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LNG FUEL FOR INTERNAL COMBUSTION ENGINES FROM AN ENGINE MANUFACTURERS PERSPECTIVE

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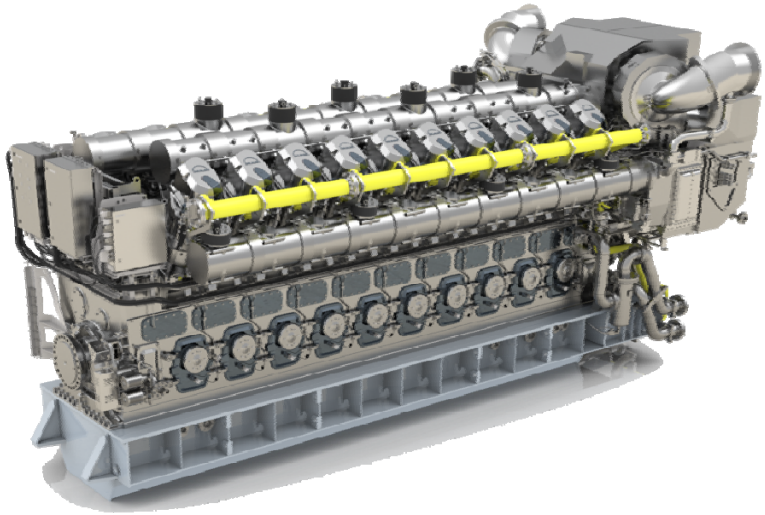
Background

Driven by global Megatrends such as growing transport and travelling demands, the continuous growth of world population linked to increasing urbanization as well as the change of climate requiring distinct protection, are influencing the future applications of gaseous fuels.

Amongst all available fuels Gas is considered a secure resource which often offers reduced first costs (investment) and reduced operating costs, low emissions and high efficiency. Technology of synthetic gas production is available and already in place.

Gas engines remain a key technology to extract energy from gas fuel with overall plant efficiencies exceeding 90%.

Today's 4-stroke gas engines are available in Multiple fuel technology (Dual Fuel =DF) as well as Otto-Gas engines, which differ in technical parameters. While the Otto-Gas engines are fully optimized to burn Gas fuel only, the DF-engines offer fuel flexibility and can be operated on liquid fuels and/or gas fuels without any need of technical modification. Both engine principles are lean burn combustion engines with lowest possible emission-levels.



The MAN 20V35/44G Otto-Gas engine, rated output 10.6MW

In a power production scenario such engines can be utilized in either single cycle, combined cycle or combined heat and power, where the highest possible plant efficiencies are

reached. The most modern gas engines offer their maximum power output (up to 19 MW per engine) within 5 Minutes from a standstill condition. Multiple starts and stops per day are possible with no effect on the maintenance schedule.

The fuel gas requirements are conform to common Natural Gas compositions and have few limitations for instance towards sulphur, Fluoride, chlorine content.

Modern engines may offer their full power on Gas fuel with Methane Numbers as low as 60. A fuel gas pressure before engine of 5-10 bar is sufficiently ensuring continuous operation.

Application of Gas-engines in maritime propulsion systems

The challenges when utilizing gas engines lay in the installation of tanks and gas admission systems. Furthermore rules and regulations for gas fuels for maritime use need further validation, although meanwhile being basically put in place. Local gas infrastructure and bunkering possibilities are to be improved. Coverage of those in worldwide ports is insufficient. Global common standards are needed to assure compatibility of equipments presently preferred in various geographical regions.

Container Ship powered by MAN 2-stroke Dual Fuel engine ME-GI

The MAN 2-stroke DF engine series has reached great recognition in the market by more than 100 units having been ordered and offers fuel flexibility amongst various liquid fuels and gas fuel combined with high efficiency at reduced emissions. In combination with Exhaust Gas Recirculation (EGR) and Waste Heat Recovery (WHR) Technologies significant reduction of CO_2, NO_X and SO_X emissions are realized at an optimized combustion process.

Further applications of gas fuelled engines are LNG-Tankers, which fuel engines with boil-off gas occurring during the voyage.

The use of gas fuels in some Cruise liners is still mostly limited to a reduced emission harbor operation.

It would be required to agree and implement further international standards and regulations for the use and bunkering of gas fuels on ships and to accelerate the installation of related infrastructure in order to make gas fuel more attractive to worldwide ship operators.

