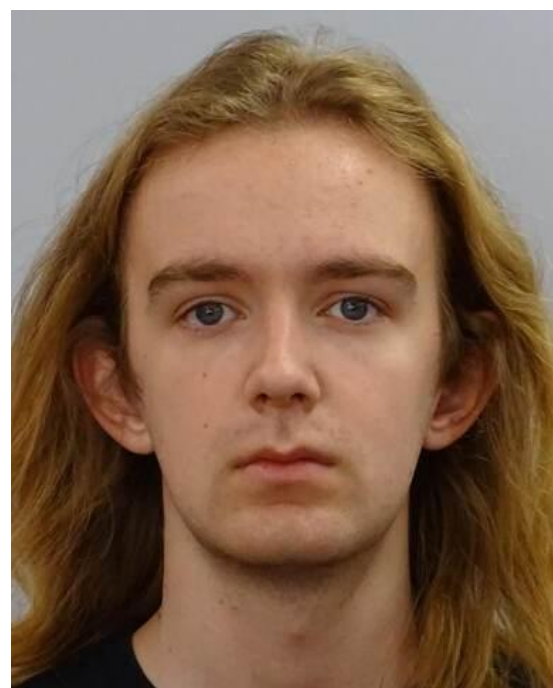




Technical Lecture Review – Sustainability

Joseph Dashwood (2404498)

Andrew Noble

Wales Institute for Science & Art

BEng (Foundation) - Motorsport Engineering

Introduction

Sustainability is an important topic to consider in the context of engineering, as the impacts of manufacturing and other processes involved in the automotive industry affect our environment in very significant ways. It is important that **all** manufactures find ways to cut down on waste and emissions, while still meeting our current needs.

Key Concepts

What is Sustainability?

- Sustainable development is defined by the UN Brundtland Commission as Development that meets the needs of the present **without** compromising the ability of future generations to meet their own needs.
- A key part of sustainability is having an Equilibrium of resources and aiming to have a **replacement rate** that is **equal or higher** than the rate of consumption. This is so that material stores are topped up and not depleting faster than they can be restored.[1]

