Volvo Trucks. Driving Progress

ALTERNATIVE FUELS FOR TRUCKS:
A GUIDE TO THE PROS AND CONS

While diesel is still the most widely used fuel in the trucking industry, it is under increasing pressure from ever-stricter legislation on CO_2 emissions, changing consumer preferences and the growing viability of alternative fuels. Optimism about alternatives to diesel is rife across the board. For instance, Bloomberg predicts that by 2040, electric vehicles will account for 56% of all light commercial vehicle sales and 31% of medium duty commercial vehicle sales in China, US and Europe. But it's not just electric vehicles that are growing in popularity; alternatives like LNG (liquefied natural gas) are also projected to grow significantly between now and 2030 while the Hydrogen Council believes that 15 million to 20 million trucks, and around 5 million buses could be powered by hydrogen by 2050.

But which is the best fuel source for trucks? Here we take a look at some of the main advantages and disadvantages of different alternatives fuels and also outline some of the key considerations to take into account when adding a vehicle with an alternative driveline to your fleet.

HYDROTREATED VEGETABLE OIL (HVO) – WHAT IS IT?

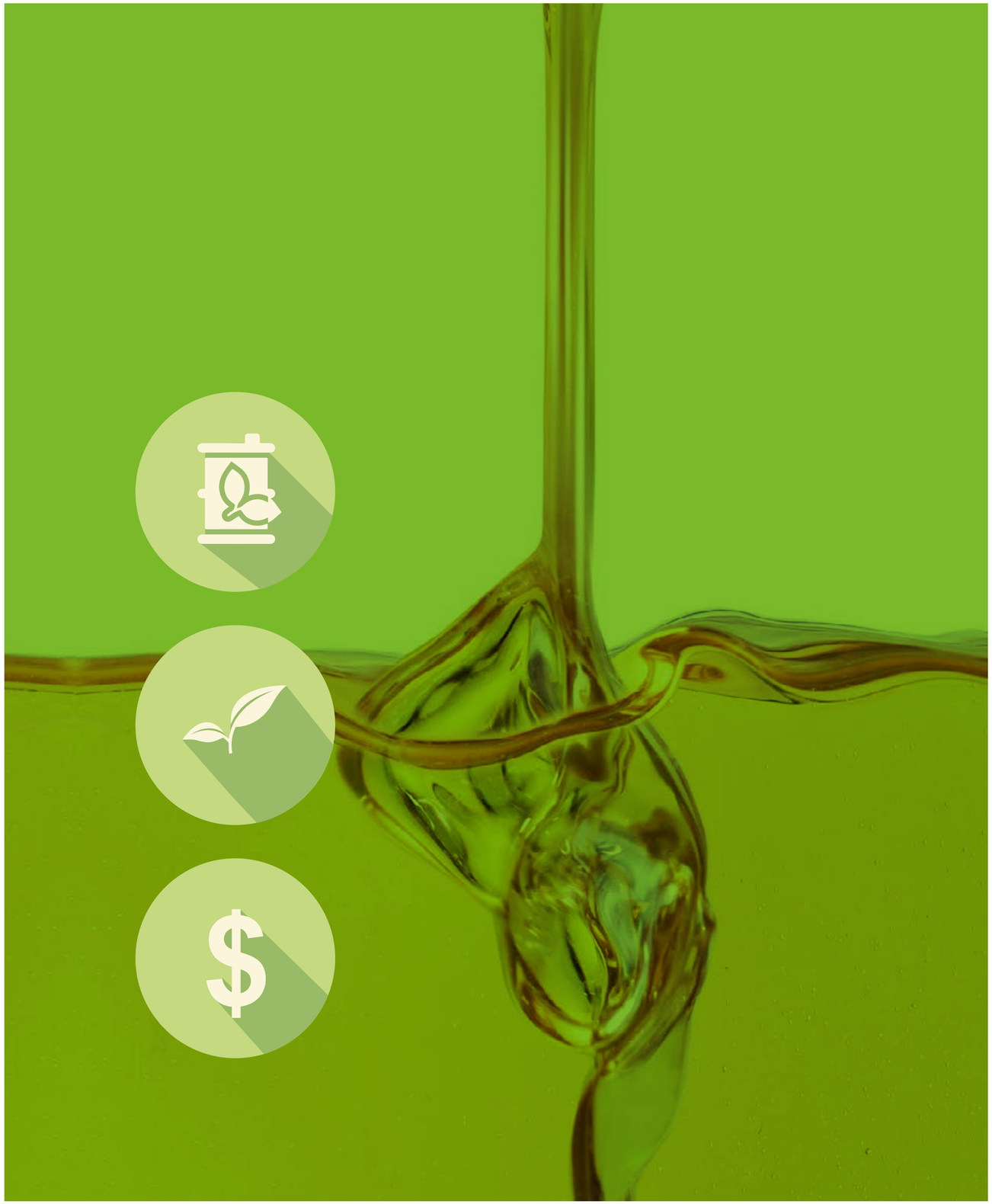
HVO is essentially a second-generation biodiesel that can be produced from a wider range of materials. The production process involves adding hydrogen to vegetable oil to create a fuel that is very similar to conventional diesel. Production of HVO is expected to reach **between 6-7 million tonnes in 2020**, most of which will be used in the Nordics.

