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Identifying the ecosystem for CCUS: Liquid CO2 and the Port of Rotterdam

By [Stephen B. Harrison](#) on Aug 06, 2025

Carbon dioxide (CO2) supply is again tightening in some regions, while business cases continue to build at the intersection between decarbonisation and carbon capture and utilisation.

Some might say this is where seasonality and security of supply meets the enduring imperative of environmental and industrial sustainability; where the ecosystem for carbon capture, utilisation and storage (CCUS) are defined and optimized.

Increasingly regarded as a port for all seasons – and all business cases – is the Port of Rotterdam.

gasworld recently interviewed Boudewijn Siemons, CEO of the Port of Rotterdam, courtesy of Stephen B. Harrison, Managing Director at sbh4 consulting in Germany and a member of gasworld's Editorial Advisory Board.

In a wide-ranging interview, the conversation first focuses on the port's role in connecting the dots of supply chains and its inherent play in the capture of CO2, before moving the talking points toward hydrogen and the wider energy sector.



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gasworld: Boudewijn, before we get into hydrogen and industrial gases on the Port, let's try to understand the Port operations more clearly. There are so many operating companies on the port, and they've got their own teams, their own

assets, their own employees, their own ships. What is your role in holding this all together?

Simons: I see the Port as an orchestra, and we try to be the conductor. We do not make the music. That is made by 3,000 companies which are active in the port. We try to bring it together into one symphony. That's why my job so extremely interesting. We have to understand everything that goes on in the port, and not only on an individual basis, but also how it works together and forms an ecosystem.

That means we invest in infrastructure that enables the Port to be successful, and at the same time, we oversee supply chains so we can link the dots where others might not be in the position to do so. And in that way, we try to support businesses which operate in the Port of Rotterdam to be successful. And we enable continuous change and support the energy transition.

Considering various north-western European ports such as Antwerp, Amsterdam, Rotterdam, and Wilhelmshaven, Rotterdam is as busy as all of the others added together. What's been the secret of your sustained success and continued growth over the past 50 years?

I think it's like the real estate market. If you ask somebody from the real estate market, what is the success factor, they will say there are three success factors: location, location and location. And I think the same goes for ports.

A port has to be very accessible from sea, and it has to have very credible and non-congested hinterland connections. The cargo chooses the port. It's not the other way around. So you have to have a number of attractive propositions to the cargo in order for it to choose your port. In that sense, I think we're blessed to be at the end of several river Deltas in Northwest Europe and have these strong hinterland connections.

Many ports have road and rail connections, in addition to those, we have very inland waterways leading all the way to Switzerland. The strength also comes from the fourth modality, and that's pipelines. A lot of energy travels through pipelines to the hinterland. Crude oil arrives here by ship, 100 million tonnes annually. Half of it goes underground to Antwerp in Belgium or the Rhine Ruhr area in Germany to feed refineries; the other half goes to the four large refineries in Rotterdam itself, and that's already a little bit less than a quarter of the throughput that we do in this port. Imagine that 13% of the energy for Europe flows through the Port of Rotterdam.

We'd be very interested to hear more about some of the industrial gas operators here... A lot of hydrogen is being produced, and there are some good plans to decarbonise that hydrogen production. Do you, as the port operator, take an interest in what the companies operating in the Port are doing to decarbonise their operations?

Absolutely. As a port, we have embraced the 2015 Paris climate treaty. We want to be climate neutral in 2050 and by 2030, we want to achieve a 55% reduction on the 1990 baseline. I'm not going to say we will make it. I'm also not going to say we're not going to make it. But big things have started in the port, and we take a huge interest.

As an example, we are one of the three investors in the Porthos CCS project. It will sequester two and a half million tonnes of CO₂ annually from the second half of 2026. The four launching customers are Shell, ExxonMobil, Air Liquide and Air Products. CCS will enable the production of blue hydrogen. So absolutely, we take an interest – and our interest is so sizeable that we also are willing to put our balance sheet to it and go invest in decarbonisation initiatives like Porthos CCS.

