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# Methane splitting: a dual opportunity for clean hydrogen production and carbon utilization

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### The need for alternative clean hydrogen production



PLIED SCIENCE

### Methane splitting into hydrogen and solid carbon



#### **Opportunities:**

 $\checkmark$ 

 $\checkmark$ 

- No CO<sub>2</sub> emissions.
- Low energy consumption (15 kWh/kg H<sub>2</sub> vs. 50 kWh/kg H<sub>2</sub> for water electrolysis)
- Negative  $CO_2$  emissions with biomethane as input gas
  - Carbon byproduct with high quality and purity





### Methane splitting into hydrogen and solid carbon



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#### Challenges:

 $\checkmark$ 

✓ High CAPEX costs

- **Å**,
- Heavily reliant on revenues from solid carbon by-product



### **Carbon as valuable by-product**



UNIVERSITY OF APPLIED SCIENCES







graphite

activated carbon



Source: Hydrogen Europe, Intratec 2024

### **Examples of carbon applications**







Innovatiemotor van de groenewaterstofeconomie

### **Carbon for soil improvement**

#### Effects biochar in soil

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yield (129,546) 2020yield temperate agriculture(44,598) 2017yield tropical agriculture (62,527) 2017yield through biochar + fertilizer (56,264), 2020agriculutural productivity (153,1254), 2020yield through biochar co-composting (14, n/a) 2019root growth (136,2108) 2019tree growth (17, n/a) 2015microbial biomass (50,395) 2015microbial biomass (72,964) 2020enzyme activity (72,964) 2020microbial activity (49,265) 2018microbial biomass (97,1073) 2017legume N-fixation (4,25) 2018soil organic carbon (50,395) 2015negative priming (27,1170) 2018heavy metal uptake (97,1813) 2018-CH4-emissions (42,189) 2016-CH4-emissions (n/A, 204) 2020-N2O-emissions (88,608) 2019-GHG-emissions (129,444) 2020nitrate leaching (88,120) 2019photosynthesis capacity (74,347) 2020water use efficiency (74,347) 2020plant available water (34,74) 2016water use efficiency (43,284) 2020plant available water (82,176) 2020plant available phosphorus (124,n/a) 2019-N-loss during composting (114,532) 2020-NH3-loss (41,144) 2019-





value improvement in % Source: Agroscope, Schmidt (2021) [1] Prohaska, 2024

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- > Manure digestion  $\rightarrow$  biogas (CH<sub>4</sub>) as input gas
- Increase organic matter content, water and nutrient retention, and carbon sequestration.
- > Contributes to circular agriculture.

#### **Preliminary results:**

- No toxic compounds
- High water holding capacity
- Enhanced plant growth under drought conditions<sup>[1]</sup>
  - Pot and field experiments with WUR

### Conclusions

Bl@gas

- Methane splitting promising way to produce clean hydrogen and carbon
- LCOH largely dependent on carbon revenues and electricity price
- Carbon suitable for variaty of applications

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• Carbon shows potential in soil enhancement

## Thank you! Questions?

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