ADVANTAGES

- In terms of performance, HVO is virtually the same as diesel.
- It can be produced from a broad range of raw materials including a lot of low-quality waste products that cannot be used in biodiesel.
- It has the same climate benefits as biodiesel and depending on the materials used in its production – for example bio-oils – it's wheel-to-wheel carbon emissions can be even lower still.
- It can be used in vehicles as a direct replacement for diesel. No modifications are needed.
- It is free of biodiesel's technical limitations – such as solidifying in cold weather or producing harmful organisms in the fuel tank.
- Diesel refineries can be converted to HVO production as demand for fossil fuels decreases.

DISADVANTAGES

- Even with a broader range of raw materials that can be used in production, resources are still limited.
- If produced from palm oil or waste from palm oil production, HVO could contribute to deforestation and high carbon emissions.
- While carbon emissions are low, emissions of NO_X and particulates are not reduced.
- At this stage, HVO is more expensive than diesel in most markets.



ELECTROFUELS – WHAT IS IT?

Electrofuels are a class of fuel produced by electrolysing water to create chemical building blocks, which are used to create a diesel-like fuel with many of the same properties. The field is still in its infancy however if a source of cheap, renewable electricity can be secured, then production of carbon neutral fuel would be virtually limitless.

ADVANTAGES

- The key raw material – water – is plentiful.
- If the electricity used is from a renewable source, then the resulting fuel will be carbon neutral.
- It can be used in vehicles as a direct replacement for diesel.

DISADVANTAGES

- For minimal climate impact, the electricity needs to be from a renewable source.
- Without access to cheap electricity, the production process is likely to be expensive.
- Emissions of NO_X and particulates are not reduced, thus Electrofuels do nothing to improve air quality.

SYNTHETIC DIESEL – WHAT IS IT?

Synthetic diesel is produced from gas, which converts a mixture of hydrogen and carbon monoxide into a diesel-like liquid fuel – a process also known as Fischer-Tropsch. The knowledge and technology that enables this has been around since the 1920s however the production process has been too expensive to make it commercially viable. In a study conducted by Bosch, it was estimated that if renewable and synthetic fuels were widely used by European passenger cars by 2050, **this would save around 2.8 gigatons of CO_2** being released into the atmosphere.

ADVANTAGES

- If the gas used is from a renewable source, then it will result in low carbon emissions well-to-wheel.
- It can be used as a direct substitute for diesel, and no modifications to the vehicle are needed.
- Likewise with infrastructure. The same equipment for refilling, storage and transportation used for diesel can be used for synthetic diesel.

DISADVANTAGES

- Synthetic diesel is expensive to produce and energy intensive. To be commercially viable, typically gas prices need to be low and oil prices high.
- To date it has only **been produced in small quantities.**
- The well-to-wheel emissions are dependent on the gas used to produce the synthetic diesel, and currently the two main sources are fossil: gas and coal.
- Synthetic diesel still emits NOx and particulates.

ELECTRIC VEHICLES – WHAT IS IT?

Electric vehicles typically come in the form of hybrid electric (HEV), plug-in electric (PHEV), battery electric (BEV). **Lithium ion batteries** are a key component in such vehicles, with their size, cost and capacity often determining their viability.

ADVANTAGES

- Zero tailpipe emissions of CO_2, particles and NO_X.
- The well-to-wheel CO_2 emissions depend on how the electricity is produced, but even when produced from fossil fuels, an electric vehicle is nearly always cleaner than one powered by diesel.
- Electric drivelines make less noise than a combustion engine.
- Less service and maintenance is required since an electric vehicle has fewer moving parts.

DISADVANTAGES

- Electric vehicles cost more than their diesel-powered equivalents.
- The infrastructure required for charging is still under development.
- The batteries add weight to the truck and may result in lost payload.
- The current range of an electric vehicle is typically up to 300 km on one overnight charge – well-short of what is required for long-haul applications.
- The overall environmental impact of electric vehicles is still being assessed. For example, where the batteries are made and how they are charged has a huge impact on how clean the technology is. If you are interested in learning more about electric truck batteries click here

HYDROGEN – WHAT IS IT?

