AMMONIA AND THE GREENING OF EU INDUSTRY

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A chemical traditionally used in the fertiliser industry, ammonia is now also entering the realm of energy as a way to store and transport hydrogen, or as an alternative transport fuel in its own right.

Composed of hydrogen and nitrogen, ammonia (NH₃) liquefies at only -33°C under ambient pressure compared to -253°C for hydrogen, making it an attractive candidate to transport hydrogen over long distances.

However, regulatory and financial support will be needed in order to bring down costs and clean up ammonia production. Read this EURACTIV special report to find out more.
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A carbon border tax on fertilisers? Think twice, EU told

By Frédéric Simon | EURACTIV.com

The fertiliser industry is increasingly cited as an ideal testing ground for the EU’s upcoming carbon border levy, due to be tabled in June. But industry figures warn this risks causing an increase in food prices that could trigger social unrest.

The European Commission is expected to propose its carbon border adjustment levy in June as part of a broader package of climate laws aiming to cut EU emissions by 55% before the end of the decade.

The EU’s so-called “carbon border adjustment mechanism” will apply to foreign competitors unless they enforce comparable measures to lower emissions on the industries covered by the levy.

The steelmaking sector is often cited as an ideal candidate for the levy because it is a largely traded commodity exposed to foreign competition – in particular from China, which the EU accuses of dumping.

But another – and probably lesser known – potential candidate is fertilisers.

“I think fertilisers are indeed

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a very good sector to start,” said Adam Guibourgé-Czetwertyński, undersecretary of state at Poland’s ministry of climate and environment.

“It’s a standardised product, it’s a bulk commodity which is relatively difficult to hide into other products, and it’s relatively easy to identify,” he told an online event organised on Wednesday (24 February) as part of the EU industry days.

Designing a carbon border levy is tricky because it involves measuring the carbon content of imported goods. A complex product like – say – automobiles, would be difficult to measure because they contain thousands of smaller parts, each of which have their own supply chain and carbon footprint.

This is why EU officials have said they were likely to “start with raw materials” – as a way to gain experience – and then gradually extend the scheme to cover more complex supply chains.

**EU TO TRACK CARBON CONTENT OF IMPORTED GOODS**

The starting point, though, is to have a measurement system in place. So to better track the carbon content of manufactured goods, the European Commission is now considering introducing a “digital product passport” for products made or imported into the EU.

“The first thing we want to develop is a digital product passport which will allow complex value chains to follow the carbon content of products,” said Gwenole Cozigou, director at the European Commission’s department for the internal market, industry and entrepreneurship.

“And then we might be able in the years to come to add information on this passport beyond carbon only,” he told participants at the event.

The idea of introducing a “passport” for imported goods is not entirely new. In October, the Commission tabled new green standards for car batteries, announcing an EU “battery passport” to ensure the tracing of materials used in the manufacturing process.

“We should not underestimate the fact that the market can value green products,” Cozigou said. And for that to happen, consumers and buyers must be aware of the carbon content of the products they buy, he added.

However, introducing a carbon border levy on fertilisers may also have unintended consequences.

Tove Andersen, executive vice-president for Europe at Yara, the Norwegian fertiliser company, warned about the potential impact on the affordability of food.

“We need to look also at the impact on consumers,” Andersen said, warning about “food production and farmers”. When designing its carbon levy, “the EU needs to make sure that food production in Europe will be affordable,” she stressed.

Others agreed. “People don’t want to pay more” for sustainable food, said Massimiliano Giansanti, president of Cofagricoltura, an Italian farmers association. “When we talk about carbon emissions, we need to realise that we are in a global market,” he said.

Guibourgé too warned about the potential impact of a carbon border levy on the price of food.

“I think this is a very relevant question and something we should be looking at more closely – it’s the social impact of our policies in Europe, and how we can mitigate this, making sure that our climate policies do not create an additional burden on most vulnerable citizens.”
Ammonia has until now been used chiefly in the fertiliser industry as a way to return nitrogen to the soil. But it also has potential in boosting renewables – both as a replacement for hydrogen in long haul shipping and as a way of storing and transporting hydrogen.

