

DFT and Office for Zero Emission Vehicles Consultation on a New Heavy Goods Vehicle CO₂ Emissions Regulatory Framework for the United Kingdom

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Response from Brunel University of London

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Responses to selected questions: 2, 3, 8, 9, 11, 17, and 19

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Q2 – What are your views on Option 1 regarding a strengthened and expanded CO₂ standard for HGVs?

Stronger CO₂ standards encourage continued improvements in engine efficiency and supporting technologies, helping reduce emissions from conventional HGVs that will remain in operation for many years. Clear and progressive CO₂ targets also give manufacturers greater certainty for long-term investment and planning in low-carbon vehicle technologies. This also can reduce emissions in the near term while allowing the freight sector to transition gradually toward zero-emission technologies.

Q3 – What are your views on Option 2 regarding the introduction of a ZEV mandate limiting the sales of non-ZE HGVs

Limiting the sale of non-ZE HGVs helps align the freight sector with long-term climate targets by ensuring a gradual shift toward zero-emission vehicle fleets. However, flexibility mechanisms or transitional provisions may be necessary to accommodate niche applications and ensure a smooth transition for manufacturers and operators. It is also important that the definition of ZV vehicles is clear, practical and technology neutral. While battery-electric and hydrogen fuel cell vehicles are currently the main pathways, the framework should not prematurely exclude other technologies that could deliver zero emission.

The definition of ZE shall also align with other major economies, e.g. EU where ZV is defined as emission not more than 3 g CO₂/(tkm) or 1 g CO₂/(pkm) for HGV.

Ref: https://climate.ec.europa.eu/eu-action/transport-decarbonisation/road-transport/heavy-duty-vehicles_en

Q8 – Of the options presented, what is your preferred approach, or combination of approaches, for reducing emissions from HGVs and delivering a phase-out of new non-ZE HGVs?

Among the three options, the preferred approach is Option 1, which is technology neutral.

Q9 – Are there any alternative approaches that the government should consider to reduce CO₂ emissions from HGVs?

Using **hydrogen and other zero-carbon fuels (ammonia, e-fuel) in both existing and new internal combustion engines (ICEs)** can play an important role in reducing CO₂ emissions from HGVs. Recent work has shown that a base hydrogen combustion engine also produces much lower NO_x than current diesel engines, and which can be reduced even further to trace levels (i.e. to many times lower than Euro VII), by using the standard SCR system as used on all HGVs for many years.

Ref: Mohamed, Mohamed, et al. "A Comprehensive Experimental Investigation of NO_x Emission Characteristics in Hydrogen Engine Using an Ultra-Fast Crank Domain Measurement." *Energies* 17.16 (2024): 4141.

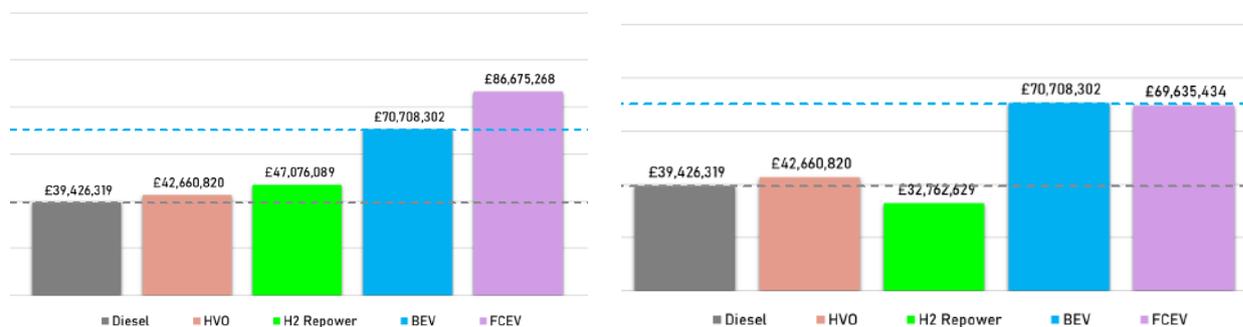
Ref: Webster, Lucy J., et al. "Evaluating low NO_x hydrogen engines designed for off-road and construction applications." *Environmental Science: Processes & Impacts* 27.2 (2025): 486-497.

a) Utilising existing engine technology

Hydrogen can be used in modified internal combustion engines, allowing the heavy-duty sector to leverage existing engine platforms, manufacturing capabilities, and engineering expertise while significantly reducing tailpipe CO₂ emissions. This is evidenced by the Metier Hydrogen (Repowering) Engine technology which converted existing engine into hydrogen operation with Zero CO₂ emissions and much lower TCO.

