

Independent Inquiry

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Introduction

This independent Inquiry explores the automotive industry in relation to climate change specifically for the future of track racing. With climate change an environmental emergency (BBC 2019). Governments have had to respond accordingly. Policies have been introduced to address this. These policies have had a direct impact upon the automotive industry with current emissions worldwide, accounting for 13% of the greenhouse gases (Mamalis, Spentzas et al. 2013).

Independent Inquiry plays a vital part in our learning and provides an excellent starting point when designing for a chosen subject. By Implementing Evidence based Independent Inquiry, it highlights the issue, but also explores why they are occurring and raises awareness through research and possible future progression. An independent Inquiry allows for critical reflective reviews of the literature out there to support the chosen topic (Todd, Bannister et al. 2010).

For the purpose of this inquiry, the headings “What is climate change”, “What can be done in the Automotive industry?”, “Which power source is best suited to the automotive industry in relation to track racing” and “Where will the development of technology lead us in the future of the automotive industry?”. This structure will allow for the exploration of climate change and how this is directly impacting on the automotive industry in relation to track racing, and where the future is progressing.

The Inquiry will be based on evidence within a 10 year period, relevant quotes and policies prior to this will be considered and included where deemed relevant.

Climate change is defined as “Climate change is also a change in Earth's climate. This could be a change in Earth's usual temperature. Or it could be a change in where rain and snow usually fall on Earth”. (NASA2014)

Chapter 1

What is Climate change?

Climate change is having a large impact on the way we live out lives with constant reminders that things have to change (WEA 2016) . Ever since the 1800s humans have gradually increased the contribution of greenhouse gases to our atmosphere since the introduction of burning coal to warm, items up as a result carbon is released and combines with oxygen to form carbon dioxide (Ritchie and Roser 2017). This gas is released into our atmosphere which over time this has gradually accumulated and is increasing everyday in the worlds atmosphere (Lo 2010).

Why has the Automotive industry had to change?

With everyday vehicles using combustion engines Government policies have implemented specifically in the UK a plan to ban all petrol and diesel cars by 2040 (Allen 2019). Combustion vehicles emit Carbon Dioxide (CO₂) and small nano particles that are proving to be bad for the environment with emissions rising to our atmosphere (Myung and Park 2011). With this in mind catalytic converters were introduced to control the levels of emissions and reduce toxic gases. Having a catalytic convertor fitted to a vehicle is a legal requirement in order to pass an MOT for a vehicle driven on public roads in theUK (DVSA 2017). With technology and research progressing over the past 30 years, power and speed has been improved so has the level of fuel efficiency from track racing to road use. With the reduction of pollutants such as carbon dioxide and nitrogen oxides

and other partial matter emission standards have been put in place to reduce these emissions by 99% (Energy 2013).

Greenhouse gases found in our atmosphere include:

Water vapour: water vapour is made up from hydrogen and oxygen forming H₂O. H₂O is the most abundant greenhouse gas in the world's atmosphere and plays an important role of absorbing long wave radiation and as a result radiates it back to the surface of the earth.

Methane: is a greenhouse gas composed with hydrogen and carbon with a formula of CH₄ also known as a hydro carbon.

The gas contributes approximately "16%" (Denchak 2019) to the world's atmosphere. The natural gas is released by the decay of organic matter and waste in landfill.

