

Green Fuels for Long-Distance Transport

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Quantifying Health Cost

Toxic air a 'national health emergency' responsible for 40,000 early deaths and £20bn in costs each year, MPs warn

'It is unacceptable that successive governments have failed to protect the public from poisonous air'

Each car in London costs NHS and society £8,000 due to air pollution, report finds

'We know the health impacts of air pollution, and now the economic case for cleaning up the air we breathe has been laid bare'

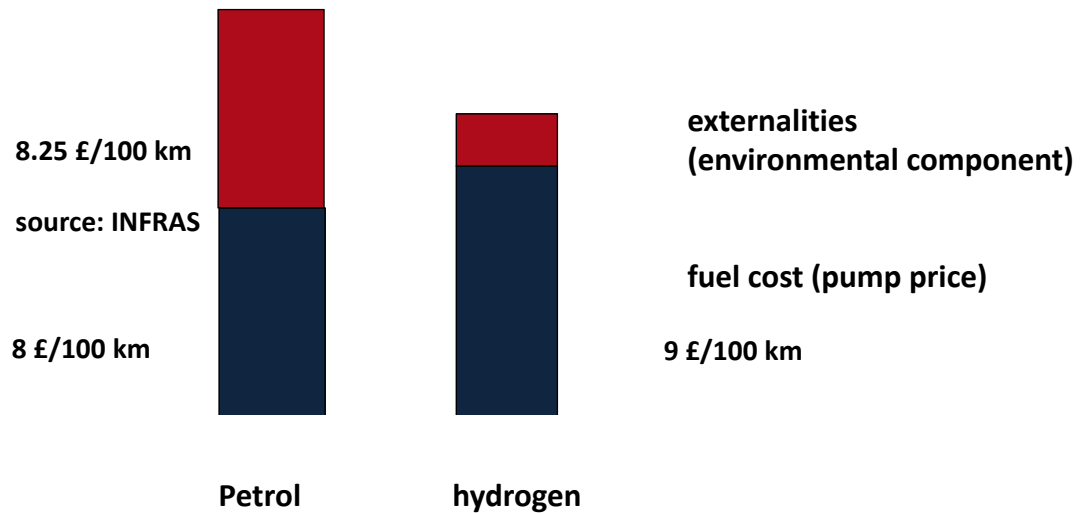
Extreme weather to cost UK billions and leave 2.5m homes at risk of flooding unless ministers take action, warns WWF

Report on the risks posed by climate change in 2050 warns there could be significant damage to the economy if it is not 'future-proofed'