David Herrero Fuentes is industry director at Fertiberia, a Spanish company and leader in fertiliser and ammonia production. It recently joined with Iberdrola, a Spanish multinational electric utility, in an alliance on green ammonia.

Tove Andersen is the executive vice president at Yara, a fertiliser company that recently announced plans to produce 500,000 tonnes of green ammonia annually in Norway.

Both are board members of Fertilizers Europe, a trade association.

What is green ammonia? And why do you believe it can be significant for the energy transition?

Andersen: Today when you produce conventional ammonia you use natural gas in the production, to get the hydrogen that you need to create ammonia. Green ammonia is ammonia that is produced with renewable electricity, with water, and with air.

Ammonia is a basic chemical that has many different applications, but for us, the main application is fertiliser production. It is the first building block in bringing nitrogen into the fertiliser which is one of the key minerals that a plant needs to grow. It has many industrial applications as well.

Can you give a sense of the scale of the uses of ammonia currently?

Herrero: There is production of roughly 180 million tonnes of ammonia per year. Most of it is what we call ‘captive production’ used on the same site. Roughly 10% of it is seaborne trade, where ammonia is transported to other places to be transformed. In terms of uses, something like 30% is used for industrial purposes different from fertiliser application. And the rest – roughly 70% – is mainly fertilisers.

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**How can ammonia be expanded and used in energy applications? Is it an alternative to hydrogen?**

**Herrero:** I think it's complementary. The main applications for ammonia in the energy sector will be for fuel and for storage, as an energy carrier. It will be an enabler of the hydrogen economy, it will complement hydrogen and will assist, together with other technologies like electric batteries, in storing energy, depending on the use and the application. Each of these technologies will find their way based on their properties and economics.

**Andersen:** The advantage with ammonia is that, if you want to liquefy it, you only need to take it down to -33 degrees. While hydrogen you need to take it down to -253, so to liquefy hydrogen is much more expensive.

If you look at long haul vessels, the energy density is much higher in ammonia than in hydrogen, so the storage capacity you need on ships to use hydrogen for long hauls doesn't seem to be an efficient solution.

Our belief is that, for long haul shipping, ammonia can be an energy carrier and fuel in itself, which can replace hydrogen. And for other applications, we see ammonia as a battery for hydrogen. It will actually be an enabler of the hydrogen economy.

**Herrero:** The shipping application of ammonia is quite direct. There are many developments in terms of engines for combustion of ammonia, even the cost of adapting existing vessels shouldn't be too high. So the potential for shipping is quite high, but to reach this potential the production of ammonia needs to increase.

**Andersen:** Equinor has announced that they will have a vessel running on ammonia within a couple of years – their target is to have it in test operations in 2024. You see quite a lot of interest in this and this is the challenge for the shipping industry – if they're really going to decarbonise and meet climate targets, they need to find different solutions for different distances and ammonia currently seems like the best solution for long haul.

In its hydrogen strategy, the European Commission said it would aim for 100% renewable hydrogen production in Europe. **What do you believe is ammonia's contribution to this? How can it accelerate the deployment of green hydrogen?**

**Herrero:** Today, 55% of all the hydrogen produced in Europe goes into the production of ammonia. This is why ammonia is going to play a crucial role in the initial deployment of a green hydrogen economy: because of the current size of production.

And by gradually replacing grey hydrogen with green hydrogen or implementing some CO2 capture technology, ammonia can be a key enabler of this deployment of the hydrogen economy.

**Andersen:** I think we can really participate in some of this early development, to drive down the cost, and improve the technology. Secondly I do think ammonia can play a role in the storage of energy. You can use ammonia as a battery for hydrogen, so it can also play a role in the infrastructure for having a hydrogen network in Europe.

