

V O L V O

SUSTAINABLE TRANSPORT WITH FUTURE FUELS

Volvo Group | Materials Science | Dr. Donald McCarthy | Lubricant Expo Europe 2024

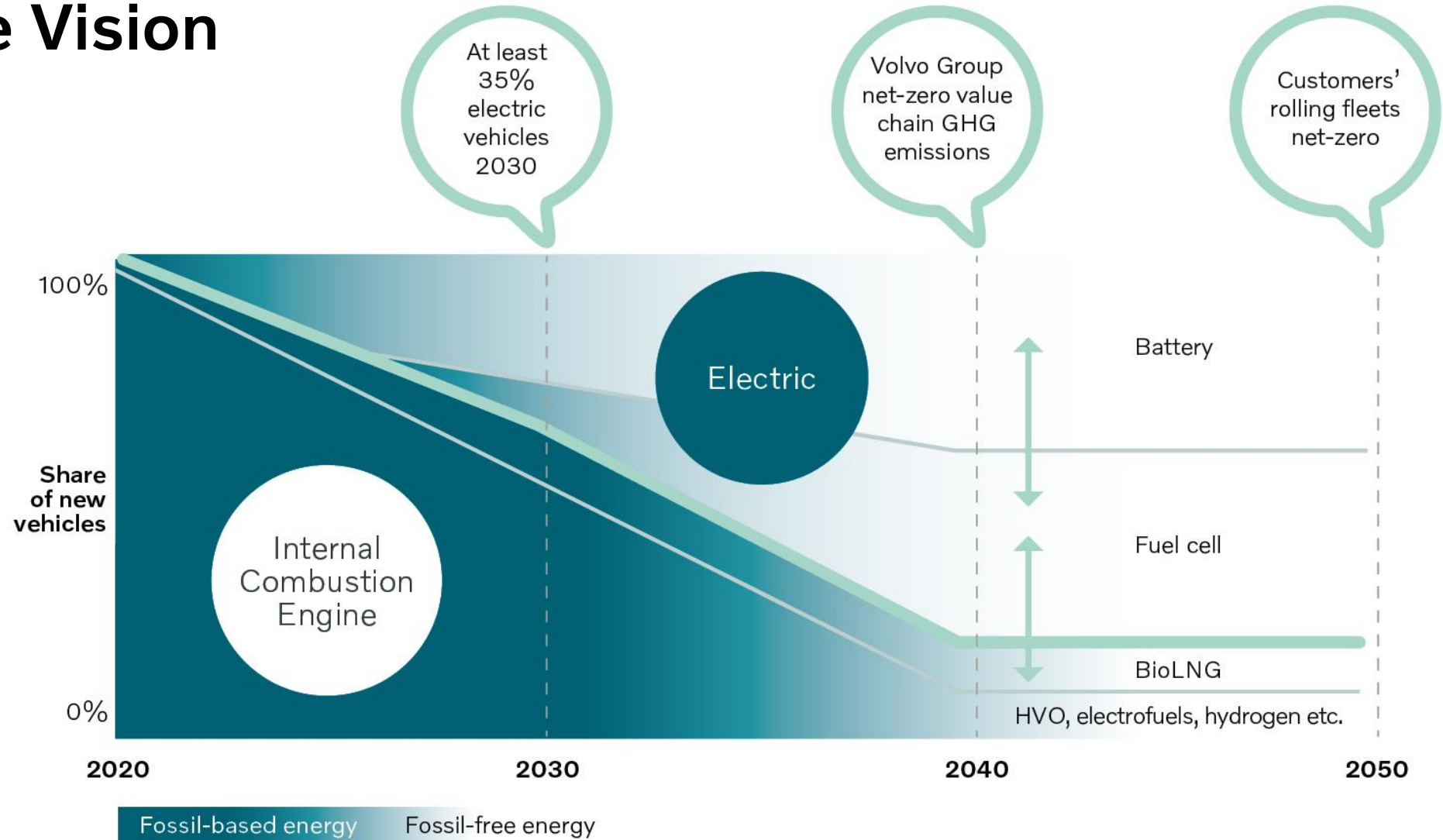
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Volvo Group

- Offers trucks, buses, construction equipment and power solutions for marine and industrial applications.
- Committed to the Paris Agreement.
- Net-zero greenhouse gas emissions **by 2050.**
- 100 % carbon neutral vehicles **by 2040.**
- Lower the CO₂ emissions with 40% per vehicle km for our trucks and buses **by 2030.**



Future Vision



Fuels in Short

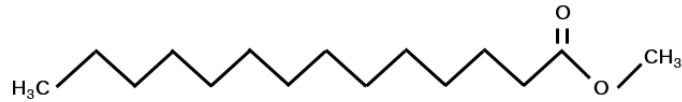
- Alternative and future fuels
 - At Volvo Group we use FAME, HVO, methane, hydrogen and electricity as alternatives to standard diesel.
- How can other fuels contribute to the Volvo Group's sustainable goals?
 - Alternative fuels lower CO₂ emissions.
 - Important to include well to wheel.
- Benefits and challenges with other fuels
 - Source (feedstock)
 - Quality
 - Availability
 - No “one solution fits all”.