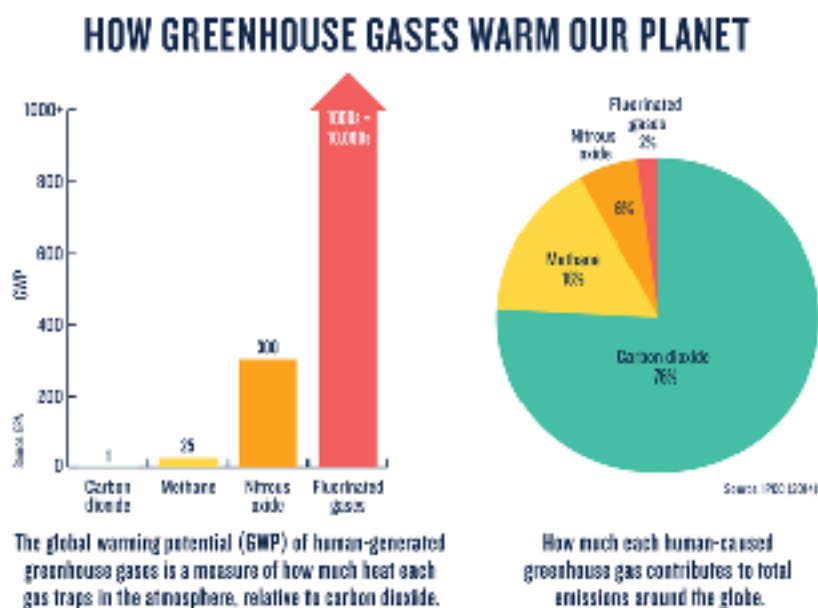


Fig1: Greenhouse effect 101

Nitrous oxide: is found in our atmosphere and it plays an important role. Nitrous oxide is released from fossil fuel combustion and burning of biomass. The gas can also be produced by other means such as soil cultivation. The chemical formula is N_2O . The gas makes up approximately “6%” of the greenhouse gases (Denchak 2019).

Chlorofluorocarbons also none as CFCs are synthetic compounds that contribute to the greenhouse effect and are greenhouse gases.

Carbon dioxide (CO_2) has a very small part to play in global warming however very important. CO_2 is released through combustion of natural resources such as coal and is a byproduct of respiration in humans. It has the largest volume within the atmosphere contributing to approximately 76% (Denchark 2019). Since the industrial revolution human activity has increased the volume of CO_2 in our atmosphere by a third. The gas has increased so drastically the gas is causing great concern as it is speeding up the process of climate change. (Nunez 2019)

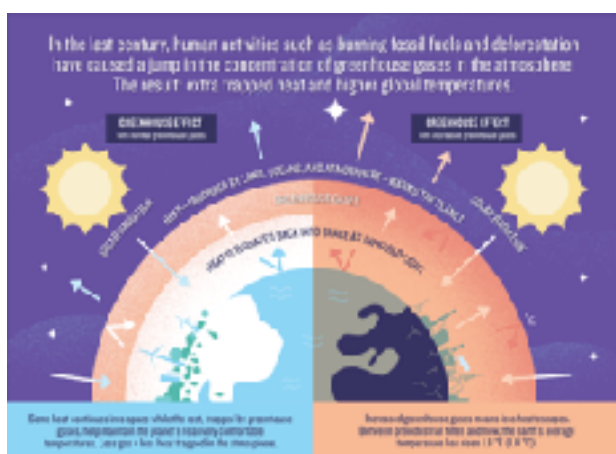


Fig2: Greenhouse effect 101

With all of these gases being released into the atmosphere they create a blanket effectively around the earth. When the sun shown in the diagram) emits its ultraviolet radiation it hits this blanket of gases and some of the radiation, is reflected back but the majority will pass through until it comes in contact with the surface of the earth. The

earth absorbs the radiation and emits a different source or type of light called infrared radiation back up into the atmosphere. Some of this radiation gets trapped under the blanket of greenhouse gases and is absorbed and remitted back down to earth. The majority of the infrared radiation will leave the atmosphere into space. The infrared that's trapped under the greenhouse gas blanket causes the earth surface to warm up. We call this the 'greenhouse effect' (Perkins 2018).

Without this greenhouse effect, the earth would be incredibly cold and would be critical to life on earth for animals and species and unfortunately we will be unable to survive. There are negatives to this effect that too many greenhouse gases are accumulating creating effectively an even thicker blanket over the earth with it increasing even more infrared radiation and thus being trapped and absorbed (Perkins 2018).