**Yara is looking into “blue” and “green” ammonia. Which one is more promising at the moment?**

**Andersen:** In Yara, we believe that the best option is always to eliminate the production of CO2, so we do prefer that you never produce the CO2. However, we don’t exclude that CO2 capturing can be a good solution for certain assets. We believe that the climate challenge is so big that we need to utilise all opportunities to reduce emissions, so we will not exclude one, but our focus is on renewables.

**The main advantage of ammonia is that there's already existing production, thanks to the fertiliser industry. There is storage infrastructure already in place, and there is an existing fleet of ships for transport. Do you expect that this infrastructure, over time will need to be scaled up?**

**Herrero:** Existing infrastructure could be perfect for the initial development. And based on the adoption by the shipping industry, this infrastructure may need to be adapted because terminals were designed to be used only in one way – to load or unload. But initially, we could use the existing infrastructure.

**Andersen:** Yara is currently the largest trader of ammonia globally. We have a fleet of vessels with a capacity of around 200,000 tonnes of ammonia that we can ship. We have storage capacity of around 580,000 tonnes.

We have 18 marine terminals around the world. There is infrastructure there today and I think the good thing with ammonia is that there is confidence and knowledge
on aspects like storage, handling etc. I think that's a good foundation to build upon. But if this really takes off in the rest of the shipping industry, then of course the infrastructure will need to be expanded.

**Herrero:** For example, there are eight terminals for LNG in Spain, which are supplying all the needs of Spain and Portugal. Now, for ammonia, we have six terminal in Spain and Portugal, so the numbers are quite similar to the existing LNG infrastructure. It's already quite a big infrastructure.

**What are the challenges associated with ammonia? And what kind of regulation do you believe is necessary to overcome them?**

**Andersen:** The key challenge is, of course, the cost of producing green ammonia versus conventional ammonia. We estimate that the total cost currently is two to four times as expensive.

That needs to be overcome by support, especially for early movers, and through EU innovation funding mechanisms.

It also needs to be overcome by the full value chain. We need to work together to distribute these costs so that they do not fall only on the producer. We have done some calculations and, if you look at the fertilisers, it costs them two to four times as much to produce this. For the consumer, the additional cost will be very limited as long as you can get those costs transferred to the final consumer.

**Herrero:** We need to look at the whole supply chain – from the energy providers and renewable power production until the end consumer – in order to reduce costs. But the most important part is to intensively support early movers because investments in ammonia infrastructure are highly capital intensive. So early movers need support to fill this gap.

**Have you applied for funding under the EU’s recovery plan?**

**Andersen:** There are funding schemes available, both at the EU and national level. And we are pursuing applications to get support from those.

**Herrero:** We have already applied for funding, both at national and European levels. And, for sure we need to apply for those funds to have a business case as explained before.

**Together with its hydrogen strategy, the Commission also launched a European Clean Hydrogen Alliance bringing together some industry leaders in order to scale up production. Is ammonia represented in this alliance?**

**Herrero:** Within this alliance, there are several roundtables or working groups that have been established for different applications. And both Yara and Fertiberia are represented in the industrial application roundtable. And indeed Fertiberia is co-chairing this round table.

**Do you believe policymakers have realised the potential of ammonia? And do you think that is well reflected in these industry alliances?**

**Herrero:** Two years ago we were worried because there was no visibility at all for ammonia in the European institutions. Everything related to hydrogen was driven by other types of companies. In the last 6 to 12 months, there has been an increasing awareness around ammonia, but still I think there is a potential to increase it further. Because we believe that there is a huge potential in ammonia for enabling the energy transition.

**There is growing interest in ammonia from the energy sector. What kind of change does that mean for the ammonia industry? Is it becoming more of an energy-related industry and less of a fertiliser-type industry? And what are the consequences of that: do you expect big oil majors to get into this business?**

**Andersen:** Ammonia will increasingly be linked to energy, as a carrier for hydrogen, which creates different market dynamics than when it was only used as a fertiliser. We view this as a huge business opportunity because it will increase consumption and demand significantly at the same time as it enables a reduction of global climate emissions.