Biodiesel

FAME (Fatty Acid Methyl Ester)

- Blended into diesel, usually at 7%
- An ester
- Produced from vegetable oil and methanol



Pros

- Renewable
- Low cost
- No aromatics
- Oxygen content

Cons

- Ages fast
- Usability in cold climates
- Oxygen content
- Limitation of feedstock
- Lower energy content

Renewable Diesel



HVO (Hydrotreated Vegetable Oil)

- Can operate our engines in neat form.
- Paraffinic.
- Produced from vegetable oil (also wood, used cooking oil, slaughterhouse waste) and hydrogen.



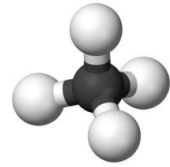
Pros

- Renewable
- Does not age
- No aromatics
- No oxygen
- Can function in cold climates

Cons

- Higher cost
- Limitations of feedstock

Methane



Liquid methane

- Can be used lean together with diesel (or HVO) in gas-powered vehicles.
- Produced from natural gas, manure, food waste, wood waste, etc.

Compressed methane

- Stoichiometric operation in CNG vehicles.
- Produced from natural gas, manure, food waste, wood waste, etc.



Pros

- Renewable (if not natural gas).
- No aromatics.
- No oxygen.
- ~20% lower CO₂ than diesel (tailpipe).

Cons

- High GWP factor of methane.
=> contributes to global warming if emitted.

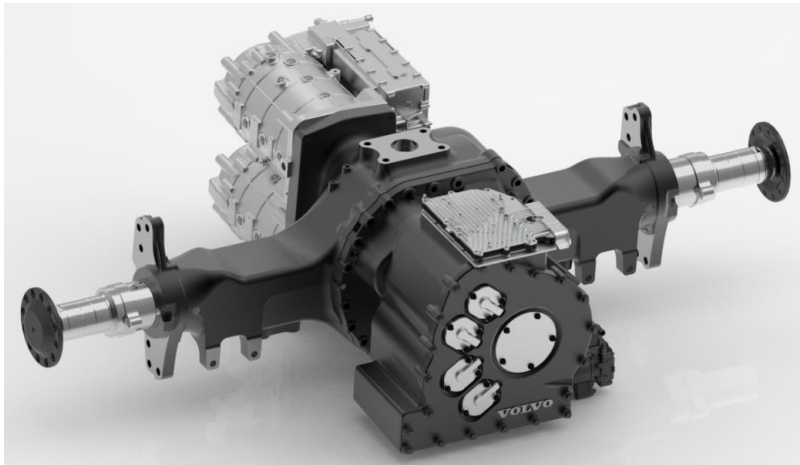
JV Volvo and Westport - HPDI

- JV planned to start mid 2024.
- High Pressure Direct Injection (HPDI) – fuel system technology for combustion engines.
- Replace diesel with carbon neutral fuels – biomethane or hydrogen.
- HPDI has been used in Volvo trucks for over five years.
- Possible for customers to reduce their CO₂ emissions in LBG applications.
- Potential way forward for hydrogen.



Electric

- Battery electric and full-electric (cable).
- Source of electricity plays an important role.
- Infrastructure requirements.



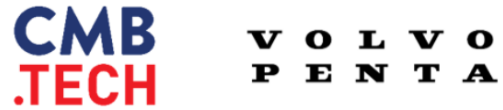
Volvo Fuel Cell Truck

- Operational range up to 1000 km.
- Tests in demanding and harsh climates.
- Heavy loads up to 65 tonnes.
- Tests ongoing. Commercialisation in second half of decade.
- Gen I - two fuel cells (300 kW).
- Gen II – three cells with more power.
- Refuel time - less than 15 minutes.



Dual Fuel ICE

D8 Stage V Dual Fuel



CMB.TECH builds and designs large marine and industrial applications that run on hydrogen.

