Ammonia industry
Net-zero industry tracker

Ammonia
Key highlights

Ammonia is the chemical sector's largest emitting product, generating 1.3% of all man-made emissions.

Ammonia demand for fertilizer and industrial use is projected to increase up to 37% by 2050 (23% in the IEA Net Zero Scenario), risking a corresponding rise in emissions.

The pathway to decarbonize ammonia production relies on developing blue or green hydrogen technologies.

Given the high costs of technologies, low-emission ammonia is expected to have a green premium of up to 100%.

More than $850 billion will need to be invested in low-carbon power and CO_2 infrastructure to enable green and blue hydrogen production.

Demand signals from ammonia buyers and supporting policies must improve drastically to incentivize investments.

Net-zero industry readiness

Readiness stage

3 Technology

The low-emission production technologies are **largely demonstrated in commercial conditions.**

2 Infrastructure

The necessary infrastructure required by the low-emission industry **is emerging.**

1 Demand

Only very early adopters in the market can pay the required green premium.

2 Policies

Limited policies complement current environment (technology, infrastructure, demand, capital), to support growth of the low-emission industry.

2 Capital

Low-emission investments generate sufficitent return for a **minority of** CapEx to flow towards low-emission production assets.

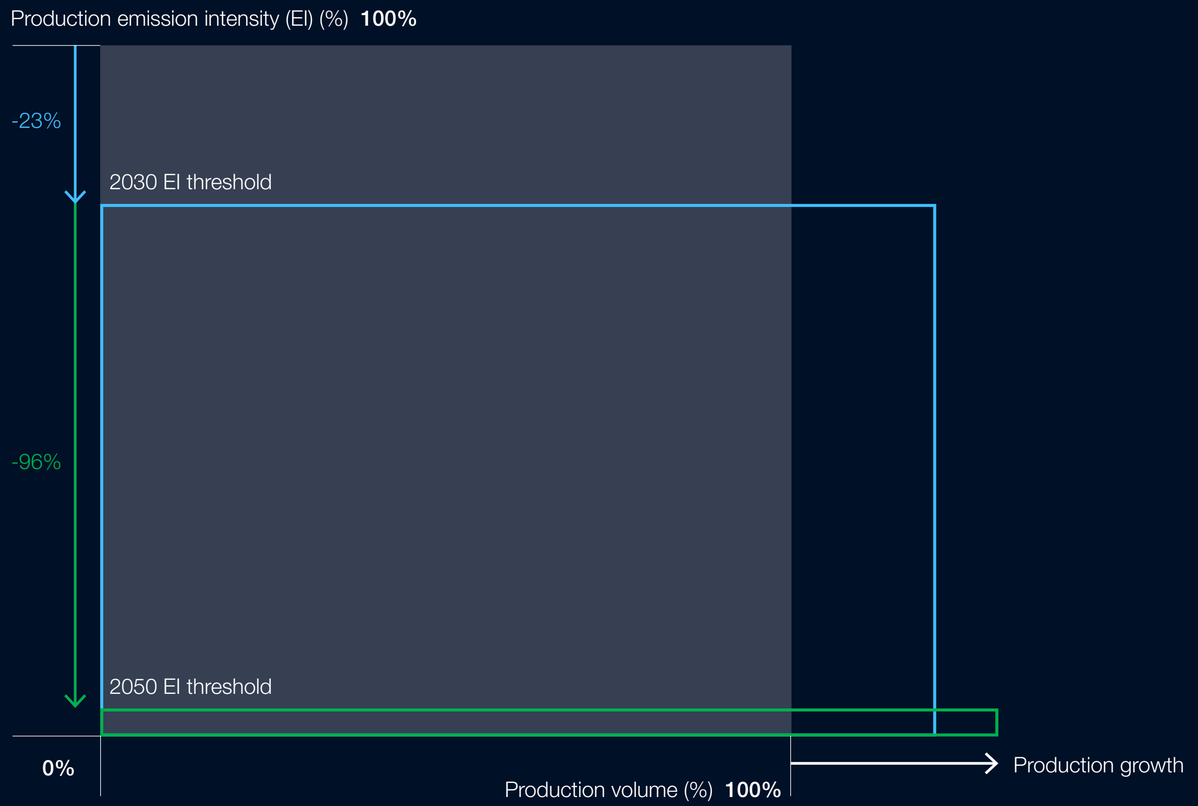
Net-zero industry performance

Size of box indicates industry GHG emissions in:

2020 2030 2050

Today's production meeting "reduced emission" intensity threshold[1]

Today's production meeting "low-emission" intensity threshold[1]



Notes: 1 As defined in the "Mission and methodology" section of this report.

Ammonia
Executive summary

Ammonia is a primary chemical used as an intermediate and end-product for the fertilizer industry (70%) and other industries (30%). Ammonia is critical for the agriculture sector and global food security. It has also been identified as an energy carrier for clean hydrogen in the future. More than half of the world's ammonia is currently produced in four countries: China, US, India and Russia. 99% of ammonia production relies on coal gasification and steam methane reforming to make hydrogen. Hydrogen production generates 90% of total ammonia synthesis emissions.

