



The Future of Internal Combustion Engines

Darryl Diaz (2404983)

Andrew Noble

Wales Institute for Science & Art

BEng Motorsport Engineering with Foundation Year

Introduction

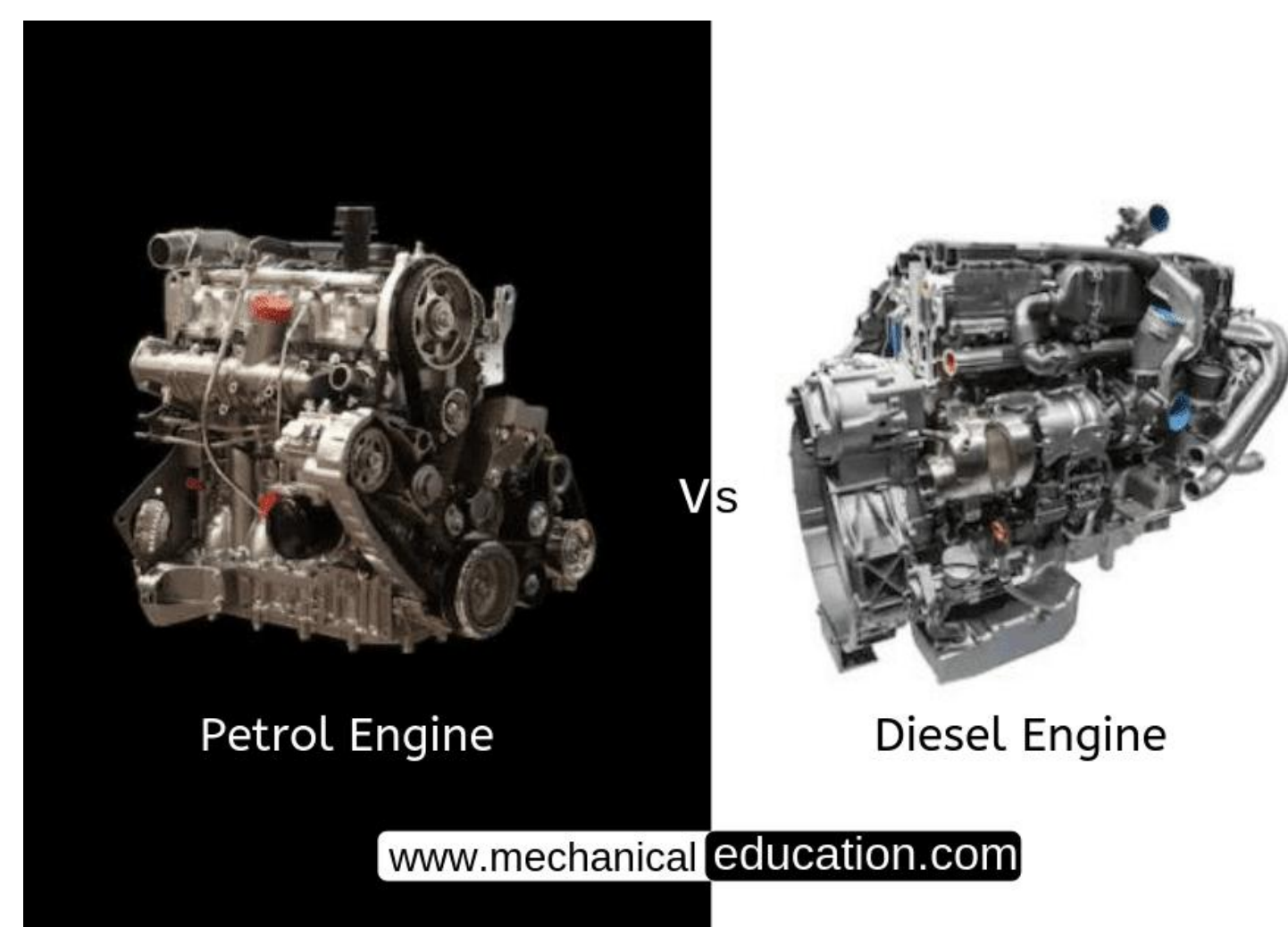
The internal combustion engine (ICE) has been a vital source of power for decades, producing 25% of the worlds power (according to R Reitz, H Ogawa, R Payri, T Fansler, S Kokjohn, Y Moriyoshi, AK Agarwal, D Arcoumanis, D Assanis, C Bae, K Boulouchos, M Canakci, S Curran, I Denbratt, M Guenther, C Hasse, Z Huang, T Ishiyama, B Johansson, TV Johnson, G Kalghatgi, M Koike, SC Kong, A Leipertz, P Miles, R Novella, A Onorati, M Richter, S Shuai, D Siebers, W Su, M Trujillo, N Uchida, B M Vaglieco, RM Wagner, H Zhao).

