Quantifying the emissions footprint of the nitrogen industry

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Chris Lawson
Head of Fertilizers
New York
Chris.Lawson@crugroup.com

About CRU

CRU's reputation with customers across **mining**, **metals** and **fertilizers** is for integrity, reliability, independence and authority.

CRU's insights are built on a twin commitment to quality primary research and robust, transparent methodologies.

CRU invests in a global team of analysts, the key to gaining a real understanding of critical hard-to-reach markets such as China.

We strive to provide customers with the best service and closest contact – flexible, personal, responsive.

CRU – big enough to deliver, a high quality service, small enough to care about all our customers.

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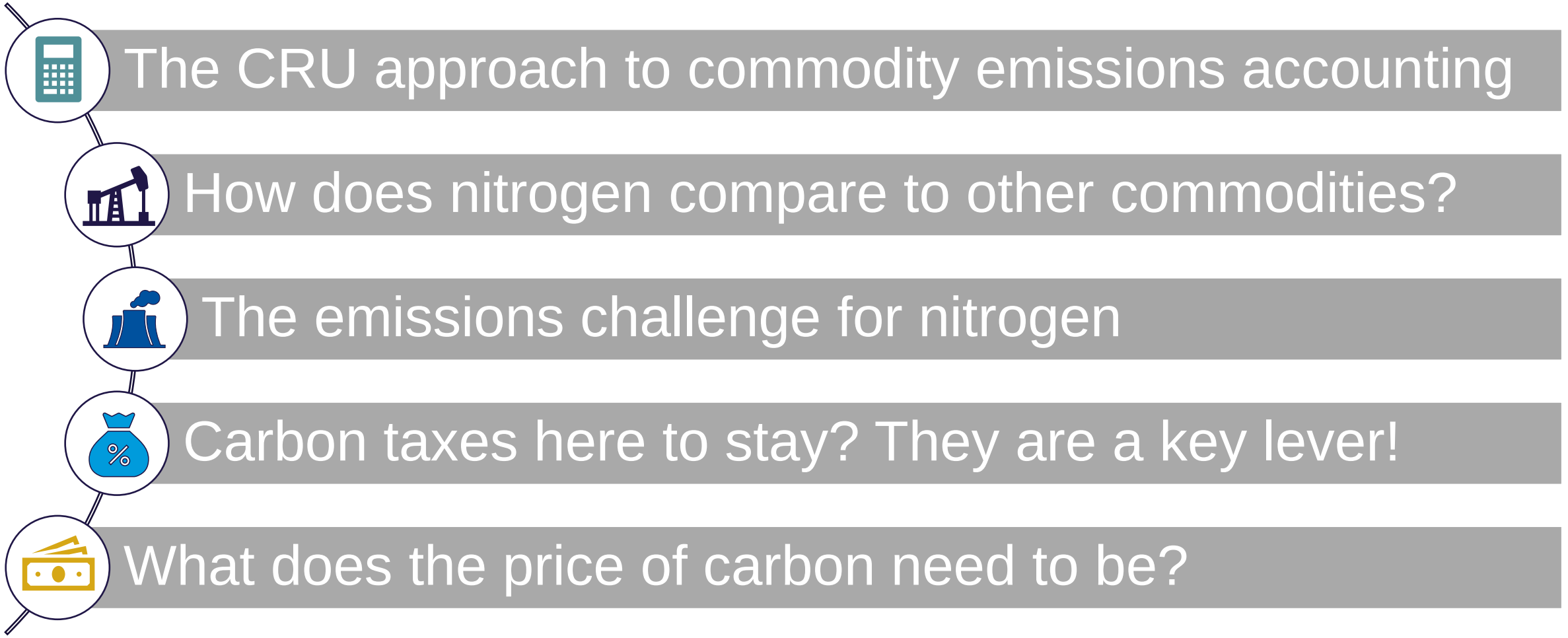
Agenda

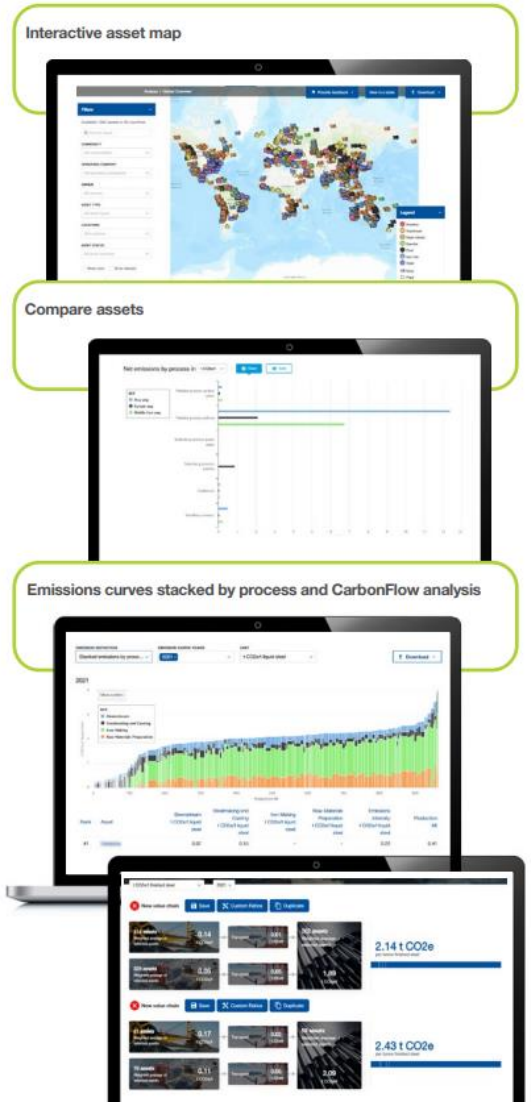

The CRU approach to commodity emissions accounting
How does nitrogen compare to other commodities?
The emissions challenge for nitrogen
Carbon taxes here to stay? They are a key lever!
What does the price of carbon need to be?