Emissions

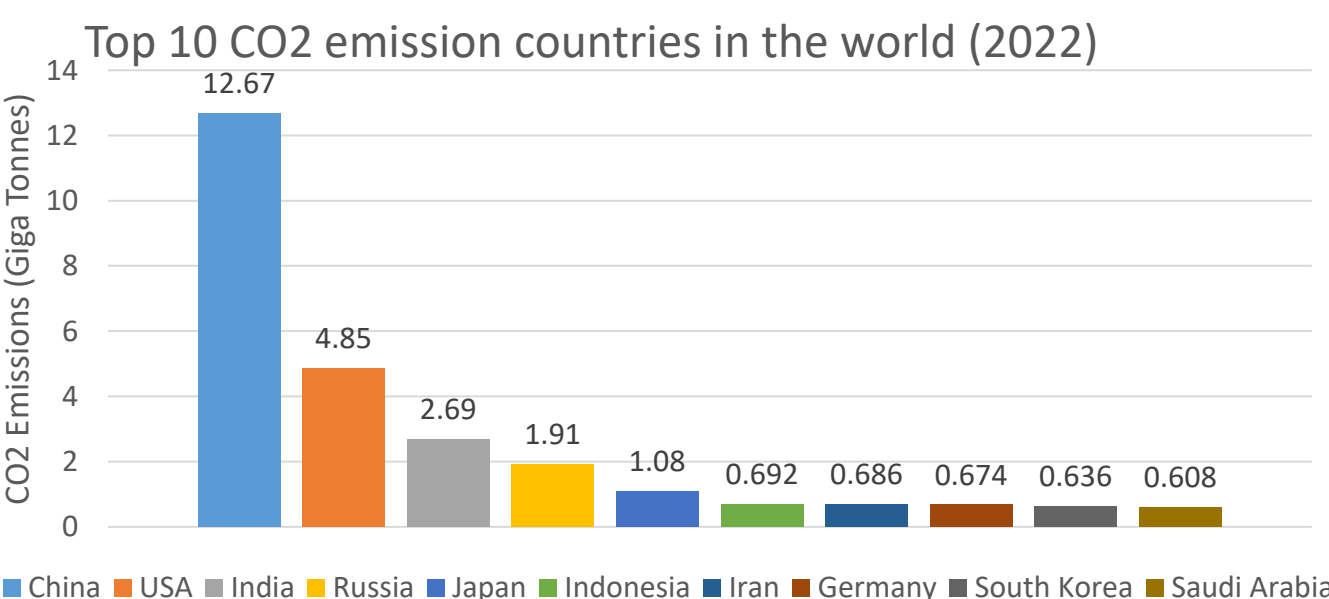


Figure 1 – CO2 emissions per country

As seen in Figure 1, Countries such as China, the United States and India have the highest CO2 emissions, however, these three countries also have the highest populations at just over 1.4 Billion for India and China each, and nearly 350 million for the United States.[2]

Though this doesn't show the full picture, as the top countries CO2 emissions per capita are very different, with the small island nation of Palau coming out on top as the highest polluter. Palau is located East of the Philippines and has a population of just over 17000 people. Due to the remote nature of the island, trade is very difficult and expensive, and all goods have to be imported via air or sea. Electricity is provided to infrastructure largely through Diesel generators which lead to Palau having nearly **60 tonnes of CO2** emitted per capita. This is **over 4 times** the amount of the previously mentioned 3 countries per capita in Figure 2.

