INTERNATIONAL FERTILIZER ASSOCIATION

Helping to feed the world sustainably

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IEA's Ammonia Technology Roadmap

IFA Summary for Policymakers

Ammonia is the starting point for all mineral nitrogen fertilisers, forming a bridge between the nitrogen in the air and almost half of the food we eat. About 70% of ammonia is used for fertilisers, while the remainder is used for various industrial applications, such as plastics, explosives and synthetic fibres. Ammonia makes an indispensable contribution to global agricultural systems through its use for fertilisers. Its production is an emissions and energy-intensive process, relying on fossil fuels**:** global ammonia production today accounts for around 2% (8.6 EJ) of total final energy consumption.

In the future, the world will need more ammonia but with fewer emissions**.** An increasingly numerous and affluent global population will lead to growth in ammonia demand, during a period in which governments around the world have declared that emissions from the energy system must head towards Net Zero.

The recently published Ammonia Technology Roadmap by the International Energy Agency (IEA) examines three scenarios for the future of the ammonia production:

1) under a Stated Policies Scenario (the sector's current trajectory, influenced by existing and announced policies) ammonia production increases by nearly 40% by 2050, driven by economic and population growth. CO_2 emissions grow by 3% by 2030, before entering a decline that is mainly spurred by increases in energy efficiency and in 2050, emissions are 10% lower than today.

2) In a Sustainable Development Scenario (that puts the energy system as a whole on a trajectory compatible with the goals of the Paris Agreement), direct CO_2 emissions fall by over 70% by 2050 relative to today thanks to the widespread deployment of near-zero-emissions technologies.

3) a Net Zero Emissions by 2050 Scenario describes a trajectory where emissions fall by 95% by 2050**.**

Ammonia producers are already starting to implement measures to reduce CO_2 emissions from their operations. The implementation of best available technologies in energy efficiency in existing plants can achieve some additional emissions reductions, that have allowed IFA's members to achieve close to 10% reduction in CO_2 emissions per tonne of ammonia produced and 5.5% net improvement in energy efficiency on average since 2004 according to to IFA's ammonia energy efficiency and CO_2 emission benchmark.Companies are also taking major steps towards the adoption of near-zero-emission technologies such as green ammonia (electrolysis), but most near-zero-emission technologies like blue ammonia (Carbon Capture and Storage) or turquoise (Methane pyrolysis) are not yet available at commercial scale in the marketplace. Significant deployment of near-zero technologies is needed to meet the goals of the Paris Agreement.

The industry is primed to reach the objectives of the Sustainable Development and Net Zero Emissions Scenarios, but will need the support of stakholders to achieve them. On the fertilizer industry side, the priorities are to establish transition plans, accelerate RD&D in near-zero-emission technologies, and engage in initiatives to develop supporting infrastructure. **Collaboration among stakeholders – including governments, producers, consumers, technology suppliers, financial institutions, researchers, non-**

governmental organisations and others – will be integral to accelerating progress to put ammonia production on a pathway to achieving deep CO_2 emission reductions.

What can stakeholders do? Recommendations from the IEA Report to accelerate progress:

- **Establishing plans and policy for long-term CO_2 emission reductions**:

Governments will be instrumental in providing clarity, certainty and a business case for investing in near-zero-emission technologies. They can help establish a strong and stable market signal for emission reductions by incorporating Paris Agreement-aligned medium- and long-term plans and targets for the ammonia industry within climate, energy, and industrial strategies. In consultation with the industry, they should develop sustainable transition plans for ammonia production, which could be supported by researchers and NGOs through roadmapping exercises.

- **Mobilising finance and investment**

A massive redirection of capital investment will be required for the sustainable energy transition, away from incumbent technologies and towards R&D, demonstration and deployment of near-zero-emission technologies at existing and new plants, and in supporting infrastructure.