How does CRU cover emissions?

CRU's Emissions Analysis Tool allows you to compare emissions across the complete value chain on an intuitive, easy-to-use digital platform.

Readily available standardised data and methodologies – calibrated to existing schemes including the EU emissions trading system (EU ETS), worldsteel, and International Aluminium Institute (IAI) – are groundbreaking for companies seeking to accurately and meaningfully understand the emissions landscape.

The Emissions Analysis Tool gives you visibility and functionality – with like-for-like comparisons of process level emissions across assets and regions delivered in seconds. Reduce emissions, navigate evolving supply chains, adhere to increasing regulations – and lead the journey to a sustainable future.



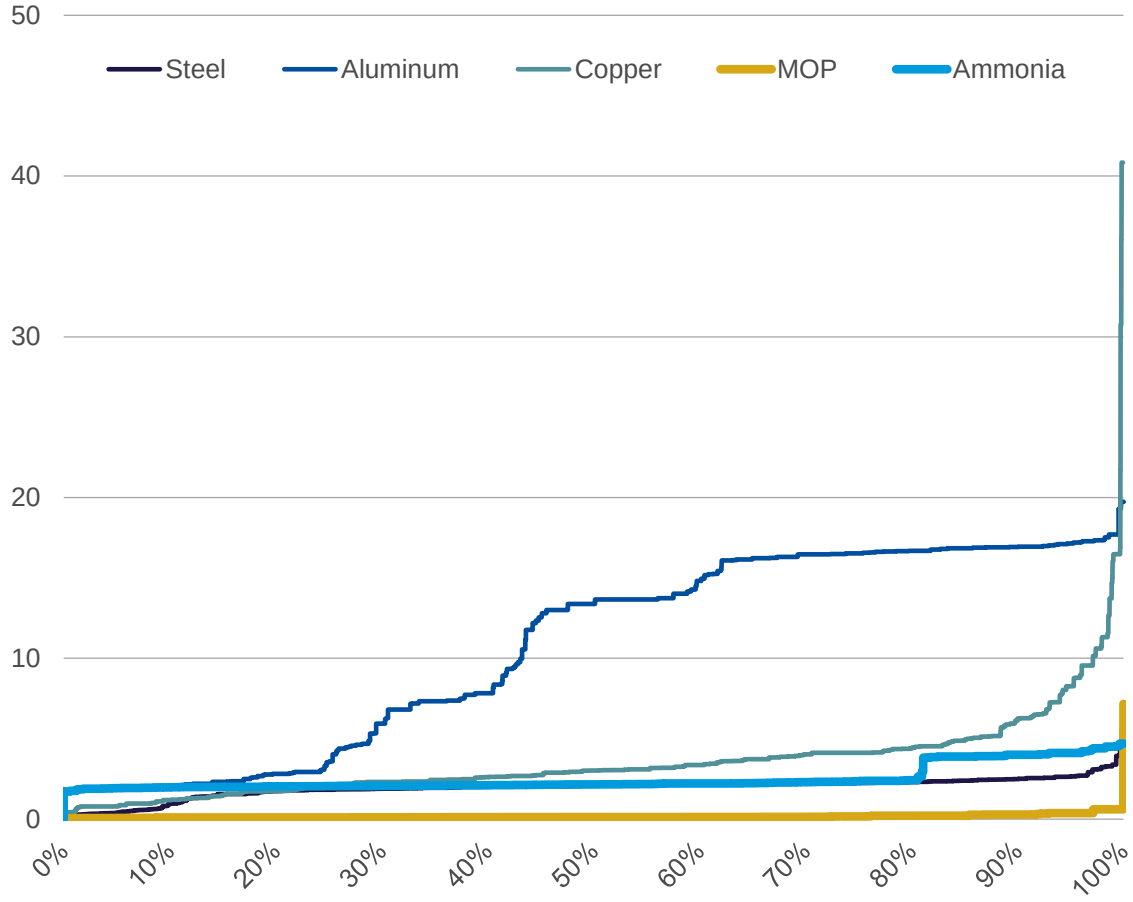
Find out more:

https://www.crugroup.com/emissions-analysis-tool/

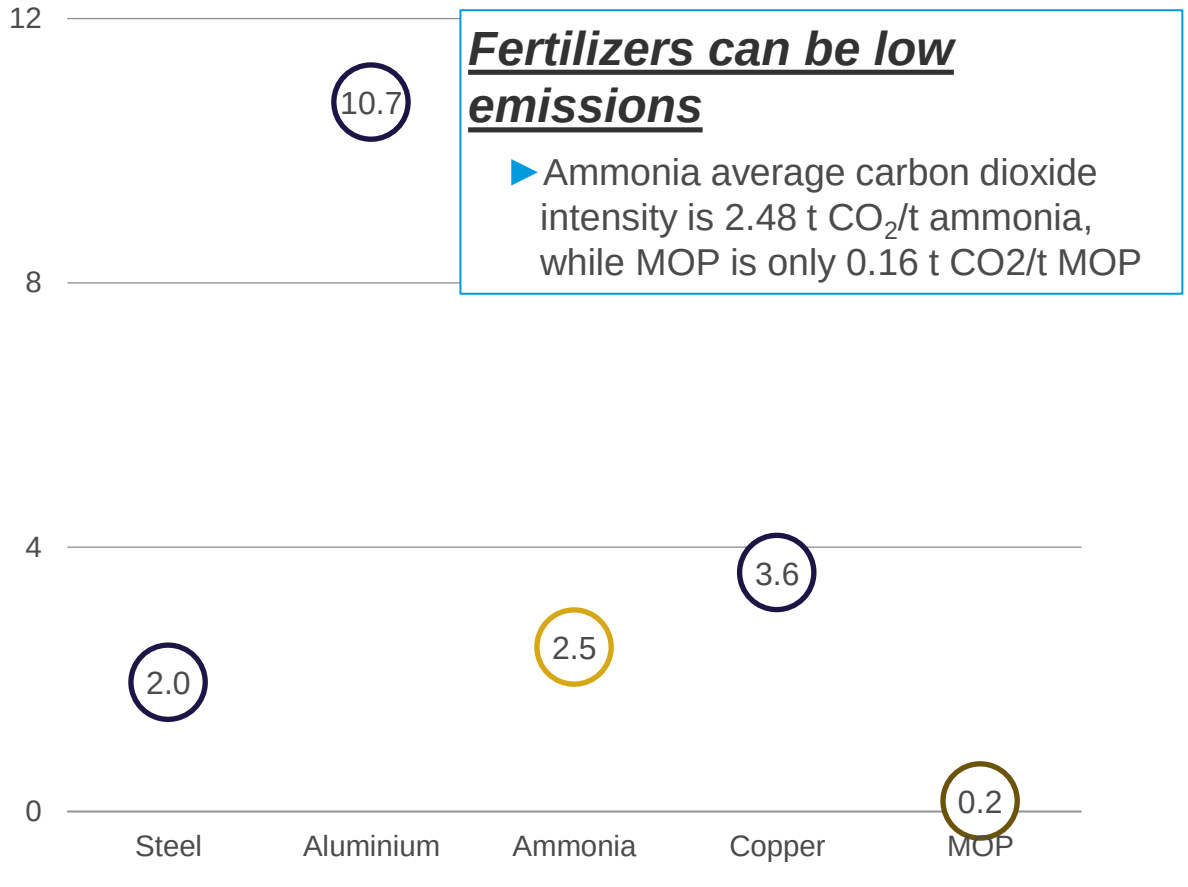
Nitrogen emissions are small but significant