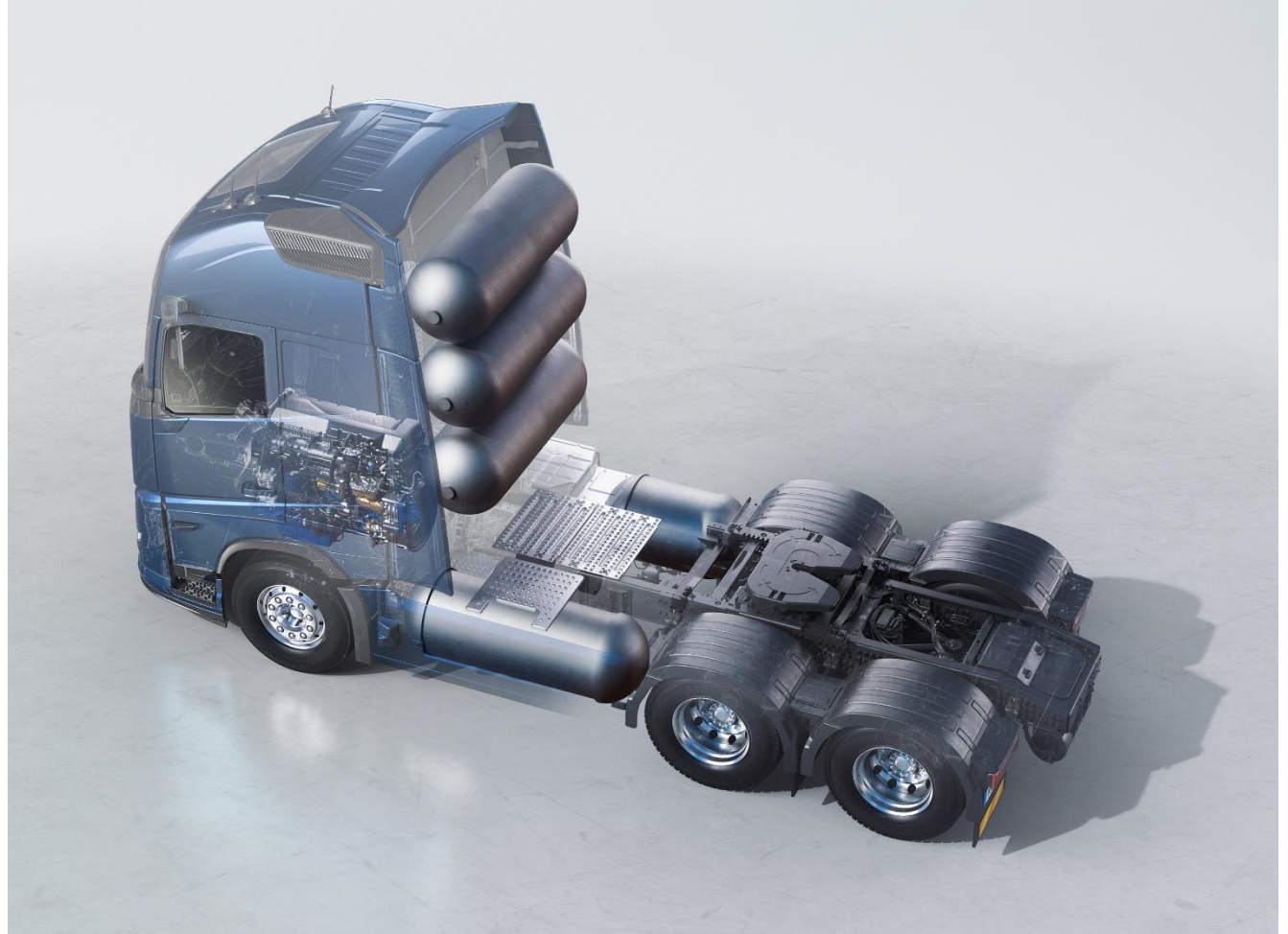
Partnership established regarding Industrial and Marine H₂ Dual Fuel engine development

Pilot launch 2023



Hydrogen ICE

- Bench tests with several different H₂ ICE engine models are ongoing.
- Volvo will begin customer tests with trucks using hydrogen combustion engines in 2026.
- Trucks are planned to be commercially available towards the end of the decade.



Lubrication Challenges for H₂ ICE

Work is ongoing using traditional engine oils as well as innovative formulations.

- Pre-ignition is a recognised problem which needs to be addressed.
- Water – Still unknown if this is a real issue. Oil temperature is important. Low temperature (approx. 30°C) is needed for water to form.
- Deposits in the combustion chamber. Low ash oils can be important to avoid coking deposits. Depends on ignition method (e.g. spark) and fuel type or blend (100% gas or gas/diesel).
- Sustainability profile of the lubricant.



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