At Yara, we are always looking for sustainable businesses that can grow and I think this is one of those.

But yes I think we can expect to see many other players that will show interest in ammonia, especially big energy companies.

**Herrero:** We see ammonia as a building block. The fertiliser industry will continue to be a major user of ammonia for many years to come. At the same time, the upstream production of ammonia will see a lot of interest from the energy majors. And we will probably see alliances and opportunities. For sure the industry will need to adapt to this new scenario, but we see a nice outlook with very attractive opportunities.
The fertilizer industry has identified the most promising technologies for making green fertilizers. The challenge is to make the business case for decarbonised products. This can be achieved by driving down the cost and addressing technical challenges on the supply side at the same time creating a market for premium food products with a low-carbon footprint.

Today, 50% of global food production is possible thanks to mineral fertilizers. But its production is energy-intensive, with the production of ammonia being responsible for about 5% of the world gas consumption. To decarbonise this process, the fossil fuels used to produce ammonia (a key component of mineral fertilizers) must be replaced by renewable energy. The so-called green ammonia could help decarbonise food production through low-carbon fertilizer.

Given that the technological solution exists, the challenge now is to make a business case for low-carbon ammonia. Public support for investment and operational cost is necessary to upscale this technology.

FRONTRUNNERS

Several fertilizer producers recently announced projects to make hydrogen from water using renewable energy. In Spain, Fertiberia together with Iberdrola will use solar panels to produce energy for a 20MW electrolyser, thus producing 5% of the hydrogen needed for ammonia production in one fertilizer plant. By 2027, the two companies plan to install 800 MW of green hydrogen production capacity at different sites.

Meanwhile, Yara has announced electrolyser projects in Dutch and...
Norwegian ammonia plants. Their Dutch Sluiskil plant will have a 100MW electrolyser installed, with operations starting in 2024-2025. The Norwegian Porsgrunn plant has a commercial start-up for a small electrolyser unit (5+20 MW) scheduled for early 2023, with the prospect of full electrification of 500 kt of ammonia in the next 5-7 years in partnership with Aker Horizons and Statkraft.

**MAKING BUSINESS CASE**

The frontrunners who announced low-carbon projects underline that public co-funding and an adequate regulatory framework is pre-requisite to make these projects work.

The main barrier is the cost of green energy sources that are still far more expensive than gas, also given the amounts of electricity needed for electrolyzers. Abundant and competitively priced clean electricity to produce hydrogen is a pre-condition for green ammonia to become competitive and challenge the current production technology. Furthermore, as fertilizer plants with ammonia production are scattered all over Europe, electricity and/or hydrogen transport infrastructure is required for balanced development.

The next challenge is creating markets that reward low-carbon ammonia. We need to define and create certification schemes for green and low carbon ammonia and by extension fertilizers so that farmers can make this a premium selling point in the food chain.

**DECARBONIZING FOOD**

Green ammonia can be used to produce green fertilizers. If fertilizers are decarbonised it would lead to an important reduction in the carbon footprint of agricultural production and a step towards decarbonizing food. But it can only be achieved through close cooperation and determination in the value chain.

**JOIN THE DEBATE**

On 24 February, Fertilizers Europe is organizing a public event on “Decarbonising Industry Value Chains: Hydrogen over Ammonia to Green Agriculture Products” as part of EU Industry Days. The event aims to demonstrate how deployment and scaling up of most promising technologies on the supply side requires changes to incentives and consumption patterns on the demand side.

The panellists composed of representatives across the value chain including renewable energy producer, fertilizer manufacturers, farmer representative and policymakers will discuss how to make a case for green fertilizers. For more information visit [https://www.fertilizerseurope.com/decarbonising-industry-value-chains/](https://www.fertilizerseurope.com/decarbonising-industry-value-chains/)