Alternative fuels for HD transport

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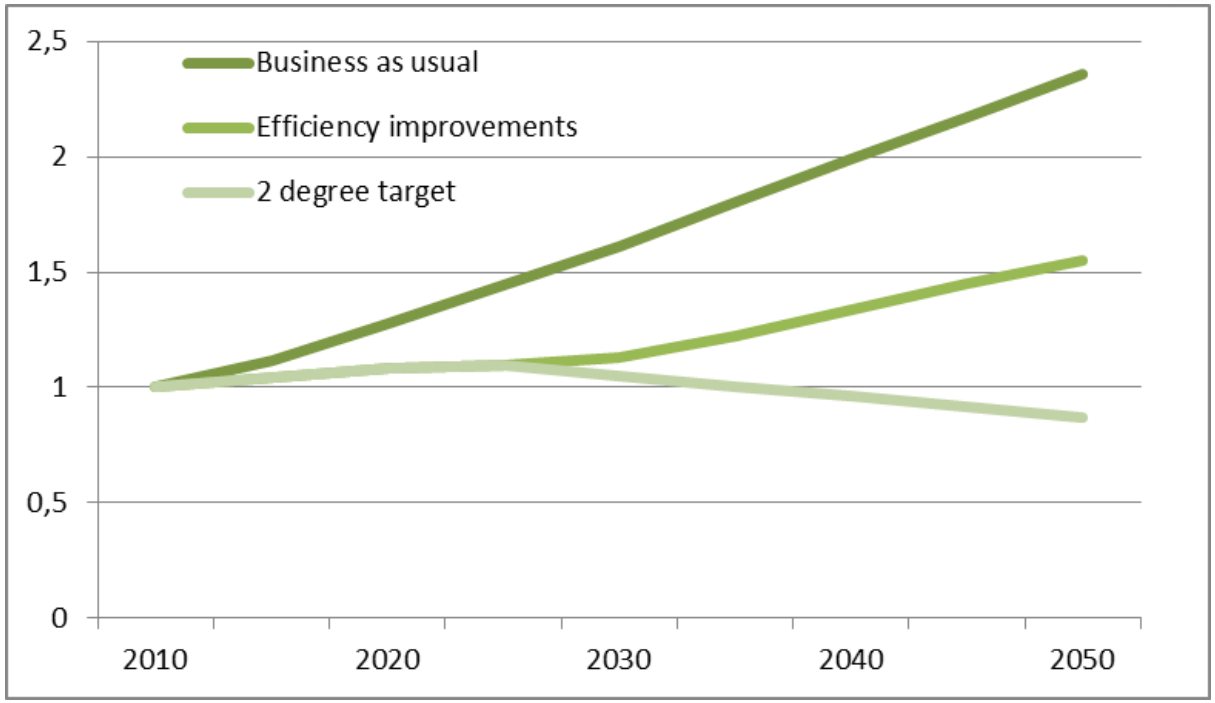
GHG emissions from HD transport - "global" summary picture



- Most ambitious efficiency measures, also including battery technologies, not sufficient to meet GHG targets
- In addition ~> 75% renewable fuel needed 2050 to reach 2 deg. target

- The COP21 agreement from Paris implies that emissions from HD trucks should follow the lower curve

Source: IEA MoMo 2012

Fuels evaluated

Biodiesel is a renewable, biodegradable fuel made from various vegetable oils, animal fats and recycled restaurant greases. It is produced through a chemical process called transesterification. Glycerine is separated from the fat and vegetable oil. Palmoil based biodiesel is the most commonly used form. Biodiesel can be mixed with conventional diesel.

HVO, Hydrotreating of vegetable oils or animal fats is an alternative process to esterification for producing biobased diesel fuels. In the production process, hydrogen is used to remove the oxygen from the vegetable oil.

Synthetic diesel is produced via gasification, which converts a mixture of hydrogen and carbon monoxide – derived from biomass, natural gas or coal – to a liquid fuel. Synthetic diesel is a highly paraffinic product with no sulphur.

Ethanol is a renewable fuel made by fermenting crops that contain starch or sugars. Currently, corn, wheat and sugarcane are the most predominant crops for producing ethanol. Waste from paper mills, potato processing plants, breweries and beverage manufacturers can also be used.

Methanol is the simplest alcohol, produced via the gasification process.

DME – Dimethyl ether is a clean-burning non-toxic alternative that can be made from natural gas, coal, or biomass via a gasification process. DME is a liquid in room temperature at a pressure of 5 bars.

Methane, the simplest of hydrocarbons, is the main component of natural gas and biogas. Natural gas is a fossil fuel found in the earth. It is composed of methane, ethane, butane, propane and other gases. Biogas can be produced from all kind of biomass. The biomass is anaerobically fermented into gas. The raw biogas is cleaned and the final product consists of methane. LNG and CNG are abbreviations for Liquefied Natural Gas and Compressed Natural Gas.

Electricity can be produced from a variety of primary energy sources, including oil, coal, nuclear energy, moving water, natural gas, wind energy, and solar energy.

