Nitrogen+Syngas Expoconference 2025

A review of papers presented at CRU's Nitrogen+Syngas 2025 Expoconference, held in Barcelona from February 10th-12th 2025.

With the nitrogen and syngas industries facing perhaps their greatest transition since the move from coal to natural gas as feedstock, CRU's 38th Nitrogen+Syngas meeting once again attracted large numbers of delegates from around the world to discuss the latest developments in markets and technology. An innovation on the first morning was a session on business development, which ran in parallel to an operator training seminar organised by UreaKnowHow.com in cooperation with the University of Twente and the Fertilizer Academy which covered case studies for analysing hazards associated with green ammonia production. There was also a separate series of technical showcases covering biogas for sustainable fuel production, steel alloys for high pressure equipment, high temperature pressure measurement, sustainable nitric acid production, mist elimination and steam reformer efficiency improvements.

PHOTO: CRU

Nina Fahy delivers the keynote address.

Business development

Heading up the business development session, Marti Leppälä, Secretary General of PensionsEurope, gave an investor's eye view of the climate for investment in sustainable technologies. While acknowledging the uncertain financial climate, particularly as regards the new government in the USA, Marti argued that a "net zero ambition is no longer optional but increasingly mandatory, especially in Europe." The US pension funds of course dominate the sector, with up to 65% of assets held, but even so, 35% of all global investments are into sustainable projects, and much more will need to be invested to reach 2050 targets. While Marti touched on the forest of EU regulations and reporting requirements, recent EU reports appear to belatedly acknowledge that the continent's welfare model is unsustainable without increased competitiveness, and there is a new focus on innovation and digital transformation, and reducing some of the onerous green reporting commitments.

Key takeaways from the subsequent investment panel discussion, chaired by CRU's Head of Fertilizers Chris Lawson, and including representatives from ING, Rabobank and Société Generale, as well as the Oxford Institute for Energy Studies and Germany's Nitric Acid Climate Action Group, were:

- the hype for the low carbon hydrogen and ammonia sectors is passing, but 2025 will be a "crunch year" for final investment decisions into green and blue ammonia projects, with Chile, Morocco, India and the Middle East all seeing projects coming up to key milestones.
- certainty is required in regulation to reassure investors – the US IRA has generated few green ammonia projects because of lack of clarity in the subsidy regime, whereas the US Gulf Coast, already used to large scale carbon capture, utilisation and storage projects, and with a more robust subsidy programme, has generated some important blue ammonia projects such as OCI/Woodside at Beaumont and Air Products in Louisiana. In Europe, the EU has taken a more puritanical approach that has tried to favour green projects, while the UK has been more relaxed in encouraging blue investments such as at Teesside.
- there is still plenty of room for investment in N_2O reduction, with up to 100 million t/a of CO_2e still to be abated. Companies who sell into the EU are aware of the upcoming Carbon Border Adjustment Mechanism which is encouraging producers to make N_2O abatement investments, but regulation is not a level playing field worldwide.
- low capex is important, but the key driver of investment in low carbon ammonia is guaranteed offtake agreements; everything else can be worked out once that is in place. There is little concern about technical risk, but more so about

scale up. Mandated consumption of low carbon ammonia has a place to play in creating certainty in demand to kickstart developments – infrastructure will follow naturally from that.

But where will this supply come from? An optimistic answer came from Bernd Haveresch, KBR's Chief Technical Advisor for Business Development, Clean Ammonia and Hydrogen. Europe's current ammonia capacity is around 20 million t/a, but demand for 2040 is forecast to be as high as 47 million t/a, with demand rising rapidly in the 2030s for clean ammonia and hydrogen to feed energy and industrial sectors, and towards the end of that period strong demand as a bunker fuel, representing perhaps 50% of maritime consumption by that time. Current low carbon ammonia projects worldwide that have reached a final investment decision total perhaps only 5 million t/a, leading to a gap of up to 20 million t/a, perhaps more if more grey ammonia capacity closes in Europe. KBR puts production cost at anything from $440/t for blue ammonia in the US ($330/t with IRA incentives) to $670/t for blue ammonia in Europe and $700/t for green ammonia in Chile. The recent announcement by H2Global and Fertiglobe for delivered low carbon ammonia from Egypt to Rotterdam at $1,000/t leaves plenty of headroom for investors.