Y Axis: Tonnes CO_2e per tonne product, t CO_2e/t product

X Axis: Production volumes if percentage terms, %



CO2e emissions per tonne product, t CO_2e/t product



Fertilizers can be low emissions

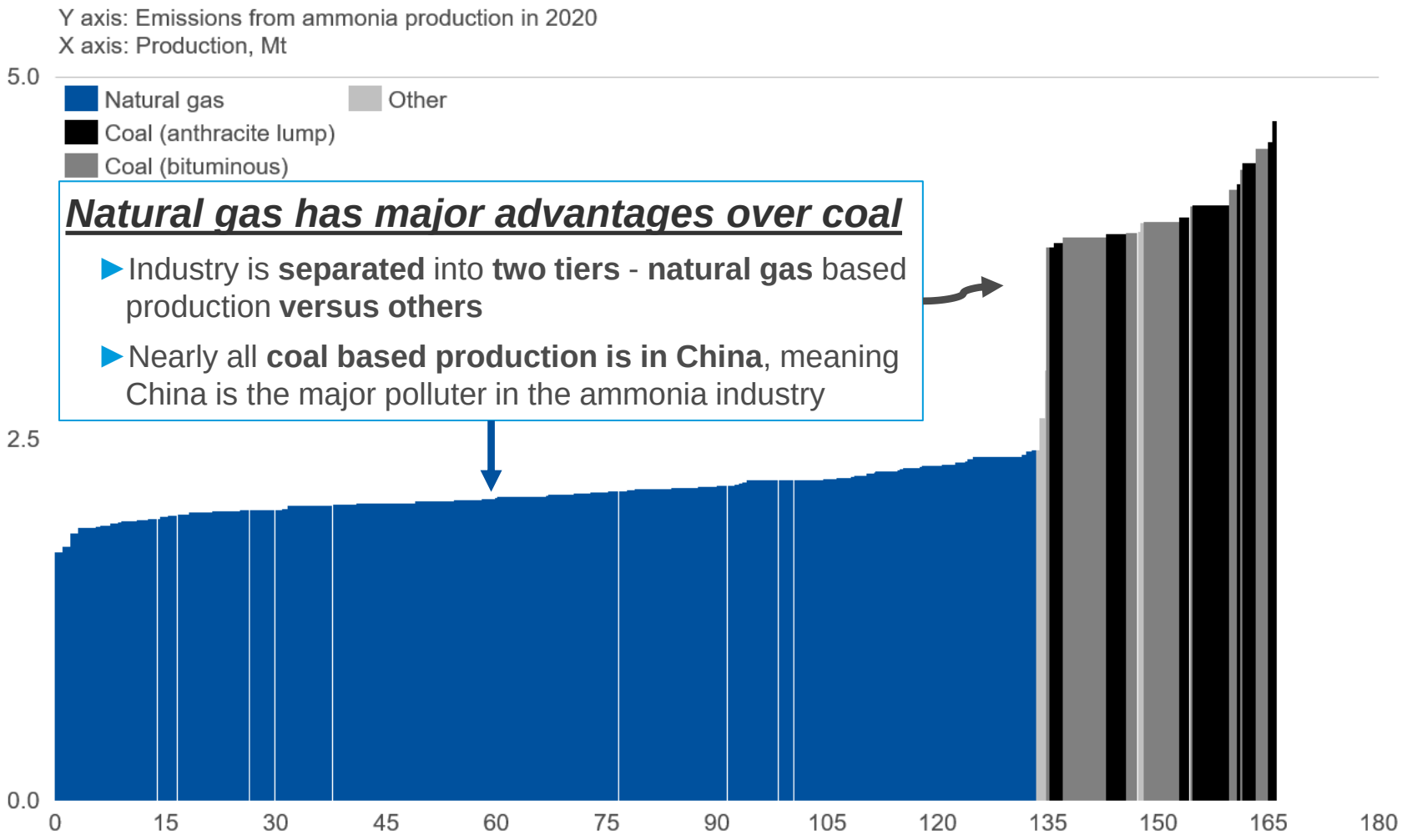
- Ammonia average carbon dioxide intensity is 2.48 t CO_2/t ammonia, while MOP is only 0.16 t CO2/t MOP

DATA: CRU Nitrogen cost service; Steel Emissions Analysis Tool; Base Metals Emissions Analysis Tool; Aluminium Emissions Analysis Tool

Nitrogen industry defined by feedstock

The ammonia industry is two tiered

- **Ammonia** is primarily produced via **hydrocarbons**:
  - **Natural gas**
  - **Anthracite coal**
  - **Bituminous coal**
  - **Petroleum coke**
- The **liberation of hydrogen** leaves **carbon dioxide** as a **waste product**
- The hydrocarbon **"fuel & feed"** component is the **main source of carbon dioxide emissions** in the nitrogen fertilizer production process
- **Power** is **another smaller source** of emissions in ammonia production



Natural gas has major advantages over coal

- Industry is **separated** into **two tiers** - **natural gas** based production **versus others**
- Nearly all **coal based production is in China**, meaning China is the major polluter in the ammonia industry