Hydrogen fuel is a zero-emission fuel burned with oxygen. When used in fuel cells, hydrogen is combined with oxygen and the resulting chemical reaction generates electricity. It is a clean process with the only by-products – apart from electricity – being warm air and water vapor. Check out this link if you are interested in learning more about hydrogen as an alternative fuel source.

ADVANTAGES

- Hydrogen is one of the most abundant resources on earth.
- It is a clean burning process that produces no tailpipe CO_2 or NO_X emissions.
- Hydrogen-powered vehicles operate with low noise.
- Compared to lithium ion batteries, hydrogen fuel cells can deliver longer ranges. They can also be used as range extenders in conjunction with batteries.
- Low well-to-wheel emissions if the hydrogen is produced from a renewable source.
- Hydrogen can offer the same benefits of electromobility – namely low emissions and noise – without being a drain on a country's power grid.

DISADVANTAGES

- Around 95% of the world's hydrogen is produced from fossil sources, namely natural gas and coal.
- Fuel cells are expensive to produce. As such hydrogen is currently 3-4 times more expensive than diesel.
- The infrastructure is lacking and is expensive to build. With so few hydrogen-powered vehicles on the roads, it is not commercially viable to invest in new infrastructure either.

LIQUEFIED NATURAL GAS (LNG) – WHAT IS IT?

Liquefied natural gas is natural gas that has been cooled down to liquid for shipping and storage. While natural gas is a fossil fuel, Liquefied Natural Gas (LNG) can provide between 10-20% less CO_2 emissions compared to diesel. Global demand for LNG is expected to grow by 3.6% per year up until 2035. Currently there are around 200 LNG refilling stations in Europe, which is increasing rapidly.

ADVANTAGES

- Lower tailpipe CO_2 emissions than diesel. The exact reduction can vary depending on location but its approximately 10% lower in spark ignited engines and 20% lower in compressed ignited engines.
- Natural gas is widely available and cheaper than diesel.
- Currently LNG-powered trucks can travel up to 1,000 km before refilling, making it a viable fuel for long-haul applications.
- The LNG refilling network in Europe at least, is growing rapidly.

DISADVANTAGES

- Natural gas is a fossil fuel.
- While its growing rapidly, the infrastructure and refilling network is still very limited and will require continued investment.
- The infrastructure required for production of LNG is expensive and can be energy intensive.
- For a vehicle to use LNG, additional tanks are needed, which will incur an extra cost as well as decrease the truck's payload by adding extra weight.

BIO-LNG – WHAT IS IT?