Nitrogen markets

The main conference programme began on Monday afternoon with the commercial sessions, introduced by Lisa Connock, *Nitrogen+Syngas magazine's* Publisher and Technical Editor, who remarked that it had been a year now since the magazines were brought back into the CRU fold, and showcasing our new website.

Keynote speaker Nina Fahy of Rabobank noted that investment into clean energy projects had dipped in 2024, presumably due to political uncertainty. Nevertheless, the US IRA has generated $500 billion of new spending in the US on green projects. Going forward, she said, there needs to be a balance of risks between producers and consumers, which may require a role for government.

Charlie Stephen, CRU senior analyst for fertilizer costs and emissions, presented the nitrogen market outlook. The EU has pivoted from Russian gas to LNG, a move made easier by large new incremental supplies from the US. High gas prices and falling ammonia prices will make 2025 a difficult year for European producers, who may have to switch to ammonia imports, but gas prices will ease over the decade as more LNG comes onstream, and European producers may be assisted by new tariffs on Russian fertilizers, especially after 2028-29 when they will push Russian product out of the market.

There was much discussion of the EU Carbon Border Adjustment Mechanism, including a paper on its economics by Halima Abu Ali of CRU. January 1st 2026 is the first time that EU importers will have to pay a capped carbon price of around $50/t ammonia (on an average grey ammonia energy basis), but this will rise to as high as $350/tonne of ammonia by 2034. By 2029, it should have reached a break even point where EU low carbon producers will be advantaged, especially for downstream nitrate production, which has better margins than urea.

Nevertheless, CRU's Chris Lawson and Charlie Stephen gave delegates "a dose of realism" on the market potential for low carbon ammonia and hydrogen. Carbon capture and storage requires a carbon price of $150/t to incentivise in Europe, ranging up to $400/t for ammonia as a transportation fuel and $500 to make green hydrogen gas grid injection worthwhile. Enabling policy frameworks are at risk due to the new US administration, and possible opt-outs and delays for the CBAM. Policies to support the development of market demand will be required. Nevertheless, if we are now in the 'trough' of the Gartner 'hype cycle', at least that means that the only way is up.

Technical sessions

Days 2 and 3 of the CRU's 38th Nitrogen+Syngas 2025 Expoconference turned to the technical sessions, organised in three parallel streams covering: green ammonia technology, nitric acid and ammonium nitrate, plant operations and reliability, urea technology, digitalisation, carbon capture, emissions reduction and sustainable fertilizer production, and fertilizer finishing. As always the conference and exhibition provided a great forum for those involved in the industry to catch up on the latest developments, with thought-provoking papers and good audience participation.


PHOTO: CRU

Delegates in the exhibition hall.

Renewable ammonia

Several licensors looked at ways of tuning plant operations to cope with fluctuating power from renewable sources, including modelling and plant control programs. thyssenkrupp acknowledged that market development has been slow for green ammonia, with technical risks and high costs of production, as well as variability in definitions of 'clean hydrogen' and a slow roll out of policy seeding incentives. They have developed RHAMFS – the Renewable Hydrogen and AMmonia Feasibility Simulation – for modelling projects, whether using grid electricity, renewables and battery storage, or a hybrid of the two. Turndown capacity has the highest impact on the storage size of the key parameters of the synthesis loop, while the levelised cost of ammonia is primarily determined by power cost (52% of cost). Construction costs can be lowered

by modularisation, while operating and maintenance costs can be lowered by digitalisation. In their designs, a proprietary master control can vary the loop pressure in the ammonia converter to increase efficiency of operation.

Casale considered the impact of varying pressure and temperature on mechanical stresses in the plant. After using screening criteria to assess if a design for cyclic loads is needed (ie there is more than around 15% variation in load), their design aimed at minimising temperature and pressure variations and ensuing mechanical stress using computer modelling for ammonia converter stresses with fluid dynamic finite element analysis. Current code methods do not address the effect of nitriding on crack formation, so Casale developed their own proprietary method to cover this.

Linde and Yara gave an overview of their work on adding a green hydrogen feed to Yara's Porsgrunn ammonia plant in Norway, providing some real world experience of the challenges involved. They admitted that Porsgrunn is fortunate in having hydroelectric power available, removing the fluctuating input of solar or wind, and also in having an ammonia plant already in site. PEM electrolysers were chosen for the project, as they are compact, with a small footprint, produce high purity hydrogen at the correct pressure (30bar), removing the need for a compressor, and can ramp output up and down quickly. The electrolysers produce 10.4 t/d of hydrogen, which is converted into 20,000 t/a of ammonia, and saves 41,000 tonnes of CO_2 equivalent. High purity water is essential, as well as a buffer to prevent hydrogen/oxygen mixing and consequent explosive risk. Linda say that they can now supply prefabricated PEM modules as a 10MW core unit. Scaling up to GW capacity is still a work in progress, but two 100 MW projects are under construction. They acknowledged the need to reduce capital costs, however.