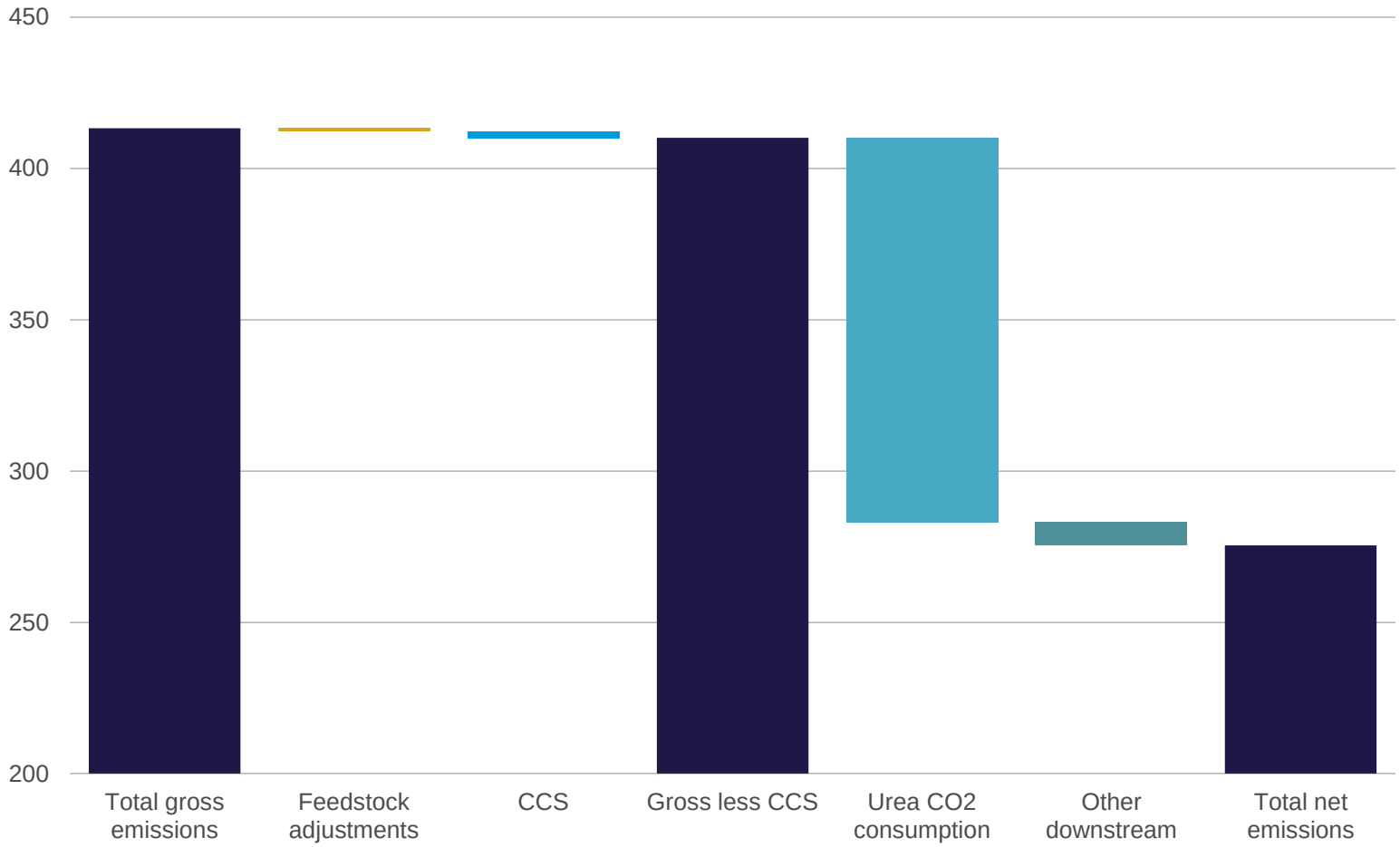
DATA: CRU Nitrogen cost service

Avenues of carbon capture are accessible for nitrogen producers

Gross versus Net emissions

- **CO_2 produced** via ammonia production is **high quality** allowing for use in downstream products
- **Urea, Methanol, NPKs, direct CO_2 sales** etc. can all reduce the amount of CO_2 being released directly by the plant
- **Emissions** can therefore be **examined** on a **gross basis** or a **net basis**
- **Gross emissions** are **total emissions** from ammonia production **before any CO_2 adjustments**
- **Net emissions** are **gross less all types of carbon consumption** – regardless if the capture is permanent or not
- The **industry is focusing on gross emissions less permanent carbon capture** – highlighting the challenge the industry is facing

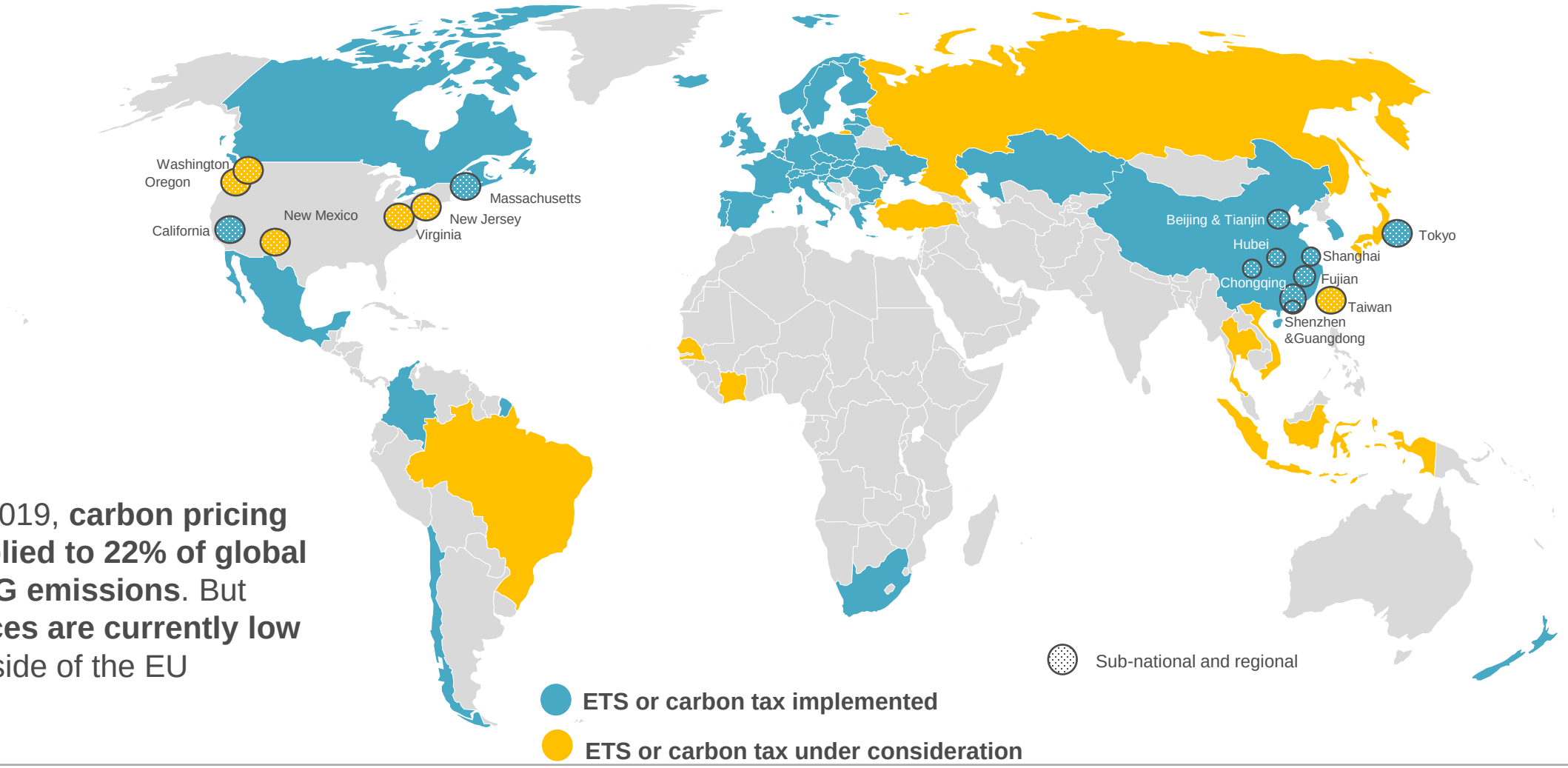
Breakdown of total ammonia emissions, Mt CO_2



