H2SHIPS

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North-West Europe

H2SHIPS

European Regional Development Fund

Summer Newsletter

Students edition

Dear readers and H2SHIPS-followers,

We would like to use the summer time to highlight the work of 2 students who participate in the H2SHIPS project.

Ana Carolina Alves is a Chemical Engineer at TU Delft and works on the conceptual design of a sodium borohydride (NaBH4) fuelled hydrogen propulsion plant and its adaptation to a diesel cargo ship.

Eli van Witsen is doing a graduation internship at the Port of Amsterdam for his master programme in Science, Business & Innovation in Energy & Sustainability on the topic of alternative fuels and more specificaly on the role of ports in stimulating innovation.

We hope you will enjoy reading this end-of-summer edition!

"Be a student as long as you still have something to learn. And this will mean all your life."

Henry L. Doherty

About H2SHIPS

The Interreg North-West Europe project H2SHIPS will demonstrate the technical and economic feasibility of hydrogen bunkering and propulsion for shipping and will identify the conditions for successful market entry for the technology. For more information, visit our project website: www.nweurope.eu/h2ships

TUDelft

The adaptation of an H2 system on a diesel cargoship



About Ana Carolina Alves

Ana Carolina Alves is a Portuguese Chemical Engineer currently pursuing a Professional Doctorate in Engineering (PDEng) in process and equipment design in TU Delft. In this context, she is working on the project "Zeroemission retrofit of an inland cargo ship".

What is your role in the project?

I work on the conceptual design of a sodium borohydride fuelled hydrogen propulsion plant on a short inland cargo ship. In other words, I work on the adaptation of the H2 system on a diesel cargo ship (it involves the energy and thus the powder needed, the costs, the chemical concentration...).

Which challenges do you face?

Working in a field I didn't study, because it gets me out of my comfort zone. Another challenge is the communication because I have to adapt the language level to the people I am talking to, change my technical presentations into small conversations.

What are you learning from this experience?

Do your homework before doing your thing!

Try to understand what's been done, what worked and what didn't so that you won't repeat work that's already been done. The second important thing I learned was:

First test it, then optimise it!

That means not to spend too much time on details at the beginning, to separate what is fundamental and what is added value.

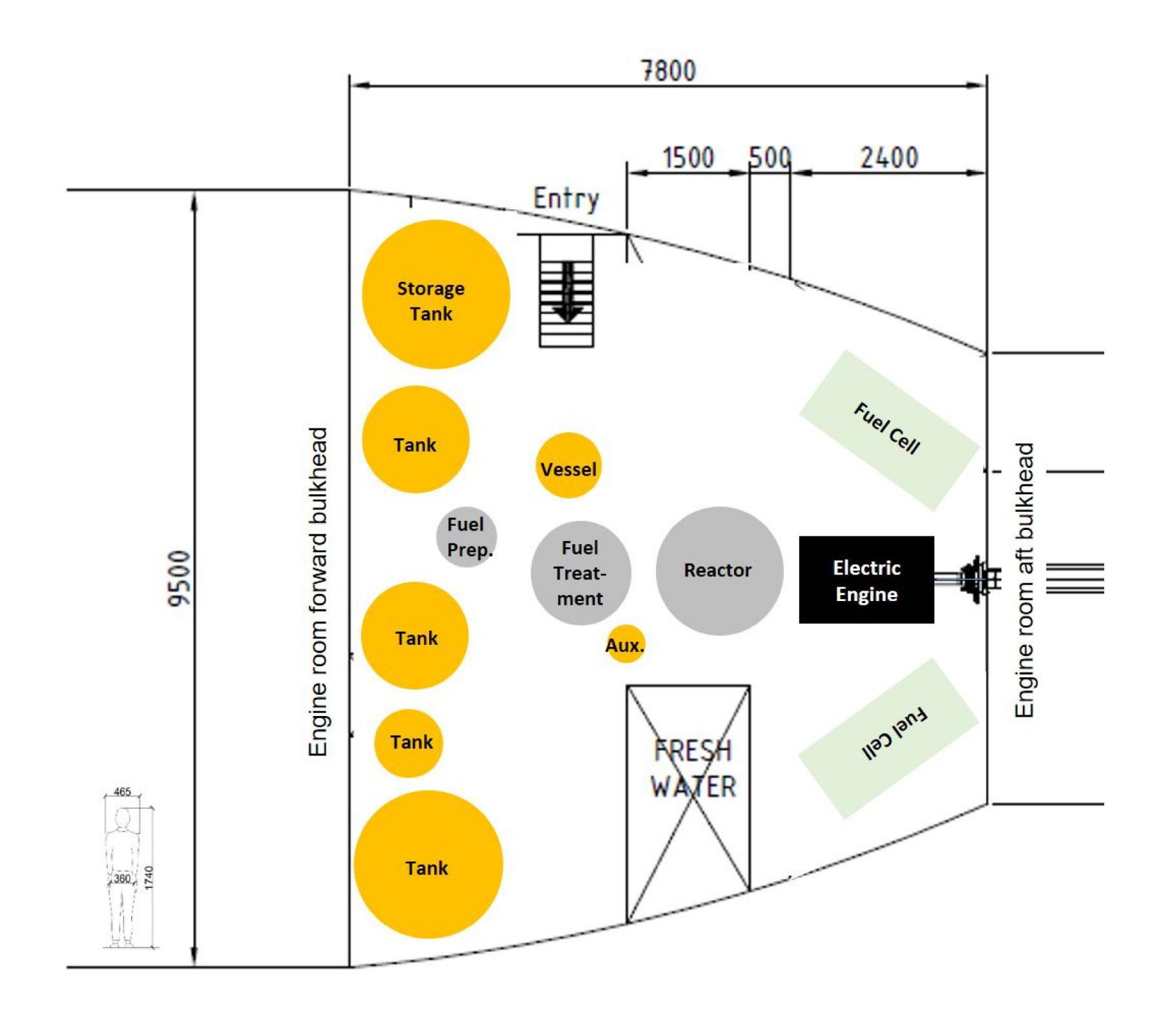
Which aspect of this study made you rack your brain for a solution - and how did you solve it?

