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Entreprises et territoires
des Hauts-de-France

CO2 TO CHEMICALS:
AN OPPORTUNITY FOR DUNKIRK?

Dunkerque Grand Littoral
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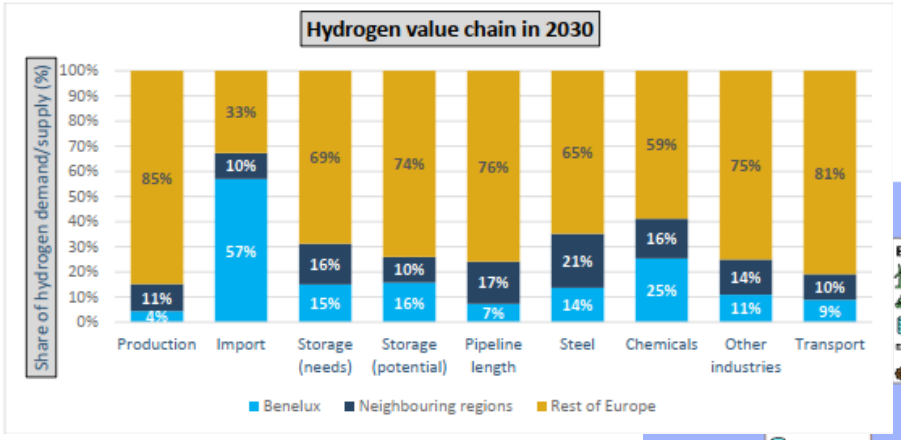
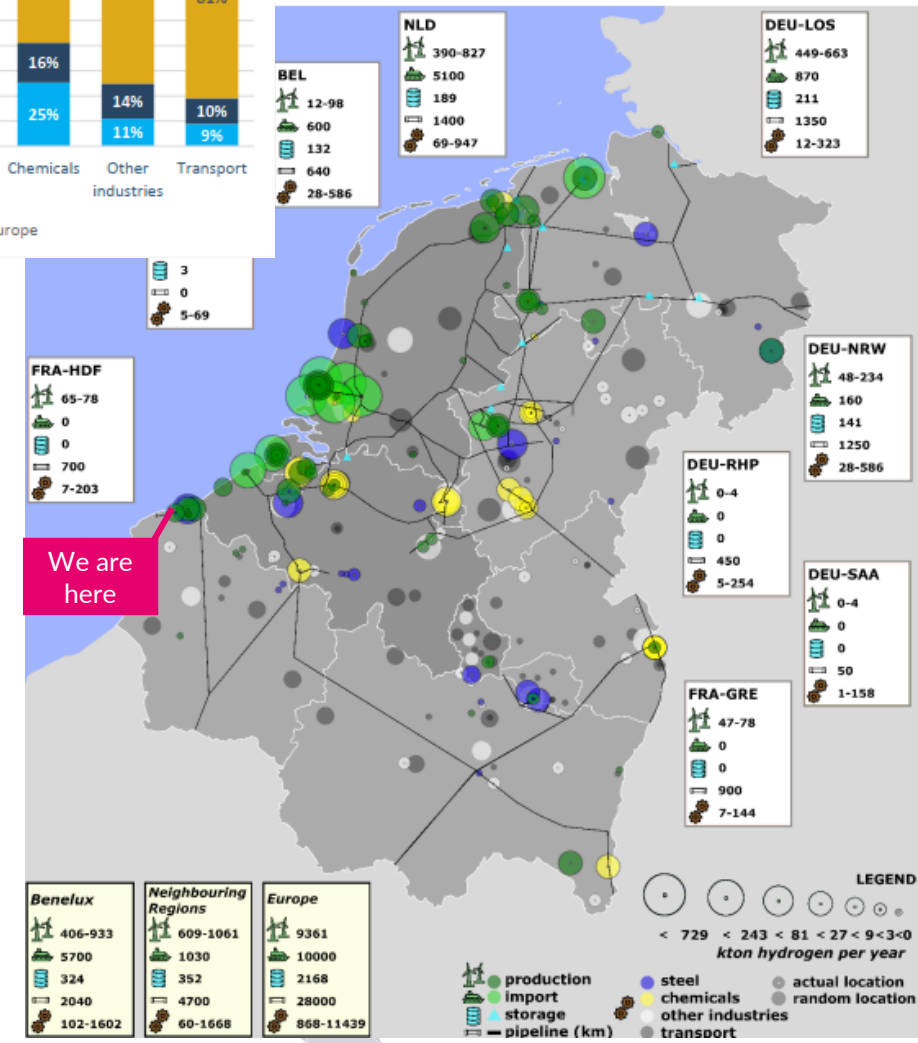
BENELUX+6 NEIGHBORS: THE BEATING HEART OF EUROPE'S HYDROGEN INDUSTRY



- **THE 9 REGIONS WILL REPRESENT THE EU IN 2030:**
  - 15% of its production capacity
  - 67% of its import capacity
  - 26% of its storage capacity
  - 24% of its hydrogen pipeline lengths