DATA: CRU Nitrogen cost service

Carbon pricing is emerging internationally to incentivise emissions cuts

Status of carbon pricing schemes, by country/region



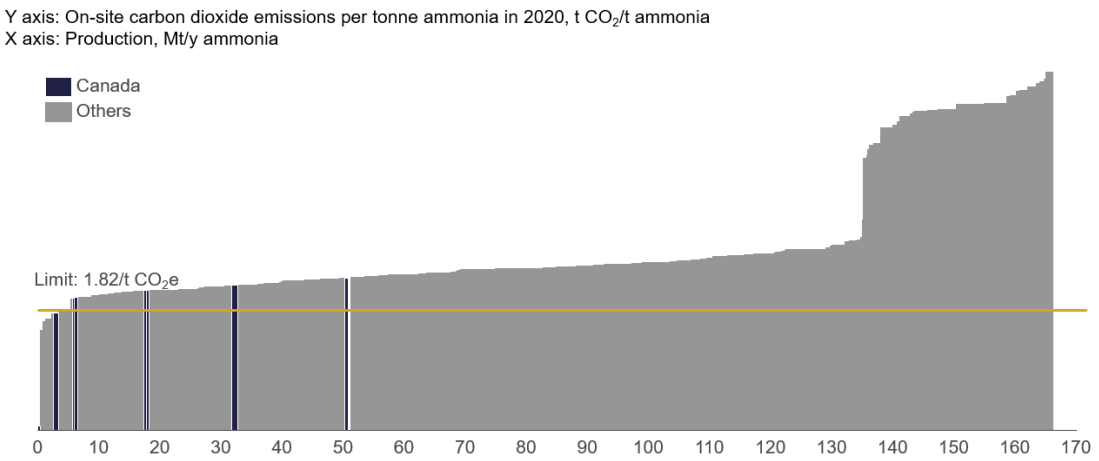
In 2019, **carbon pricing applied to 22% of global GHG emissions**. But **prices are currently low** outside of the EU