With 1.3% of all man-made emissions, ammonia is the largest emitting product of the chemical sector (450 $MtCO_2$), ahead of high-value chemicals (250 $MtCO_2$) and methanol (220 $MtCO_2$). Demand for ammonia is projected to rise nearly 40% by 2050, driven by demand for fertilizers in Africa, Latin America, the Middle East and South-East Asia. Aligning with the IEA Net Zero by 2050 requires limiting the increase to 23%.

Two main pathways for low-emission ammonia exist, CCUS and electrolysis; both technologies are available today, however, blue and green hydrogen production costs typically range 10% and 40% higher, respectively, and require further cost reduction. Methane pyrolysis and biomass gasification are also emerging as potential technological alternatives.

Besides investing in production assets, a 50/50 green/blue ammonia supply in 2050 will require more than $850 billion in investments in decarbonized power and CO_2 infrastructure to be deployed – nearly 12 times the annual value of the ammonia market. Building ammonia and fertilizer producers' confidence to pass a green premium over 10% to farmers is essential to unlock demand and incentivize investments. Governments should be cautious of the impact on food price and food security due to the widespread use of mineral fertilizers and low margins in farming.

More robust policy measures and international cooperation on carbon pricing, carbon border tax adjustments or public procurement can help create a differentiated and economically viable market for first movers into the low-emission ammonia industry. $450 billion is necessary to transform the ammonia industry asset base – nearly seven times the value of the current asset base. This is expected to decrease over the coming decade as the cost of electrolysers and green power falls.

We emphasize five priorities for the sector:

1. Boost the number of green and blue ammonia projects to accelerate the learning curve, drive costs down and increase the competitiveness of low-emission ammonia technologies.
2. Prevent infrastructure bottlenecks by developing the low-emission power capacity, and the CO_2 transport and storage required to enable green and blue hydrogen production.
3. Multiply demand signals for low-emission ammonia and fertilizers to incentivize producers and investors to direct investments towards low-emission production assets.
4. Develop policies to support low-emission plants, infrastructure and demand, and strengthen the business case for low-emission ammonia production.
5. Ensure decarbonization of ammonia and fertilizer production does not impact food security for poorer households.