Great interest was generated by Technip Energie's solutions for low-carbon hydrogen which includes ROX, a cutting edge solution for clean hydrogen production, achieving up to 99% CO_2 with maximum efficiency.

On the methanol side, Kei Fukuzawa of TEC showcased his companies digital solutions for next generation methanol plants, aimed at the projected increase in use of renewable methanol as a marine fuel, using captured CO_2 and electrolytically generated hydrogen. Their design uses a conventional MRF-Z adiabatic methanol reactor, assisted by a design program, *Methamaster*, which aims to mitigate the variability of renewable electricity via additional facilities (e.g. battery, hydrogen storage), and an operating program, *Methadynamics*, which monitors and alters plant parameters to cope with a fluctuating input of renewables.

Blue ammonia

Klemens Wawrzinek of Linde presented an interesting case study which showed that the optimum carbon capture rate for large scale ammonia plants based on ATR is not 99+% but may be closer to 95% if plant design is focused on carbon intensity rather than carbon capture. Maximising carbon capture only may lead to over-engineered flow sheets, which will not bring benefits with respect to the carbon intensity of the final product.

Ammonia cracking

Ammonia cracking continued to be a topic of interest, with a good turnout for Unicat's presentation on its new ACTS catalyst based on its established *Magcat* spherical support base, designed for a tubular fired reactor, with 75-96% hydrogen efficiency, depending on the main cracker heating source. Michael Lutz and Laurent Prost of Air Liquide also presented their company's low risk approach to developing an ammonia cracking technology, now at the pilot plant stage, and examined the issue of nitriding of construction materials due to high temperature hydrogen attack.

On the supply side, Andrea Zambiano of Saipem discussed the potential issues with large scale ammonia storage worldwide, once the use of low carbon ammonia becomes more widespread, particularly as a hydrogen carrier, and presented Sapiem's own gravity-based terminalling solution, based on their own experience in designing large LNG tanks.

Catalysts

BASF has developed a new methanol catalyst specially optimised for the synthesis of e-methanol from CO_2-rich feedstocks under dynamic operating conditions.

Another new catalyst development by BASF presented at the conference was its 3D printed catalyst X3D® secondary N_2O abatement catalyst for nitric acid plants, which has demonstrated significant economic and environmental savings by reducing blower energy requirements and improving operational efficiency.

Other highlights

Stamicarbon in collaboration with Curtiss-Wright has developed a special mechanical plug made of Safurex® for urea applications which has been successfully installed in a pool condenser for the first time.

Manuel Prohaska of MPC2 provided an update on the latest improvements to non-destructive test methods enabling quick and reliable on-site assessment of critical process equipment at the manufacturer's workshop and the end-user's plant.

Operator experiences

As usual several operators shared their real world experiences of plant operation, issues encountered and how they were tackled. Winandyo Mangkoto of PT Pupuk Sriwidjaja Palembang (Pusri) in Indonesia described issues with a vacuum pressure increase at the Pusri IIB ammonia plant which was leading to increased steam import. The issue was traced to the cooling water system, with increased dissolved oxygen content due to air ingress into the vacuum system, but the root cause was fouling. Chemical injection of scale inhibitors and slime control agents improved operating efficiency, leading to a reduced consumption of steam by 4-5 t/h and savings of $150,000/month.

Muhammad Imran Idris and Muayad Qatan of Oman's OQ looked at plans for decarbonising production from their 3,000 t/d methanol plant and 1,000 t/d ammonia plant fed on purge gas from the methanol plant. The aim is to reduce carbon intensity of production by 25% in 2030 from a 2021 baseline, using flare recovery, reducing steam venting, increased process integration, electrification of heating and other services, and carbon capture, utilisation and storage. Better integration of the methanol and ammonia plants is the most significant step to boost efficiency. Other operators presenting their experiences included Engro Fertilizers, Indorama Eleme, MOPCO, Fauji Fertilizers, Helwan, Yara and PT Petrokemija Gresik. ■

Next year the Expoconference will be held in Barcelona once again, on 10-12 February 2026. See you there!