Due to the climate changes average temperature of the earth has increased by 1°C since the industrial revolution, temperatures continuing to rise with large CO₂ volumes being released into the atmosphere. The heat and temperature increase is all dependent on your position on earth with some places being warmer than 1°C. (LO2010)

As the temperatures have increased this has caused several issues for the polar ice caps and its habitat. Ice caps contain ice sheets and glaciers which are beginning to melt this causes further complications for concern as the ice caps maintain the earth's temperature sea levels and climate (GLICK 2019). Not only does the white surface of the ice reflect the light from the sun but it prevents the absorption of heat radiation due to the ice's shiny white surface which is an excellent reflector of light. The ice sheets and glaciers are effectively giant containers of CO₂ when the ice melts not only do they release pure water into the seas reducing the salt concentration this destroys habitats and sea life. If we have

a set concentration of salt in our seas and then we increase the volume of pure water. Without adding salt the habitats and sea life within our waters will die and species will not be able to survive. As well as the ice melting the water that's been contained for several years above sea level and below sea level has got to go somewhere. If we take a glass for example with a rock placed inside, the cup being our land and with water surrounding this rock being our sea. If we place an ice cube within the cup being our ice caps at first the water level remains the same however eventually the ice begins to melt increasing the water level within the cup as the water level rises the amount of rock above the water decreases. Effectively the large volume of land we have on this planet will decrease destroying habitats that take in CO₂ for photosynthesis, and coastal areas are at risk from flooding as sea levels continue to rise. Oceans absorb 90% of the extra heat from global warming this means as warmer water expands, so does our oceans which are effectively taking up more space (Dahlman and Lindsey 2018). Not only does the seas absorb this heat but it is also absorbing large volumes of CO₂ which is causing ocean acidification effectively reducing the volume of oxygen available to our sea life and our coral reefs. By destroying the coral we effectively are destroying a quarter of our sea life habitats shelter and breeding grounds. (Cho 2011).

With climate change affecting habitats this effectively is destroying the quality of our air what we drink and the nutrition in the food we consume. The World Health Organisation (WHO 2019) have estimated we could see as many as 250,000 deaths each year between 2030-2050 if we don't make these changes.

Chapter 2

What can be done in the Automotive industry?

The most important and crucial part of slowing down or reducing climate change is effectively reducing the volume of greenhouse gases and emitted into our atmosphere (Brueck 2018). There are several different ways we are trying to combat this with several organisations, businesses, individuals and the government to effectively combat this climate change emergency including the UK Parliament (BBC 2019) . The automotive industry have had to set rules and regulations even in track racing. The biggest change is the carbon emissions with the UK automotive industry making the most impressive strides to cut the level of CO₂ with the mission by a third since 2000 (SMMT 2018).The UK Government are encouraging the use of electric powered vehicles (EPV) on the the road in order to reduce air pollution and greenhouse gas emissions (Parliament 2017-2019). The introduction of Formula E has been introduced to allow the users to enjoy an emission free racing sport.

EPV are powered by the use of a battery and an electric motors and can be powered by the use of renewable power sources (Crowell 2017) including our National Grid. The energy is stored within the vehicle in the form of battery lithium powered battery pack. EPV are excellent and provide a cleaner driving path without producing harmful gases within the pedestrian environment (House of Commons 2017-2019) including to drivers on track.

Due to the nature of the electric batteries when driving, an electric vehicle produces a lot of heat but eliminates sounds. This is an important factor to monitor in high speed scenarios on track. The sound element is eliminated and can cause huge implications for those who rely on the sound of a vehicle.