Application of Gas-engines for power generation

High efficient stationary power plants using gas burning engines are already in operation in all geographical regions. Reasons for opting for the highest possible efficiency (= Otto-gas engines) or alternatively for the DF engines are often dictated by presently missing gas-supplies and related infrastructure in the relevant countries. Those with a good gas-infrastructure go for the optimum in efficiency, the others being well prepared for future gas use by deciding for DF-engines which may bridge the time with operation on liquid fuels until a suitable gas infrastructure is brought in place.

Globally the substitution of liquid fuels by gas fuels is progressing with increasing pace.

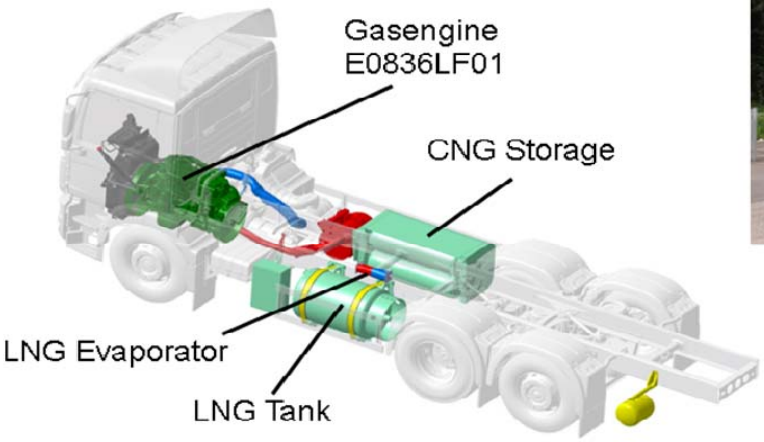
The application of gas engines will offer increased operative flexibility compared to other technologies, such as combined gas and steam turbine solutions.

Gas fuelled mobile power generation by means of floating power barges or even self propelled power ships is another growing segment of the power generation market.

Power ship with MAN 51/60DF engines and heat recovery steam turbines with total power >110MW

Application of Gas-engines for traffic and transport

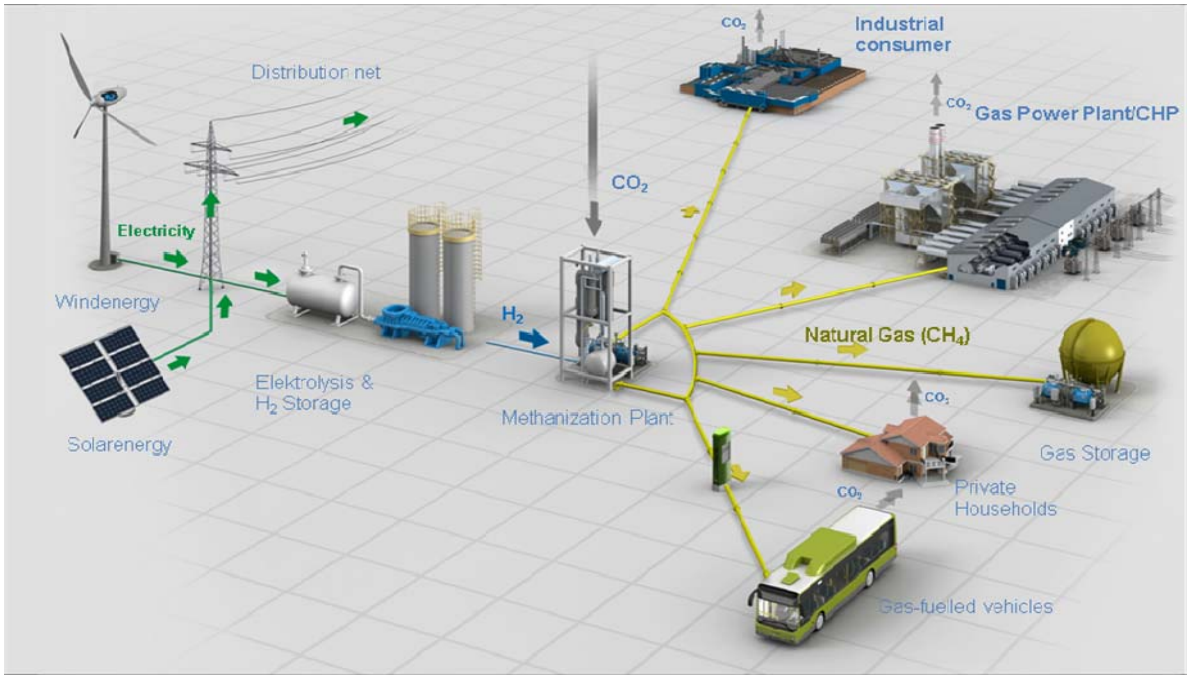
Starting 1943 a continuous development of gas fuelled city busses and commercial trucks has now reached a stage, where globally such vehicles are in operation. Similar to the maritime application, the obstacles for a more significant growth are within the on board carriage of the gaseous fuel and the related re-fuelling infrastructure. Codes and standards have to be agreed on a global level in order to support gas fuelled cross border haul. The presently most attractive gas fuel applications in this segment are Compressed Natural Gas (CNG) and Liquified Natural Gas (LNG). Countries like Iran or Turkey are good examples for the change from liquid fuel to modern gas-fuelled vehicles with the related engine technology.



