Fact Sheet

GAS-TO-LIQUIDS FUEL: A CLEAN BURNING TRANSPORTATION SOLUTION

GAS-TO-LIQUIDS (GTL) TECHNOLOGY PROVIDES BOTH A CLEAN AND RELIABLE ENERGY SOURCE FOR THE 21ST CENTURY. DOMESTICALLY PRODUCED GTL FUELS BURN MORE CLEANLY THAN CONVENTIONAL DIESEL AND MEET THE MOST STRINGENT CLEAN AIR REQUIREMENTS FOR ULTRA-LOW SULFUR FUEL.

CLEAN, HIGH-QUALITY TRANSPORTATION FUEL

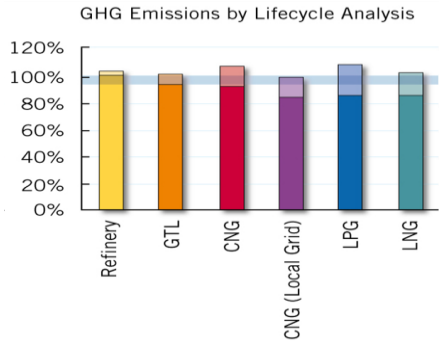
- Gas-to-liquids (GTL) diesel, the main product produced using the GTL process, is a clean, odorless and colorless synthetic fuel produced from natural gas that can be used in existing fuel distribution infrastructure and modern diesel engines.
- GTL technology can also produce kerosene for use as an aviation fuel blending component.
- GTL transportation fuel is cleaner burning than conventional diesel with a comparable, and potentially lower, greenhouse gas (GHG) profile – offering significant environmental benefits.
- GTL diesel can be used in modern diesel engines, with significantly lower emissions of local pollutants, such as particulates, carbon monoxide, hydrocarbons and nitrogen oxides than conventional ultra low-sulfur diesel.
- GTL fuels are virtually free of sulfur and aromatic compounds and reduce emissions of particulates, nitrogen oxides, carbon monoxide and other pollutants and will improve air quality.
- GTL diesel has a high cetane number (typically above 70 compared with a 45 to 55 rating of crude oil derived diesel fuel). The cetane number is a standard gauge of the combustion quality of diesel fuel. It measures a fuel's ignition delay (the time period between the start of fuel injection into the cylinder and start of combustion) as the fuel self ignites under pressure. Higher cetane fuels like GTL offer performance advantages and lower emissions. Diesel engines using higher cetane fuels emit less nitrogen oxides (NOx).

GREENHOUSE GAS PROFILE

Using sophisticated Life Cycle Assessment (LCA) techniques to capture fully the unique quality benefits of all GTL products, it has been shown that the GHG impact of a GTL system is equivalent to that of a modern, efficient petroleum refinery system. The majority of the production scenarios that have been studied suggest a neutral to positive GHG performance for GTL.

- A report by Five Winds International that reviewed several LCAs of GTL, found that GHG emissions resulting from GTL fuel production and use are comparable to the GHG emissions associated with fuel refined from petroleum.
- In 2005, PricewaterhouseCoopers conducted a LCA of a number of transportation fuel processes, including a modern petroleum refinery and a GTL plant. The study showed that GTL offers substantial air quality benefits compared to an oil refinery due to its lower sulfur dioxide, nitrogen oxide and hydrocarbon emissions.
- The Institute for Environmental Research produced a harmonized set of vehicle emission data, and performed a tank-to-wheels health and environmental impact assessment for an urban environment which showed similar benefits.
- Due to greater energy demands, higher GHG emissions are associated with the production phase of GTL. These are offset by high quality co-products (which are accounted for in a proper LCA analysis).

- According to a study commissioned by ConocoPhillips, GHG production can be significantly reduced (by more than 10 percent) when GTL fuel is produced from associated gas (natural gas produced as a by-product of oil production) which would otherwise be flared.
- Compared to refineries, GTL emissions are concentrated in only a few sources, thus there is the potential to significantly reduce the GHG profile of the GTL production phase by capturing this CO_2-rich stream for enhanced oil recovery or sequestration.



Source: PWC, 2005

BENEFITS BEYOND LCA ASSESSMENTS

While LCA can be an important tool for identifying process improvements, there are a number of positive environmental effects that would result from the production and use of GTL fuel that are not included in LCA assessments.

- GTL diesel is produced without the associated heavy residual fuel and petroleum coke that are by-products of crude oil refining.
- GTL technology, though commercialized, is still in the early stage of its development. Both the GHG and energy requirement performance will likely improve as the technology matures.
- GTL fuel offers significant benefits for criteria pollutants, the impacts of which are often not fully captured by an LCA analysis.

OTHER ENVIRONMENTAL BENEFITS

- The smog formation potential of a GTL system (arising from the emission of volatile organic compounds and nitrogen oxides) is significantly lower (from 30 to 70 percent less) than that of a refinery system.
- As shown in LCA analysis, acidification impacts resulting from sulfur oxides (SOx) and NOx emissions is substantially less (a 21 to 41 percent reduction) from GTL technology than those produced in a crude oil refinery system due to the high purity of GTL products.
- Road trials in a number of cities have demonstrated that GTL diesel can provide significant reductions in tailpipe emissions (particulate matter, nitrogen oxides, carbon monoxide, and hydrocarbons), contributing to improvements in local air quality.
- GTL diesel, when combusted, results in a significant reduction in nano particulate carbon formation. These ultra fine particles have high deposition rates in the lungs and are associated with increased levels of asthma and lung cancer.
- Since it can be used in the existing vehicles and fuel delivery systems, the benefits from the use of GTL fuels can be achieved without the need for expensive modifications to refueling infrastructure and engines, making GTL diesel a cost-effective option for reducing pollutant emissions in urban areas.
- The benefits of lower emissions from GTL diesel fuel will have an immediate positive impact on emissions from existing vehicle fleets, particularly in places where older vehicles are in operation.
- The high-performance properties of GTL fuel enable the development and use of advanced exhaust systems and engines.
- GTL's more efficient, cleaner combustion leads to a substantial reduction in engine wear and can extend oil drain intervals.

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