In recent years, there has been a shift in society, leading to ICEs being required to have:

- Better fuel efficiency
- Reduced emissions

So far, this has been achieved by:

- Downsizing engine displacement
- Improving engine design
- Greater electronic control of the engine



Traditional petrol and diesel engines, Mechanical Education (2025)

The Future of Internal Combustion Engines

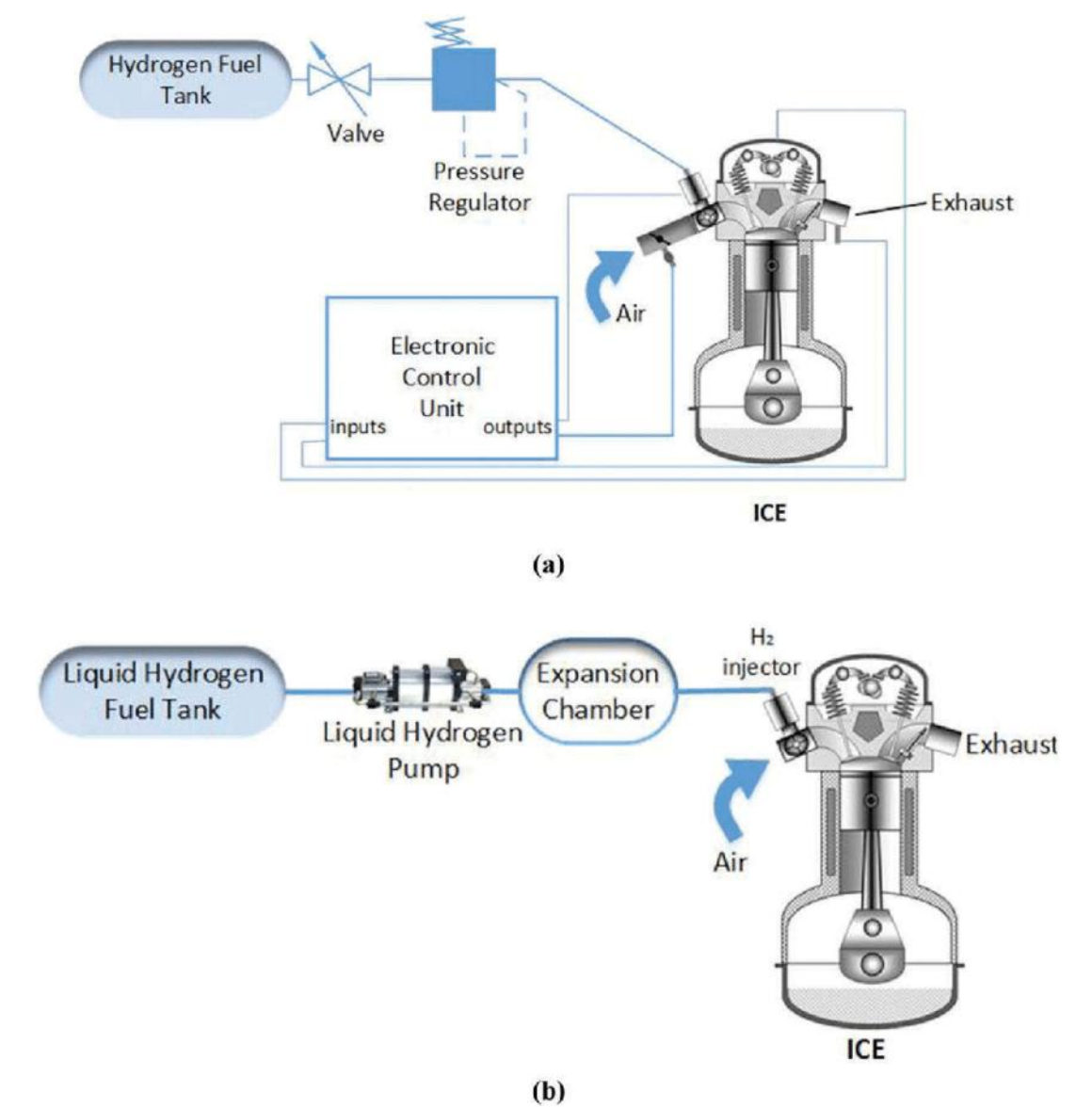
The future of ICEs is likely to involve being fuelled by hydrogen or synthetic fuels as society reduces its reliance on fossil fuels.