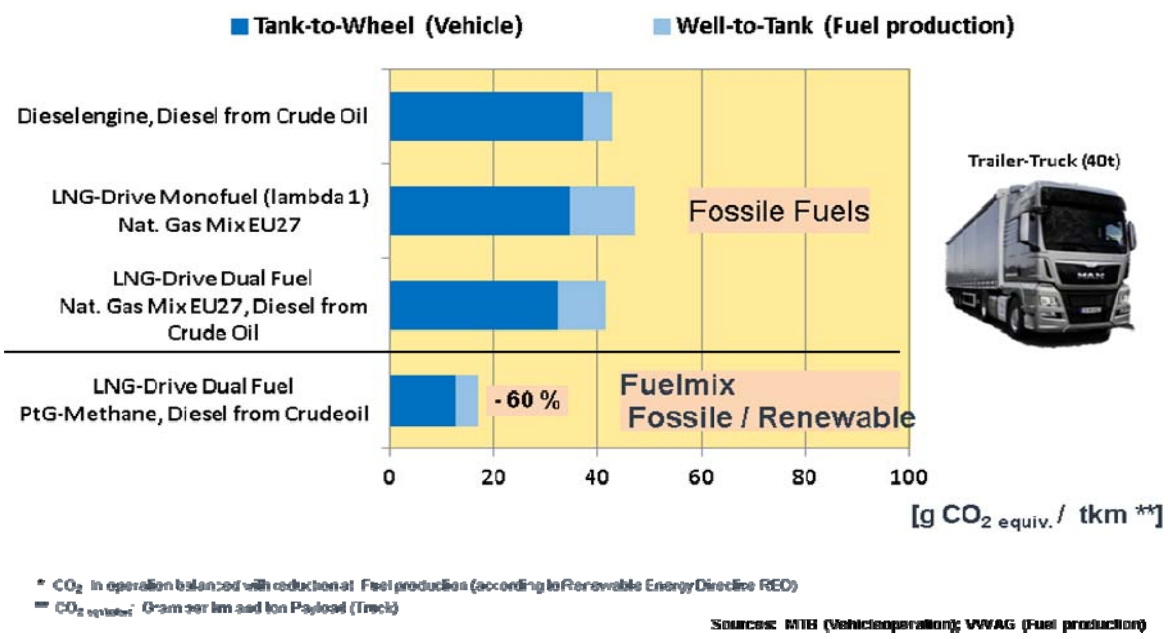
New MAN LNG/CNG Concept vehicle presently in Trial operation

Conclusions

Governmental targets being set across the globe to support protection of our environment remain an extreme challenge when the fulfilment is restricted to technical improvements on the user/consumer side. Additionally a far bigger potential of savings could be leveraged when including the opportunities lying in the concept of fuel production. Switching from Diesel to gas fuel on commercial vehicles will certainly account to a positive contribution to reduce Greenhouse Gas (GHG). However, far bigger savings of GHG are offered by the new processes of synthetic fuel gas production using renewable energies.



Power to Gas potential process scenario with great Greenhouse Gas reduction potential



Potential GHG savings depending on fueltype/fuelmix on long haul trailer-trucks considering newest engine research and development

References

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