

Guest Editorial

Johnson Matthey Technology Review Special Edition on Clean Mobility

The world is at the start of an energy revolution: the biggest energy transformation since the Industrial Revolution, during which the use of fossil fuels drove growth and prosperity, with global temperature increase implications that we have only started to understand relatively recently. This energy revolution will drive the world towards a lower carbon, more sustainable future, with major implications for energy and electricity generation, heating, industrial power and transportation. Governments, states and regions are proposing, and in some cases (such as the UK) committing to, net zero greenhouse gas (GHG) or carbon dioxide emission targets over the coming years. To date, 15 countries have set defined targets to become net zero economies by 2050 or earlier, with over 50 others, including Germany and Canada, discussing when to implement such a target. Perhaps most significantly, the European Union (EU) intends to be net zero by 2050: this objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement.

Interestingly, at the time of writing, around 49% of global gross domestic product (GDP) derives from nations and regions discussing, or with legislated, net zero emissions targets to be achieved by 2050 at the latest (1). Significantly, eight months previously this figure was only 16%, demonstrating the rapid rate at which such commitments are being made. Companies are also making net zero commitments, and this pace is accelerating too: in 2017, 87 companies made such commitments, in 2018 this rose to 174, and in 2019 398 companies announced net zero targets.

Figure 1 summarises the proportion of global fossil-derived CO₂ from each of the major

sectors. While electricity generation is the largest contributor, the transportation sector comes second, accounting for around 23% of global CO₂ emissions.

Figure 2 looks into the transport sector in a little more detail, revealing that passenger road vehicles contribute almost half (45%) of transport CO₂, with freight vehicles accounting for another 30%, so road transport accounts for almost 75% of the emissions. The aviation and shipping industries also release large levels of CO₂, each at around 11% of global transport-derived emissions, with rail being a relatively minor contributor, at 1%. But to add a little context, these rail CO₂ emissions are around 0.1 billion tonnes per year, the same level as those of Belgium or Austria. Therefore, it is clear that transport has a critical role to play in the global decarbonisation agenda.

Decarbonisation of Transport

This special edition of the *Johnson Matthey Technology Review* looks at the challenges faced in the decarbonisation of the transport sector, and highlights the likely solutions that will be implemented to enable this transition. The articles consider the regulatory frameworks already in place, and those likely to come in the near future, to accelerate the moves to net zero across the transport ecosystem. The current status of the technologies that will play a key role in this transition is discussed, along with expected future developments and performance targets. It is clear that both battery-based and hydrogen fuel cell-based electric vehicles will make major contributions to the decarbonisation of ground transportation, across cars, vans, buses and trucks, and these technologies are discussed in detail. Challenges with the roll-out

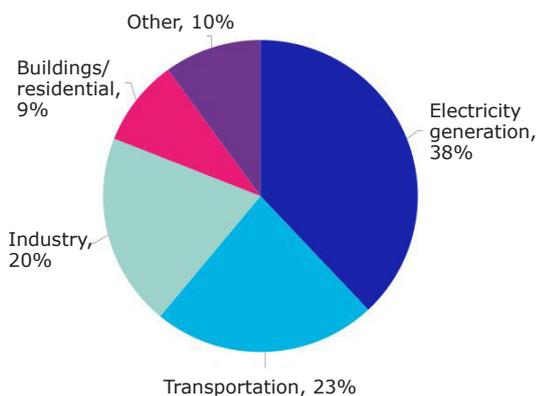


Fig. 1. Proportion of global fossil-derived CO₂ emissions by sector (2)

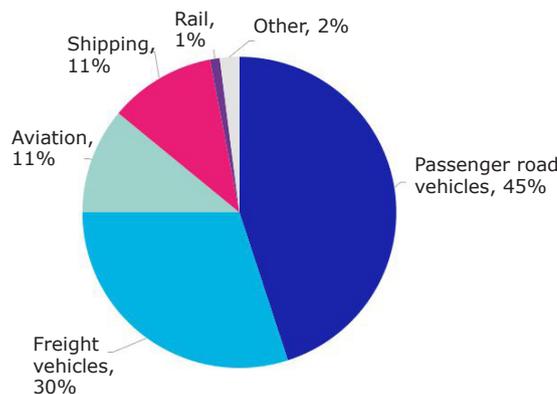


Fig. 2. Global transport CO₂ emissions by segment (3)

of the infrastructure for these new vehicles are also assessed, and the likely paths forward are presented.

Battery and fuel cell technologies are unlikely to see large scale uptake in the marine and aviation sectors in the foreseeable future, so here the focus is on the development and deployment of alternative, sustainable, lower carbon fuels which will replace the existing heavy fuel oil and aviation fuels, to mitigate carbon emissions from these two very large sectors.

Meeting net zero GHG emission targets within the transportation sector can only be achieved alongside clean generation of electricity and hydrogen, since these will be the fuels for the highest volume future transport modes (cars and trucks). Therefore, articles in this special edition also look at the changes required in electricity and hydrogen generation to enable the move to clean transport. Recall that electricity generation currently accounts for around 38% of global CO₂ emissions, so increasing the use of renewables and nuclear power are an essential piece of the net zero jigsaw puzzle.

This brings me to the final message: reducing transport CO₂ or GHG emissions to zero is not in itself enough to stabilise earth's climate. It is a critical step, but needs to take place alongside the decarbonisation of the other major sectors: power generation, industry and building heating and cooling. There is a need for a cross-sector, systems-based approach, rather than looking at individual large emitters in isolation. The article on hydrogen looks at the role that it can play as an energy vector, enabling cross-sector coupling

to facilitate the decarbonisation of transport, as well as other key areas such as domestic heating, industrial processes, and as a feedstock for low or zero carbon chemicals and fuels. It also discusses hydrogen's use as a source of low carbon dispatchable power, as well as how it is a key enabler of significant increases in renewable energy or electricity generation. To reach net zero GHG emissions all the key sectors need to work together, and this special edition, though focused on transport, considers the other changes in the future energy ecosystem that link to, and in some cases enable, clean mobility.

ANDY WALKER

Johnson Matthey, Orchard Road, Royston,
Hertfordshire, SG8 5HE, UK

Email: andy.walker@matthey.com

References

1. 'Almost Half of Global GDP Under Actual or Intended Net Zero Emission Targets', Energy and Climate Intelligence Unit, London, UK, 18th February, 2020
2. M. Crippa, G. Oreggioni, D. Guizzardi, M. Muntean, E. Schaaf, E. Lo Vullo, E. Solazzo, F. Monforti-Ferrario, J. G. J. Olivier and E. Vignati, "Fossil CO₂ and GHG Emissions of All World Countries: 2019 Report", EUR 29849 EN, Publications Office of the European Union, Luxembourg, 2019
3. J. Teter, P. Le Feuvre, M. Gorner and S. Scheffer, "Tracking Transport", International Energy Agency (IEA), Paris, France, May, 2019