

Research Manifesto

Are electric powered cars the answer to our current climate change problem? Or simply a short-term solution compared to using hydrogen as a fuel source. Whilst public opinions of hydrogen powered cars do not tip the balance in its favour. Is it the long-term solution that will revolutionise transportation as we once knew it?

What is climate change? Our planet's average temperature is 15°C. Whilst there are natural fluctuations our planet is continually increasing in temperature. The Greenhouse Effect is the science behind this is when the Sun's rays are trapped by the carbon dioxide that is emitted into our atmosphere. The greater the amount of carbon dioxide the longer the heat is retained, as a result the temperature increases. So, who is one of the biggest contributors to climate change? Automotive and transport vehicles contribute 22% of total UK emissions, ENVIRONMENTAL PROTECTION UK (2016).

How can the automotive industry combat global warming? The general forward-thinking answer is to go all electric. Adopting a fully electric transport system would; guarantee no exhaust gases emitted, in turn slow down the effects of climate change and purify the air we breathe, especially in heavily populated cities. A big benefit is cost; £2 to drive 100 miles in an electric car compared to £11.60 for the same distance using fossil fuel. A saving on average of 23% on the cost of maintenance and servicing. EDF ENERGY (2015).

Why do cars need to change from fossil fuel? The newest generation of cars produced nearly 7% more emissions than those manufactured to earlier emissions standards. So, it is apparent that new vehicles, whilst endeavour to advance environmentally. The reality is they are digressing. This is due to the increased demand of larger cars, driving up emissions, despite the use of innovative technology such as PPF (petrol particulate filter), driving up emissions.

Why Lexus? Lexus was created with only the absolute best designers and engineers, that are handpicked, from Toyota and they continue to do so. Every vehicle is created with the upmost passion and attention to detail. Something that is apparent in every single vehicle that Lexus makes from past, present and the future. So, I believe that with Lexus' values and passion they will continue to excel and innovate.

The Lexus LFA, developed in conjunction with Yamaha, is a 2-door sports car arguably the best sounding car in the world. Lexus once again showing that incredibly good is not enough, with constant evolutions during manufacture and even changes of material for the chassis, in the search for driving perfection.

The Lexus LC can be equipped with 2 engine options, a 5.0 n/a V8 (2UR-GSE) and a 3.5 V6 hybrid (8GR-FXS) both going through a 10-speed direct shift transmission to then end, at the rear wheels. With the choice of two different engines with little difference in performance. The hybrid only being 0.2 slower 0-60MPH but able to achieve 10 mpg more than the V8 mixed with cheaper insurance and road tax, the hybrid drivetrain becomes a very viable option for a forward-thinking consumer.

The future question, is no longer what is the mpg or how many litres is the fuel tank? It is how quick can it charge or how many miles can it do on one full charge? So, what does the future hold for the EV? Worldwide, governments are under pressure to reduce global warming. They are then putting the pressure on all manufactures to initiate and develop fully electric vehicles that are not only desirable but practical and affordable to the consumer. CLIMATE CHANGE COMMITTEE (2019) Currently we have vehicles with 200 -400 plus mileage range.

The battery is the key to the global sale of EV's. It is no secret that this is the biggest concern for consumers. Last year a German company called 'Innolith AG' announced that they are working on a new EV battery that could have a range of 620 miles. INNOLITH(2019)They are proposing this could be commercially available as early as 2022. This technology would use a non-flammable inorganic electrolyte, that reduces the risk of igniting compared to the flammable organic electrolyte found in traditional EV batteries.

The battery's environmental impact and safety. In 2019 a climate change committee warned that if all 31.5 million cars in the UK were replaced by EVs by 2050, this would double the current annual global supply of cobalt. Manufactures are aware of this and are currently pioneering ways to reduce the amount of cobalt they use in their battery packs and are committed to ethically sourcing their supply chains. Elon Musk the co-founder of Tesla has vowed that the next generation of Tesla vehicles will be totally free of any cobalt. Tesla, the leading manufacture of electric cars, engineered their batteries into a flat tray like pack that is placed in the floor, within the cabin chassis. If the vehicle has a collision the battery will not be compromised or violated owing to the appropriate crumple zones. SIDDIQUI,F.(2020)

How can hydrogen power our cars? The HV is powered when, hydrogen enters the fuel cell, mixes with Oxygen to create H₂O in a chemical reaction this generates electricity on demand. Hydrogen powered engines first originated more than 2 centuries ago. Francois Isaac de Rivaz developed a primitive engine powered by hydrogen mixed with oxygen which is then ignited by an electric spark. CONNECTUS(2020)

Hydrogen infrastructure? Future refuelling: under 5 minutes for 300 miles (Toyota Mirai) TOYOTA (2020) Once the nozzle is secure onto the vehicle's receptacle, the vehicle communicates with the pump via infrared to relay information such as air temperature, tank pressure and remaining tank capacity. hydrogen stations are potentially able to produce the fuel not only offsite but also on site. Using such methods as electrolysis (using electricity to split water into hydrogen and oxygen) or steam reforming (where high-temperature steam is used to produce hydrogen from a methane source.)