EPV provide no noise at all, there was huge concerns for the safety of pedestrians. The European Union (EU) enforced the regulation this 2019 with the introduction of acoustic vehicle alert system (Avas) to all electric cars manufactured from 2021 (BBC 2019). This will be in the form of a high pitch whistle. The whistle although a great idea, still poses concern of safety issues. Another downside to the EPV is the battery life, few places provide charging points currently in the UK. EPVs rely heavily on being plugged in over night. Although fairly easy to charge using a household 3 point socket, cars including the Electric Golf provide a low mileage with very long charging times. The EGolf for example, provides 100 miles of range on a fully charged battery, however this can take up to 13 hours to charge (Watson 2018) . Combustion engines in comparison take a few minutes to fill up, with the equivalent Diesel Golf's ability to travel 1046 miles on a full tank of fuel (Smith 2019). EPVs are not able to compete at the moment for fuelling times and range. Although they're not very quick to charge, costs are considerably less to charge with an average cost of £8-£12 (Moldrich 2019), in comparison to a full tank fuel costing around £70. Within Formula E, an additional car is used when the battery is running low, due too long charging times. The savings in terms of running costs are quite marginal, which poses the question is electricity the future of track racing?

Research would suggest that this is not the case, although electric powered vehicles do not produce any fumes when driving which is beneficial to racing drivers health.

A lot of the electricity to power these vehicles come from the National Grid. In the UK 5% generated electric comes from coal fired power and 42% through the use of gas (Ambrose 2019) . In a thermal power station where coal is used to heat up water which produces steam the steam is then used to turn turbines which effectively produces electricity by the use of a generator. As shown in Figure 3.

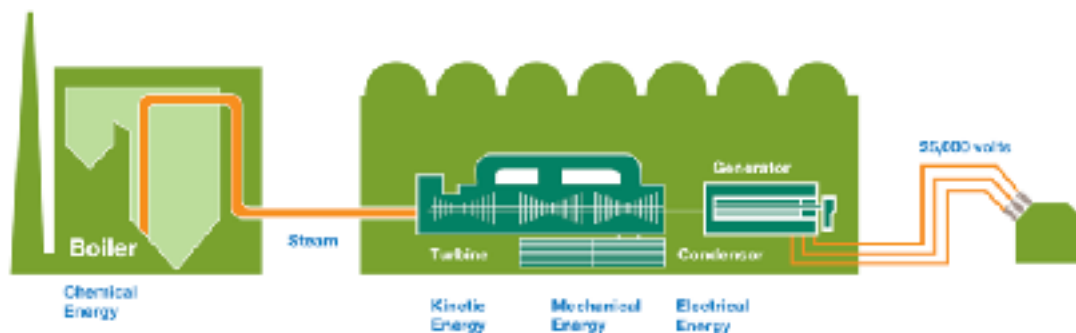


Fig 3: Author Unknown

As such a low proportion of our electricity is renewable, coal when burnt does produces carbon emissions, effectively moving the fumes from one place to another. The government does have plans to increase the volume of renewable electricity significantly in the next few years. A target to reach a huge deduction of carbon emissions with 34% by 2020 and states 80% by 2050 (Government Wales 2016).

To reduce global warming the automotive industry have invested in two main sources, electricity and hydrogen, both emit zero carbon emissions and only produce byproducts. As heat from the battery or in the case of hydrogen It produces water. Both sources use electricity to drive electric motors, both eliminate the pollution and inefficiencies of the fossil fuel combustion engines. Elon musk called hydrogen power 'mind-bogglingly

stupid'(D'Allegro 2019) . In contrast to this the Japanese Government announced they were going to become the first hydrogen society. Japan announced it wants to build 160 hydrogen station and over 40,000 Fuel Cell Vehicles (FCV) by 2020 (KYDO NEWS 2018) . Their second target is to achieve “900 stations” stations and over 800,000FVCs (Tajitsu 2018) including commercial vehicles such as buses and lorries. Looking further into the hydrogen fuel cell technology companies such as ASDA and Amazon are using hydrogen powered forklifts as an alternative, due to the fumes produced by conventional combustion engine forklifts. The use of electric powered forklifts are not quite there yet with limited battery life and long charging times. These factors are not practical in large operational warehouses where the use of the vehicles are needed around the clock. So is hydrogen the answer?

