CLEAN TECH AVIATION JOINING THE FOUNDED IN GRONINGEN CAMPAIGN

The overall LNG Well-to-Wing impact

IN THIS SUMMARY

The overall LNG Well-to-Wing (WtW) impact

In addition to low GHG emissions, natural gas is the cleanest fuel able to guarantee in all the operating conditions a particulate-free combustion, aromatic-free and close-to-zero NMHC (Non Methanic Hydrocarbons), as well as dramatically reduce nitrogen oxides (NOx) emissions.

Technology-neutral Approach

The results of the study show the European total carbon footprint of **CNG** on a **Well-to-Tank** basis of 12.5 g CO2-eq/MJ), as average weighted value considering the different EU sources for natural gas supply.

Concerning the **LNG** Well-to-Tank pathway, the results are in line with the data from the WtW Study from JEC3 (19.9 g CO2-eq/MJ compared with 19.4 g CO2-eq/MJ).

With a progressive alignment of the technologies even further reduction can be achieved. Conversely, the results from the EXERGIA study indicate much higher values (24.6 g CO2-eq/MJ vs 19.9 g CO2-eq/MJ), due to different and older data sources.

Considering the overall Well-to-Wheel (WtW) impact, there are significant benefits and reduced GHG emissions from passenger cars as well as light and heavy-duty vehicles when switching to CNG or LNG from petrol and diesel.

For passenger cars, on a WtW basis, natural gas reduces GHG emissions by 23% compared with petrol and by 7% compared with diesel.

In heavy-duty applications, benefits compared to diesel amount to 16% for CNG up to 15% for LNG.

In maritime applications, the use of LNG provides an overall Well-to-Wake benefit up to 21% compared with conventional HFO (Heavy-Fuel Oil) fuels.

Methane Emissions

Over the Well-to-Tank side, there is a general misunderstanding about methane emissions from vehicles (often referred to as "methane slip"). No natural gas leakage comes from engines or vehicle. Only very low methane emissions as exhaust unburned hydrocarbons are generated, and they are taken into account as CO2-equivalent.

Best practices exist with many already in place and delivering good results. It is also evidence of

the additional potential for further reducing GHG emissions. For example, the installation of compressors at LNG terminals allow the re-injection of the boil-off gas instead of flaring it, or a wider use of leak detection systems and repair campaigns aimed at reducing fugitive emissions.

CTA ´s strategy to Scale-Up

However, the best technical solutions will only have a reduced impact if market penetration is limited. CTA has tackled this problem by contracting and partnering with the LNG supplier producers & the technical scientific institutes, partner with the National Aerospace Center NLR and attracted the Lycoming Engine manufacturer and Textron Aviation aircraft manufacturer industry to join CTA as partner and support the disruptive technology innovation program with the use of liquid Natural Gas in aviation.

CTA will penetrate the GA and BA market through the existing maintenance and repair stations and reach through them the end client users; Flight Schools and Business Aviation operators. The first LNG aircraft is scheduled to fly within 18 months after February 2020 work package 1 start.

CTA has established two launching customers a MRO repair station and a large European Flight School.

The large Transport Aviation industry and airfield operators will be assisted with adopting our LNG energy solution first through Ground Power Units (GPU) and followed with the Auxiliary power units (APU) supplying the onboard electricity. CTA executes the R&D together with the German based DLR on the design and build of the composite LNG fuel tanks and demonstrate a favorable hybrid APU innovative solution for electric taxiing disruptive technologies in transport aviation.

Only for Schiphol International airport our solution would save annually 7.5 Billion Houses having each 500 M^3 volume on emissions only by using a hybrid APU engine operating on LNG during the 20 Minutes taxiing time per aircraft.

When we would also use the electrical power driving two electric engines on the main landing wheels and use no longer the main engines for taxiing power, we will save a tenfold of the current 7.5 Billion houses 500 M^3 volume emissions on an average international airfield like Schiphol size, but also present a very favorable business case for the airline industry.

LNG Engine test lab

CTA´s APU LNG engine test lab at the Energy Transition Center on the Hanze University in Groningen the Netherlands

Global Warming

We produce worldwide 8 Gigaton Co2 annually of which the oceans absorb 6Gt and the Co2 cumulates annually and each molecule have a 100 years lifecycle. The severe Hurricane experiences we have seen devastating the Caribbean and parts of Florida and Houston shown the temperature influences and severe wind velocities increase with these natural disasters.