Hydrogen engines burn hydrogen mixed with air, much like a conventional petrol engine. According to Jim Nebergall, the emissions they produce are mostly water with negligible amounts of CO₂. Nitrogen oxides (Nox) are still produced, which need to be treated. This can be done by fitting a catalytic converter to the exhaust system.

Synthetic fuels are man made fuels which may be a direct replacement for the currently used fossil fuels. They are made to match, as closely as possible, the properties of petrol and diesel. The carbon capture process is used to remove carbon from the atmosphere and use it in the production of synthetic fuel, preventing any new carbon from being released. Petro Online says that the carbon is blended with hydrogen to create the fuel.

The benefits of synthetic fuels are:

- Potential for zero environmental footprint
- Direct replacement for current fossil fuels
- Removes CO₂ from the atmosphere
- Hydrogen can be cheap and 100% green (using electrolysis and renewable energy)



Schematic of hydrogen engine, Gurz et al. (2017)

References

R Reitz, H Ogawa, R Payri, T Fansler, S Kokjohn, Y Moriyoshi, AK Agarwal, D Arcoumanis, D Assanis, C Bae, K Boulouchos, M Canakci, S Curran, I Denbratt, M Guenther, C Hasse, Z Huang, T Ishiyama, B Johansson, TV Johnson, G Kalghatgi, M Koike, SC Kong, A Leipertz, P Miles, R Novella, A Onorati, M Richter, S Shuai, D Siebers, W Su, M Trujillo, N Uchida, B M Vaglieco, RM Wagner, H Zhao City, University of London (2019) IJER Editorial – The Future of the Internal Combustion Engine. Available at: <https://openaccess.city.ac.uk/id/eprint/22917/1/IJER%20Editorial.pdf> (Accessed: 26/04/2025)

Jim Nebergall Cummins Inc. (2022) Hydrogen internal combustion engines and hydrogen fuel cells. Available at: <https://www.cummins.com/news/2022/01/27/hydrogen-internal-combustion-engines-and-hydrogen-fuel-cells> (Accessed: 26/04/2025)