The upsides of hydrogen. No harmful exhaust gasses are emitted, only water is produced as a biproduct. Hydrogen as a fuel has near twice the fuel economy of fossil fuels. Robust reliability: fuel cell technology has proven itself against temperatures as low as -40°C . hydrogen fuel cell are 40-60% efficient compared to the combustion engine which is typically 25%. Lower operational costs: fuel cell eliminate the need to manufacture, change, charge and manage batteries.

The downsides to hydrogen. Hydrogen cars, like petrol and diesel, can be instantly refuelled at a filling station however Hydrogen needs to be compressed into a pressure tank to power the vehicle. Fuel cells wear out at rapid rate and are difficult to recycle and regenerate. Hydrogen as a fuel source is extremely hard to manufacture and distribute. Additionally, hydrogen fuel cells have bad theoretical and practical efficiency.

Is hydrogen safer than electric? Hydrogen fuel cells have been given a bad reputation. One example is the Hindenburg hydrogen-filled airship that exploded over Lakehurst. AIRSHIPS.net(2009) We are generally comfortable with the likes of gasoline which is an extremely flammable fuel. Even though hydrogen shares the same flammable and explosive properties. Car manufactures have designed fuel tanks that are pressured up to 10000 psi. Hydrogen is 16 times lighter than air so if the tank were to be compromised the hydrogen would instantly dissipate into the atmosphere.

Current lack of infrastructure is a problem. Most of the 16 hydrogen fuelling stations are located near the M25, South-East England, so not easily accessible to the vast majority of motorists, BALLYMENA TIMES (2020). Conversely, there are in excess of 30,000 electric charging points across the UK in over 11,000 locations. This equates to a greater number of charging points than petrol stations. With a further 10,000 added in 2019 alone, EDF(2020). The biggest advantage is that charge points are cleaner, simpler to install and the locational structural footprint required is far less than for a petrol or hydrogen station due to the compact size required.

Potential future concepts. By utilising solar panel technology, it is possible to extend to the distance range of any EV vehicle. "Solar-Technology International Ltd" offer many products such as: 'Rigid mono high density solar panel' –with an overall size and weight 20% less than a conventional panel. 'Semi-flexible' it offers a low profile, lightweight, flexible panel that will conform to shaped and curved surfaces. How can solar technology be applied to cars? Integrating these semi-flexible solar panels into the roof of a vehicle initiates constant, storable, regenerated electricity, even when the vehicle is stationary. This would particularly benefit SUVs, due to the ample roof size, and their height making the panels less visible. In the case of a roof box being fitted then the same technology can be applied to the roof box itself.

Running the numbers on solar. 1X 100W outputs 600 watts per day. Standard EV has a 40 KWH battery. $40,000\text{W} \div 600\text{W} = 66 \times 12\text{hour daytime} = 792 \text{ (DAY)hours} = 113\text{days}$ Roof dimensions; 1000mm W 1300mm L 2X 100W solar panels (1000mmX665mm) Total output of 1.2Kw per 12hour day Standard 40kw battery; regenerate 3% per day.

Can the energy of wind be harnessed? Vehicles travel through the air and car manufacturers try to make theirs as aerodynamic as possible. So, on an EV is it possible to harness that energy which has previously been an enemy and turn it into an ally? Similar to a combustion engine a fan is used for cooling. The front of the EV could have a small grill allowing air flow to also turn the fan instead of just cooling the electric motor and battery. Although the motor and battery generate heat when in use, they have the ability to harness the aerodynamic force.

How would this be achieved? This concept would act as a wind turbine. When the air flows across the blades it creates air pressure. The difference in air pressure across the two sides creates lift and drag. The lift is greater than the drag so the fan spins. The fan would be connected to a generator which would create the electricity and send it back to the battery. This concept would only work when the vehicle is moving so this would be most effective whilst driving long distances on the motorway. To have the ability to regenerate electricity on the motorway for an EV vehicle is vital.

Running the numbers. 5 blade lantern turbine. Spec; 3 phase permanent magnet ac generator. Start up speed of 4.4 mph. Survival wind speed;100mph. Rated output 3500W. 350w per hour at 24mph. 0.8% charge per hour for a standard 40kw battery. 72 mph= 2.4% charge in 1 hour.

My creation of 'hybrid passive energy' By utilising both solar and wind energy the vehicle would be able to recover 7.8% on current adapted technology (12-hour day+ 2X-1-hour commute). Adding an additional 11.2 miles of range. With the average distance to the nearest supermarket being 1.86 miles=3 round trips.

