Yara Clean Ammonia

Ammonia Energy Association
“Renewable Energy Opportunities - Pilbara”

16th August 2023

Brian Howarth
Project Director

Our Mission

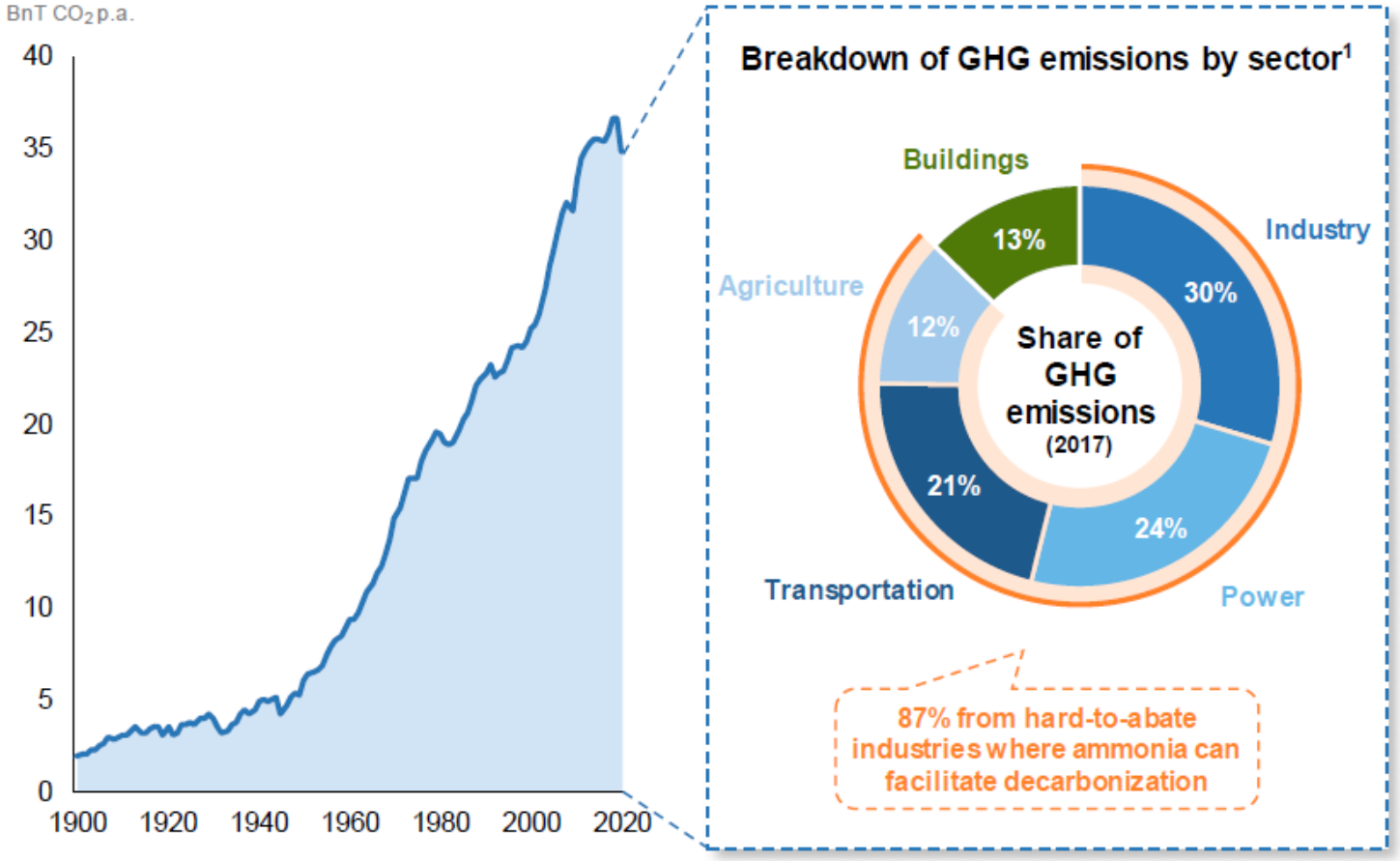
to responsibly feed the world and protect the planet