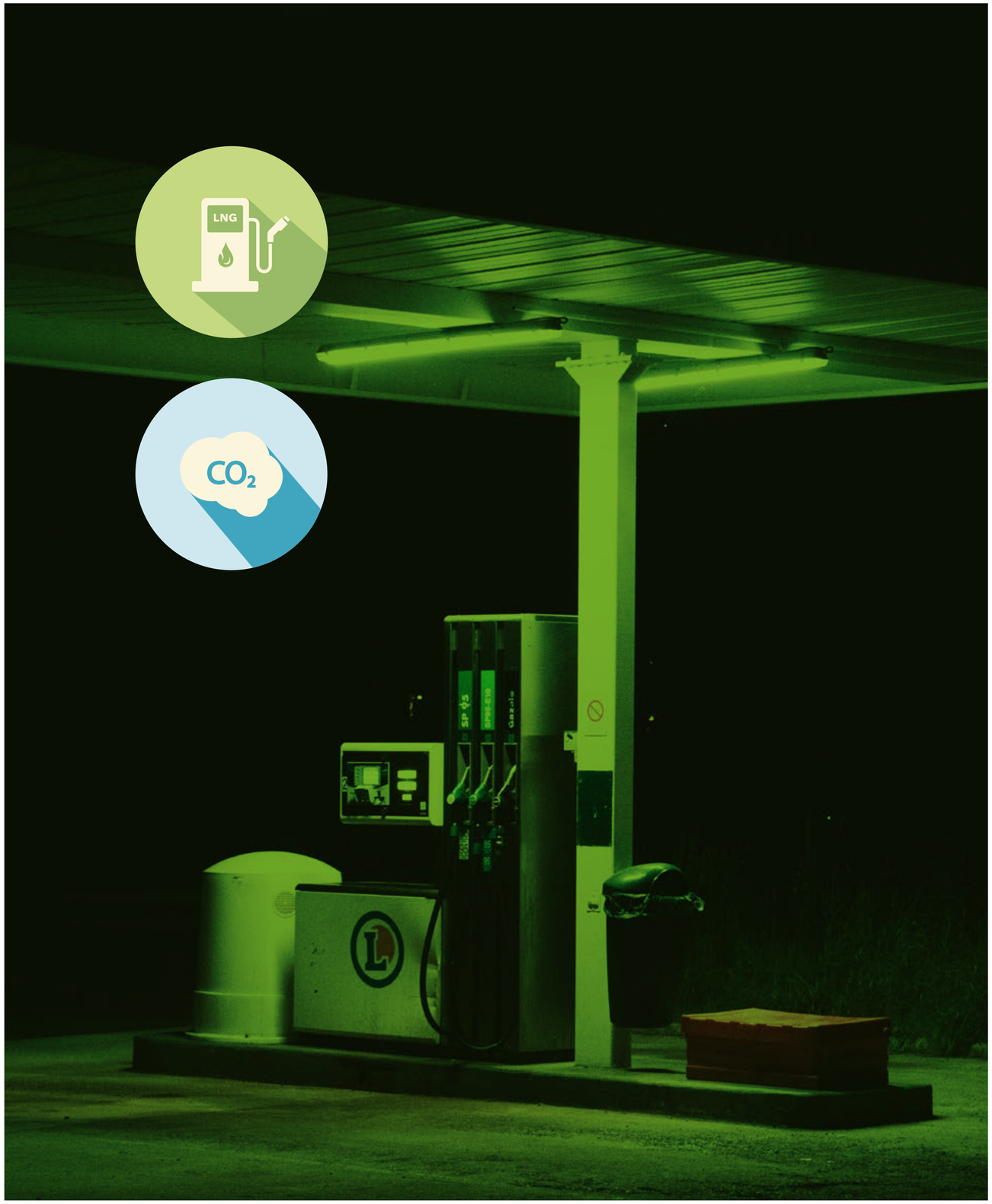
Bio-LNG, otherwise known as liquefied bio-methane (LMB) has the same chemical formula as LNG. It is produced through a process where biogas from organic waste such as animal manure, sludge and green waste is converted to high-quality biomethane and liquefied to -162 degrees Celsius.

ADVANTAGES

- Bio-LNG has in comparison with LNG significantly less CO_2. It also has higher fuel potential (the ability to replace diesel) than other alternatives like biodiesel.
- Raw material is plentiful and as it is derived from waste or agricultural biomass, Bio-LNG can be produced locally saving transport costs and carbon emissions.
- Like LNG, Bio-LNG has a high energy density and is therefore suitable for long-haul transport.
- Bio-LNG could operate on existing LNG infrastructure.

DISADVANTAGES

- Bio-LNG is still an evolving technology with limited production infrastructure and capacity.
- Investments, research and development is necessary to produce the required amount of biogas to make Bio-LNG a viable alternative.
- Bio-LNG is significantly more expensive to produce than LNG, and therefore typically requires subsidies to be competitive.



DIMETHYL ETHER (DME) – WHAT IS IT?