Ammonia Performance tracker

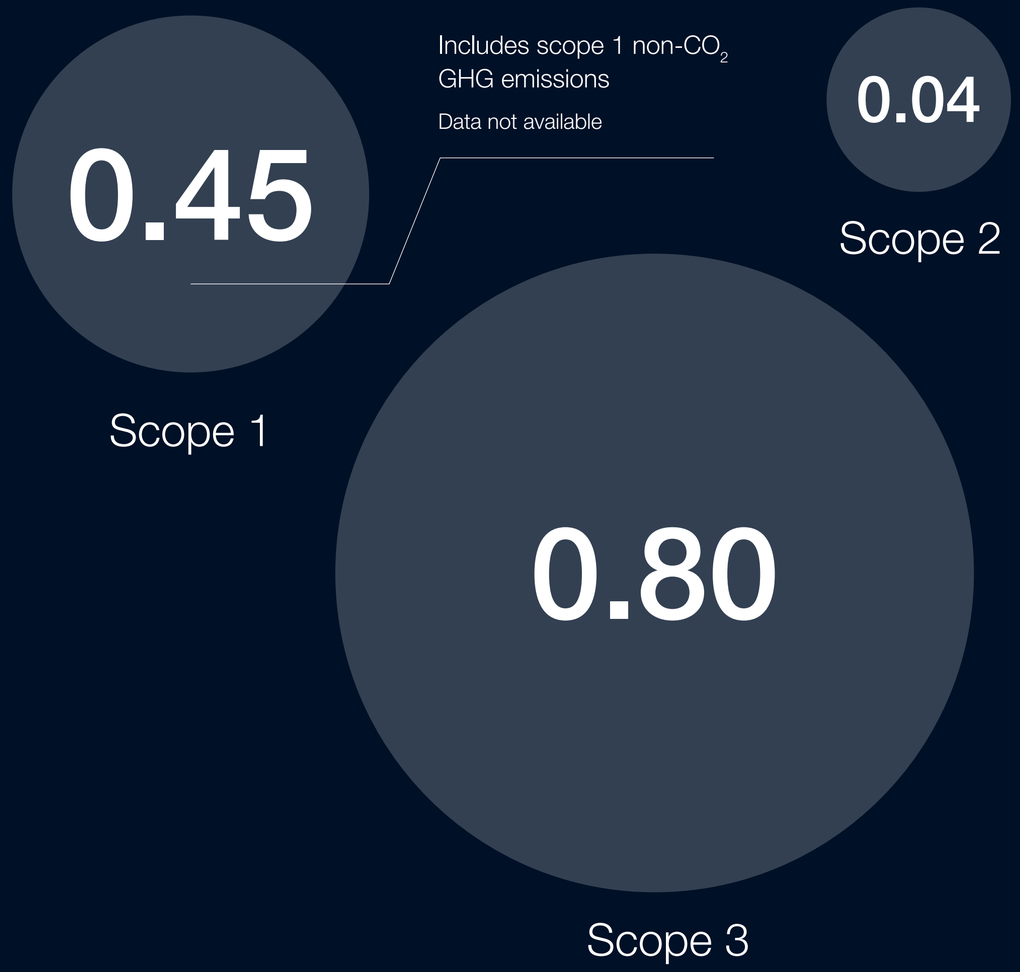
Accounting for 1.3% of all man-made emissions, ammonia production is the largest source of emissions within the chemical sector.

Click here to see the full data:

Visual | Full data

What ammonia emits, captures and offsets

Scope 1, 2, and 3 GHG emissions (Gt CO_2e)



Total CCS (Gt CO_2e)

0.0036

Total offsets

Data not available

Ammonia Summary

Low-emission ammonia is a reality today, however, further cost reduction, stronger demand signals and supporting policies are needed to accelerate.

Click on the enablers below to find out more.

Key messages

Low-emission production methods are emerging, including electrolysis, methane pyrolysis and carbon capture.

Delays in developing infrastructure risk creating bottlenecks in deploying electrolysis and CCUS technologies.

Increases in fertilizer costs could significantly impact food security around the world; governments would need to take measures to lessen the effect of green premiums.

More robust policies can support a differentiated and viable low-emission ammonia market.

Further de-risking and better returns will be needed to re-orient investment flow towards the low-emission industry.