- **9 REGIONS ACCOUNT FOR BETWEEN 19 % AND 41% OF EU H2 DEMAND**
  - BENELUX and its 6 regions are Europe's center for steel and chemical production
  - BENELUX accounts for 20% of Europe's methanol, olefins and aromatics production capacity
  - BENELUX represents 14% of the industrial sectors with CO2 emissions that are “hard to abate" and the 9 regions, 27% (i.e. much more than the respective shares of GDP: 10% and 19% and shares of population: 7% and 17% and shares of surface area: 1% and 5%).
  - The 9 regions concentrate major ports in size that act as energy transmission hubs

- **A LARGE PROPORTION OF HYDROGEN PRODUCTION AND CONSUMPTION SITES ARE LOCATED CLOSE TO THE HYDROGEN PIPELINE ROUTES PLANNED FOR 2030.**



3 CHEMICAL REACTIONS TO STAY AT THE HEART OF EUROPEAN HYDROGEN

THREE BASIC REACTIONS TO CONVERT CO2 AND MIMIC NATURE'S PHOTOSYNTHESIS

Reverse water gas **shift** reaction (**RWGS**):

$$H_2 + CO_2 + \boldsymbol{catalyst} \rightarrow CO + H_2O + H_2$$ in excess

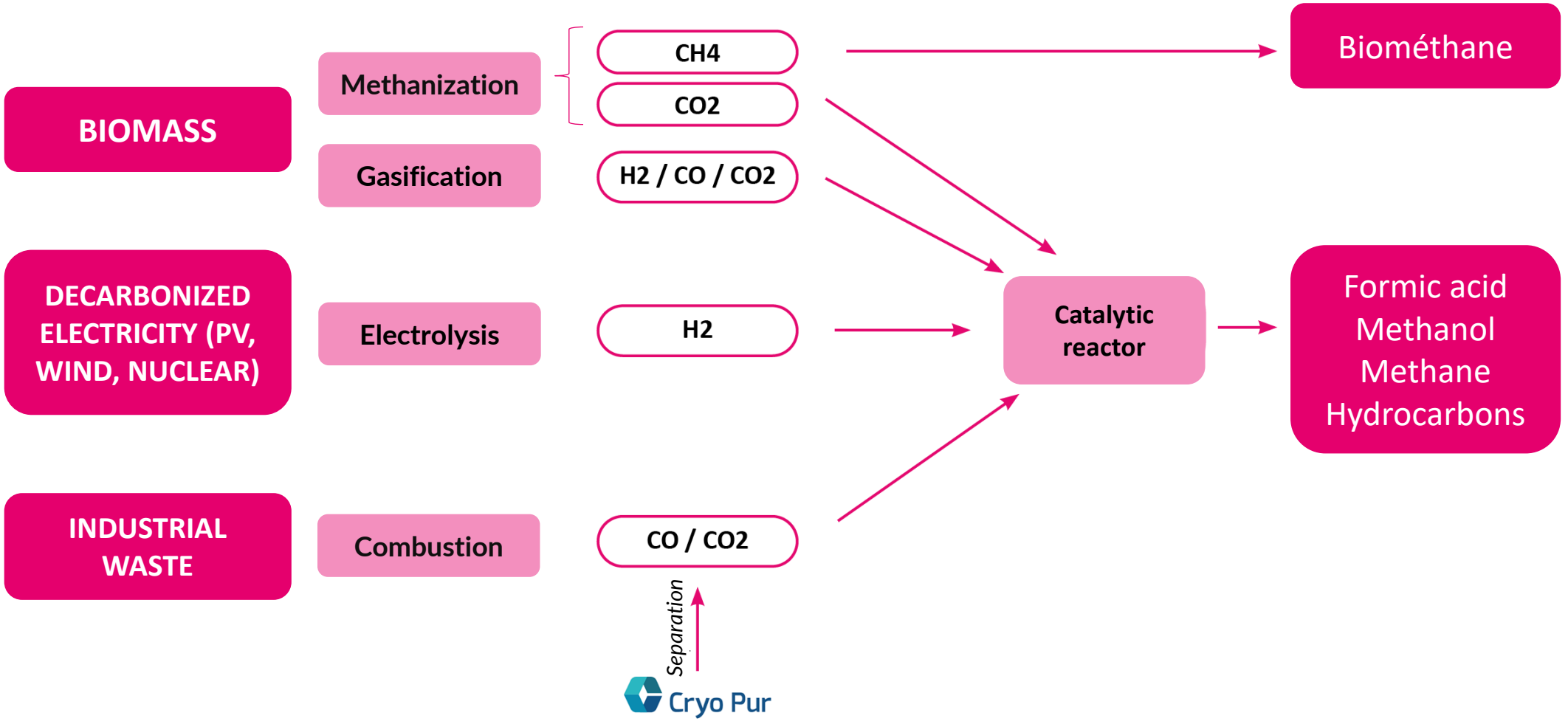
Fischer Tropsch reaction:

$$CO + H_2 + \boldsymbol{catalyst} \rightarrow \boldsymbol{C_n H_m \ ou \ R-OH}$$