Ref: <https://www.metiertechologies.com/our-technologies/hydrogen-repowering>

The below graphs show the *Total Cost of Ownership* of Diesel (grey), HVO (orange), hydrogen re-power (green, the Metier project), battery electric (blue), and fuel cell electric (purple); a repowered hydrogen combustion engine truck is always lower cost. The baseline is a brand-new diesel vehicle, with the initial investment (CapEx) spread over 6 year and the hydrogen re-power cost is also spread over 6 years and includes the value of the donor vehicle.



Total cost of Ownership, £; on the left at a hydrogen price of £15 per kg, on the right at £3 per kg.

b) Accelerating near-term emissions reductions

Deploying hydrogen in ICES can provide a faster decarbonisation pathway for some HGV applications, particularly where battery-electric solutions may face range, payload, or refuelling challenges.

c) Supporting a technology-neutral transition

Hydrogen ICE technology complements other zero-emission solutions such as battery-electric and hydrogen fuel cell vehicles. Maintaining multiple pathways supports innovation and helps address the diverse duty cycles in the HGV sector.

d) Enabling the use of zero-carbon fuels

When powered by zero-carbon hydrogen or other sustainable fuels, advanced combustion engines can contribute to substantial lifecycle CO₂ reductions while maintaining the operational characteristics required for heavy-duty transport.

e) Leveraging existing infrastructure and supply chains

Developing hydrogen-compatible engines can help utilise parts of the current vehicle manufacturing and maintenance ecosystem, supporting a more practical and economically manageable transition for industry.

Q11 – Do you think a regulatory framework for reducing CO₂ emissions from the HGV sector should be extended to include coaches?

Yes, extending a CO₂ regulatory framework to include coaches is both logical and beneficial. Coaches share many technical and operational features with HGVs, such as heavy weight, long-distance operation, and high fuel consumption, meaning efficiency measures and zero-emission technologies are equally applicable. Applying consistent standards across heavy-duty vehicles avoids regulatory gaps and ensures operators are equally incentivised to reduce CO₂ emissions.

Q17 – What criterion, or combination of criteria, should be used to set the eligibility of a ZE HGV?

An EU approach can be considered:

“zero-emission heavy-duty vehicle” means any of the following vehicles:

- (a) a heavy-duty motor vehicle without an internal combustion engine, or with an internal combustion engine that emits not more than 3 g CO₂/(tkm) or 1 g CO₂/(pkm) as determined in accordance with Article 9 of Regulation (EU) 2017/2400;
- (b) a heavy-duty motor vehicle without an internal combustion engine, or with an internal combustion engine that emits not more than 1 g/kWh of CO₂ as determined in accordance with Regulation (EC) No 595/2009 and its implementing measures or not more than 1 g/km of CO₂ as determined in accordance with Regulation (EC) No 715/2007 of the European Parliament and of the Council ^(*) and its implementing measures, provided that no CO₂ emissions have been determined pursuant to Regulation (EU) 2017/2400;
- (c) a trailer equipped with a device that actively supports its propulsion, and that has no internal combustion engine or has an internal combustion engine that emits less than 1 g CO₂/kWh as determined in accordance with Regulation (EC) No 595/2009 and its implementing measures or in accordance with UNECE Regulation (EC) No 49.

Ref: EU 2019/1242: https://climate.ec.europa.eu/eu-action/transport-decarbonisation/road-transport/heavy-duty-vehicles_en

Q19 – For your preferred criterion, or combination of criteria, what eligibility threshold do you propose? Why?

See answers to Q17.

The definition of ZE GHVs under EU 2019/1242 is broad enough to include battery-electric and hydrogen fuel cell vehicles, supporting multiple pathways to zero emissions without prescribing a single technology. By concentrating on tailpipe CO₂ during vehicle use, the regulation encourages actual reductions in operational emissions, which are the most immediate source of climate impact from HGVs. Having a legally recognised ZE HGV category allows policymakers to link incentives, mandates, or fleet requirements directly to zero-emission vehicles, accelerating adoption.