The use of alternative fuels as a key strategy to address the European Green Deal

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The Paris Agreement’s long-term goal on global GHG emissions
IEA forecast for the global energy consumption

Source: IEA, 2017
Global emissions abatement by technology in the 66% 2°C scenario relative to the New Policies Scenario

Source: IEA, 2017
Methanol Economy and soil improvement for closing the carbon cycle

Honorary Doctorate conferment on Professor Radermacher, Nov. 8, 2013

Association Foundation Aug. 27, 2020
Methanol Economy principle

- Solar energy drives electrolysis to separate $2\text{H}_2 + \text{O}_2$
- $\text{H}_2$ and $\text{CO}_2$ make methanol ($\text{CH}_3\text{-OH}$)
- That can be burnt in industry or vehicles releasing $\text{CO}_2$
- The process includes large scale $\text{CO}_2$ recycling.

Source: Ernst Ulrich von Weizsäcker - Honorary President of the Club of Rome, Brutally short summary of Franz Josef Radermacher’s proposal for a “Methanol Economy” or “Desertec 2.0”, 2019
Carbon Cycle energy today

Power plants, heavy industry, chemicals, mobility sector, heating, …

Approximately 35 billion tons CO₂ per year are released into the atmosphere.

Energetic utilization, e.g. power plants, heavy industry, …

Extraction of around 13 billion tons of coal, oil and gas per year from fossil energy sources.

Today’s soils are an additional source of CO₂ emissions.
Closed Carbon Cycle energy **future**

Industry sectors connected to fossil fuels (e.g. power plants, heavy industry) preserved/transformed within their current economic magnitude.

Industries based on two pillars: primary (fossil fuels) & secondary (methanol economy)

Closed carbon cycle – fossil energy sources & the soil as carbon sink

- Extraction of ~3 bn tons of fossil fuels p.a. - primary carbon sector
- Soil becoming a carbon sink
- 2 bn hectares at ~10 tons sequestration per ha and year: binding 6 bn tons C!
- Humus, biochar, charcoal in global soils: Carbon sink!

Inner carbon cycle in form of a secondary sector (4× recycling of CO₂ into methanol), thus flexible **solar energy storage**!
Energy situation 2020

7.5 billion people global GDP 80 trillion €
High inequality, especially between countries

Composition of primary energy consumption:

81% fossil energy carriers  5% new renewables

0  81 100

others, e.g. nuclear energy, hydropower
Energy situation 2050
(according to reference scenario)

10 billion people (peak of the global population growth?!)
Global GDP 140 trillion €

Distinctly more and more equal prosperity in developing and emerging countries / implementation of the SDGs

Composition of primary energy consumption:
Cost structure

If electricity is available for 2 Cent/kWh with the process of electrolysis, the following cost for synthetic fuels (including taxes) result:

1. Cost of green hydrogen 1 Euro per kilo
2. Cost of green methanol (Europe) 350 Euro per ton
3. Cost of green methanol (Africa) 250 Euro per ton
4. Cost of green methanol when used as fuel 1 – 1.20 Euro per double litre, incl. VAT
5. Cost of green methanol-gasoline 1.70 – 1.90 Euro per litre
6. Cost of green methanol-diesel 1.80 Euro per litre
7. Cost of green methanol-kerosene 1 Euro
Lazard’s cost of energy analysis (October 18, 2020)

29 US$ per MWh ~ 2,4 Euro cents per kWh
Trends of wind and solar energy costs

Source: Lazard, 2020
Potential benefits of suggested approach

- Achieve CO$_2$-neutrality (via “carbon recycling“)
- Maintain rainforests (financed by developed countries)
- Soils to be kept in good order (carbon storage)
- Produce food for all mankind (reverse desertification)
- Marshall plan for Africa (create there 20 million jobs p.a.)
- Avoid two-tier society in Europe (less migration)
- Reduce global inequity (development of poor areas)
- Stabilise world population to 10 billion
- Help industry survive (especially conventional energy)
- Reduce the probability of world economic crises
- Avoid economical stifling of individual countries
- Prevent international tensions
- Contribute to achieving all SDGs
Thank you for your attention!

Engineering for Sustainability - Challenges for the Future

30 years Laboratory of Heat Transfer and Environmental Engineering

1990 - 2020

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