- USA – 14.3t
- China – 8.4t
- India – 2.1t

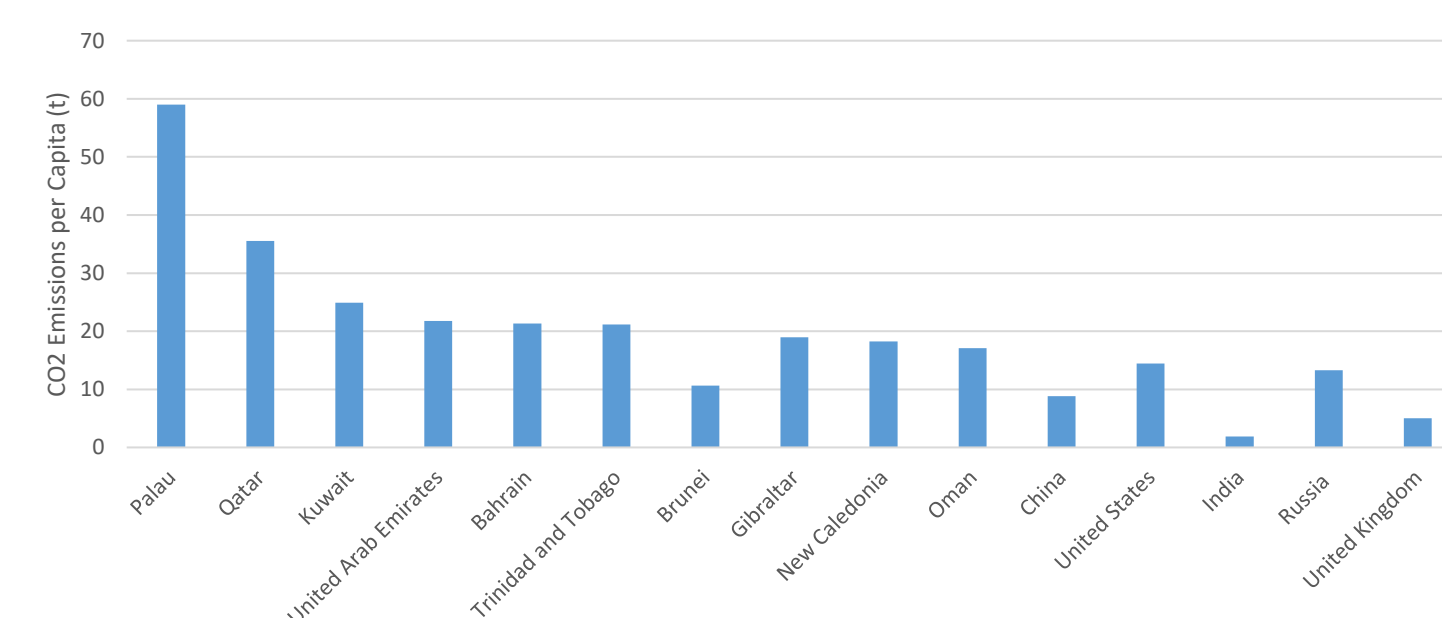


Figure 2 – CO2 emissions per capita per country

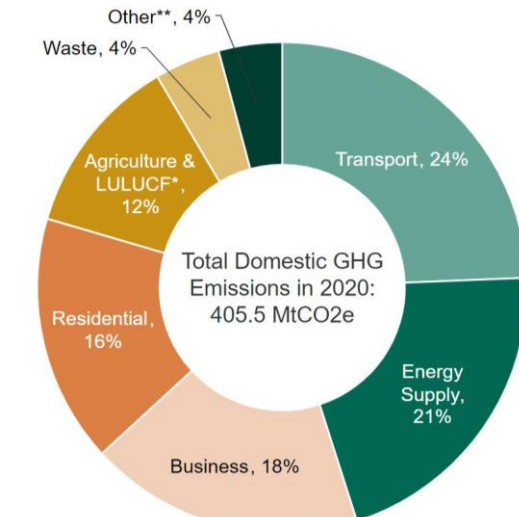


Figure 3 – Greenhouse Gas emissions by sector in the United Kingdom, by proportion, 2020



Figure 4 – Escondida Lithium Mine in Chile

Manufacturing

Sustainability in the automotive industry is very important for our planet. As seen in Figure 3, the **Transport sector is one of the largest polluters in greenhouse gasses**, not just in the United Kingdom, but across the globe. However, this isn't just tailpipe emissions, although there are plenty of options for vehicles with zero tailpipe emissions such as Battery Electric Vehicles, the production process for the batteries used in these vehicles is very damaging to the environment, using precious metals such as sulphur and lithium. These mines span thousands of acres of land, such as the one shown in figure 4.

Life Cycle

The complete life cycle of a vehicle also has a significant environmental impact, as vehicles produce emission throughout their entire life cycle. Not just from manufacturing and the extraction of raw materials, but the use and fuel cycle of the vehicle, as well as the end-of-life recycling of vehicles, see figure 5. As vehicles reach the end of their useful life, they can be recycled and re-used, either to produce new vehicles, or repair vehicles still in use to keep them in service for longer.