Technology

Readiness stage **3**

The low-emission production technologies are **largely demonstrated in commercial conditions.**

10-100%

Production cost increase for low-emission production today.

Available

Expected year of commercial readiness of first low-emission production.

Infrastructure

Readiness stage **2**

The necessary infrastructure required by the low-emission industry **is emerging.**

$849 billion

Investments required in low-emission power generation, transmission and distribution.

$8-18 billion

Investments required in CO_2 transport and storage.

Demand

Readiness stage **1**

Only very early adopters in the market can pay the required green premium.

+10-100%

Green premium for ammonia buyers.

+5-60%

Green premium for end consumers.

Policies

Readiness stage **2**

Limited policies complement current environment (technology, infrastructure, demand, capital), to support growth of the low-emission industry.

$36-360 /$tCO_2$e

Carbon price equivalent required to level competitive landscape.

Capital

Readiness stage **2**

Low-emission investments generate sufficient return for a **minority of** CapEx to flow towards low-emission production assets.

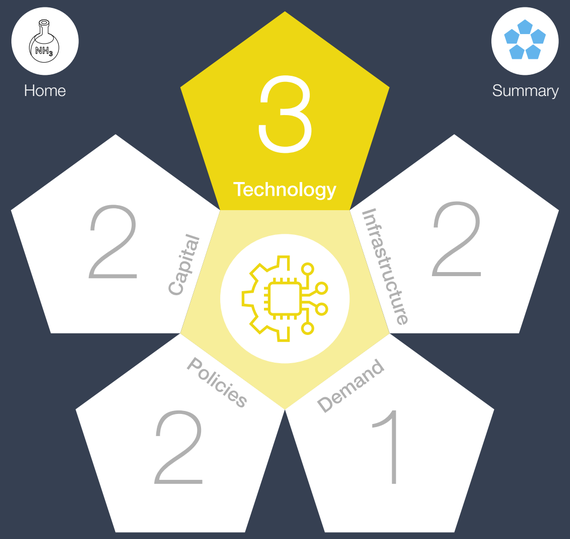
$450 billion

CapEx required to transform industry asset base.

Ammonia Technology

CCUS and electrolysis technologies are available today, but production costs remain at least 10% and 40% higher, respectively.

The low-emission production technologies are **largely demonstrated** in commercial conditions.



Key messages

Producing low-emission ammonia[3] will lead to cost increases of +10-100%.[6]

Low-emission ammonia production methods are emerging, including electrolysis, methane pyrolysis, and biomass gasification. While fossil-based routes with CCUS are currently available, adoption remains limited.

These emerging routes are typically 10-100% more expensive per tonne of ammonia, depending on energy prices and other regionally varying factors. However, costs are expected to drop significantly as the technology matures.