Sources: Independent/Dan Kitwood/Getty

Externalities of Passenger Vehicle

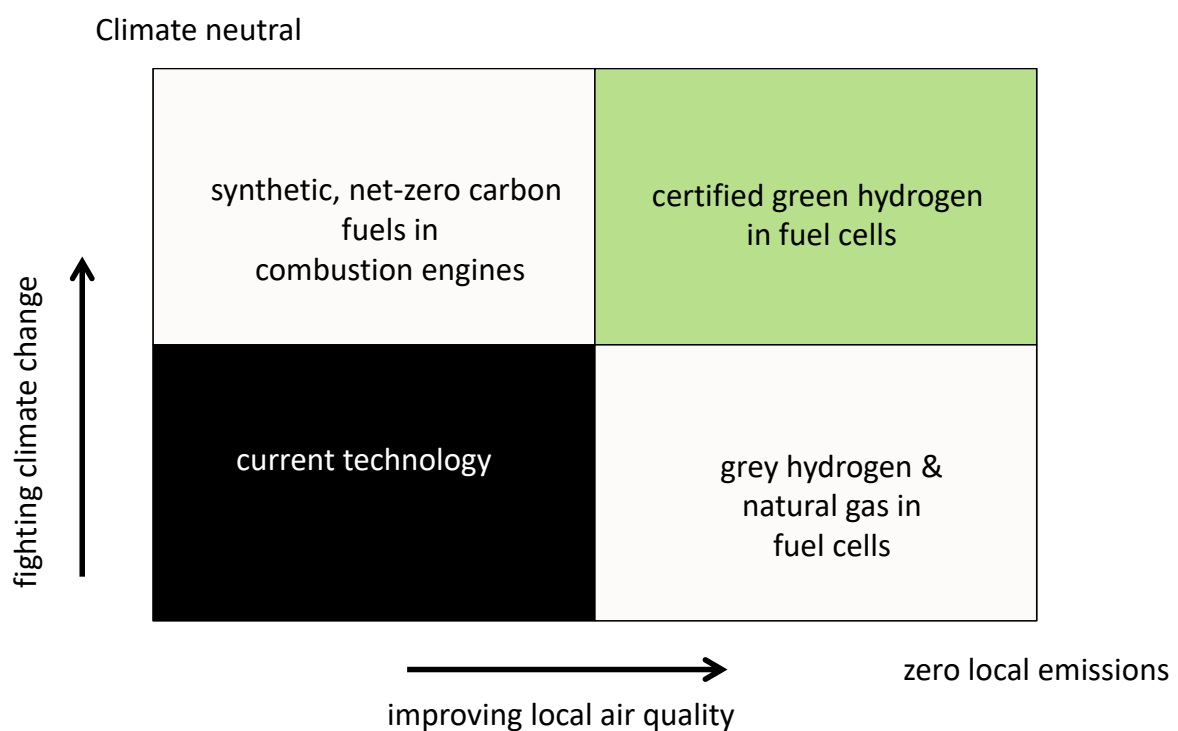
values for Daimler A-class



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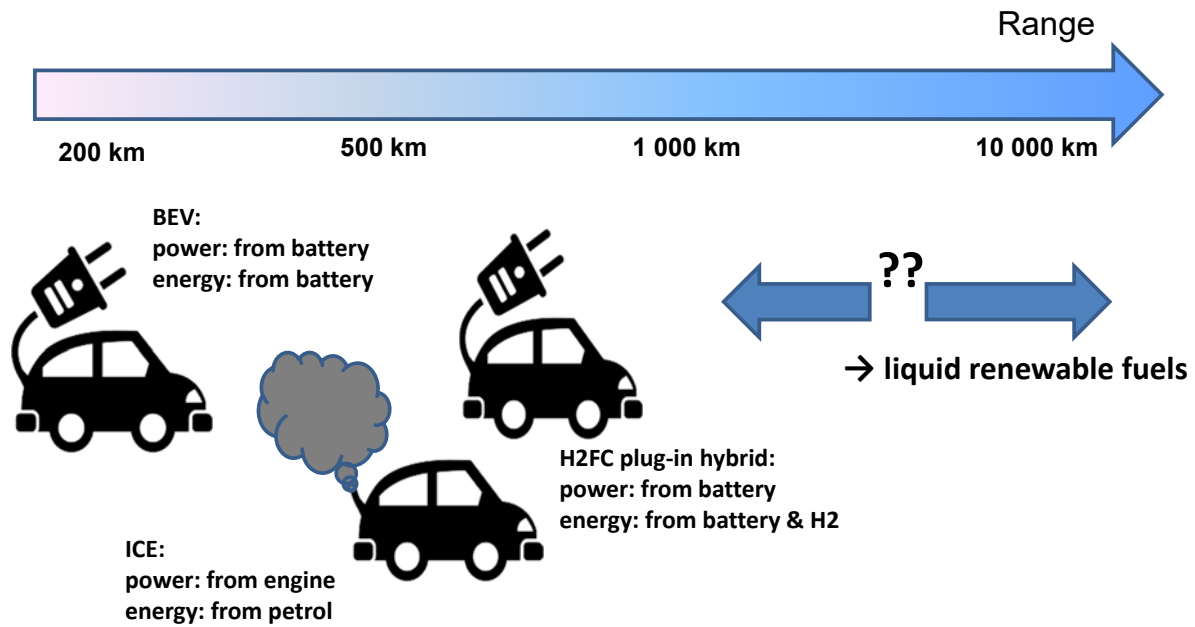
Global vs. Local Zero Emissions