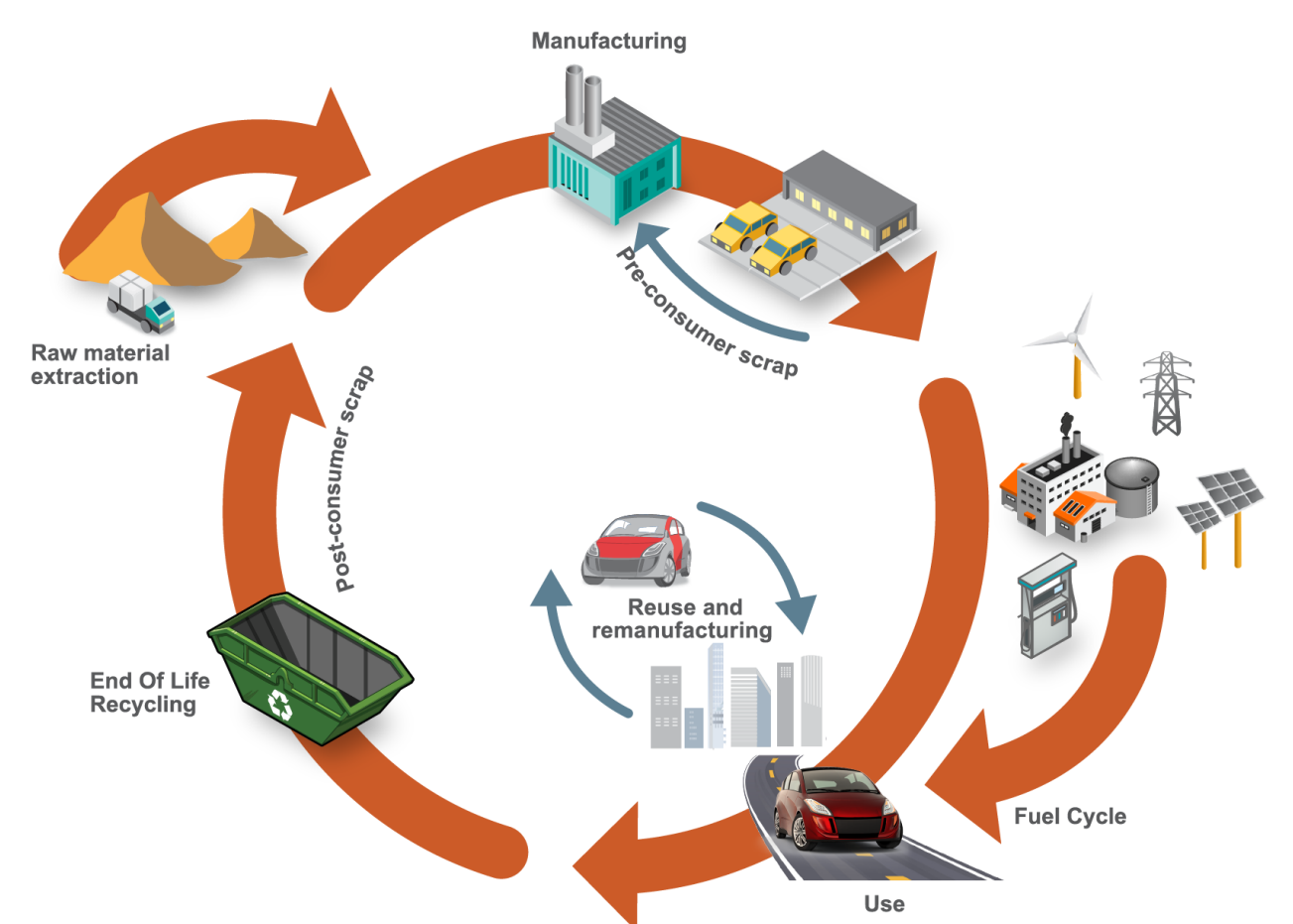


Figure 5 – The life cycle of a vehicle [3]

Conclusion

The environmental impacts of manufacturing products, and the life cycle of products, such as vehicles, has had, and is currently having very significant impacts to our climate. It is important going forward that manufacturers aim to cut down on waste and emissions across the entire life cycle of their products, as well as the consumers who use these products. Furthermore, the collection and farming of resources going forward should aim to be done in such a way that as little as possible damage is done to the environment.

References

- [1] UCLA, (2024) "What is Sustainability" Available at: <https://youtu.be/zx04Kl8y4dE?si=Qh48FJEZ-M1hSJ04> [Accessed Apr. 2025].
- [2] WorldoMeter (2025). *Countries in the World by Population (2025)*. WorldoMeters. Available at: <https://www.worldometers.info/world-population/population-by-country/>.
- [3] Balzer, R. and Malen, D. (2021). *Life Cycle Assessment for Vehicle Development*. Steel E-Motive. Available at: <https://steelemotive.world/life-cycle-assessment-for-vehicle-development/>.