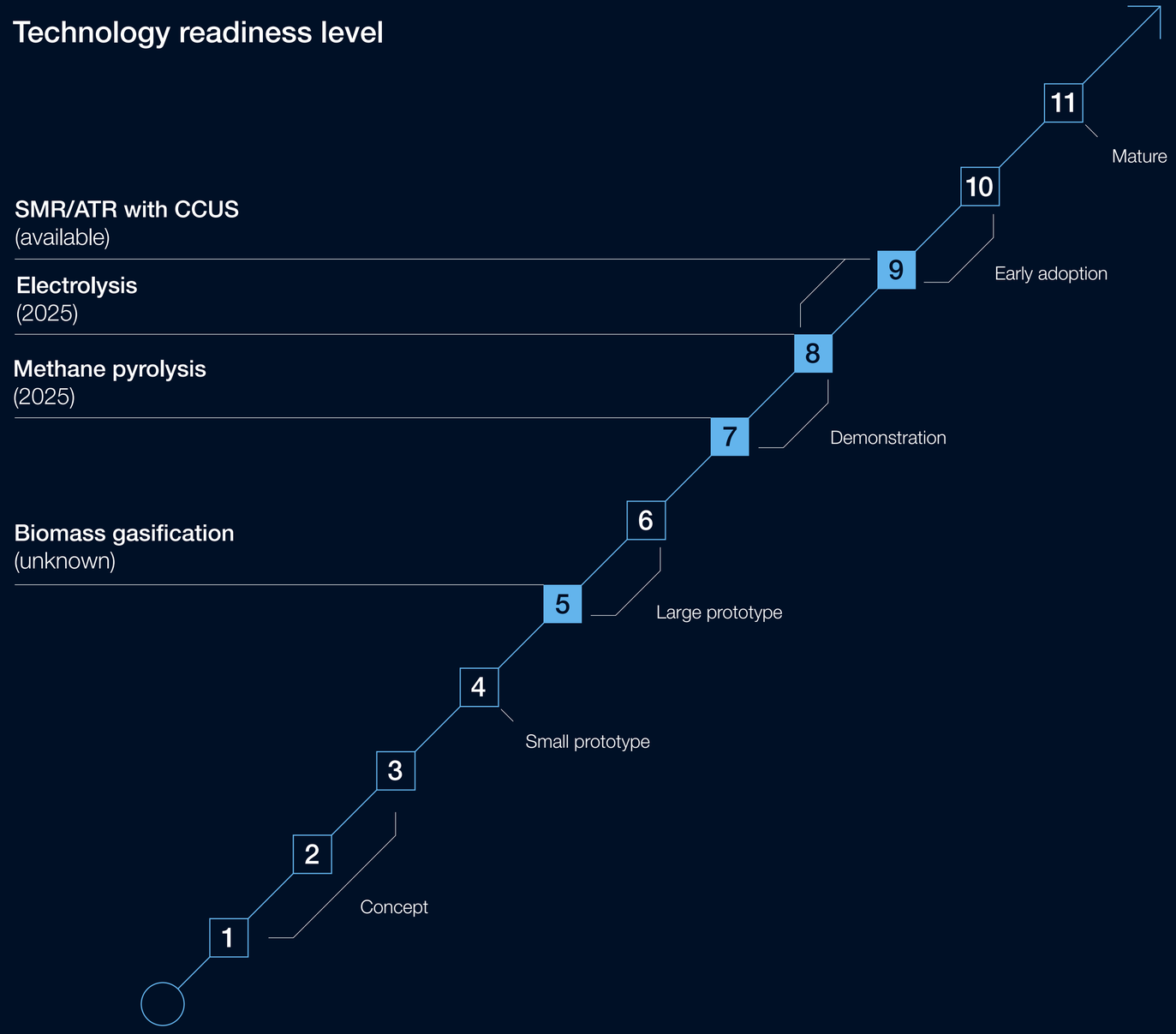
Current commercial production through steam methane reforming (SMR) can be retrofitted with CCUS, while new-build plants with CCUS will be autothermal reforming (ATR) based.

Sources: IEA, Global CCS Institute, Accenture analysis

Click here to see the full data:

Visual | Full data

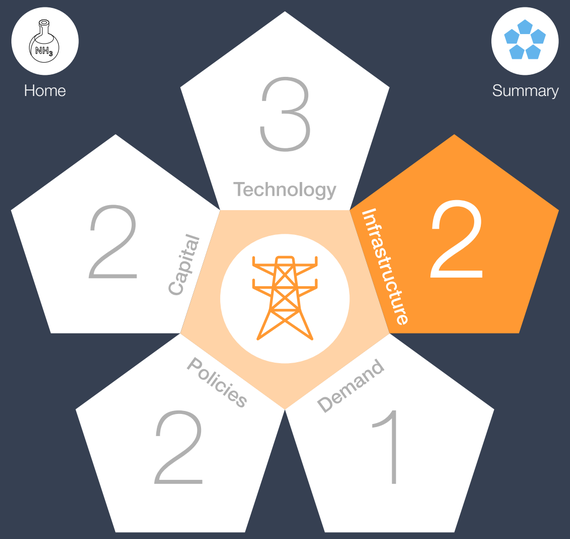
Technology readiness level



Ammonia Infrastructure

A 50/50 green/blue ammonia supply in 2050 will require more than $850 billion in investments in decarbonized power and CO_2 transport and storage infrastructure.