Chapter 3

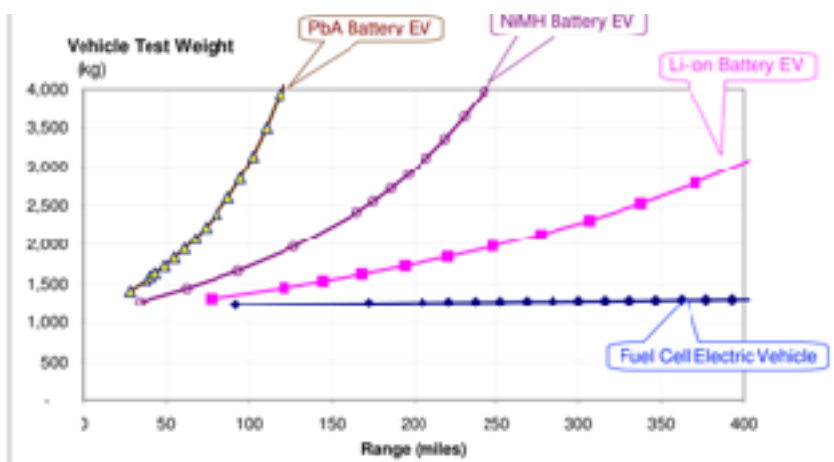
Which power source is best suited to the automotive industry in relation to track racing?

Hydrogen is the most common element in the Universe and can be found almost anywhere (Geggel 2017). Most of the earth's hydrogen is within natural gases or water and we extract this gas from these materials by several methods. Hydrogen is incredibly powerful and has 40000Wh/kg whereas lithium ion is only considered to have 278Wh/kg (Tsakiris 2019). This means the hydrogen is approximately 236 times as much energy per kg, due to its compressed light weight nature. Hydrogen cars can therefore, provide long range distances without adding a large amount of weight. As demonstrated by a Welsh company 'Riversimple' who developed a vehicle half the weight of a small hatchback weighing under 600kgs. The light weight nature of the vehicle allowed less material to be used (Frangoul 2019) and could be utilised in the future of track racing. Lightweight properties are deemed essential for track racing.

EPVs are a little more complex if we increase the range. We have to add layers of additional batteries as lithium ion can only contain so much stored energy. As we increase the volume or layers of batteries this increases the weight of the vehicle, which will not benefit in a racing situation. As a result we will need more power to power the vehicle, larger brakes and therefore the car's technical package will increase. Larger vehicles are generally a lot heavier, therefore higher torque is needed to push the vehicle and more weight is now being pushed around. So are we gaining anything by increasing the battery size? Unfortunately not. Lithium ion technology unfortunately is still far away. The best battery available claims to provide 379 miles of range on a full charge, research

demonstrates that the more realistic range is actually between 200-300 miles, at a charging cost of £12 (Watson 2019). Charging times for this specific type of battery is approximately takes 16 hours on a standard home charger (Watson 2019). Whilst a hydrogen powered car takes less than 5 minutes to fuel (Frangoul 2019).

With hydrogen all these factors are not an issue and actually prove to be a lighter car than



an electric car and provide a perfect balance as shown in the fig 4. The results are based on a 5 seater car with of a weight of just under 1300Kg (Thomas 2010).

Fig 4: Hydrogen-Powered Fuel Cell Electric Vehicles Compared to the Alternatives

Looking at Fig 2 we can see little increase in the weight of the Fuel Cell Vehicle (FCV) as we increase the range of the vehicle. The EPV on the other hand seems to increase almost at 50/50 rate and shows as we increase the range of the vehicle we increase the weight.

