ENTRANCE
CENTRE OF EXPERTISE ENERGY

## Assignment Name

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| **Client** | Jorrit Reede Docent-onderzoeker Chemische technologie |
| **Related project** | Turning Waste into Power: pH-splitting for Ammonia Electrolysis |
| **Start date** | Summer/ autumn 2026 |
| **Suitable for training** | ILST, Chemical Engineering |
| **Learning Community** | REMO-lab |

## Assignment description

One of the major challenges faced by wastewater treatment plants is the emission of nitrous oxide ($N_2O$). Nitrous oxide is approximately a 300 times more potent greenhouse gas than carbon dioxide ($CO_2$) and it is estimated to account for around 60-80% of the total carbon footprint of wastewater treatment facilities. Conventional treatment processes rely on microbiological systems to break down ammonia. However, under certain operating conditions, these biological pathways may result in the unintended production of nitrous oxide.

This project explores an alternative approach to ammonia removal through electrolysis **(1)**. Unlike microbiological processes, electrochemical methods have shown in literature to operate under conditions that do not generate nitrous oxide emissions. An electrolyzer system could serve as a viable replacement for biological treatment processes to remove ammonia. However this process performs much better at higher pH whilst the incoming fluid is has a more neutral pH. Increasing or decreasing pH is usually done by adding chemicals. These come at a cost and finally need to be removed.
The aim of this study is to investigate a pretreatment method we call pH-splitting: neutral fluids are split in an alkaline and acid streams using innovative membrane technologies. If successful, this technology could be implemented at wastewater treatment plants, offering a more sustainable solution with significantly reduced greenhouse gas emissions.

$$\mathbf{2NH_3}\ (\boldsymbol{aq}) \rightarrow \boldsymbol{N_2}(\boldsymbol{g}) + \mathbf{3}\boldsymbol{H_2}\ (\boldsymbol{g})\ \mathbf{(1)}$$

## Assignment

The assignment may encompass several components.

1. Laboratory experiments can be conducted to generate data on the pH-splitting setup . A initial set-up has already been prepared, and initial data have been collected by researchers. In these experiments different membranes and fluids will be explored.
2. Third, simulations or engineering can be performed to evaluate the electrolyzer configuration for potential upscaling.

### Research questions

*"How can pH-splitting contribute to reduce chemical for ammonia electrolysis and reduce the overall carbon footprint in wastewater treatment systems?"*

### Sub-questions

1. *How do membrane setups and operational factors influence the pH splitting in both model solution and wastewater?*
2. *What control strategies and sensor integrations are most effective for real-time monitoring and regulation of the pH-splitting process?*
3. *How do flow dynamics, reactor geometry, and energy requirements affect the feasibility of large-scale implementation?*

## General information

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| **Final Product** | Report |
| **Location** | Entrance/Zernikelaan 17 |
| **Parties involved** | Lectorate sustainable gases and fuels |
| **Contact person** | Jorrit Reede |
| **Guidance** | Jorrit Reede |
| **Details** | j.reede@pl.hanze.nl |

## What are we and where can you find us?

Entrance is a learning knowledge community, in which students and teacher researchers from various programmes work together with researchers, companies, governments and civil society organisations to accelerate the energy transition.

Entrance is the place where, as a student, you work together with lecturers, researchers, businesses, governments and/or civil society organizations on complex issues. We do this at the following locations:

- Location Proeftuin, Zernikelaan 17

- Location Energy Academy Europe, Nijenborgh 6.

## What do we offer?

Entrance offers you a multidisciplinary, inspiring learning, working and research environment in which you can develop the competencies needed to shape and accelerate the energy transition. There is room for collaboration with professors, researchers, lecturers and the professional field. In addition, you will be supervised by professionals who are part of the EnTranCe Learning Communities (ELC).

## Contact us

Are you interested in the vacancy? Do you have questions or would you like to apply directly?


- Jacqueline Joosse, Coordinator EnTranCe Learning Communities.
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