed and perfected, the potential for revolutionising the automotive industry is massive. Imagine not having to tax millions of cars off the road which ultimately would be scrapped creating another environmental issue. You could simply replace the current fuels at the petrol stations with a synthetic fuel that is carbon neutral. Well synthetic fuels could be the answer if the

UK government invested heavily to manufacture this new synthetic fuel which could be rolled out across the UK.

4.1. How does this technology work?

Patrick Lowe posted a report called 'Petrosynthesis, The completion of the industrial revolution'. In this report Patrick talks about the new term petrosynthesis was created to 'describe the industrial equivalent of photosynthesis producing organic chemicals and oxygen from non-biological energy sources' (Lowe, 2020). The simple explanation of how the fuel is created is: the carbon is captured from the atmosphere in a process called carbon capture which is mixed with hydrogen which is sourced from water via electrolysis which creates a 'clean and pure fuel' (Zero Petroleum, 2020).

4.2. Why consider it as the future in the Automotive industry?

While this technology is relatively new and still being developed, this could have a major part to play within the automotive industry, especially in the United Kingdom. With the support and backing from the government, Patrick and his team could develop and roll out a revolutionary fuel to help reduce the carbon footprint of the company. The drawback at the moment is the cost per litre and the scale of the manufacture process. If these were to be developed enough then the fuel being generated by extracting carbon from the atmosphere would play a huge positive impact on the country. It will also mean that all the current and new cars on the road now could remain on the road for its working lifetime reducing the amount of car scrap and ultimately reducing the impact of scrapping cars on the environment.

5. The link between the Automotive and Motorsport Industry

Motorsport within the UK as well as globally could be more important than ever to help with research and development. In a report written by Joey Powis of Cranfield University says that the cutting edge capabilities of motorsport teams can support the development and innovative solutions of the automotive industry (Powis, 2016). The rapid development and testing programs of the motorsport industry becomes the ideal proving ground to test automotive technology to its limits. A good example of this is the news that formula 1 is moving to synthetic fuels in 2026 with its aim to be net-zero carbon by 2030 (Benson, 2022). With the new fuel being developed by formula 1 teams as well as the likes of Patrick Lowe, this technology being developed and tested in formula 1 and other means of motorsports can be the potential future of the automotive industry. Formula E is also another race series that can play a huge role in developing battery and motor technology with its all electric race series, which is also the first series to be carbon neutral in motorsport (Formula E, 2022). Ultimately, Formula E is the perfect stage to market battery technology as well as trial research and development in EV technology.

6. What should the government Consider (Conclusion)

In reflection, the government should reflect on where they are investing their money and should consider the future legislations of outlawing new petrol and diesel cars. The legislations of 2030 and 2035 should be reconsidered with the key focus of the fuel being developed by Patrick Lowe's company, Zero Petroleum. If this fuel could be rolled out across the United Kingdom with the aim of replacing the current fuels in the petrol stations. With the government's backing and investment, this could revolutionise the future of automotive sustainability as this would mean the cars currently on the road as well as future, more advanced cars would run on carbon neutral fuel. This would also reduce the amount of cars scrapped in the United Kingdom also reducing the emissions. The use of implementing this new fuel into motorsport series as a test development program would help push this fuel into the automotive industry. The motorsport industry can play a pivotal role in the future

legislation changes surrounding energy carriers as it could prove that normal cars could switch to a carbon neutral fuel changing the way the nations automotive industry. Developing the infrastructure to not only increase the number of charging points across the UK to cope with the number of EVs on the road, the development for manufacture of a carbon neutral fuel that can be rolled out across the country, that is affordable, into current petrol stations. As there are millions of petrol stations already built and functioning in the UK, the cost of investment to roll out this new fuel would be a fraction compared to the cost of electric charging points. This is an area the government should seriously consider as part of the sustainable future in the automotive industry. If EV chargers are correct with their estimate of 2.3million chargers by 2030, then the government needs to put some serious thought into whether this target is met. Overall, the future of the automotive industry is not only electric vehicles, but also the possibility of the new carbon neutral fuel.

Bibliography

- Benson, A. (2022, 06 27). *Formula 1 develops synthetic sustainable fuel to be introduced in 2026*. Retrieved from BBC: <https://www.bbc.co.uk/sport/formula1/61942876>
- BMW. (2019, 12 5). *Hydrogen fuel cell cars: everything you need to know*. Retrieved from BMW: <https://www.bmw.com/en/innovation/how-hydrogen-fuel-cell-cars-work.html>
- Darkwah Williams Kweku, O. B. (2017). Greenhouse Effect: Greenhouse Gases and Their Impact on Global Warming. *Journal of Scientific Research & Reports*.
- EV Chargers. (2021). *How many EV charge points does the UK need?* EV Chargers.
- Formula E. (2022). *Sustainability Report 2022*. Formula E. Retrieved from Formula E.
- Hannah Ritchie, M. R. (2020). *CO₂ and Greenhouse Gas Emissions*. Our World in Data.
- Kristan, L. (2022). Hydrogen fuel cell cars explained: Should I buy a hydrogen fuel cell car? *Autotrader*.
- Lowe, P. (2020). *PETROSYNTHESIS, The completion of the industrial revolution*. London: Go Zero.
- Martin Weiss, K. C. (2020). Energy efficiency trade-offs in small to large electric vehicles. *Environmental Sciences Europe*.
- Mcquilling, D. (2023). How Many Miles Before An Electric Car Is Greener Than A Gas Car. *Slash Gear*.
- MER UK. (2023). *A 2023 Guide To Government Incentives & Grants For EVs*. MER UK.
- Perry, T. (2022). 21 Hydrogen Fuel Cell Car Advantages And Disadvantages. *Green Car Future*.
- Powis, J. (2016). *The impact of global sustainability trends on the Automotive sector and Motorsports role in supporting the industry's adaption to these pressures*. Cranfield University.
- RAC. (2020, 09 16). *Hydrogen cars: are they the future?* Retrieved from RAC: <https://www.rac.co.uk/drive/advice/buying-and-selling-guides/hydrogen-cars/>
- RAC. (n.d.). *Mobility*. Retrieved from RAC Foundation: <https://www.racfoundation.org/motoring-faqs/mobility>
- Riebeek, H. (2010). *Global Warming*. Earth Observatory.

- Simone Franzo, A. N. (2021). The environmental impact of electric vehicles: A novel life cycle-based evaluation framework and its applications to multi-country scenarios. *Journal of Cleaner Production*.
- Stein, Z. (2023). Energy Carrier. *Carbon Collective*.
- UK Government. (2020). *Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030*. Government UK.
- UK Government. (2022). *Tenfold expansion in chargepoints by 2030 as government drives EV revolution*. London: UK Government. Retrieved from Government UK.
- UK Government. (2023). *Consultation on a zero emission vehicle (ZEV) mandate and CO2 emissions regulation for new cars and vans in the UK*. London: UK Government.
- Zap Map. (2023). *EV Charging Statistics 2023*. Retrieved from Zap-Map: <https://www.zap-map.com/statistics/>
- Zero Petroleum. (2020). *Technology*. Retrieved from Go Zero: <https://www.zero.co/technology>