Carbon Recycling - the Untold Story

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Climate Summits become more and more a striking ingredient of politics, both on domestic and global level. Kyoto resulted in lots of pledges and commitments, but green house gas emissions happily increased for the sake of economic growth. IPCC`s Global Carbon Budget represents the actual master plan how to achieve the turnaround of enhanced manmade global warming. Energy efficiency, increase of renewables, drastic reduction of fossil derived fuels and avoiding Methane emissions are the major demands of this plan.

Some Thoughts about Hydrogen

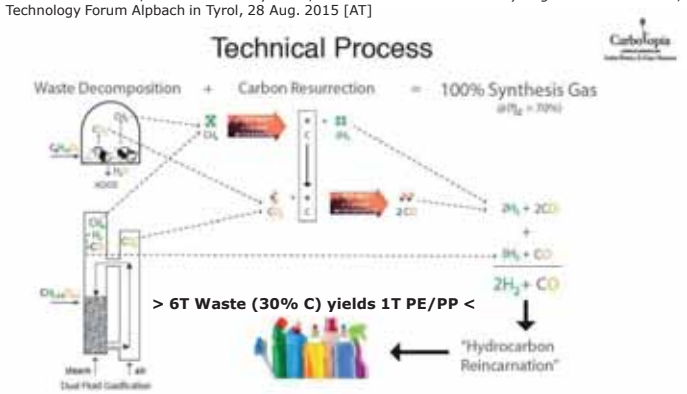
Approximately 48 Mega tons [Mt] of Hydrogen representing 96% of annual volume are produced by steam reforming, generating 0.44 Gt CO_2. This is the compounded Carbon Emissions from contemporary feedstock composition being 50% Natural Gas, 31% Crude Oil and 19% Coal, totally consuming 1,25% of world fossil primary energy supply consuming 266.4 million m³ water. Average Energy Efficiency of this Hydrogen production is 86% [1].

Further 4% are produced by electrolysis of water at an Energy Efficiency of 55.5% (underlying electricity hypothetically at 100%) consuming 20 million m³ water. In most cases the Hydrogen is used with adjacent flue gas CO_2 to synthesize Methane as energy storage yield from volatile New Renewable Electricity excess productions [2]. This is equivalent to 10 million capita´s dietary irrigation needs.

In a way this can be seen as a single loop Carbon Recycling approach, evidencing Carbon Efficiency to prevail over Energy Efficiency. However such Synthetic Natural Gas [SNG] costs ~100 times current market price – or over 600 times current European Carbon Exchange [ECX] rate per metric ton of CO_2 [3].

The biggest show-stopper for Carbon Efficiency improvement by a **Hydrogen Mobility implementation** is the awkwardness of Hydrogen in storage and transportation. There is hope that **decentralization of onsite Hydrogen production** will create a big enough market for sufficient cost-down roadmaps of investment costs [4].

1. Hans Geerlings: Sustainable Hydrogen. *Shell Global Solutions TU-Delft,* Oct 2009 [NL] https://www.tue.nl/.../Serie_1_2008_2010/2009_10_08/Geerlings.pdf
2. Hermann Pengg: e-fuels – Potential Future Propellant *Presentation CO2 as a Resource*, Linz, 27 Nov. 2012 [AT]
3. Bloomberg Business: Energy Markets *Crude Oil & Natural Gas, Refined Products, Emissions*, 23 March 2016 http://www.bloomberg.com/energy
4. Ernst Fleischhacker, Fen Sustain Systems; Green Corridor of EU: *Hydrogen and Fuel-Cells,* Technology Forum Alpbach in Tyrol, 28 Aug. 2015 [AT]