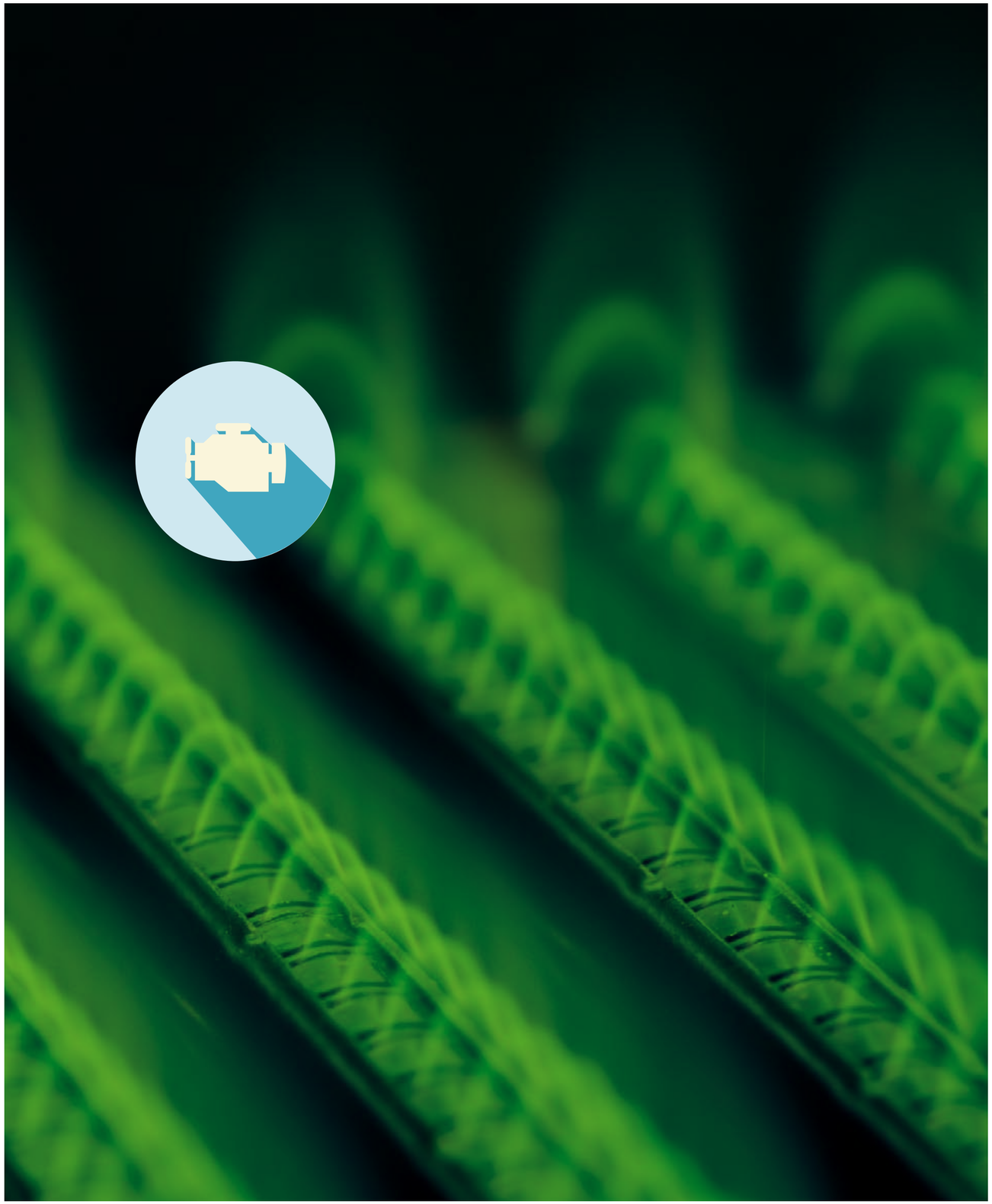
DME can be produced from biomass or fossil sources to create a clean-burning fuel with similar properties as diesel. It can be used in a conventional diesel engine with an adapted fuel system, and deliver the same performance and efficiency.

ADVANTAGES

- Tailpipe CO_2 emissions are approximately 8-10% lower than diesel.
- If produced from biomass, well-to-wheel CO_2 emissions are the lowest of all biofuels.
- Very low emissions of NO_X and particulates.
- Compatible with current diesel engines.

DISADVANTAGES

- Production capacity and infrastructure is limited and there are no plants of significant size currently producing DME.
- DME has around half the energy content of diesel so a truck needs to carry twice the amount of fuel for the same range.



ALTERNATIVE FUELS – CHECKLIST

Are you thinking of adding a truck with an alternative driveline to your business? Choosing the right alternative fuel will depend on many factors. Here are some things to consider when deciding which fuel is the best fit for your business:

✓ **Total Cost of Ownership.** This isn't as simple as comparing prices. If one fuel is cheaper but less efficient it could actually turn out to be more expensive. Will fuel savings cover the cost of additional equipment and vehicles? Will you be affected by tax incentives, service and maintenance costs, local electricity prices, resale value, insurance or payload capacity? Calculate the Total Cost of Ownership over the vehicle's entire lifecycle using a tool like this.

✓ **Drive cycles.** Some fuels will only deliver their full benefits if the vehicle is operating in certain conditions so ask yourself if they apply to you. For example LNG might be a good choice if you are in the long-haul business whereas an electric vehicle could be suitable in urban distribution.

✓ **Infrastructure.** Will new refilling stations be required, and if so, are any such investments forthcoming? Will you need to invest in any new facilities or equipment on your sites? If so, take these costs into consideration in your calculations.

✓ **Availability.** How secure is the fuel source going forward, and are you confident that there will always be a ready supply?

✓ **Reliability.** How well-established is the fuel source? Unproven technology comes with increased risk.

✓ **Legislation and policy.** Both current and upcoming. Are there any restrictions on diesel-powered vehicles planned? Or government subsidies and incentives for using alternative fuels? Do some thorough research and consult widely.

Did you find this interesting?

Subscribe to get the latest blogs and content offers from the Volvo Trucks Knowledge Hub!

SUBSCRIBE NOW