FUTURE FUELS

SYNTHETIC FUELS

Determined to raise the level of debate around which fuels will power transportation in the not-too-distant future, Jorgen Pedersen (SYSTRA Transport Technologies) delves into more future fuels and asks if there are any emerging fuel technologies that can be used in the short term to help meet Net Zero by 2050.

Jorgen Pedersen
Director of New Technology
SYSTRA

Future Fuels – Synthetic Fuels

Global climate change

Many of us are aware of the impact of global climate change, and the need to reduce our individual and collective carbon footprints. There are few that would now deny the impact that climate change is already having on our daily lives. Just this year we have experienced an unprecedented level of rain, in some cases equating to more than three times annual norms. In my home county of Nottinghamshire they have experienced three twenty-year flooding events this year alone. While waters are starting to subside there is more rain forecast, which will undoubtedly bring additional flooding.

So, when I was asked to write a series of articles on future fuels, I readily accepted. I believe that we need to bring awareness to the options that are, or soon could be available. We need to better understand the pros and cons of the solutions/options that are available, and only through in-depth investigation can we make the right decisions based on fact rather than speculation. It must also be acknowledged that heavy freight is unlikely to be served by traditional battery electric technology, and therefore it is necessary to think about other less commonly discussed options that are available.

Which fuel

On starting this article, my first thought was to write about synthetic fuels. However, the more I looked into this the broader the subject became, not only are there synthetic fuels that have been around for years, there are also bio fuels, and even carbon capture fuels. Each of these options provide a true opportunity to significantly reduce our carbon footprint, and perhaps without the need to build a number of new power stations or wind farms to serve the needs of all those EV's that are so alluring, yet unfortunately out of the price range of a significant proportion of us. Therefore, this write-up attempts to cover them all at a very high level, but it must be acknowledged that each one is a subject in its own right, and therefore this article only scratches the surface. Perhaps we will discuss each of these in turn over the week and months ahead.

So lets start by discussing the differences

Synthetic Fuels

For more than 100 years, synthetic fuels have traditionally been generated using CTL (Coal to Liquid) transformation with an output of liquid hydrocarbons. But now, other input materials such as Natural gas using a GTL (Gas to Liquid) transformation are also considered to provide synthetic fuels. Depending on the process used, and the input material, the output can be a direct transformation to liquid-based transport fuels or through a multi-staged conversion process. This process was used to a significant degree by Germany during the second world war who developed more than 120,000 barrels per day of a variety of fuels including jet fuel, diesel, and petrol, to date global production using this transformation process is almost double that at about 240,000 barrels per day.

Bio Fuels

Bio fuels essentially try to replicate the slow natural processes that produce crude oil. As a result bio fuels are generally developed from bio degradable waste, plants, and/or domestic or industrial waste materials. Here there are also two different streams, where one approach produces bioethanol, the other biodiesel. Bioethanol utilises a fermentation process to break down sugars to create an alcohol, while biodiesel uses a transesterification process to convert industrial fat and oil waste to a diesel type product. A huge amount of research has been undertaken on algae-based biofuels, in particular by the Japanese and the Americans who have invested more than $25M in research, which identified as many as 3,000 forms or Algae and aquatic plants identifying that some of these could produce as much as 70% oil as their dry weight. While some large scale tests have been conducted, the cost per barrel still remains well beyond the current costs.