The necessary infrastructure required by the low-emission industry **is emerging.**



Key messages

More than $850 billion needs to be invested in CO_2 transport and storage infrastructure and green power capacity by 2050 to prevent bottlenecks in the deployment of electrolysis and CCUS technologies.

Only a small fraction (~1%) of the required green power has been developed for the ammonia industry.

The cost of low-carbon power and CO_2 transport and storage is projected to decrease, favouring infrastructure development.

Sources: IEA, Accenture analysis

Click here to see the full data:

Visual | Full data

Investments required for enabling infrastructure ($ billion)

Ammonia Demand

A green premium over 10% is too high to be passed on to farmers and consumers without impacting food security; further cost reduction is required to unlock additional demand.

Only very early adopters in the market can pay the required green premium.

Key messages

Low-emission ammonia could arrive on the market with a 10-100% premium[4] for ammonia buyers depending on regions and production routes.

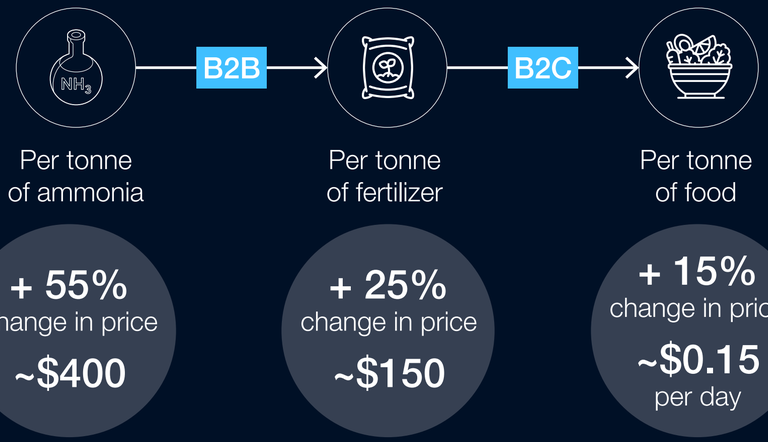
Passing the green premium to end consumers could result in a 5-60% increase in fertilizer cost. This could cause a rise in food prices by 3-26%, given the widespread use of fertilizers and the low margins in agriculture and farming. Governments will need to put cross-subsidies and other measurements in place to protect the food security of poorer households.

Sources: IEA, International Fertilizer Association (IFA), Polish Academy of Sciences, Leibniz University of Hannover, Accenture analysis

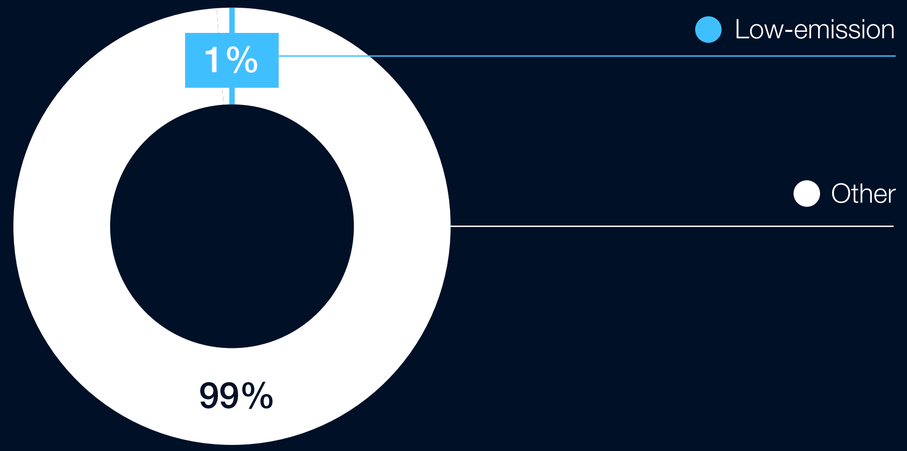
Click here to see the full data:

Visual | Full data

Green premiums



Market penetration



Ammonia Policies

Significant policy measures are needed to create a differentiated and economically viable market for first movers.

Limited policies complement current environment (technology, infrastructure, demand, capital), to support growth of the low-emission industry.

Key messages

Policies vary widely across geographies, and only examples of critical policies that have been recently introduced are included in this section.

A 36-360/tCO_2e carbon price equivalent is required to level the competitive landscape, depending on technologies and geographies, and "carbon border adjustment mechanisms" through international cooperation can help to prevent carbon leakage.

Long-term policies and financing mechanisms can support the deployment of carbon capture and electrolysers to produce low-emission ammonia and create a viable low-emission ammonia market.

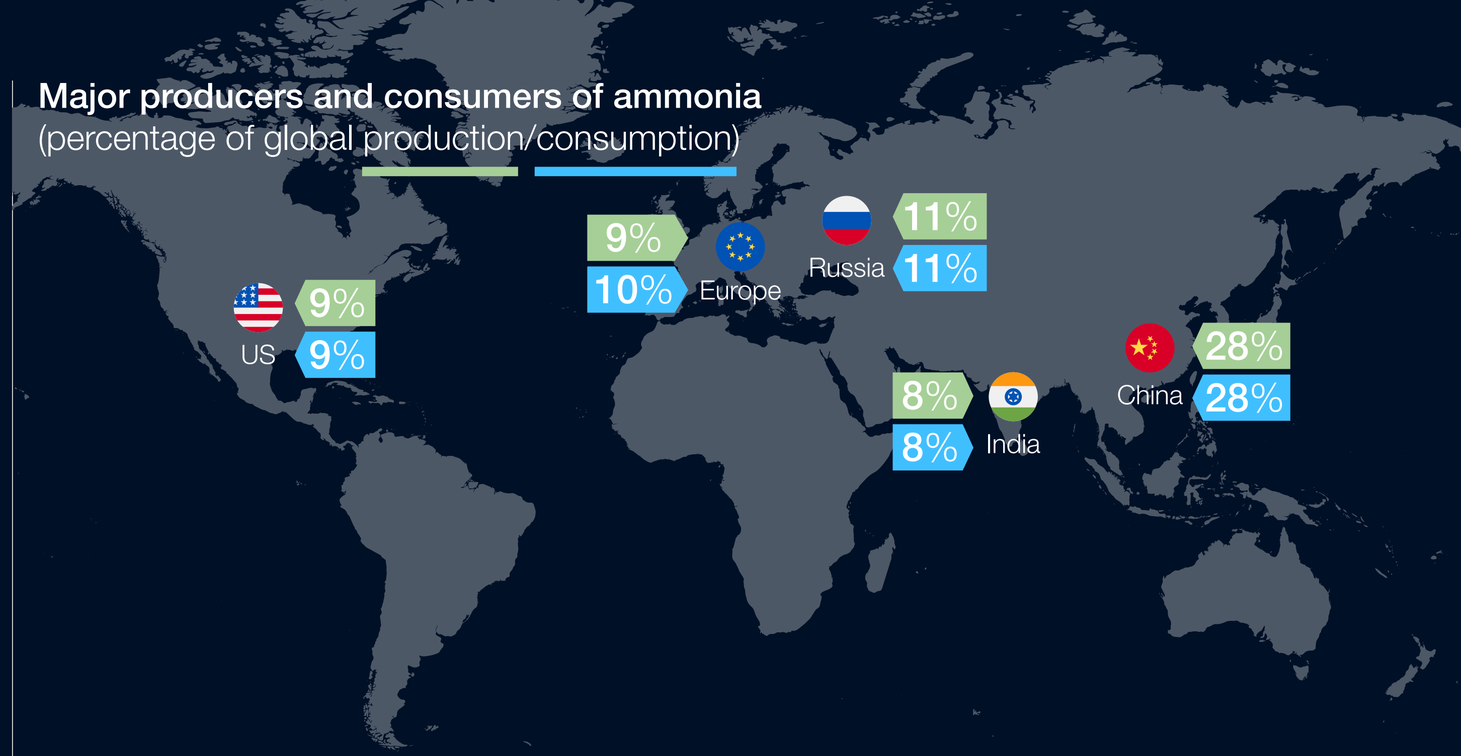
End-use policies can optimize fertilizer and application methods and manage the demand for ammonia-based fertilizers.