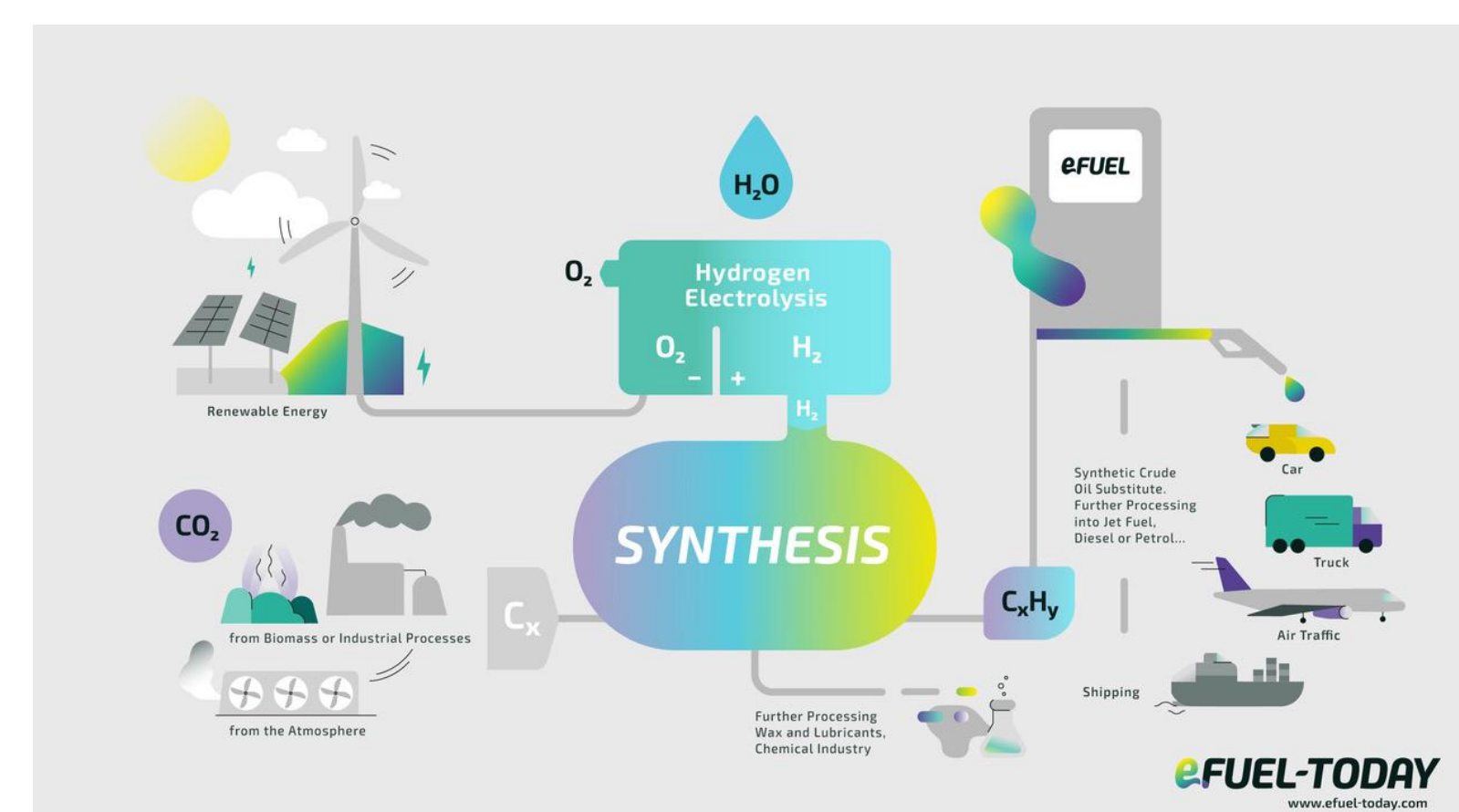
Petro Online (2025) Can All Cars Use Synthetic Fuel? Available at: <https://www.petro-online.com/news/synthetic-fuels/180/breaking-news/can-all-cars-use-synthetic-fuel/59250> (Accessed: 26/04/2025)

Petro Online (2025) What Are the Benefits of Synthetic Fuels? Available at: <https://www.petro-online.com/news/synthetic-fuels/180/breaking-news/what-are-the-benefits-of-synthetic-fuels/59267> (Accessed: 26/04/2025)

Mechanical Education (2025) Difference between petrol engine and diesel engine. Available at: <https://www.mechanicaleducation.com/difference-between-petrol-engine-diesel-engine/> (Accessed: 26/04/2025)

Gurz et al. (2017) Schematic of (a) Pressure-boosted H2ICE (b) Liquid hydrogen internal combustion engine. Available at: https://www.researchgate.net/figure/Schematic-of-a-Pressure-boosted-H2ICE-b-Liquid-hydrogen-internal-combustion-engine_fig2_336778181 (Accessed: 26/04/2025)

eFUEL-TODAY (2023) The production process of e-fuels. Available at: <https://efuel-today.com/en/production-process-of-e-fuels/> (Accessed: 26/04/2025)



Synthetic fuel production process, eFUEL-TODAY (2023)