Financial institutions can promote investment in low-emission technology deployment among investors through sustainable finance schemes, by issuing green and transition bonds and working with governments on blended finance mechanisms and sustainable finance taxonomies.

Governments also have a role to play in providing funding through direct grants and other subsidies, most likely targeting areas with the highest risk or other barriers to overcome, such as R&D, first-of-a-kind commercial projects and perhaps shared infrastructure. They should also lead the development and application of sustainable finance taxonomies that set a clear standard for sustainable investment in the fertiliser sector.

- **Managing existing assets and near-term investment**

Considering the long lifetimes of typically 20-50 years or more for ammonia plants, specific attention is needed on emissions-intensive plants built recently and any added in the coming few years before near-zero-emission technologies are available at commercial scale. For existing assets, ammonia producers have started to pursue energy efficiency gains through equipment upgrades to incorporate technologies such as waste heat recovery and improved process operations. However, investment in new capacity should be focused in near-zero-emission technologies in order to meet the Sustainable Development Scenario targets.

Governments can promote improvement through energy benchmarking schemes, energy performance schemes and incentives for energy efficiency improvements. Financial institutions can use sustainable finance taxonomies and climate risk assessment frameworks to guide investment away from emissions-intensive technologies to avoid stranded assets.

- **Creating a market for near-zero-emission nitrogen products**

Investments in N-zero-emission ammonia production technologies are likely to be considered higher risk and initially have significantly higher costs than conventional technologies, with production costs anywhere from 10% higher to more than double. Manufacturers may face challenges securing private finance and competing in the market due to their higher of cost production using these technologies. Establishing stable, early market demand for near-zero-emission ammonia-reliant products would give certainty to producers investing in early commercial projects and would facilitate cost reductions through continued technology development.

- **Developing earlier-stage near-zero-emission technologies**

Near-zero emissions production methods are emerging, including electrolytic hydrogen from renewable electricity (green ammonia), decarbonization of ammonia production by capturing, using or storing CO_2 (blue ammonia) and methane pyrolysis that splits natural gas into hydrogen and solid carbon without CO_2 emissions (turquoise ammonia). Increased R&D is needed to continue developing near-zero-emission technologies for ammonia production. This will contribute to bringing down technology costs and expanding the portfolio of near-zero-emission technology options, enabling technology choices better suited to regional circumstances. R&D is particularly needed for technologies that are not yet market-ready. Public-sector financial support for R&D is helpful given the level of risk and the uncertainties of bringing technologies to market. While a number of government R&D funding programmes for near-zero-emission technologies are already in place, increased and more targeted funding would enable faster progress.

- **Improving use efficiency for ammonia-base products**

Optimising the efficiency of use of nitrogen fertilizers and other ammonia products is another important lever to reduce the sector's emissions. Farmers and agronomists have a lead role to play in optimising fertilizer application efficiency on farmland, through the "4Rs" (applying the Right source of fertilizer at the Right rate, at the Right time and in the Right place), and other best practices.
This should be supported by research, to generate knowledge on efficient nutrient use under varying conditons, and to help created support tools for efficient fertilizer application.

What does an enabling environment look like?

1- **An enhanced international co-operation and creation of a level playing field**, to ensure that uneven policy ambition in different regions does not lead to the relocation of production to countries with lower ambition.
2- **An efficient, multi-stakeholder approach to planning and developing infrastructure.**
3- **Tracking progress and improving data to identify best practices and opportunities for improvement.**

Milestones to meet in the next decade for all stakeholders:

- **Establishing long-term CO_2 reduction plans, policies and finance mechanisms,**
- **Pursue better technology performance and fertiliser use efficiency,**
- **Build supporting infrastructure and incorporate plant readiness,**
- **Accelarate and support R&D.**

Further reading:

IEA (2021), *Ammonia Technology Roadmap*, IEA, Paris https://www.iea.org/reports/ammonia-technology-roadmap

International Fertilizer Association: www.fertilizer.org