Weidlichgasse 12/6, AUT – 1130 Vienna
Tel/Fax +43 1 876 0029, E-Mail: go@int88.biz

Production of Hydrogen and Nano Carbon from Organic Matters

GUO Business Development Consult is an independent technology company of entrepreneurs and engineers from Europe and Asia, highly committed to develop knowhow and intellectual property in energy efficient and clean renewable energy production and storage technologies. The meaning of GUO has the implication of "International" and "go further". In English or Mandarin, it sounds like" GO", giving us a spirit of momentum to internationally succeed our strategies. Our headquarter is in Vienna Austria, and our core team has over 25 years of experience in business development and manufacturing from Technology in the field of thermal management material solutions for electronics, automotive or household appliance applications. With a strong science and technology background, we have been creating cost effective solutions from using latest state of the art technologies and materials that secured our systems or OEM customers' technology leadership as a basis for their future market leadership. The Technology in subject matter hereto has been developed over the last 10 years, through Nanotechnology research collaborations with scientific institutes, universities and industrial R&D teams in Europe, United States, Hong Kong, China and Australia, aiming to establish a clean city with sustainable development.

We own a Technology to produce Hydrogen by thermo-catalytic extraction of Carbon in nano morphologic forms from carbon hydride gases and strive for developing this technology into the application of anthropogenic Methane remediation. Methane represents the second largest Green House Gas Emissions, almost even with the CO_2 emissions from power generation, industry plus transportation. Hydrogen production by our proprietary Nano Carbon Capture for Use [nCCU] method is a Catalytic Chemical Vapor Deposition [CCVD].

$$C_xH_y + \text{Metal catalyst} \rightarrow nC + 2H_2$$

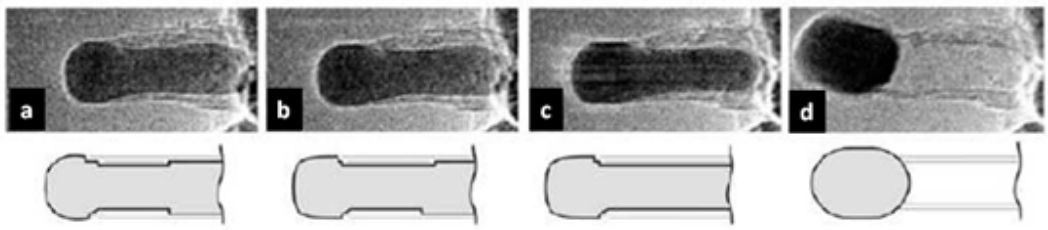

Figure 1 In-situ growth of Carbon Nanofiber over catalyst

The dissociation energy needed per mol H_2 is about 55% only of H_2 production by Steam Reforming [SMR], today's most common production method for H_2, causing several times the produced H_2 mass CO_2 emissions and requiring about 9 times the produced mass of H_2 in H_2O input.

Nano Carbon [nC] is a kind of high grade Carbon Black [CB] product, produced at > 12mill t/yr today, at in average 3.5 times its produced mass in CO_2 emissions. Most feasibilities for CB substitution through nC have delivered equivalent functionality at 10–20%wt of the ratios used in CB.

Therefore transforming e.g. landfill-gas into the two commercially usable products, Hydrogen as well as the nano Carbon contributes to Green House Gas Emission reduction cumulatively. E.g. 1t CH_4 (reduce 23t CO_2 equivalent) plus nCCU H_2 (reduce 2t CO_2 versus SMR) plus nC substituting CB (reduce 10t CO_2) = Σ35t CO_2 reduction.

Hydrogen

Today 82% are used on site, 10% for Methanol and 8% for other industrial applications. Onsite 1/3 goes into gasoline de-sulfuring and upgrading while the bulk goes into fertilizer production. In gasoline refining Hydrogen is the most important intermediary, helping to platform lower grade Carbon Hydrides to higher potencies. Actually the two products from nCCU – highly surface active Carbon and Hydrogen are representing the two basic elements of Carbon Hydrides, enabling in the presence of CO_2 from the decomposition gas, synthesis of various gaseous or liquid Carbon Hydride products.