Source: World Bank

Canadian carbon tax hits nitrogen and potash producers

Canadian carbon tax is introduced

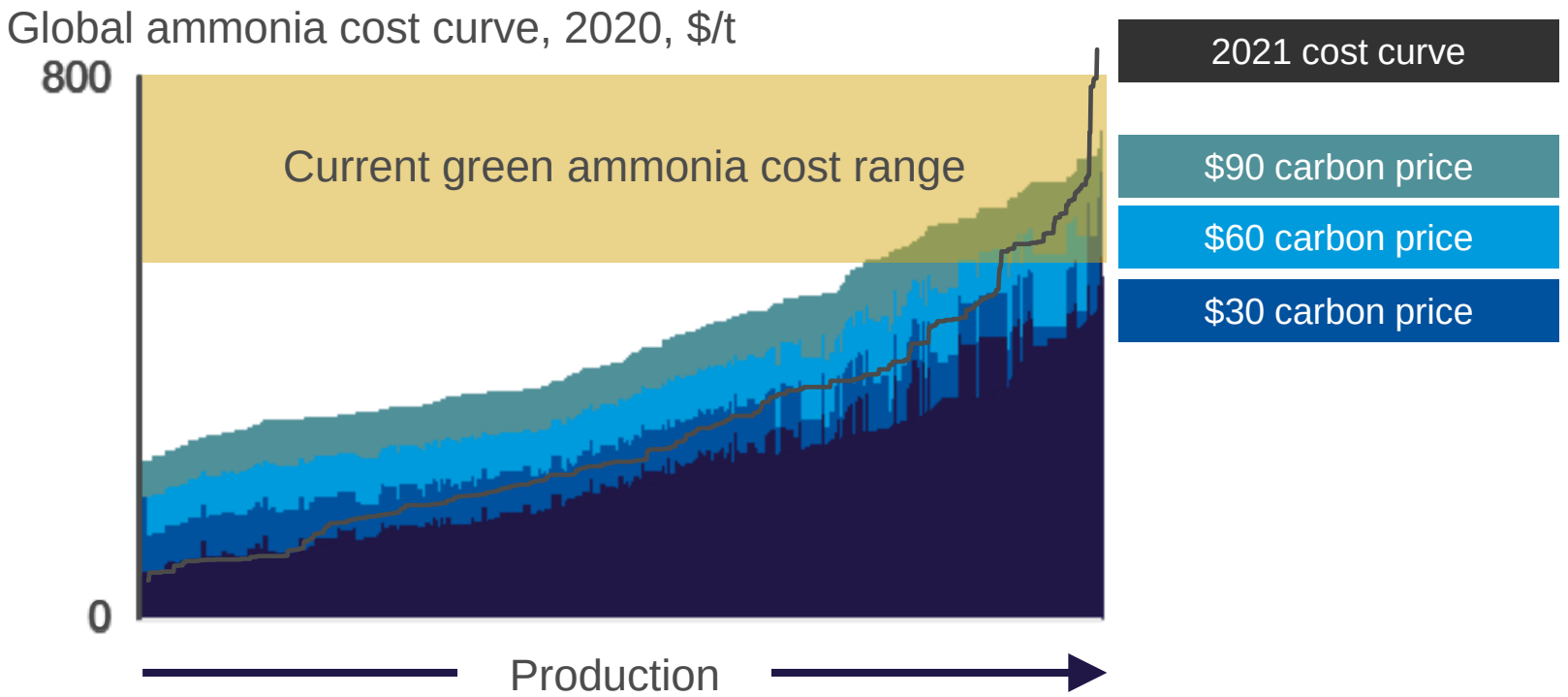
- Federal Canadian Government introduced the **Greenhouse Gas Pollution Pricing Act in 2018**
- All facilities emitting above **50,000 t CO_2e** will be required to abide by the new rules
- **Potash and nitrogen** facilities will only be **liable to pay for emissions in excess** of the **Federal limits** for the specific industry. Facilities that emit less than the industry limits will receive credits.
- A limit of **1.82t CO_2e/ t for ammonia**; 0.331 t CO_2e/ t for nitric acid; and 0.162 t CO_2e/ t for urea liquor
- **CO_2** consumed or capture at a plant that is **not permanently stored** is considered **emitted by the plant**
- **Could add around USD10 /t additional costs to ammonia production in 2021…**



Source: Canadian Government, CRU Nitrogen Cost Service

Low emission (green) ammonia is more competitive under carbon pricing

Technologies such as electrolysis need to be improved and scaled up to bring costs down



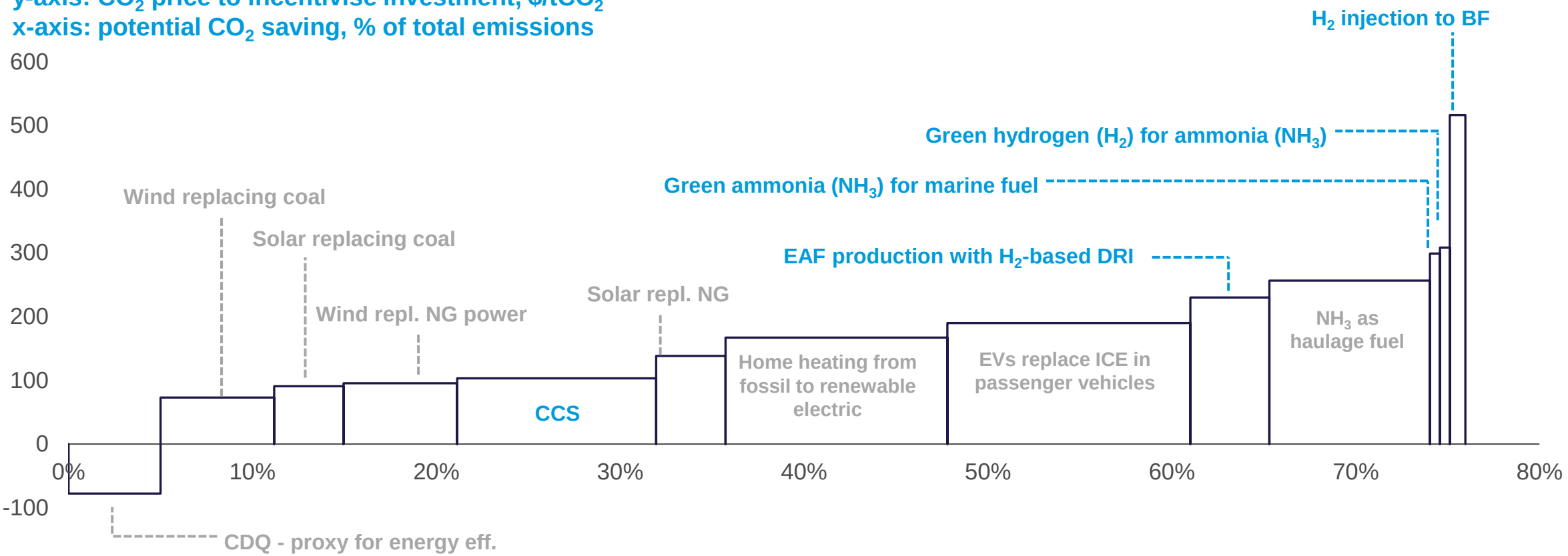
Impactful carbon regulation and policy could level the playing field and speed up decarbonisation progress

DATA: CRU Nitrogen Cost Service, CRU Emissions Analysis Tool, CRU Low Emissions Ammonia Market Outlook

Carbon prices need to rise >$200/t to incentivise wide decarbonisation

2030 CO_2 abatement curve, economy-wide, EU

y-axis: CO_2 price to incentivise investment, $/t$CO_2$
x-axis: potential CO_2 saving, % of total emissions



Commodity prices will need to increase to support the green transition

DATA: **CRU Sustainability**.