Main criteria for comparing alternatives

GHG emissions (LCA)

Vehicle production

Fuel, infrastructure and distribution

Vehicle operation

Recycling

Total cost

Vehicle cost

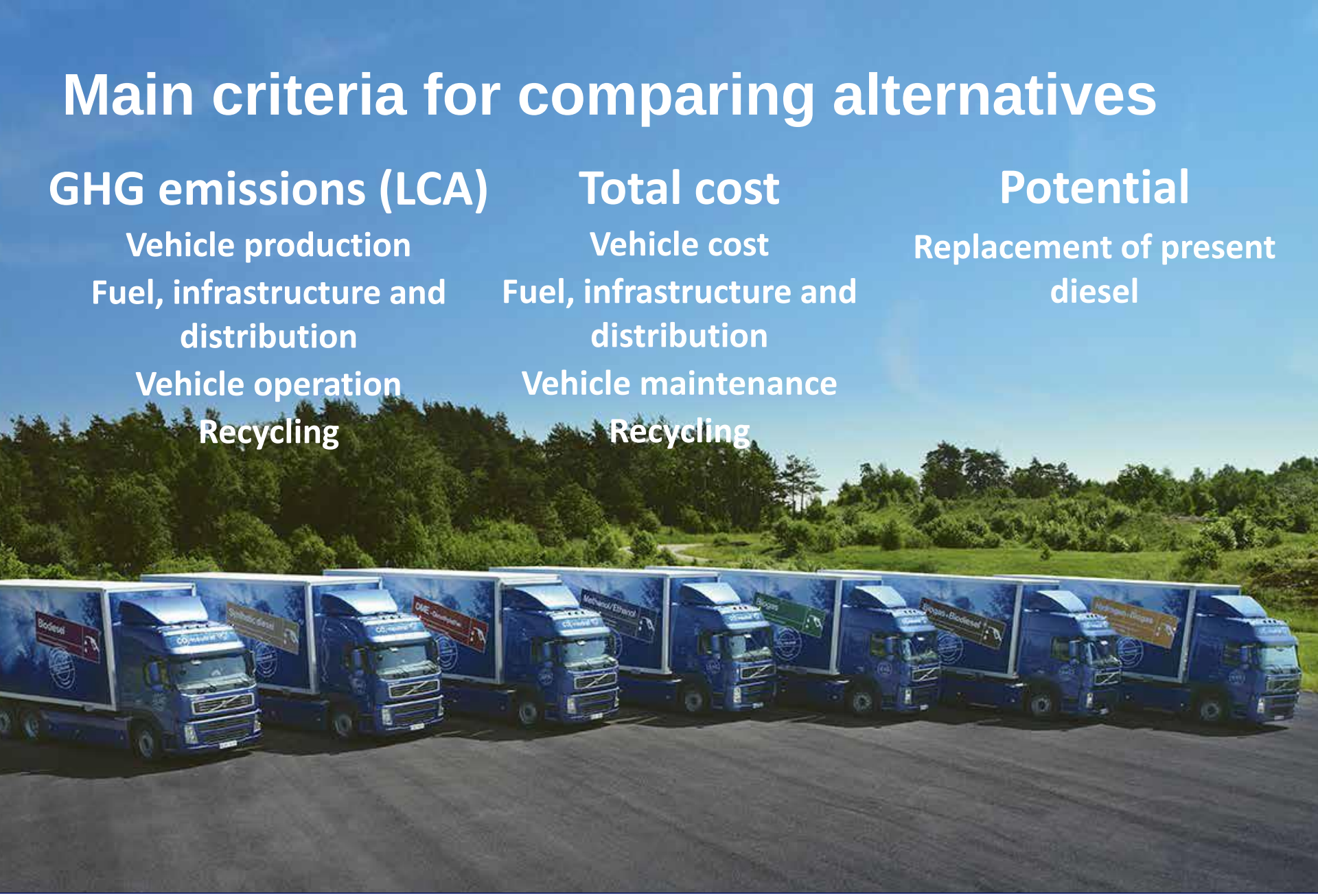
Fuel, infrastructure and distribution

Vehicle maintenance

Recycling

Potential

Replacement of present diesel



The four most promising fuels

HVO is easy to use in current infrastructure and engines. With animal fat as feedstock, HVO has good climate potential.

Electricity has high efficiency and a low climate impact. It is most suitable for urban applications. Dynamic charging is needed for long distance transport.