The technology for this is deemed to be in the early stages of development. as of yet with hydrogen looking to be the stronger competitor based on weight and distance (Thomas 2010). An excellent benefit to the future of Le Mans racing where distance and lightweight is required. The concept created by the manufacture Pininfarina called the H2 was released in 2016. The H2 was named the first high performance FCV track car in the

world (Autocar 2016). The vehicles rear wing has taken inspiration from Le Mans cars. The H2 has two hydrogen tanks located wither side of the vehicle to distribute weight and allow easy access. The H2 has yet to be manufactured with very little news as to when the vehicle will be manufactured if the company is to do so.



Fig 5: Pininfarina H2 Speed - hydrogen sports car revealed at Geneva

Production and fuelling cost are where hydrogen starts to fall behind. The Tesla model S for example costs around £12 to fully charge (Watson 2019). Where as the FCV would currently cost £44 to provide similar range (Cropley 2019) . Hydrogen is expensive, to

extract from water, due to the high volume of electricity required for electrolysis with limited renewable energy sources in the UK.

Hydrogen gas canisters are incredibly light, made from composite materials, however these canisters must be checked every 5 years as they have a lifespan of 150,000miles (cafcip.org 2019). If we look at lithium ion batteries on the other had they can only guarantee 100,000 miles or 6 years (Evannex 2019) . The benefit of lithium ion batteries is that 95% of the battery can be recycled (Heelan, Gratz et al. 2016). This is easier said than done and is a complicated process. If we look closer at the lithium ion battery throughout its lifespan, it undergoes a fairly large temperature range whilst in use, it suffers irreversible damage. This means that it's not as simple of disassembling the battery and recycling it. Due to the marketing strategies of battery efficiencies and charging times within large companies like Tesla, improving their batteries everyday

keeping its technology a secret is incredibly important. While we can see why companies do it due to the large investments they make this does provide additional difficulty to recycling batteries. Within batteries also contains an electrolyte mixture which is contained as a component within a battery. This mixture is highly explosive if not handled correctly. With these factors in mind its very expensive and dangerous to recycle a battery at the moment and contain a lot of unknown technology. The only way we can combat this problem is by creating and investing in technology that could dismantle the batteries in a safe way as it seems it's too dangerous for humans and any human error with the batteries explosive property (Heelan, Gratz et al. 2016).

Due to this huge problem of recycling batteries at the current moment it's a lot cheaper to throw them away into landfill and build new ones. Technology and investment is being made to build a battery recycling plant in the UK. With plans to recycle with around 80% of the country's batteries. The plant has future plans to process domestic lithium-ion batteries (ecoSURETY 2019). The plant will only be able to recycle your batteries found in your clock for example or TV remote. So definitely a step in the right direction. The EU reported that we are only recycling 5% of lithium Ion batteries put on the European market”(ecoSURETY 2019). This means that 95% of the batteries have been placed into landfill. This is incredibly poor for the environment and human health. The harmful chemicals within these batteries are being buried in landfill. These harmful chemicals can then leach into river, seas and habitats. This will increase the levels of pollution and problems for our environment.

If we look at large manufactures such as Volvo who have already stopping manufacturing combustible engines. The company only creates electric or hybrid power systems. If we look at current battery technology and the advancement in 10 years time, the batteries we

have now will be disposed of in landfill. With the (Gov.uk2019) reporting of over “38.7 million licensed vehicles” in June 2019, if we were to imagine the impact of effectively putting 39 million batteries into landfill in the near future. This would and could cause environmental impacts in other ways. With the Image of an electric car emitting zero emissions the environmental impact of the batteries could have the opposite effect. The more battery acid we have in our landfill effectively more battery acid thats able to leach into the environment. This could destroy habitats and enter rivers and effect sea life killing animals and wildlife.

Although hydrogen is effectively a little more expensive to produce at the current moment in the longterm we could potentially be building self generating vehicle plans with the byproduct of hydrogen FCV being water. (Frangoul 2019). UK have also set plant to create a plastic to hydrogen recycling plant (Edie 2019). The idea of these plans could possibly allow us to remove the plastic we’ve placed into landfill into a power source. With the byproduct of hydrogen FCV being water there are great scope for the use of this water in a track situation. Could the driver drink this water to remain hydrated in a race?

