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CO_2-Recycling Bio-Refineries for organic Residues

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Refineries are industrial plants for transformation of raw substances into higher aggregates. Bio-Refineries just use renewable or repeatable organic feed-stock (organic end of life cycle residues) as input material.

Anthropogenic (Men made) CO_2 increases the CO_2 inventory in the atmosphere. Recycling of such inventory for a substitution of fossil hydro-carbons consumption enhances towards a more balanced CO_2 metabolism in the atmosphere.

Current State of art for energetic use of renewable or repeatable matter has been being generally limited to prompt combustion of its recoverable chemical energy content – either for direct heating requirements, or by transformation of heat into mechanic power for electricity generation. For such unsubsidized competitively tradable electricity cost of input would need to be less than € 10/t_{DB} [DB . . . dry basis] or € 0,07/t harvested or collected food- & kitchen- waste. But in waste management already the logistics for collection are a multiple of these benchmarks.

A Bio-Refinery, able to upgrade „energy rich decomposition gas“ from organic input-matter [e.g. via bio- or thermo- chemical processing, accelerated and under capture produced landfill-gas equivalent] to 100% into so called synthesis-gas (a gas mix of Hydrogen [H_2]and Carbon-monoxide [CO]), enables via downstream chemical synthesis a number of new value adding options. For example so called Fischer Tropsch synthetic fuels. At ca. U$ 110/Barrel raw oil compared to electricity generation the added value can be six-folded for the same primary feed-stock. (for about 5-times the investment and operating cost of bio-electricity the accrued margin is about seven times). Per ton organic MSW this would enable revenues of ≈ € 145/t.

Hydrogen most commonly is produced by Steam Methane Reforming today. Carbon-monoxide can be recycled over surface active Carbon from CO_2 under high temperature. In materials Technology our team developed and patented through the last 10 years a dry catalytic process for dissociation of Methane into the co-products „high surface active Carbon“ and „Hydrogen“. Operations demonstrated that such Hydrogen produced, requires only 55% of endothermic energy needed for the steam reforming.

At available appropriate waste heat, as being the case with the flue gas from an allotherm indirect gasification of organic residues, the two splitting processes for Methane and ⅓ of the CO_2 fraction of the decomposition gas can largely be powered through otherwise unused high temperature waste heat, delivering an enhanced Output/Input energy efficiency.

Combining the existing process technologies described above (accelerated decomposition of organic residues – CVD *low energy-Hydrogen production* from Methane via Carbon-deposition – consumed by a Boudouard *transformation of CO_2* from *waste heat into chemically energy rich CO*) opens up a new level plane in the value adding- & resource- efficiency pyramid for organic residue treatment. *(Hattrick=USP)*

For the realization of this *Innovation* an industrial implementation and roll-out perspective ≥ 10 waste treatment plants for 250,000 ±20% capita (within 50km radius) each will be needed, as soon as the above describes integration will have been validated and optimized in demonstration scale by a lighthouse-project.

Integrating Materials Technology in Biomass

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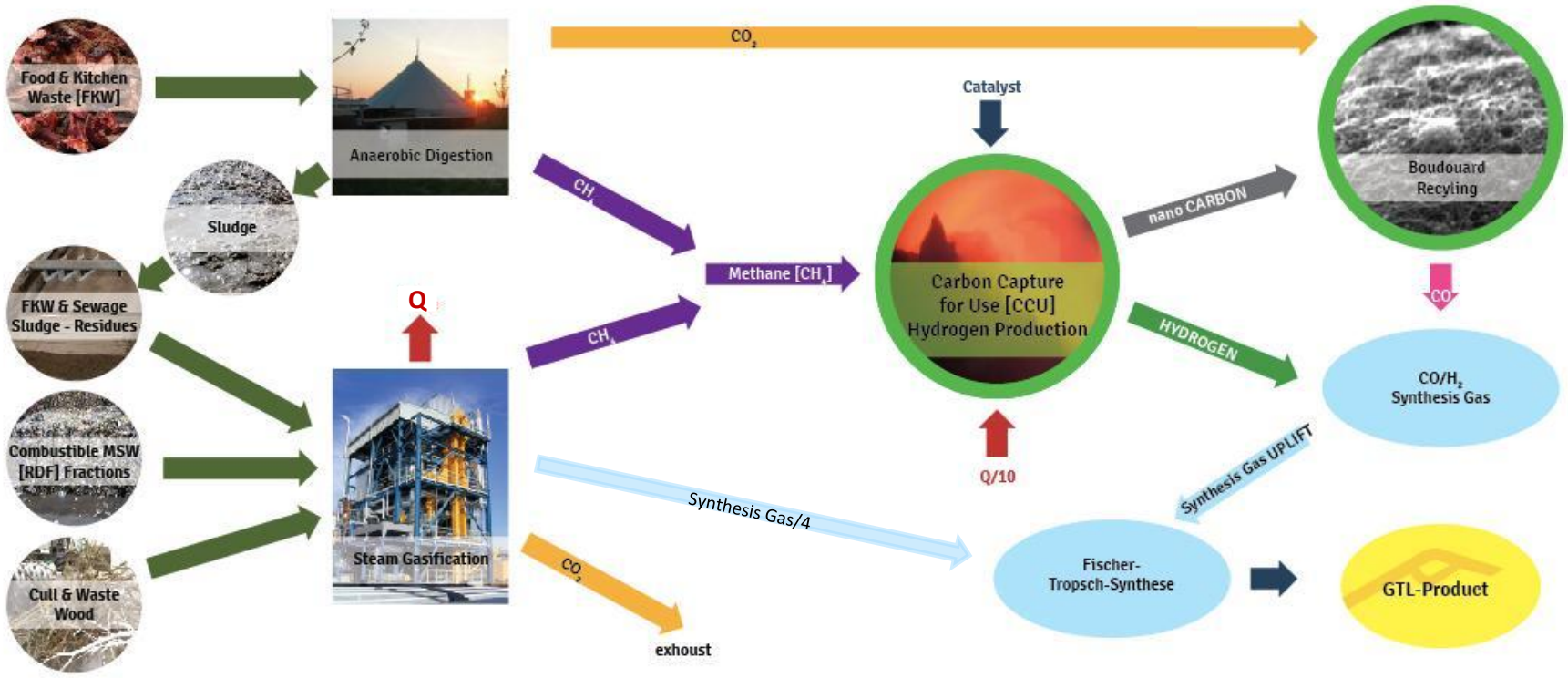
we synthesize **Waste** in**to** the **Fuel** of tomorrow by **OUR UNIQUE SOLUTION PROPOSITION [USP]**



"In 30 years we will either fly on 2nd generation bio-fuel or not at all anymore."

*(Dr. Alexander Zschocke, Senior Manager Aviation Bio-Fuels of **Lufthansa**, Fuels of the Future Conference, Berlin 2012)*