Carbon Capture Fuels

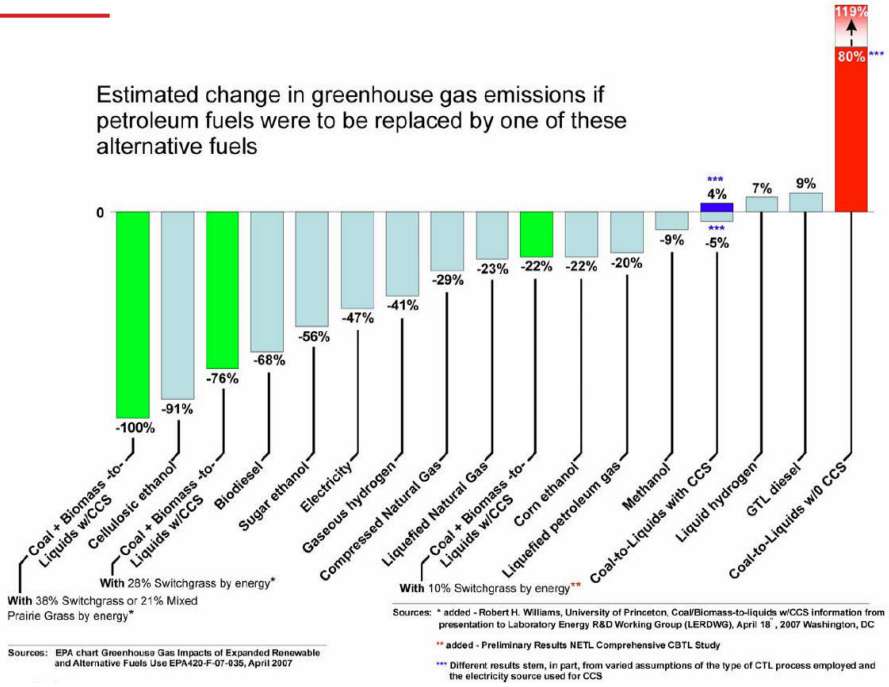
are fuels that are created by removing carbon from the air generally from a consistent carbon source, such as a kilns, furnaces, power stations, which provide a steady stream of carbon derived through burning fossil fuels. The carbon collected is then mixed with hydrogen to produce a range of fuels including petrol and diesel. Carbon capture fuels are generally considered carbon neutral fuels, in that they can be produced without adding additional carbon to our atmosphere, however this is assuming that the hydrogen that is used is green hydrogen, and any energy that is used as part of the process comes from renewable sources.

All of these different fuels when burnt do produce both CO2 and NoX. Bio fuels are generally considered cleaner than their fossil cousins in that they produce less Co2, but slightly higher NoX. Carbon capture fuels are considered carbon neutral, if the manufacturing process can be undertaken without using any carbon-based fuels. While biofuels are regarded as a renewable energy source, there is much debate about their longer-term impact on our environment if there were to become a mainstream fuel alternative in terms of deforestation, food versus fuel, impacts on biodiversity etc.

Synthetic fuel manufacture is generally considered less positively, depending on the material input, the process used to convert whether the process involves gas or coal (GTL or CTL), whether the energy used for the conversion process comes from a sustainable source, or whether Carbon Capture Sequestering (CCS) is used, will all dictate the longer-term viability of these methods. However, life is not that simple, newer techniques combining Synthetic and Bio methods CBTL (Coal and Biomass To Liquids) are proving to provide significantly reduced full lifecycle emissions. By way of capturing this, please refer to the following graph that demonstrates the broad range of fuels that can be manufactured and their current relative emissions against petroleum fuels.

Another major benefit is that these fuels do not in general require any changes to current vehicles internal combustion engines, or major changes to the distribution network. This means that we could significantly reduce full lifecycle emissions using current vehicles almost immediately while we phase out carbon-based fuels. Drivers could fill cars as quickly as they can today, and the less affluent who cannot afford EV's could also be accommodated. This could be delivered through the current service station distribution network, with very few if any changes, minimising short-term cost, disruption and emissions, but also buying time to enable charging networks to be added to every street in the UK in a more organised, controlled and considered way.

Comparing Fuels



Net zero

If we are to reach net zero, I don't believe that any of these technologies will get us there in isolation, however I do believe that these technologies could provide a very valuable steppingstone to helping us along our journey.