Chapter 4

Where will the development of technology lead us in the future of the automotive industry?

With autonomy gradually making its way into a majority of cars from a simple feature such as cruise control, where the onboard computer system is able to maintain a pre set speed of the vehicle. The system was developed and released in the Chrysler Imperial in 1958. By the year 1960 cruise control was fitted to all Cadillacs built in the USA. This technology inspired other manufacturers with Mercedes Benz introducing adaptive cruise control during 1999 in their Mercedes S Class where the car was able to monitor and maintain a pre set speed like cruise control but was now able to use its laser technology to detect when vehicles were slowing down braking and even accelerating. When possible the technology allowed the vehicle to return to its pre set speed and maintain its cruising speed set. The technology reduced stress especially in stop start traffic. The technology can be widely found in most cars these days as standard for example the VW Golf, as previously mentioned. The technology was not enough and it did not stop there. With the idea of safety in mind during traffic and potential reduction in human error semi autonomy was in development. The control of a high speed vehicle also influenced this idea.

Volvo have heavily invested into their technology to ensure vehicles are safe with it being the first automakers for the car to engage automatic braking for pedestrians and wildlife (Hunting 2017). With this technology being put into cars to ensure the safety and relaxed attitude towards driving. This effectively means drivers can be comfortable and relaxed

with any human error effectively being corrected by technology. So why bother with human intervention and have just autonomous cars?

While the thought of having a fully autonomous car might sound good, in my findings through handing out surveys I found that a 57% of drivers enjoyed driving and the thrill of it involved with 15% were unsure and 28% of the 50 people I surveyed hated it. With the majority of people enjoying the experience of driving and the freedom it involved, there was still a lower proportion of drivers that hated it. While the idea of semi and fully autonomous cars are currently being manufactured Volvo are the leaders ahead with developing fully autonomous cars and lorries (Newcomb 2017). Newcomb explains that the ability to take the hands of the wheel is not quite there and needs to be addressed. With companies such as Tesla already producing cars with pilot assist, along with other manufactures including Mercedes and Volvo. The system still requires human intervention, otherwise the system deactivates. Newcomb explains in his article that cars aren't even close to full autonomy (Newcomb 2017). The idea of a fully autonomous car was on the horizon 4 years ago however the CEO of Ford says "We overestimated the arrival of autonomous vehicles" (Autocar 2019). With the technology being so complex and the risk of a collision so high where a machine is in full control of people's lives and safety it's important that things are taken seriously. Ford have the answer with plans to create self-driving car promised for 2021 (Autocar 2019).

With the idea of creating a sports car the automotive racing industry has taken the level of autonomy in a different approach. With the use of artificial intelligence (AI) in computer games. The games have been created to replicate the experience of driving supercars with large manufactures including McLaren developing a GT super sports car specifically



Fig 6: Gran Turismo McLarenGT

for the game with the enjoyment of virtual reality technology (Favis 2019). The game Gran Turismo effectively allows the user to select a vehicle of choice and provides training and simulation of a professional driver. The

gamer and vehicle within the game

interact to set best lap times and allow

users to race with friends. The use of the games artificial intelligence (AI) provides accurate braking distances and allow users to follow accurate driving paths (Humphries 2015). The driver is able to win points and drive without the need to worry about pit stops. The game is able alert the driver if driving a manual or semi automatic gearbox when to upward and downward shift. The games intelligence is able to provide you with the vehicles full potential. Could the future of racing utilise this in the future?

With the development of new technology how could the design of a sports car interacts in other ways ?



Fig 7 Natural Talent

Artists such as Andy Goldsworthy who is a sculptor, naturalist and artist who creates art from natural materials such as leaves or twigs within natural and urban environments. The interesting thing about the artist work is that he creates a sense of magic from simple forms to create something that's more

interesting to look at in which we would take form granted for example a tree. Goldsworthy explains "I am never satisfied to look at something and say that is just a pond or a tree"(Adams 2007) he takes his work further and creates a connection between these two sources.