You've mentioned Porthos CCS, and you've also mentioned the pipeline infrastructure around the port. That large carbon capture facility will also mean a new CO₂ pipeline running through the port – how does the port view changes like that? What about the planning, the regulatory issues, the integration of infrastructure, the health and safety?

We have to consider it all, especially for the CO₂ pipeline in the port, where we are the co-investor. We think we know our port. And it's interesting that more than half of the energy transition will actually materialise underground. You can imagine a lot of cables and piping under the ground in the port. So shoeing in these sizable new CO₂ pipelines was quite a challenge, but we managed to do so.

We currently have five horizontal directional drillings in the port, to get the pipeline from Pernis in the easterly part of the port all the way up to the most westerly part of the port where the compressor station will be for the CCS operation.

We will not invest in an ammonia terminal or an ammonia cracker. Nor in a refinery or in a hydrogen production plant, nor an electrolyser. But the connecting infrastructure is something that we want to facilitate to enable our customers to go through the energy transition as efficiently and diligently as possible.



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You mentioned potential ammonia terminals... I imagine there are also liquid CO₂ terminals being planned for the port. For new terminals, new products, liquid ammonia, liquid CO₂ or e-methanol, how do you see that kind of thing developing in the port?

We enabled LNG storage and bunkering in the port. That was more than 10 years ago with the Gate Terminal. The same will happen with ammonia, with additional methanol, and with liquid CO₂. There are companies in the port active in developing and executing plans for a liquid CO₂ terminal because CO₂ that goes into CCS schemes may come in by pipeline, and it can also come in by ship, for example inland barges coming in with liquid CO₂ from the hinterland.

Also on the seaside, ships will come in with liquid CO₂. Those volumes could connect to the Aramis CCS project, which has the potential to be nearly 10 times as large as Porthos. So our strategy as the Port of Rotterdam is to aspire to be Europe's CO₂ hub of the future.

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Talking about some of those products that we've just mentioned: how do you see the development of bunkering of those new, cleaner marine fuels on the port?

I think it's all going to happen. Oil is, and was, a fantastic product because it has a high energy density. It's easy to transport. It doesn't degrade over time. So it's very hard to replace, but we have to replace it – we know that.

We already bunker LNG as 'business as usual'. Through the existing LNG infrastructure, you can also bunker LBM (liquid biomethane) and that can be mandated in. So, we don't have to go immediately from one to the other, but renewable methane can progressively be mandated into the LNG, similar to what is happening with aviation fuel.

We can already bunker methanol in the port, too. It doesn't happen that much, but it has been done. And as a Port Authority, we are facilitating the commercial bunkering operation for methanol.

A couple of weeks ago we performed the world's first in-port ammonia ship-to-ship transfer operation, simulating an ammonia bunkering operation. We took lessons from a recent operation that took place outside the Port of Singapore. Ammonia will also happen: the first ships on ammonia are on order. They'll enter operation by the end of 2026 and by that time, we must be ready to perform bunkering operations. We're a world port, and a world port has to be able to bunker all the fuels that ships need.

We're not the ones making choices. It's the market that makes the choices, and we have to be able to facilitate them. To do so, we've developed a port readiness level for marine fuels that we share with other ports in the world. It's divided into nine steps, and every step is a gated process. You have to actually fulfill the entire phase before you can go into the next step. It concerns regulations, technology, and safety standards – and it guides us through all these alternative, low-carbon bunker solutions.

Also liquid hydrogen will, for instance, be one of the future fuels that we will be able to bunker.

I think you've just touched on why I believe the Port of Rotterdam has remained relevant over so many decades and will remain leading for the next 10, 20, 30 years: because of your willingness to change, to innovate, to keep up with the times.

Let us come on to something else here, we're going to put you on the spot and ask you to do some crystal ball gazing... If you had to pick one of those cleaner, bunkering fuels for the future, by 2040 or 2050, how do you think the Net Zero end game will play out?