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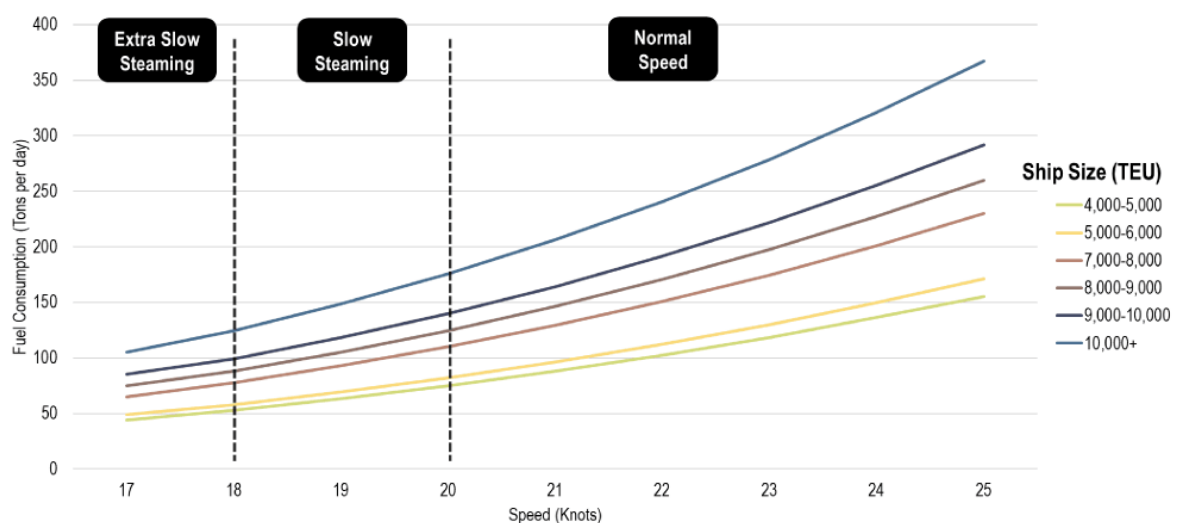
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Electric Transport Solutions



Comparison: Shipping Fuel Consumption

- steaming distance 10 days, 150 to/dy, 16 500 MWh

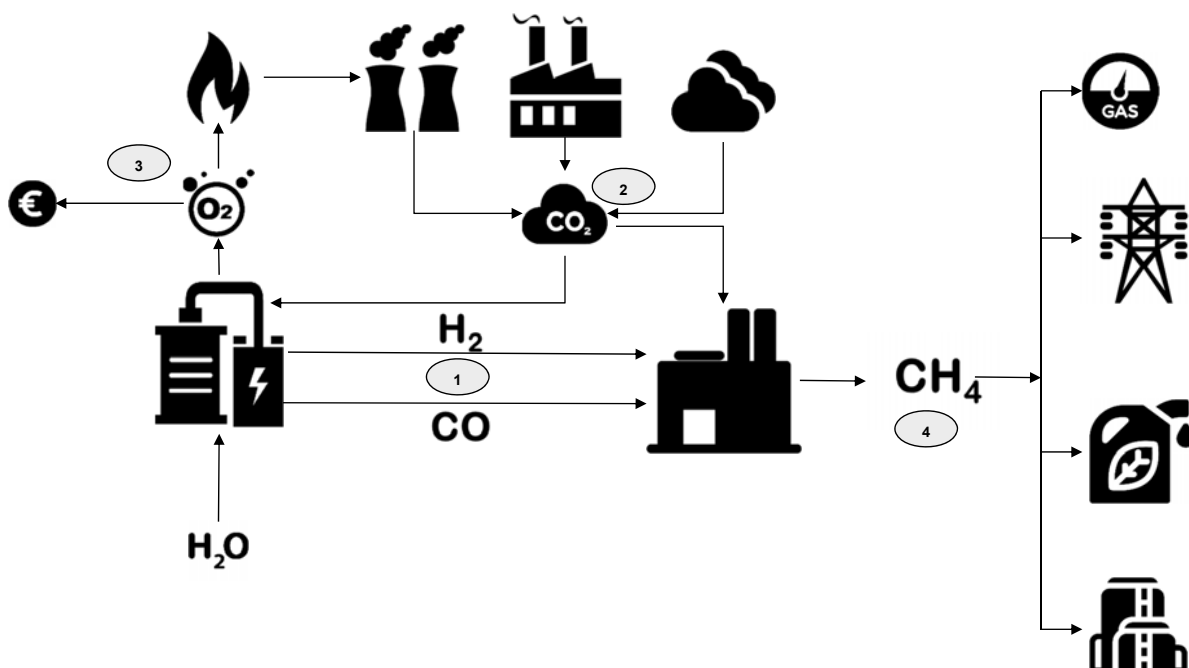


Comparison: Fuel Bunkering Volumes

- steaming distance 10 days, 150 to/dy, 16 500 MWh

	Boil. Temp. [K]	Heat.Val. [kWh/kg]	Heat.Val. [kWh/L]	Heat.Val. [kWh/ Ncbm]	bunker- volume [cbm]	Fuel weight [to]
H2 (70 MPa)	---	33	---	3	9900	500
CH4 (25 MPa)	---	14	---	9	8900	1300
LH2	20	33	2.3	---	7000	500
NH3	240	5.2	3.2	3.9	5200	3350
CH3OH	---	5.5	4.4	---	3750	3250
LNG	120	12.5	5.6	---	3500	1300
LSNG	111	14	6.3	---	3200	1200
M.Diesel	---	12	10	---	1500	1500