Even though the NaBH4 (Sodium Borohydride) carrier and the Marine Diesel Oil have similar theoretical gravimetric and energy densities, they exist in different phases.

Once I was able to experimentally use the powder I realised that I had forgotten a very important issue in my tank volume calculations: the porosity of the powder particles. In the end, the powder does not stack the same way as a liquid does and it requires more volume. Due to this bulk powder property, the calculation of the storage spaces required for the NaBH4 powder is not so straight-forward.

After experimentally determining the porosity of a NaBH4 bulk powder sample, I realised that, indeed, the volume required for the new fuel is bigger than I anticipated and can't fit in the engine room space as a single vertical tank.

Additionally, the powder must be transported to the reactor, so it also requires additional space for this connection. Together with my stakeholders I had to propose that the ship's deck also be used for the powder storage and that we require more than one single tank for NaBH4 storage. Moreover, this simple solution is very interesting because we can synergistically solve the higher storage volume constraint, facilitate the transport to the reactor and ease the loading and unloading of the components in the vessel.



Primary layout result (simplified) of a sodium borohydride fuelled hydrogen propulsion plant within a short inland cargo ship.



About Eli van Witsen

Eli van Witsen is a Dutch student currently following a master programme in Science, Business & Innovation in Energy & Sustainability track. In this context, he is doing a graduation internship at the Port of Amsterdam on the topic of alternative fuels, and could thus work on H2SHIPS.

What is your role in the project?

I did a graduation research internship at the Port of Amsterdam on the topic of alternative fuels. I wrote a thesis on alternative fuels in general and the role of ports in stimulating these kinds of innovations. I was a member of the clean shipping team of the Port of Amsterdam and could thus do some research for H2SHIPS.

Which challenges do you face?

In the Port of Amsterdam many companies are involved in the energy sector. So I included these companies in the 'ecosystem' of the shipping industry. However, most of these companies are not involved in the shipping sector and do not have priority and any strategies in stimulating and accelerating the transition from marine fossil fuels towards sustainable fuels. So I changed my 'ecosystem' from the whole energy sector towards only companies who fully focused on the maritime sector.

Study of alternative fuels and their value chains

Which aspect of this study made you rack your brain for a solution?

Writing a good analysis / story / scientific state of the art about alternative fuels in general (the subject of my thesis) and showing which alternative fuel is sustainable, suitable and usable and which is not. It is a definition that encompasses many aspects, from the energy source to the engine. Many people talk about particular phases of the value chain and some forget to include crucial parts of the value chain, making a fuel sustainable or not. Furthermore, due to the large amount of literature on particular alternative fuels published, almost every advantage or disadvantage is discussed or contradicted by scientific research.

