VOLTA CHEM
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ACCELERATING INDUSTRIAL ELECTRIFICATION

PLASMA SYNTHESIS OF CHEMICAL BUILDING BLOCKS FEEDSTOCK

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CONTEXT & TRL LEVEL

The chemical industry must cut down on CO_2 emissions, and even be completely emission-free in 2050. To do this, established chemical processes that currently run on fossil fuels must be electrified. Plasma processing is identified as one of the main ways to do this.

Within Brightsite, we are working together with Maastricht, University, Sitech, Brightlands Chemical Campus and TNO on three generations of technologies simultaneously, from TRL 1 to 9, from laboratory to factory.

The main goal of Brightsite is to electrify, among other processes, the production of olefins (ethylene) for plastic production and hydrogen for fertilizer production at an industrial chemical site. In electrifying the Naphtha crackers that produce olefins, methane co-product that is currently burnt to heat the process must be repurposed. The goal is to develop a plasma process to convert this methane into ethylene and hydrogen.

OBJECTIVES FOR 2030

- To develop plasma processes and equipment for pyrolysis of methane, replacing CO_2-emitting processes on industrial chemical sites.
- To realize and operate a Pilot plant demonstrating the feasibility of the concept at Brighlands Chemical Campus.
- To develop a scalable and highly selective ethylene producing plasma process & plasma reactors with a minimized energy consumption towards ethylene.

OPPORTUNITIES

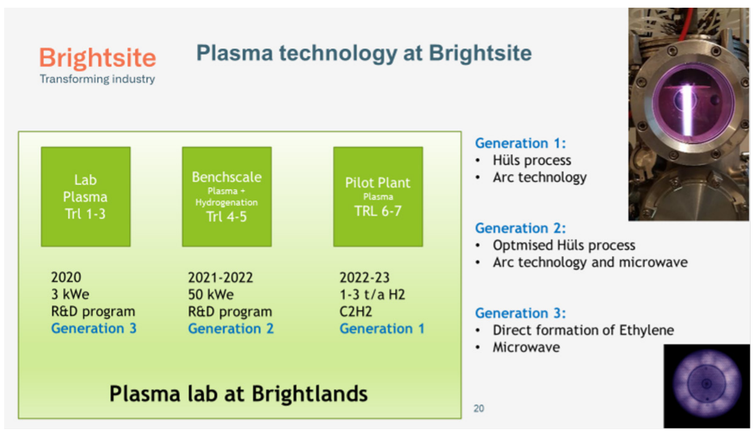
1. Product mix of plasma process (ethylene, hydrogen) good fit with the demand at an industrial chemical site.
2. The plasma process reduces CO_2-emissions without the need to scale down operations.
3. It creates a strong technology position in NL on next-generation electrified chemical processes.

CHALLENGES

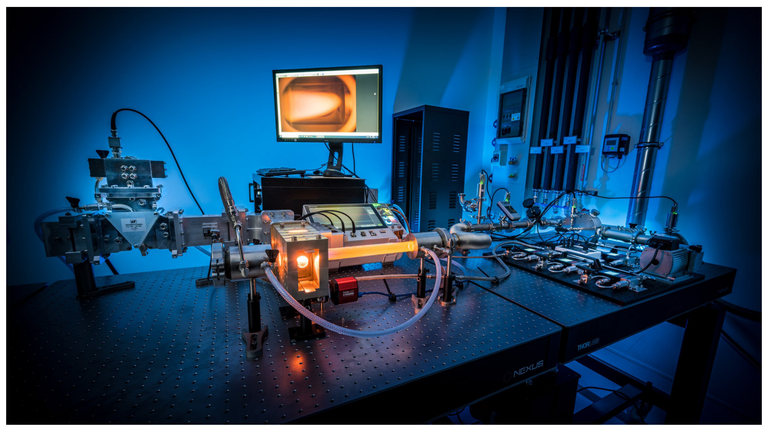
1. To optimize the process which leads to better efficiencies and yields.
2. To scale up the technology to industrially relevant systems (>10MW) before 2040.
3. To optimize process integration, including upstream- & downstream processing and heat integration.

DEVELOPMENT PLAN

2020: 3 kWe R&D program / Generation 3
2021-2022: 50 kWe R&D program Generation 2
2022-2023: 1-3 t/a H_2 C_2H_2 Generation 1



INFRASTRUCTURE



The figure above depicts our first realization of a 3rd generation plasma setup at the Brightsite plasmalab, featuring a 6kW microwave plasma for low TRL research into optimized ethylene production

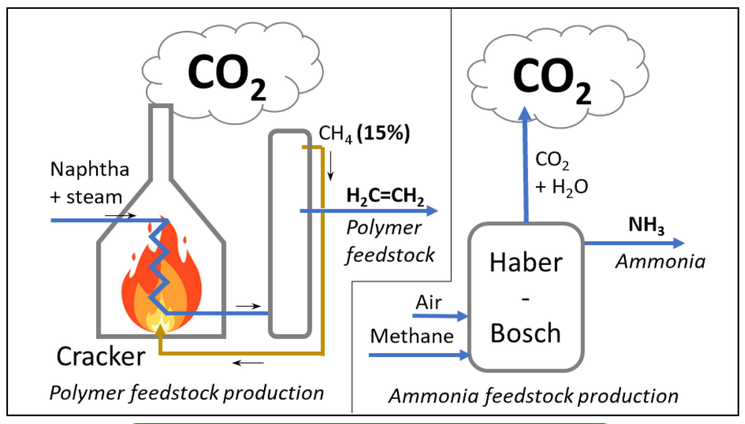
OVERVIEW OF PROJECTS

1. Generation 1: conventional, along Hüls process:
   - ERP Decarbonization
   - TSE haalbaarheid
   - Groeifonds “Groenvermogen”

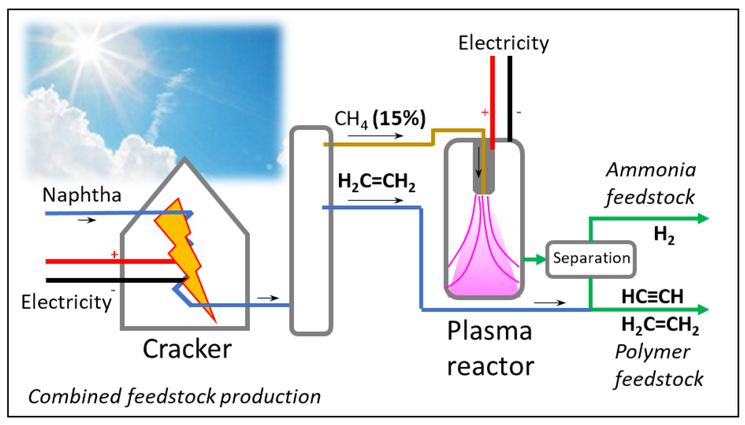
2. Generation 2: optimized Hüls process on acetylene:
   - TNO Early Research Program “Decarbonization”
   - MOOI CH4

3. Generation 3: direct formation of ethylene:
   - TNO Early Research Program “Nextgen plasma synthesis”

***NOW:* Methane is burnt to produce olefin & hydrogen**



***FUTURE:* Methane re-used as feedstock for plasma process**



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