Power to Gas: Hydrogen-Based Fuels

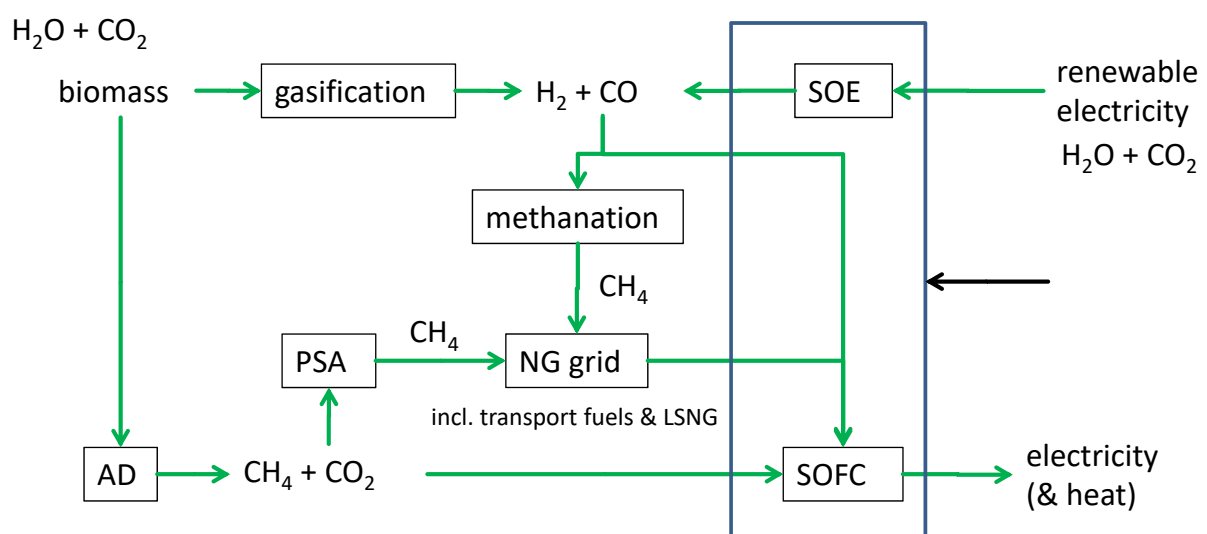


Sources of Non-Fossil Carbon Dioxide in the UK

CO₂ captured from the air via biomass and recycled within (relatively) short time spans

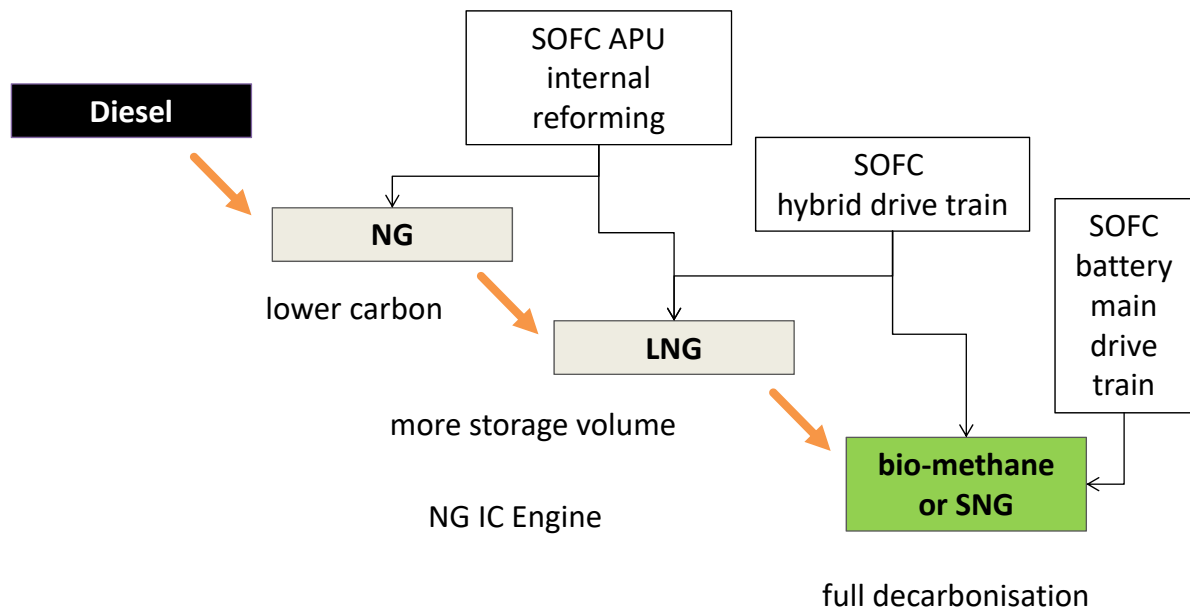
- biogas upgrading plants
- biomass gasification plants
- sewage plants
- CHP units in biogas and gasification plants
- food industry