Our Ambition

to enable the hydrogen economy, driving a green transition of shipping, fertilizer production and energy intensive industries

Clean ammonia offers a solution to the decarbonization challenge…

Rapid growth in GHG emissions from hard-to-abate industries



Ammonia is an attractive solution

- Clean ammonia available through existing blue and green production methods
- Highly versatile with multiple direct applications
- Ideal energy carrier with favorable performance across clean fuel KPIs[2]
- Well-established global infrastructure and storage network

…with real potential to unlock decarbonization opportunities in several key industries

Shipping fuel

50% higher **energy density** than liquid hydrogen[1]

Easier to scale than hydrogen, e-methanol and synfuel

Can be **stored at higher temperature** than hydrogen, lowering cost

Competitive all-in cost through existing infrastructure and know-how

Power generation

Alternative for countries with **unfavourable renewables conditions**

Economically favourable over carbon capture

Enables continued use of more **flexible producing assets**

Supports **continued use of relatively new plants**

Agriculture

Fertilizers account for a very **large share of the emissions of food and agricultural products**

Green fertilizer can provide up to **30% CO_2 reduction** on a loaf of bread at a marginal cost increase of ~1%[2]

Grey ⇨ Green

Green fertilizer requires **no infrastructure / value chain changes**

Long-term potential: Hydrogen carrier

Mature in transport, infrastructure and know-how

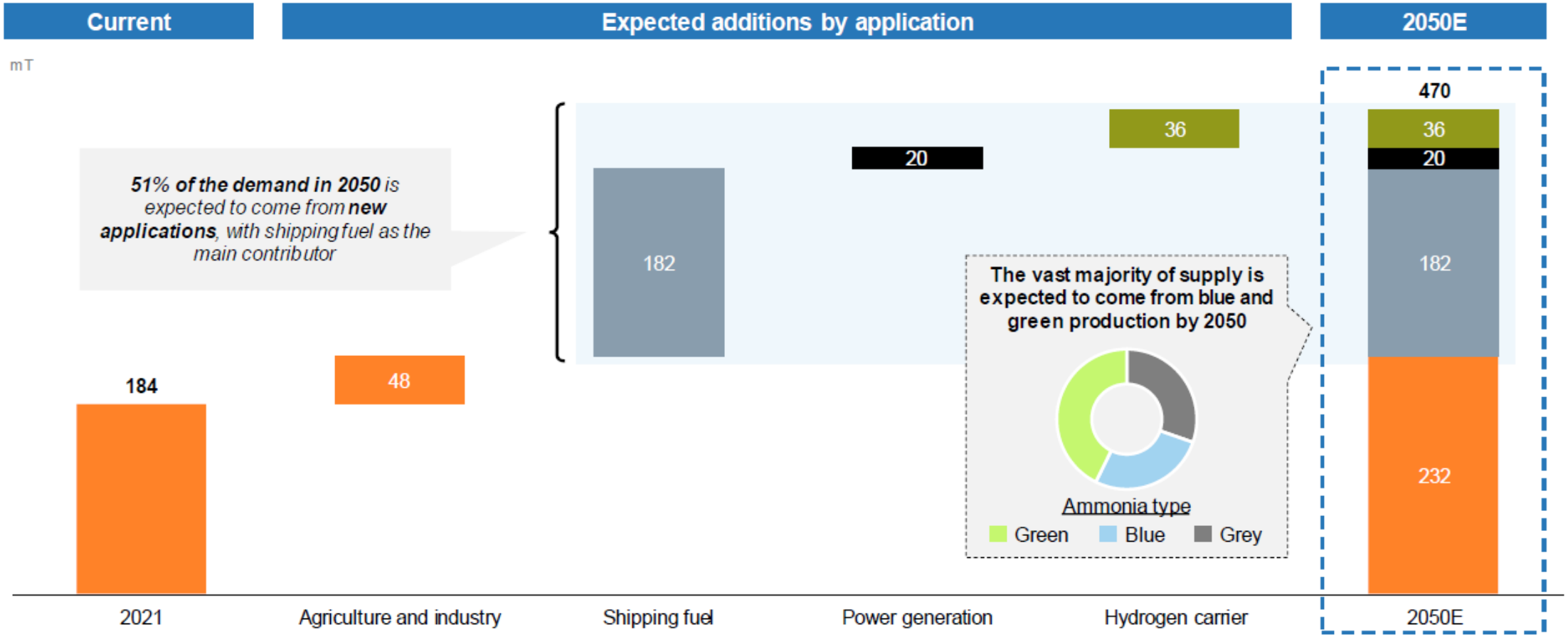
Lower long-distance transportation cost than hydrogen

