

# Trends to Follow

## *Decarbonizing Aviation Fueling Innovations*

### **SUMMARY**

Aviation fuel is critical to the delivery of services by the global air transportation system. Though fuel has been a mainstay of the industry since the end of WWII it may fast become a relic due to its substantial contribution to Green House Gas emission. The industry has made great strides in curtailing emissions, but the impact of these fossil fuels on the environment remains. Aviation fuel is now a target of both national and international institutions, most notable are the IATA Sustainable Aviation Fuel Roadmap, U.S. Securities and Exchange Commission (SEC) proposed amendments, Federal Acquisition Regulatory Council proposed Amendments and the International Civil Aviation Organization (ICAO) commitment to a Long-Term Aspirational Goal for global aviation to reach Net Zero Carbon emissions by 2050.

There have been few deployed solutions but there are now several real opportunities to achieve Net Zero Carbon (Zero-Carbon Fuels) including: Dimethyl Ether (DME), Ethanol-to-jet fuel (ETJ), Methanation, Hydrogen (H<sub>2</sub>), Ammonia (NH<sub>3</sub>), Hydrogen Fuel Cell Technology and the Electrification of Aviation Fleets.

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**Companies are pledging time and money towards innovation to reduce their carbon footprint over the next decades.**

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### **INDUSTRY INITIATIVES**

There are two major commercial options now available that are beyond the demonstration phase. These include Honeywell 100% bio-feed renewable jet fuel and Hydrogen fuel produced with minimal GHG emissions by Siemens. Are they cost effective, and will the industry respond? These are the critical questions for the near future.

### **ALTERNATIVES TO JET FUEL**

#### **Sustainable Aviation Fuels**

- Hydrogen Fuel Produced with Minimal GHG Emissions
- CO<sub>2</sub> and Hydrogen as Feedstocks

#### **Hydrogen Fuel Cell Technology**

#### **Electrification of Aviation Fleets**

# Sustainability Terms

## What does it mean to achieve net zero emissions?

Net zero is frequently used to describe a state of human existence whereby we are emitting no new greenhouse gasses into the atmosphere. To do this, net zero requires that we eliminate virtually all emissions produced to the point of almost zero, and then purchase carbon removal credits to offset only the very essential, hard-to-decarbonize emissions reductions that remain. That’s the bigger picture, but individual companies can reach net zero too, although this is usually referred to as carbon net zero or net zero carbon, because most companies will focus solely on carbon emissions.

There is some confusion about terms used in addressing GHG. Below is a short compendium of terms used to capture the concept. Note that there are both overlapping and contrary interpretations, mainly presented by different jurisdictions attempting to address different political realities. The most common meaning of terms is described below.

- The term **Carbon Neutral** refers to an activity or a company which offsets the same amount of carbon or greenhouse gases that they emit. Carbon neutral means that emissions produced, and offset are equivalent. On its own, it won’t keep the world under the 1.5°C target, set by the 2015 Paris Agreement.
- **Net Zero** (with reference to net zero commitment) means reducing all greenhouse gas emissions as much as humanly possible, and offsetting only the essential emissions that remain. Net Zero Green House Gas (GHG) emissions is designed to keep us on track for a global temperature rise of less than 1.5°C - compared with preindustrial levels. Net Zero Offsets must be carbon removal offsets, meaning that carbon that is currently in the atmosphere is extracted out - mainly thanks to carbon sinks.
- **Net Zero Carbon or Carbon Net Zero** or zero carbon means reducing carbon credits emissions as much as humanly possible, and offsetting only the essential emissions that remain.
- **Carbon Negative and Climate Positive** means that a company or an activity achieves carbon neutrality plus — basically, more carbon is removed from the atmosphere than emitted. This is more aggressive than neutral, or zero.
- **Climate Neutral** means reducing all greenhouse gases emissions as much as possible and offsetting the essentials (i.e., net zero), while also making sure an organization or activity is not contributing to any other negative impacts on the environment – such as the use of fossil fuels or causing harm to carbon sinks.
- **Greenhouse Gases (GHG)**. Following is a list of the Greenhouse gases currently identified by the US Securities and Exchange Commission (SEC.)

- **CO<sub>2</sub> Carbon dioxide** is an end product of cellular respiration in organisms that obtain energy by breaking down sugars, fats and amino acids with oxygen as part of their metabolism. This includes all plants, algae, and animals and aerobic fungi and bacteria. Increases in atmospheric concentrations of CO<sub>2</sub> and other long-lived greenhouse gases such as methane, nitrous oxide and ozone have strengthened their absorption and emission of infrared radiation, causing the rise in average global temperature since the mid-20th century. Carbon dioxide is of greatest concern because it exerts a larger overall warming influence than all these other gases combined.
- **CH<sub>4</sub> methane**, colorless, odorless gas that occurs abundantly in nature and as a product of certain human activities. Methane is the simplest member of the paraffin series of hydrocarbons and is among the most potent of the greenhouse gases.
- **N<sub>2</sub>O Nitrous Oxide** is emitted during agricultural, land use, and industrial activities; combustion of fossil fuels and solid waste; as well as during treatment of wastewater.
- **HFCs, PFCs, NF<sub>3</sub>, SF<sub>6</sub> Fluorinated Gases.** Fluorinated gases have no significant natural sources and come almost entirely from human-related activities. They are emitted through their use as substitutes for ozone-depleting substances (e.g., as refrigerants) and through a variety of industrial processes such as aluminum and semiconductor manufacturing. Many fluorinated gases have very high global warming potentials (GWPs) relative to other greenhouse gases, so small atmospheric concentrations can have disproportionately large effects on global temperatures.
- **NO<sub>2</sub> Nitrogen dioxide** is a chemical compound. Interaction of NO<sub>2</sub> and other NO<sub>x</sub> with water, oxygen and other chemicals in the atmosphere can form acid rain which harms sensitive ecosystems such as lakes and forests. Elevated levels of NO<sub>2</sub> can also harm vegetation, decreasing growth and reducing crop yields. NO<sub>2</sub> could have a potential direct role in global climate change if its concentrations were to be high enough, as it is an absorber of visible radiation, thus creating impaired atmospheric visibility and heating up the atmosphere. NO<sub>2</sub> plays a critical role in determining ozone (O<sub>3</sub>) concentrations in the troposphere (i.e. at ground level).

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