Bio-Refineries from Organic Waste

Looking at Municipal Solid Waste [MSW] usually 50% is organic (2/3 fermentable, 1/3 combustible). E.g. 450t/day MSW at above fractions could fuel an installation like illustrated. At OECD average 1.5kg/cpt a day there would be room for 4,000 such plants in MSW only, where nCCU could potentially unlock a clean energy consumable of 40Mtoe (1% of OECD energy consumption). If H_2 was used for transport, the crude oil substitution would even be 122Mtoe (5.7% of oil for transport) due to the better well to wheel transformation efficiency. Until Hydrogen Economy will need such distributed H_2 generation, the nC by-product from the Methane content of 450t/d MSW decomposition gas could generate following flexible multi product portfolio. Alternatively to the foregoing orders of magnitude, the synthetic fuel capability from OECD MSW bio-refineries could provide 12.5% of the global aviation fuel consumption from repeatable sources.

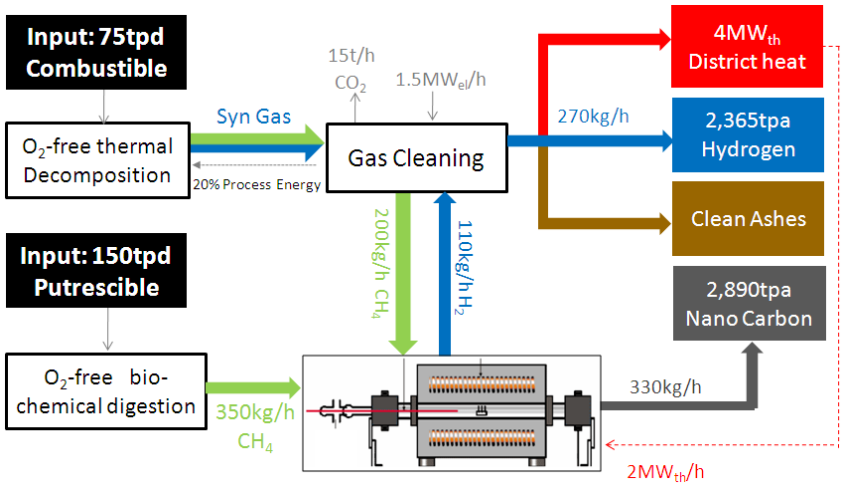

Figure 2 Bio-refinery concept in MSW remediation

Unlocking a multi-billion application markets by nC

A nC price of € 15/kg can unlock nC loaded Thermoplastic materials at the cost of resin savings enabled through mechanical enhancements by the nC (resulting in ~50% weight saving per existing parts). Adjustable electrical conductivity of nC filled plastics will soar replacement of metal in household-appliance, automotive, Solar Panel and handheld wireless, etc. Industries, with all the advantages from weight savings, corrosion free, surface smoothness and freedom in design, injection molding or extrusion allow. But a broad diffusion of this technology into actual mass application markets will involve some time to market. Therefore in the meantime bio-fuels can be synthesized.