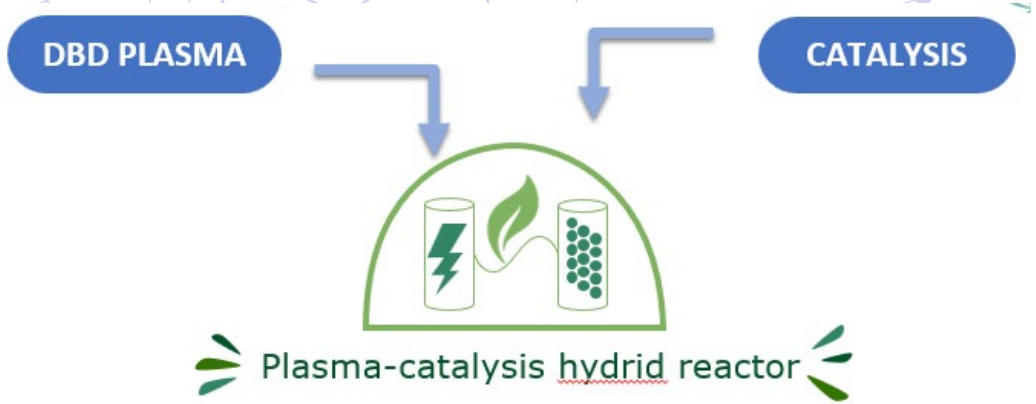
Direct hydrogenation reaction (methanation, methanolization, etc.): Sabatier process

$$H_2 + CO_2 + \boldsymbol{catalyst} \rightarrow \boldsymbol{C_n H_m \ ou \ R-OH}$$

DECARBONATED H2+RECOVERED (OR BIOGENIC) CO2 = DECARBONATED CHEMICALS



PLASMA REACTOR: THE ENERGO EXAMPLE

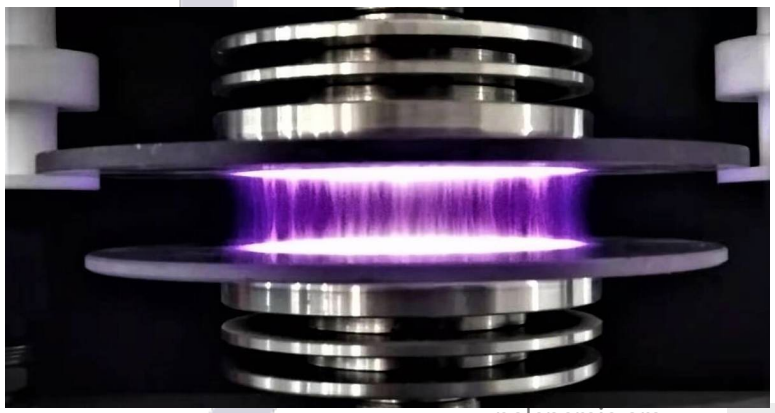


DIELECTRIC BARRIER DISCHARGE PLASMA REACTOR (DBD PLASMA)

- Moderate temperature
- Pressure - Atmospheric
- Technology compatible with polluted gases
- 50 times lower catalyst volume

POSSIBLE REACTIONS WITH ENERGO :

- Methanation: synthetic methane production
- Methanolization: methanol production
- R-WGS



BENEFITS

- 90% OF THE CARBON USED BY THE CHEMICAL INDUSTRY COMES FROM FOSSIL CARBON!
- DEVELOPING A CIRCULAR ECONOMY
- MAINTAIN, DEVELOP AND STRENGTHEN A LOCAL ECOSYSTEM WITH NEW FLOWS BETWEEN MANUFACTURERS (CO2, HEAT, ETC.)
- USE THE CO2 EMITTED TO CREATE ADDED VALUE (CCU) AND NOT TO ADD COSTS (CCS)
- DEVELOP PROJECTS THAT BRING HIGH VALUE TO A PLOT OF LAND

CONDITIONS FOR SUCCESS

- LABELING BIO-CO2 AND SUBSIDIZING CAPTURE TECHNOLOGIES
- DEDICATING A SHARE OF DECARBONATED ELECTRICITY TO THE PRODUCTION OF DECARBONATED MOLECULES
- PROVIDING A TARIFF FRAMEWORK FOR ELECTRICITY DEDICATED TO THIS TYPE OF GENERATION
- CONFIRMING THE USE OF LOW-CARBON ELECTRICITY FOR THE PRODUCTION OF DECARBONATED HYDROGEN
- CONSIDER THE USE OF NON-BIOGENIC BUT RECOVERED CO2 TO FORM RENEWABLE E-FUELS
- TERRITORIAL INTELLIGENCE: RESERVE LAND FOR PROJECTS WITH HIGH ADDED VALUE AND COORDINATE PROJECTS WITH ONE ANOTHER

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ENERGY TRANSITION AND DECARBONIZATION : AN ECONOMIC OPPORTUNITY FOR HAUTS-DE-FRANCE

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