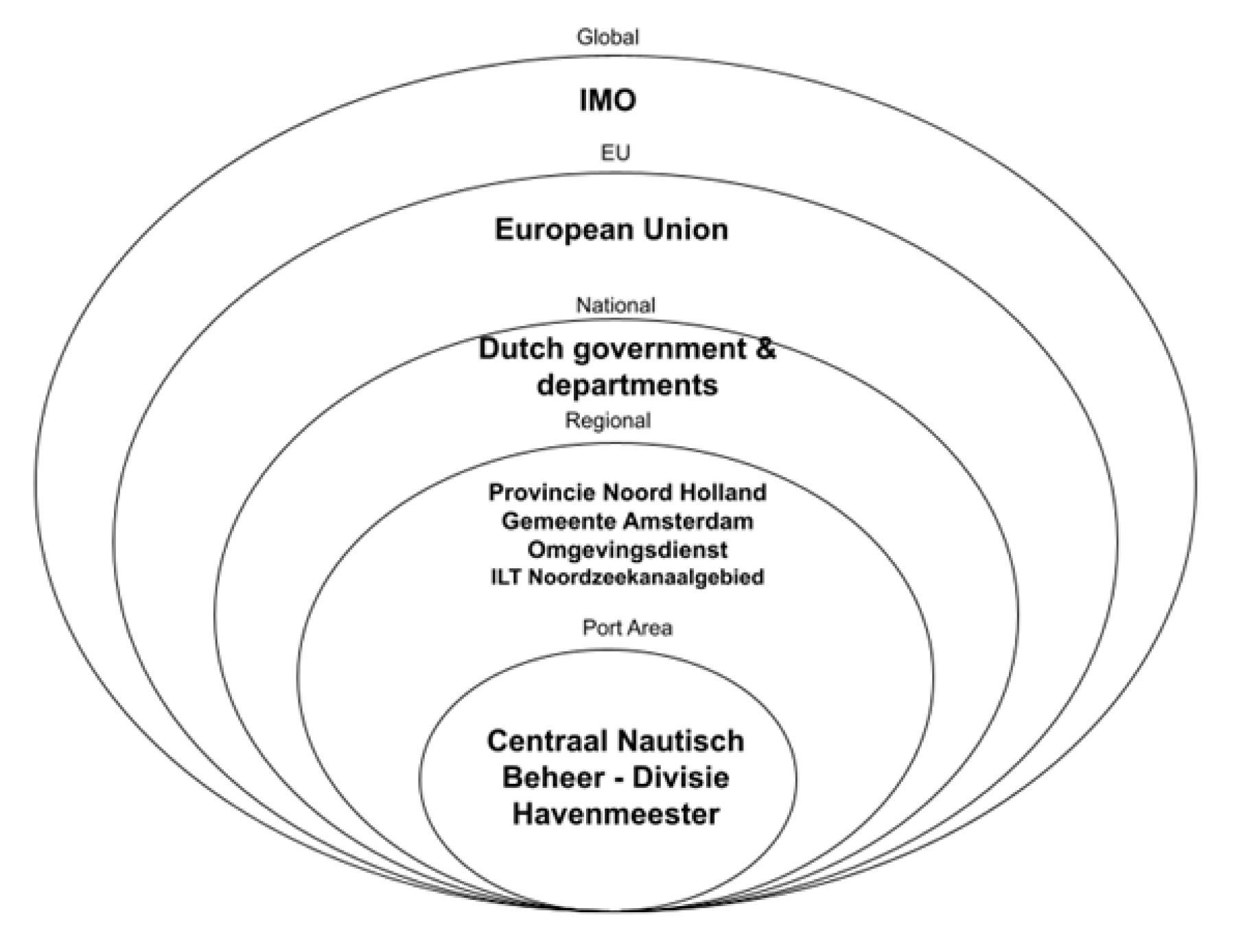
How did you solve it?

I solved this problem by beginning my story with showing the basics of alternative fuels in a value chain, from the energy source to the combustion engine. To this value chain, I added an extra component step by step. This made it clear how many routes are possible in producing alternative fuels. Next, I briefly discussed the alternative fuels with the highest potential at the moment. I ended the chapter with giving criteria evaluating the future of alternative fuels: economic, technical, environmental and supply factors.



What are you learning from this experience?

I'm learning how actors act in complex systems. I'm learning how governmental actors are key in these complex systems, and how actors DO collaborate or DO NOT collaborate. I'm also learning how an organisation as the Port of Amsterdam is structured, and what the advantages and disadvantages of this way of working are. I'm learning to evaluate and analyse a complex system at once. I think this is very useful to the fact that it is possible to have an overview. Overall, this helps me connect the dots between particular actors, innovations, departments, etc. and draw the bigger picture.



Overview of Governmental actors in the system, categorized from global to local influence. Showing the complexity of ecosystems