Next Generation Resources: Biomass and C-Containig Residual Matter

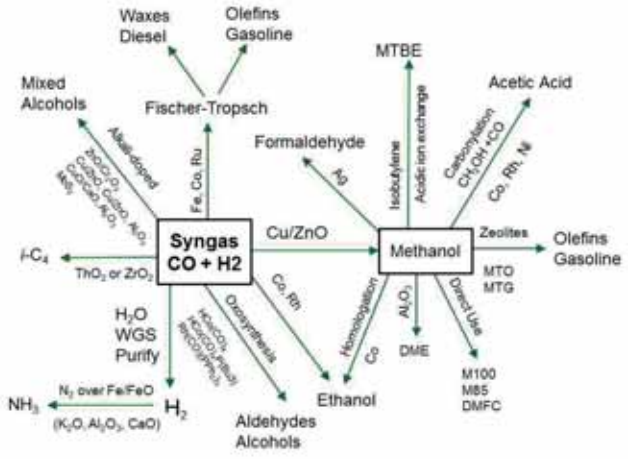
Since electricity production through solar power and wind energy becomes more pronounced and heat can be taken from geothermal sources, it is time to define new pathways for long term future usage of biomass-technology.

Biomass is some sort of an all-round champion among renewables, as it delivers both liquid and solid fuels, heat and electricity. Moreover, allothermal biomass gasification yields, after removal of CO_2 and S, a Syngas with only slight H_2 deficiency suggesting to utilize it for Bottom-Up Syngas-Platform making a wide range of chemical products accessible including Plastics.

However, the process is not limited to biomass, but can be adopted to residual MSW, Lignite and any carbon containing residual matter.

➢ **Carbotopia Product I: Hydrogen** from catalytic splitting of Methane.

Syngas: Commodity of the Future

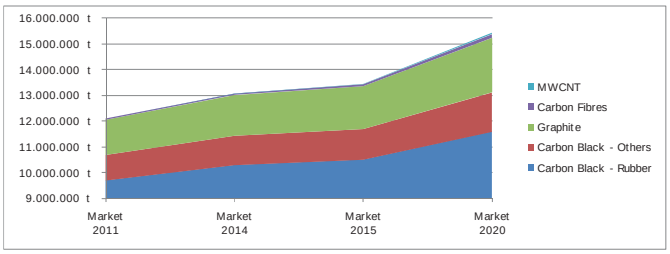


Composition and C/H Ratio of Biogas vs. Crude

Element	Fermentation % wt.	Gasification % wt.	Crude Oil % wt.
C	65	43	83
H	22	11	12
O	1	42	1
N	10	4	1
S	2		3
C/H Ratio	3,94	3	1,73

➢ **Carbotopia Product II: Synthetic Graphite**
- Appearance: black powder
- Structure: cylindrical, rolled up Graphene
- Size: d=1-20 nm, l=10-100µm
- Material Class: nano-Material

Markets of Carbon Products

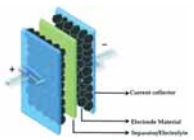
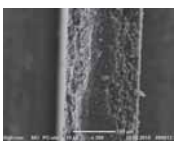


Potential High Tec Applcations for Carpotopia Synthetic Graphite:

Structural Polymere Composites (Rubbers, Thermoplastics, Thermosets)
- Reinforced Polymeres
- Antistatic Polymers

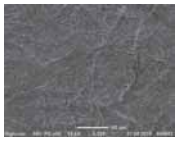

Functional Polymere Composites (Rubbers, Thermoplastics, Thermosets)
- Polymers for Thermoforming
- IR-Heating Panels (e.g. Car Interior)
- Sensing and Safety

Energy Storage:
- Carbon Electrodes
- Li-Ion Batteries
- Super-Caps

Tribology:
- High Performance Lubricants

Fabrics and Yarns:
- Structural Carbon-Carbon Composites (e.g. Brake-Disks)
- High-strength endless Filaments and Fibers



Carbotopia™ can close the loop to virgin plastic packaging made from waste derived Recycled Carbon in lieu of fossil feedstock materials – – competing at arms' length market paying off Investors by itself without need to charge civilization extra!

As everyone goes for profit, Carbon Recycling will stop waste dumping or burning, polluting air and water and go for the added value from recovered Carbon