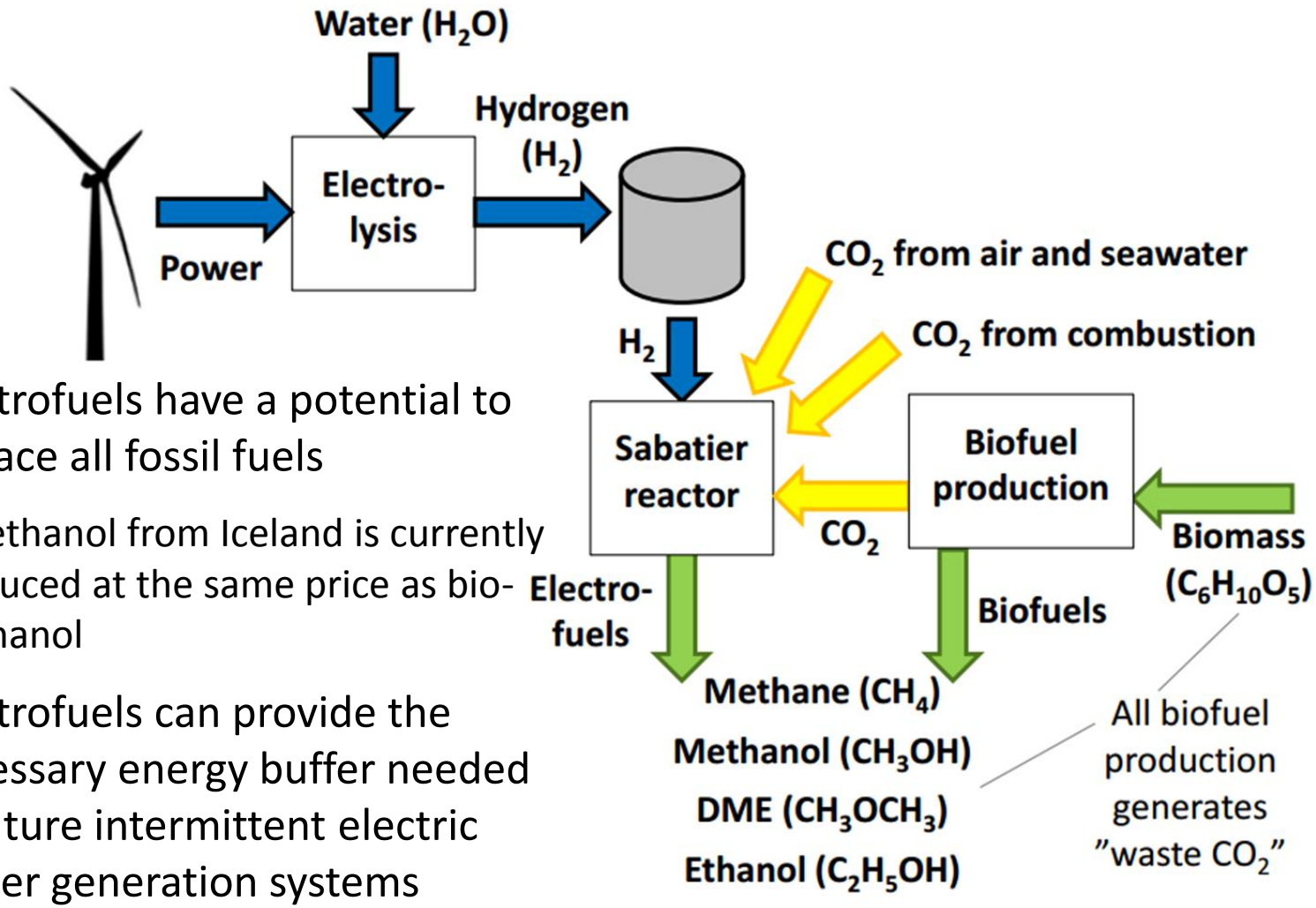
DME DME is a strong long-term candidate with low climate impact and efficiency benefits.

Methane, natural gas and preferably biogas, is widely available and already an established alternative for urban applications. Liquefied Natural Gas (LNG) is suitable for long distance transports.

Comments other analysed fuels

Biodiesel: Has technical issues and low blends are preferred. Availability as well as the climate potential is limited.
Synthetic diesel: Easy to use but high investment threshold in production.
Methanol: Long-term potential with climate benefits.
Ethanol: Present ethanol has limited climate potential, low blends in petrol are preferred.

Production of Electrofuels



- Electrofuels have a potential to replace all fossil fuels
- E-methanol from Iceland is currently produced at the same price as bio-methanol
- Electrofuels can provide the necessary energy buffer needed in future intermittent electric power generation systems

Conclusions

- Large scale introduction of renewable fuels is needed to reach necessary reductions of GHG emissions in the HD transport sector
- Biofuels are the simplest and most cost efficient renewable fuels today
- Electrofuels are needed for large scale replacement of fossil fuels
- Biofuels and electrofuels are preferably the same
- The engine and vehicle technology is not the main problem
- Some alternative fuels show potential to enhance engine performance
- New fuels with no performance nor cost benefits should only be introduced if they meet present standards (drop-in fuels)
- Carbon taxes are needed taking the full life cycle into account

More on fuels

Volvo FH LNG - Liquefied Natural Gas Truck

https://www.youtube.com/watch?v=QoiNT_ikcUk

Volvo Trucks brochure on alternative fuels

http://www.volvotrucks.com/SiteCollectionDocuments/VTC/Corporate/About%20us/Environment-2014/Alternative%20fuels_The%20way%20forward.pdf