That is difficult, and people have been proven wrong too often in predicting the future. It might not be a very brave answer, but I think it's all going to happen.

I think short sea and roll on/roll off ferries have the potential to become electric. And I think we should do electric, especially in ports, because that's where power cables from offshore wind farms come ashore. All the energy that is consumed in a port doesn't have to go to the hinterland. We already have grid congestion, so it is logical that short distance shipping should electrify. Additionally, the short sea sector will go to hydrogen. You can already see some operators investing in hydrogen for short sea routes. And I think there is merit to that solution.

I think ammonia will also become a fuel, because it will be transported over the world and fuelling your ship on the product that you transport is an obvious solution. LNG ships do so today. So, I think ammonia cargo ships will do the same – and I think that the first ammonia- fuelled ships are on order. There are toxic characteristics related to ammonia, so let's see how influential that will be in the end. I don't rule ammonia out as a maritime fuel, but I'm not going to put all my money on it.

Methanol is viable, and I think that methanol has also the potential to be a feedstock for E-SAF for airplanes. So methanol might move more towards aviation than towards ships.

Something that we are starting to talk about, and which would have a lot of merit for long distance container hauls with large ships, the 24,000+ tonne ships, is nuclear power onboard the ship. From 2040 or 2050, it is a possibility. Small modular reactors can have a low risk profile and are being developed in the range from 50-500 MW. At the lower end of that range, making sure that the risk profile stays within the dimensions of the ship actually makes it a very viable propulsion option. That's partly because all the other fuel options have a lower energy density than oil, so if you want to secure a certain mission range, then nuclear becomes viable.

I think the nuclear price will go down with the modularisation of the solutions, leveraging land-based deployment.



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That's fascinating. Thank you for bringing nuclear power into the discussion there. You mentioned that nuclear comes with some degree of risk which needs to be mitigated onboard, and you mentioned the toxicity profile of ammonia as well, which is an important consideration, especially for the Seaman's unions.

For you, as a port operator, thinking about ammonia-powered ships, must they stay out at the far western end of the port? Or can they come right into the city? Likewise with the ammonia storage facilities, how do you profile toxic products and manage the safety issues around them?

Well, in the end, it's the regulatory authorities that rule on what can happen and where certain products may be located. It sounds kind of logical with ammonia operations that you try to stay as westerly as possible in the port, but people also live on the west end of the port. In the end, it has to be safe, and it's not that if you go to the west you can adhere to lower safety standards. Simply, it has to be safe. That's what we proved with our first ship-to-ship transfer with ammonia: we had zero breach of confinement for the product and that's the way it has to be.

I've come from the petrochemical industry and I've worked with ammonia in previous roles, and I'm absolutely sure it can be handled safely. But safety has three dimensions: mindware, software, and hardware. The right safety culture must prevail; you must have the right safety procedures, and you need the right safety infrastructure, and technology. All three are important. If one is missing, then you run too much risk.

So I think we have to be very diligent. We do what we do as a port only by the grace of the surrounding communities, and they deserve a safe operation – wherever it is. Whether it's in the east or the west, whether it's a lot of people or fewer people; ultimately, people shouldn't get hurt because of what happens in a port.

Quite literally looking at all sides of the port, we've seen the extension to the west with the Maasvlakte. So 10 years from now, with even more port traffic, could you do a similar extension on the northern side of the river Maas, or could you go even further out? If somebody says, we need a bigger Port of Rotterdam, what would you do?

We'd go all the way to England! No, I don't see a lot of optionality on the north side of the Maas. We are studying what could happen if we need to expand more westerly.

Due to their reduced energy density, renewable fuels need more space. So, as a result of the energy transition, we actually might need more room. Ultimately, there are some industries that will reduce or disappear in the port, like a crude oil tank farm. I hope that 50 years from now, we don't need so much crude oil anymore, so some space will become available. We should repurpose this space for something – and for that reason, we're now in an early study phase to explore what a westerly expansion for the port could look like. We're doing that study together with local and national government organisations.

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