I would also suggest that popularist politics has no place in making the right long-term decisions. Traditionally, politics has proven to concentrate too heavily on the short-term to make the difficult decisions that will ultimately need to be made for our long-term sustainable future. A few examples of this are the ULEV extension in London, the sustainable congestion charging in Cambridge, extending our carbon zero goals, and even to some extent the cancellation of HS2.

Isn't it time to reassess, and have a sensible discussion about out longer-term approach to personal travel?

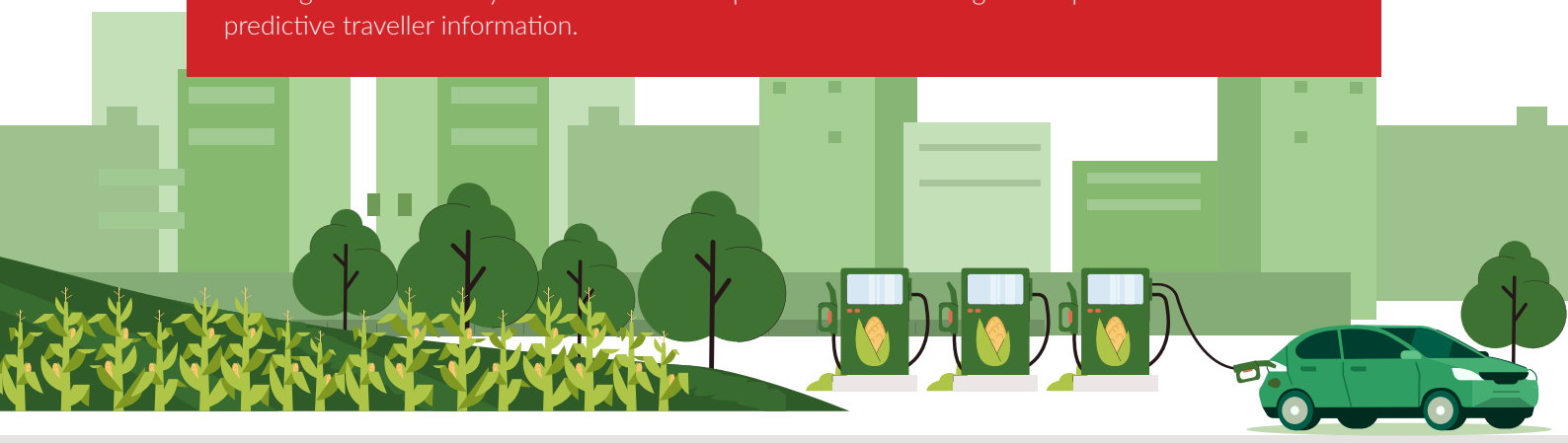
"My objective in writing this series is to stimulate a healthy debate on how we should approach future fuels, and perhaps be a little more open minded to the opportunity for alternative options to those that are currently being presented to us. I welcome your views, including those which are at odds to mine, it is only through healthy debate and scientific investigation that we will make the right decisions to reach net zero. In the next article we will be exploring Synthetic Fuels to better understand their benefits and disadvantages."

Jorgen Pedersen

During his career Jorgen has been responsible for the delivery of several innovative and business transformational ITS programs across the breadth of the traffic and transit sectors. Including connected and autonomous mobility, fare payment systems, traffic management systems, advanced traveller information systems, integrated corridor management solutions (ICM), Smart City initiatives, MaaS, On Demand and Micro-transit solutions, as well as some exposure to vehicle to infrastructure (V2X) projects.

Jorgen recently returned from the US to join the SYSTRA team as the Sector Director, Transport Technologies. The role concentrates on using a wide array of transport technologies and transport approaches to deliver improved travel options covering public, active and private modes to improve our carbon footprint.

During the 13-year tenure at TfL, Jorgen was the Head of Realtime where he delivered the award-winning London Journey Planner and was responsible for the change of emphasis from real-time to predictive traveller information.



BIO

SYSTRA

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