Minimising the impact of aviation emissions: what way forward?
An expert meeting aiming to lift off sustainable academic travelling
21 & 22 October 2019

KEROGREEN Production of Sustainable aircraft grade Kerosene from water and air powered by Renewable Electricity http://www.kerogreen.eu

by Adelbert P.H. Goede

Biography:
Adelbert Goede (M) was trained as a plasma physicist at the Institute for Atomic and Molecular Physics in Amsterdam. In 2012 at the Dutch Institute for Fundamental Energy Research he conducted the initial CO_2 plasma dissociation experiments in collaboration with University Stuttgart. From 1988 he initiated and led the Earth Observation Division at the Dutch Space Research Organisation and was Co-Principal Investigator of the space-borne spectrometer SCIAMACHY on board the ESA ENVISAT, producing an invaluable 2002-2012 data set of global atmospheric greenhouse gas distributions. By that time it had become abundantly clear that the Earth climate was changing and he choose to work on the solution rather than the problem, returning to his old field of energy research in 2006. From 1975 to 1988 he was responsible for the physics, development and first operation of a subsystem of the world leading European fusion project JET in Oxford UK, promising a CO_2 emission free energy source. He held/holds various national and European positions, including Fusion for Energy Executive Committee, Kopernikus P2X Advisory Board and EERA JP Chemical Energy Storage chair, lectured at SIF-EPS International Energy School 2014 and 2017, is fellow of the European Physical Society, was editor of the Netherlands Physics Bulletin and Euro Physics News. Presently, he is Advisor to Director DIFFER.

Abstract:
When airlines advertise their cheap flights from London to Lyon or Lisbon you may be enticed. When out of season food is on sale in the supermarket you may not think twice. Yet, the CO_2 footprint of airfreighted food is 100 times bigger than that of shipping. Travelling by rail to above EU cities emits no CO_2 at all, when powered by renewable electricity. Aviation has become prolific to all layers of society. Sadly, a sustainable solution is hard to come by. Why not electrify planes? Some experiments have started, but payload and range are limited. In order to power an Airbus 380 a 14.000 ton battery would be needed to replace the equivalent energy contained in the 250 ton kerosene payload. The plane would never take off. Hydrogen, even when liquefied, is 3 to 4 times more voluminous than kerosene. It would require a complete redesign of the aircraft fuel hold system. Subsequent qualification will take billions of euros and tens of years. Current EC policy, therefore, is directed at biofuels. Daily consumption of kerosene, however, is at a staggering 5M barrels per day. Biofuels, inevitably, will run into the Food vs. Fuel and Food vs. Flora trilemma. The prospect of a sustainable biofuel solution seems pretty dim. Fortunately, a third way has emerged, CO_2 neutral kerosene, synthesised from air and water, powered by renewable electricity. This is the KEROGREEN project proposed to the EU in 2016.

KEROGREEN addresses the energy transition challenge of the aviation industry by developing CO_2 neutral aviation fuel. It investigates a novel conversion route to sustainable kerosene synthesized from H_2O and CO_2 powered by renewable electricity. By capturing CO_2 feedstock directly from air, a net zero CO_2 fuel cycle is established. Because the synthesised kerosene contains no sulphur and no aromatic compounds, hence no soot, it meets future air pollution standards. The conversion is based on plasma driven CO_2 dissociation, solid oxide membrane oxygen separation, CO purification by pressure swing adsorption, Water gas shift production of syngas (H_2+CO) followed by synthesis of kerosene through the Fischer-Tropsch process and purification by Hydrocracking. Synergism between plasma activated species and novel perovskite electrodes of the oxygen selective membrane are expected to increase productivity. In this project the technology readiness level is raised from TRL 3 to 4 by innovative system integration into a container sized module producing 0.1 kg/hr kerosene by 2022.

This lecture presents the KEROGREEN concept, reports on early results and discusses the hurdles to be overcome. An outlook to implementation at scale will be sketched, including direct air capture, electricity generation by off shore wind farms, on site conversion into fuel, piped to destination airport.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 763909