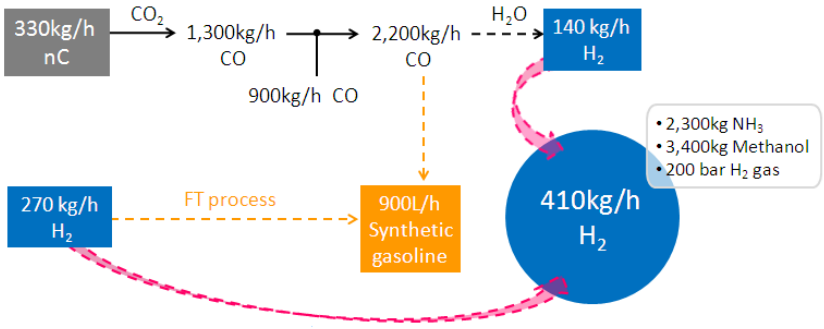

Figure 3 Flexible products portfolio in Bio-refinery

New Renewable Energy Synergies

Photovoltaic as well as wind energy come with an unavoidable volatility of supply. When the wind fades or clouds may roll in, the supply has to be compensated by back-up capacities that can economically deliver peak demand supply for limited periods. Bio-Refineries of the herein introduced kind can potentially provide utility scale back-up electricity from the Hydrogen, otherwise used in the chemicals production, by modulating the e.g. fuel synthesis capacity accordingly for those periods of operation. For example in an electricity grid with wind power, this would look as follows:

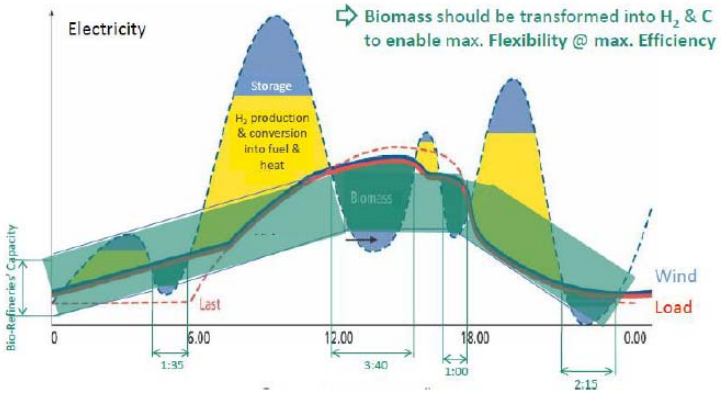

Figure 4 Flexible of Bio-refinery product deliverables with Wind Energy installation

Today's common use of decomposition gas from organic matter for base load electricity to grids would only substitute 22Mtoe for the same amount of MSW plants and conflict with lower cost base load electricity generation capacities without CO_2 emissions, as hydro or nuclear. Therefore the added value of the herein proposed nCCU H_2 based Bio-refineries for organic matter utilization is always a multiple of just straight decomposition-gas electrification.

State of the Art

Accelerated anaerobic decomposition of organic matter has been matured over the last decade for example at the European Centre for Renewable Energies in Guessing Austria and started to be rolled out elsewhere. Both processes, whether thermal or thermophilic fermentation can serve as a feedstock for the herein proposed Bio-Refineries. A continuous nCCU process has been demonstrated at C-Polymers Austria in small scale and guo – Business Development has been conducting various feasibilities at the locally involved Universities and Research Centers behind the achievements at Guessing, to scale the process and optimize thermo management as well as production gas separation and cleaning expenditures needed.

Figure 5(left) our catalytic reactor in Austria: C-Polymer; (right) gasification chamber in Austria Guessing

Total Roll-out Potential

Today combustible renewable and waste represent 4.3% of OECD energy consumption (worldwide the number is 13%, but most of that is not used sophisticatedly). This does not yet include the 2/3 of food production getting lost as waste between agriculture and distribution to consumers, accounting for another 50% of the foregoing (in the OECD the ratio is probably way higher). The worldwide potential for this approach may be in the order of 50,000 plants, able to support 60% of transportation on Hydrogen Fuel Cell Vehicles or 20% and all of aviation fuel from synthetic kerosene. And once developed, it will represent a renewable and/or repeatable energy concept, that can sustain without regulatory or subsidy supports. In contrary, the more Hydrogen that will be used directly and allow nC to go into mass product's applications, the more competitive it will become in the product mix calculation, which is part of the nature of refineries.

In terms of Green House Gas Emissions' evolution, this Technology will for sure leave a dent in the trends experienced since industrialization.