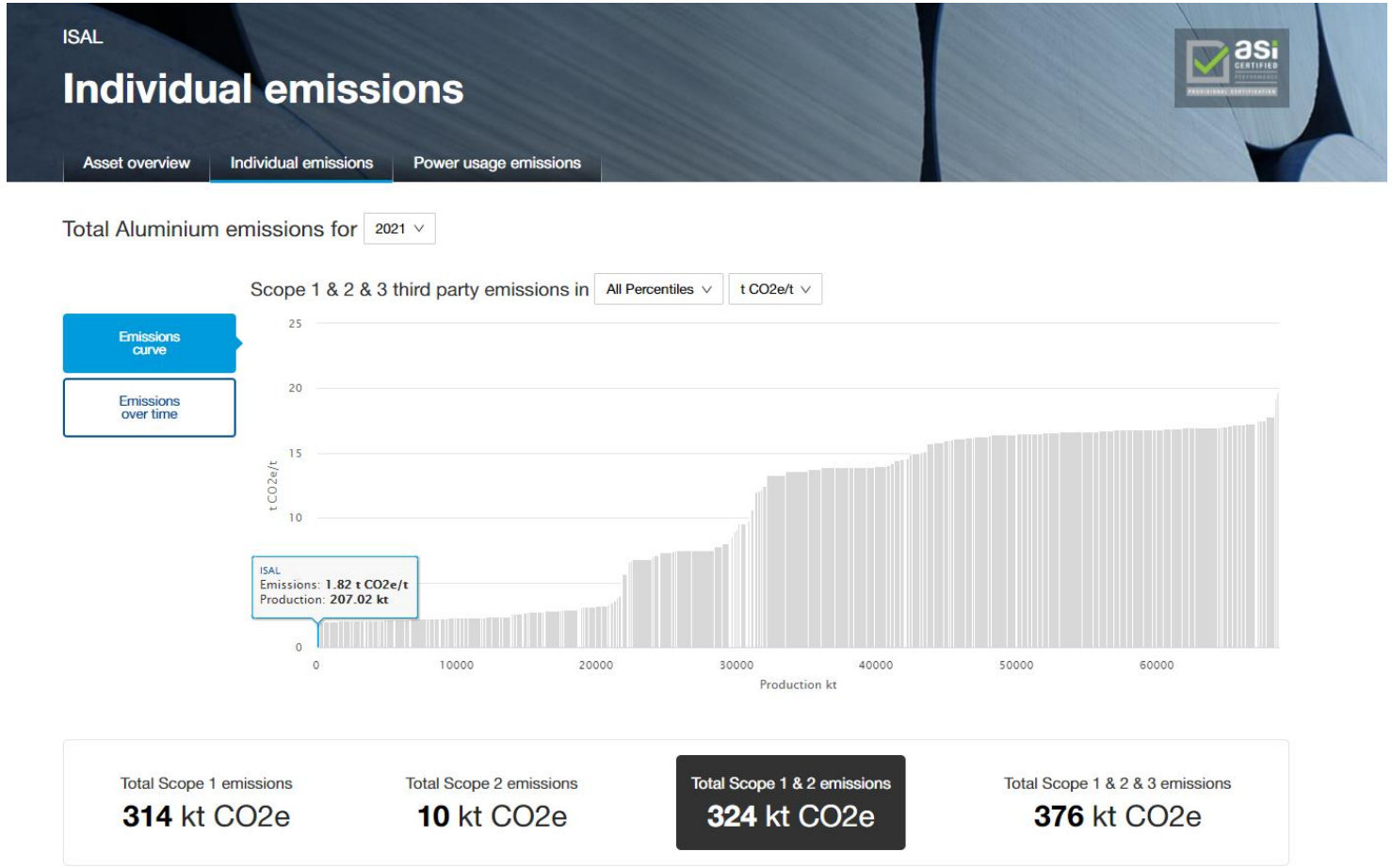
CRU is partnering with a number of associations to share this work

CRU and CopperMark

https://coppermark.org/copper-marks-assurance-framework-incorporated-into-crus-emissions-analysis-tool/

CRU and the Aluminium Stewardship Initiative

https://aluminium-stewardship.org/asi-cru-mou-bears-fruit-asi-certification-data-layer-integrated-into-cru-emissions-analysis-tool/



Emissions accounting is key for long term change!

- Understanding the emissions footprint of an industry is key to longer term change
- Emissions analysis allows us to understand industry structure under different carbon price scenarios…
- … and the longer term carbon price needs to be close to $200 /t to incentivise change – unless there are subsidies
- CRU is working with industry partners to improve transparency and understand this complicated topic
- THANK YOU!