Looking at Goldsworthy's works I came across his works of a sycamore tree in which Goldsworthy painted the base of the sycamore and its fallen leaves to create his works. Looking at his work we can sense a level of energy and magic of a working and living object in which we would take for granted. The contrast of the two elements are given a connection within the painting surrounding the tree giving us a sense of connection (Zhong 2015).

In contrast to the work completed by Andy Goldsworthy the famous sculpture, painter and printer Louise Bourgeois Known as the founder of confessional art, Louise Bourgeois

used the trauma of having a philandering father to create abstract sculptures. She expressed emotion through her work and expression of parental difficulties with her



Fig 8 : Study of a masterpiece:
"Mother" by Louise Bourgeois

farther and helpless children. She developed sculptures to express these emotions and thought. One of her most famous works was "Maman" which is a large spider like sculpture with gothic like arches which shows a lot of dark feeling and directed to the centre of the sculpture (Asper Magazine 2018). From the image

we get the sense of tension and sadness created by the spider like legs to the centre of the sculpture where the key focus is aiming towards. We get the impression is

her heart where all the tension is directed. With the legs I can only assume of being her farther with the idea of several woman visiting the house as a young child, Bourgeois described the centre of the spider to be her mother because she was "smart, patient, clean and useful, reasonable, essential as a spider" quoted from (Asper Magazine 2018).

Conclusion

What is evident from this inquiry is the change in fuel sources have been implemented due to climate change. With the development of FCVs and EPVs within the automotive industry. For the automotive track racing Industry I have come to the conclusion that hydrogen powered vehicles are the way forward, with their light weight as demonstrated by Riverside. With plans in the UK to generate hydrogen from recycling plastic I believe this is great way to utilise the use of plastics from landfill and from general waste. With water being the only byproduct of using the hydrogen source, I believe there is scope to utilise this water in other ways within a racing scenario. The water could either be used for hydration of drivers or there could be scope to reuse this water and convert it back into hydrogen. There is scope with the use of electrolysis to extract the hydrogen from the water produced effectively creating a self generating vehicle.

The use of battery technology at the present moment should be banned until a recyclable battery can be developed. The batteries we use today in vehicles are placed in landfill causing further health and environmental implications. With the safety of workers in mind the ability to recycle the batteries are not quite there yet. Drastic measures are needed in order for us to recycle large quantities of vehicles quickly and safely. The use of large batteries in vehicles should therefore be stopped until this has been sorted and put into place . In the UK we rely heavily on thermal power stations and an increase in power from the national grid will result in more fossil fuels and gases burnt. New renewable power sources need to be set up prior to the ban of combustion engines.

Within track racing I don't think autonomy will take over the industry, a level of interaction between a driver and vehicle will still be there. There will be other avenues of racing and sports cars. With the developed of sports cars for games that can be used virtually without the environmental factor. The development of autonomous racing could be another discipline for the future where high speed is key. Personally I would find this boring and would provide a similar experience to a scalelectix set up. The development of AI technology within games should be utilised within a track racing scenario, where a level of technology is able to intervene for safety, or improve track times. This could be the start of a connection between humans and machines where both need to work simultaneously in a racing scenario. I believe the future of track racing needs to utilise this experience of semi AI and create an interesting race. As cars become faster the need for AI for safety I believe is incredibly important. With the future of the design playing a key part in selling a product the philosophy of Andy Goldsworthy's work of highlighting key areas we take for granted could be used in my final concept. The design of the concept for a future track car and could highlight the technology within it as part of its beauty. With the development of creating a sports car for the track, the release of new technology may influence my work upon release. Throughout the designing process the design can change as a result of new technology. The design can also change between sketch and 3D form. The future of hydrogen FCVs has yet to be discovered and the advancement in technology has only just started.

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