Sources: World Bank, IEA, Accenture analysis

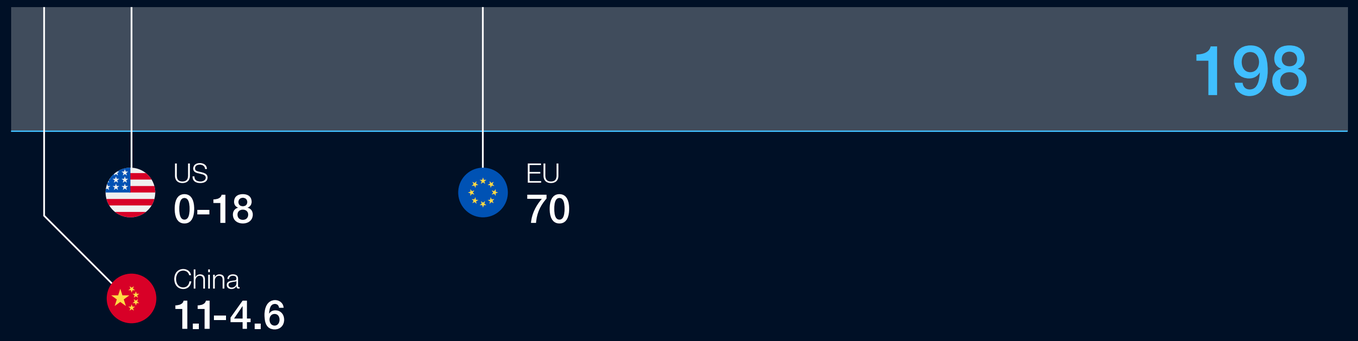
Click here to see the full data:

Visual | Full data

Major producers and consumers of ammonia
(percentage of global production/consumption)



Average carbon price required to level the playing field for low-emission production vs actual carbon prices[1] ($/$tCO_2e$)



Ammonia Capital

To transform the ammonia industry asset base, $450 billion would be needed. Despite the uncertainty on returns, some investment momentum exists.

Low-emission investments generate sufficient return for a **minority of** CapEx to flow towards low-emission production assets.

Key messages

Current ammonia production costs with low-emission technologies are too high to incentivize investments. Further de-risking and better returns will be needed to re-orient investment flow towards the low-emission industry.

More than $450 billion is required to transform the industry, this is nearly seven times more than the value of the current asset base. However, this required investment is expected to fall together with renewable and electrolyser costs.

No green debt was issued by the fertilizer industry in 2020 as the basic chemical specific criteria/taxonomy has yet to be developed.

Sources: MPP (ETC), Refinitiv, Accenture analysis

Click here to see the full data:

Visual | Full data

Assets and investments

Transformation investment required **$450 billion**

Industry net property, plant and equipment (PPE) **$65 billion**

=

6.9
Investment to PPE multiple

Debt issued (2020 bonds)