The Cycle of Zero-Fossil Carbon Methane

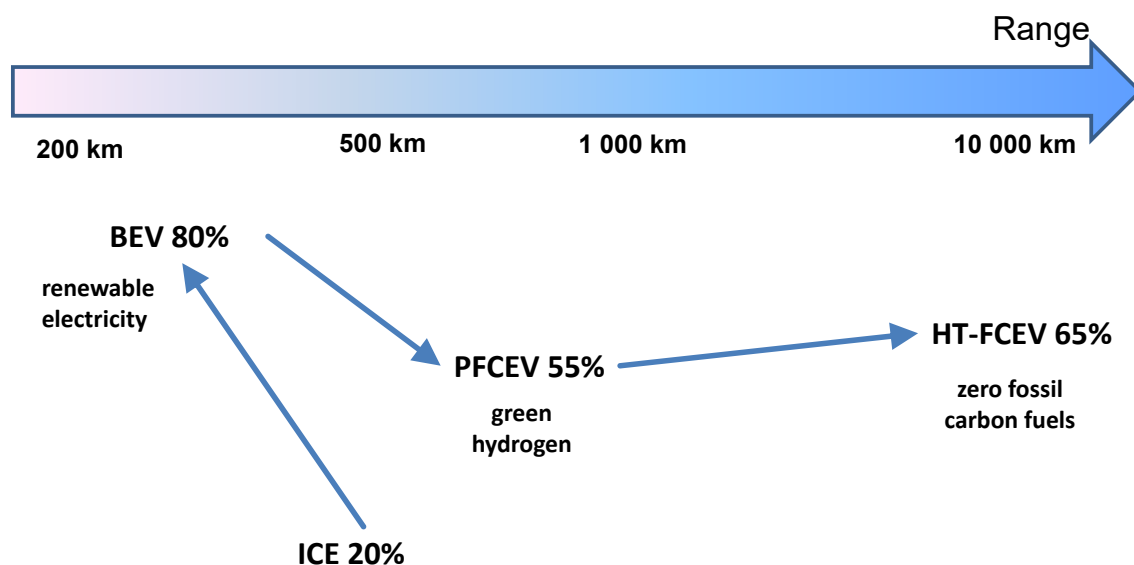


supplies fossil-carbon free gas for stationary applications and transport fuels using the existing gas network

HT Fuel Cell Propulsion for Freight Road Transport (HDV/HGV), Rail, Aircraft, and Maritime Applications



Vehicle Efficiencies



Zero-Fossil Carbon Methane for Electrifying Large Vehicles

- ✓ P2G and CO₂ from biomass (SNG)
- ✓ fully compatible with natural gas (NG) grid infrastructure
- ✓ compatible with NG/LNG trend for HDV, shipping etc.
- ✓ zero-fossil carbon fuel with considerable reductions in CO, NO_x, SO₂, particle, and noise emissions even in ICE
- ✓ global zero emission scenario when used in fuel cells



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Upcoming events:

Fuel Cell Systems Workshop –
17/18 May 2022,
Bruges, Belgium



JESS 2022 – Joint European Summer School,
12 to 17 & 19 to 24 Sept 2022,
Athens

www.jess-summer-school.eu

Thank you for your Attention!

Any Questions?

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