With the base now laid from my research I generated 3 design ideas. A compact 1 occupant personal transport. A performance family estate with an exceptional range. Finally, a hyper car utilising hydrogen technology for next generation performance. A decision was made to combine the hyper car and the estate to create a new type of vehicle, the hyper estate.

With this decision made, my chosen design direction is the Lexus L finesse design language. LEXUS (2013) It first originated in 2003 and has been described as leading-edge design and technology. Applied with finesse it incorporates L like shapes into the designs of the vehicles. This can be reflected in the grills, lights and windows. Lexus has always been very creative and passionate when it comes to designing their vehicles. This is due to the Japanese culture, something that reflects in their design. With any vehicle that Lexus has produced, you can see the incredible attention to detail and the effort that goes into designing a vehicle. With this way of thinking I would like to incorporate that and use their sheer passion to influence my design as a designer to try and regurgitate some of that immense skill.

I created a PSD which was built upon a foundation of me creating a 3D economic package drawing, for five occupants and the accompanying technology. Through development I was able to finalise exactly what I wanted from my product with a length of 5 metres long 2 metres wide and 1.5 metres tall. A predicted target weight of two tonnes as I want the vehicle to be as efficient as possible and also perform. The vehicles main propulsion will come from a hydrogen drive train, two hydrogen tanks linked to the Fusion cell to send power to all 4 motors. This would also be linked up to a graphene lightweight battery in order to store excess energy to use it a later date.

The fusion cell will be located in the middle of the vehicle underneath the middle set of seats. The vehicle will have a 750 brake horsepower and thousand newton meters of torque. The vehicle is classed as a hyper estate due to being a four door 'wagon' and performance figures that accompany the hyper status. The driver is positioned in the centre of the vehicle something that's very unorthodox, but the main focus is the driver. Positioned for the performance side whilst also creating the drama for the hyper element.

The target market for the project is a fun family, not only fun as in performance, but fun for an active lifestyle. The vehicle with its all-wheel drive system, will be suited for recreational activities. The production quantity will be 10,111 vehicles to have a fine balance of exclusivity but also so that a wide range of families can enjoy the experience as well. In conclusion with the combination of my vast research, passion and understanding from technology and the Lexus brand, not only will this vehicle create life long memories, but it will also create an experience that cannot be forgotten.

REFERENCE LIST:

Airships.net (2009). The Hindenburg Disaster | Airships.net. [online] Airships.net. Available at: <https://www.airships.net/hindenburg/disaster/>

Ballymena times (2020). Hydrogen cars: How the fuel cell works, where the UK's filling stations are and how expensive they are to run. [online] www.ballymenatimes.com. Available at: <https://www.ballymenatimes.com/lifestyle/cars/hydrogen-cars-how-fuel-cell-works-where-uks-filling-stations-are-and-how-expensive-they-are-run-1386285> [Accessed 5 Dec. 2020].

climate change committee (2019). Reducing UK emissions - 2019 Progress Report to Parliament - Committee on Climate Change. [online] Committee on Climate Change. Available at: <https://www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/> [Accessed 26 Nov. 2020].

connectus (2020). De Rivaz Engine : World's first engine to power an automobile. [online] Mobility Ahead. Available at: <http://mobilityahead.com/de-rivaz-engine-worlds-first-engine-to-power-an-automobile> [Accessed 10 Nov. 2020].

EDF (2015). EV: Advantages. [online] EDF Energy. Available at: <https://www.edfenergy.com/electric-cars/benefits>.

edf (2020). EV: Charging. [online] EDF. Available at: <https://www.edfenergy.com/electric-cars/charging-points#:~:text=Electric%20car%20UK%20charging%20points>.

environmental protection uk (2016). Car Pollution - Environmental Protection UK. [online] Environmental Protection UK. Available at: <https://www.environmental-protection.org.uk/policy-areas/air-quality/air-pollution-and-transport/car-pollution/>.

innolith (2019). Innolith Energy Technology Brings 1000km EV Within Range. [online] Innolith. Available at: <https://innolith.com/innolith-energy-technology-brings-1000km-ev-within-range/> [Accessed 10 Dec. 2020].

lexus (2013). The philosophy of L-finesse design. [online] Lexus. Available at: <https://blog.lexus.co.uk/the-philosophy-of-l-finesse-design/> [Accessed 10 Nov. 2020].

Siddiqui, F. (2020). Tesla's latest big unveiling isn't a car or truck: It's the battery tech that could power its future. Washington Post. [online] 22 Sep. Available at: <https://www.washingtonpost.com/technology/2020/09/22/musk-tesla-batteries/>.

toyota (2015). Toyota Mirai – The Turning Point. [online] www.toyota.com. Available at: <https://www.toyota.com/mirai/2020/fcv.html> [Accessed 10 Nov. 2020].