

# Ship energy and hydrodynamic modelling

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## Context

Sea transport accounts for 90% of the world's trade in goods and merchandise. Greenhouse gases from emissions from shipping contribute to nearly 3% of global carbon emissions. In a bid to accelerate the energy transition of international shipping, the IMO in 2023 revised its GHG reduction strategy, targeting a 20% reduction in emissions by 2030 (compared to 2008 levels), 70% reduction by 2040, and ultimately achieving net-zero by 2050.

With this context, project TNTM – *Transformation Numérique du Transport Maritime*, a collaborative R&D project lead by shipping company CMA CGM, is put into action with several companies, industry leaders, universities, and research centers. The aim is to reduce fuel consumption and emissions by improving the operational efficiency of ships by leveraging data and simulations of various processes. In this project, the D2SE team at the LHEEA-ECN lab is responsible for modeling of the global ship energy consumption during navigation.

## Master thesis subject

Ships are complex systems, incorporating many machines (main engines, auxiliary engines, boilers, HVAC systems, etc.). ECN has developed a Python model to represent the energy balance of the ship along a given journey during steady state as well as transient phases.

The next phase will be to integrate or connect with other tools developed in the LHEEA lab (such as xdyn, a simulator for ships in waves) and specifically hydrodynamic behavior models (for instance, STAWAVE and SNNM methods).

The candidate will first carry a research review to understand the state of the art and physics of holistic ship energy models.

Once, this will be done, the intern will help produce methods and tools to make different models communicate. This main task will be divided into subtasks:

- Collect and process ship operational data.
- Calibrate the model and if necessary, code new functionalities.
- Model and analyze machinery and hydrodynamic systems.
- Write code documentation.
- Create interoperability protocols.
- Use GitLab for version control.
- Create professional level technical reports with relevant results and concrete recommendations.
- Collaborate with operational and technical teams.

## What We Offer:

- Mentorship from experts in the maritime field
- Access to cutting-edge tools and data
- Valuable experience in one of the most dynamic sectors of the industry

## Candidate Profile

The candidate should be a 2<sup>nd</sup> year Master's student (or equivalent degree) with a specialization in Mechanical Engineering, Applied Mathematics, Thermodynamics, Energetics, Hydrodynamics or related topics.

The prerequisites for this internship are:

- Background in Energy Engineering, Mechanical Engineering, Naval Architecture, or a related field
- Solid knowledge of thermodynamics, exergy, and energy efficiency
- Proficiency in Python language
- Autonomy, analytical skills, and strong writing skills
- Knowledge of maritime systems or ship propulsion is a plus

English fluency is mandatory.

## Schedule

Candidates are invited to contact the supervisor, ([henri.busson@ec-nantes.fr](mailto:henri.busson@ec-nantes.fr)) via email, providing a CV and a motivation letter. Mention 'TNTM Internship:' in the subject line.

The candidate is expected to start during spring 2026, with the internship duration lasting 6 months.

## Conditions

The candidate will be funded for six months (at the French legal level for internships in public establishments: ~ 650 €/month; 4.35 €/hour in 2024). The working duration is 7 hours/day, for a total of 35 hours/week.

The candidate will be hosted within the D2SE team in LHEEA Lab at Ecole Centrale de Nantes.