SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Artificial Intelligence Lab

has the honor to invite you to the public defence of the PhD thesis of

Stijn Ally

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Reinforcement-learning-based power trading and control for wind farms and hybrid renewable energy plants

Supervisor:
Prof. dr. Ann Nowé (VUB)
Co-supervisor:
Prof. dr. ir. Jan Helsen (VUB)

The defence will take place on

Thursday, February 12, 2026 at 17h15

VUB Etterbeek campus, Pleinlaan 2, Elsene, auditorium I.0.03

The defence can be followed online through an MS Teams meeting: Teams-link

Members of the jury

Prof. dr. Paul Van Eecke (VUB, chair)
Prof. dr. Wolfgang De Meuter (VUB)
Prof. dr. Jeroen van Beeck (VUB)
Prof. dr. Mathijs de Weerdt (TUDelft, NL)
Prof. dr. Pierre-Elouan Mikale Réthoré (DTU, DK)

Curriculum Vitae

Academic:

- Postgraduate applied AI (EHB)
- Master in General Management (Vlerick)
- MSc Electronic Instrumentation Systems (UMIST)
- MSc Electrical Engineering (UGent)

Professional:

- Project manager & design engineer for control & safety systems for nuclear power plants
- Project manager & project engineer for engineering & construction of industrial process plants

Abstract of the PhD research

The energy transition toward fossil-free energy sources is essential to mitigate climate change and reduce our dependence on foreign energy imports. Wind energy plays a key role in this transition. However, the growing share of renewable energy in power systems also introduces significant challenges in terms of grid stability, operational efficiency, and participation in electricity markets.

This dissertation investigates how wind farms and hybrid renewable energy systems can be operated more effectively and economically through the use of artificial intelligence.

A major part of the research focuses on the development of a *digital twin* for wind farms, based on machine learning techniques and SCADA data from the farms. Such a digital replica simulates the electrical power production of the wind farm, accounting for factors such as wake effects, the variability of wind conditions, and the actions of its power controller.

In addition, the research examines several practical applications of *hybrid offshore wind farms* combined with a *battery system* or *a green hydrogen production facility*. For these applications, advanced control techniques are employed, including *stochastic model predictive control* and *multi-agent reinforcement learning*. The results demonstrate that the application of these techniques can significantly improve the profitability of hybrid renewable energy plants.

As renewable energy continues to represent an ever larger share of the energy mix, the importance of such intelligent systems will only increase.