Better **characteristics for storage** vs. hydrogen

More **energy dense** than hydrogen

Significant growth potential driven by adoption of clean ammonia in new applications

Global ammonia demand expected to grow significantly in volume from 2021 to 2050, adding close to 300mT to the market



Source: Arkwright market study 2021; IFA

Growth potential from solid upstream projects, building on YCA's leading midstream position

Blue ammonia

Robust pipeline with solid project economics and profitability without need for further subsidies

Key regions

Selected project candidates

Green ammonia

Early mover strategy where government support will be required – lower costs in the future will increase competitiveness

Key regions

Selected project candidates

Well-positioned with a maturing project hopper and additional long-term opportunities

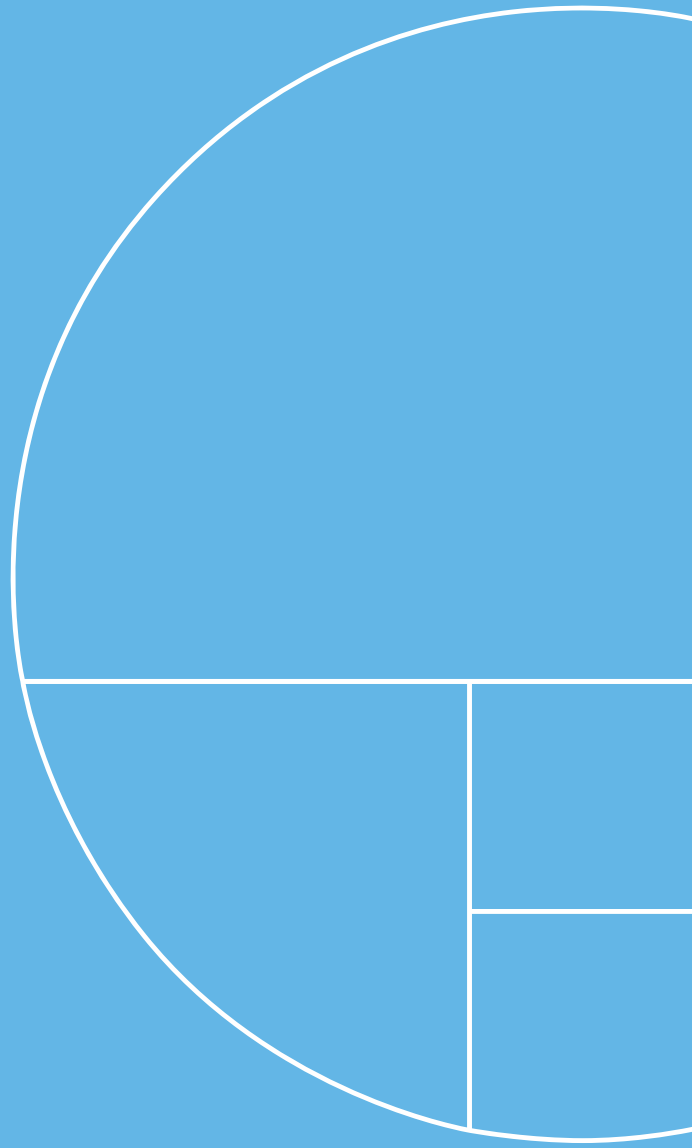
Well-positioned to succeed

Access to existing production assets that can be converted to blue or green at lower costs compared to greenfield investments

Knowledge and experience built through Yara's almost 100 years of ammonia track record and over 8 mT ammonia capacity

Market leading position makes YCA the **preferred offtaker and partner for Yara and other third-parties**, in turn enabling new projects

Project YURI – Phase 0



Project Yuri – Phase 0

YARA

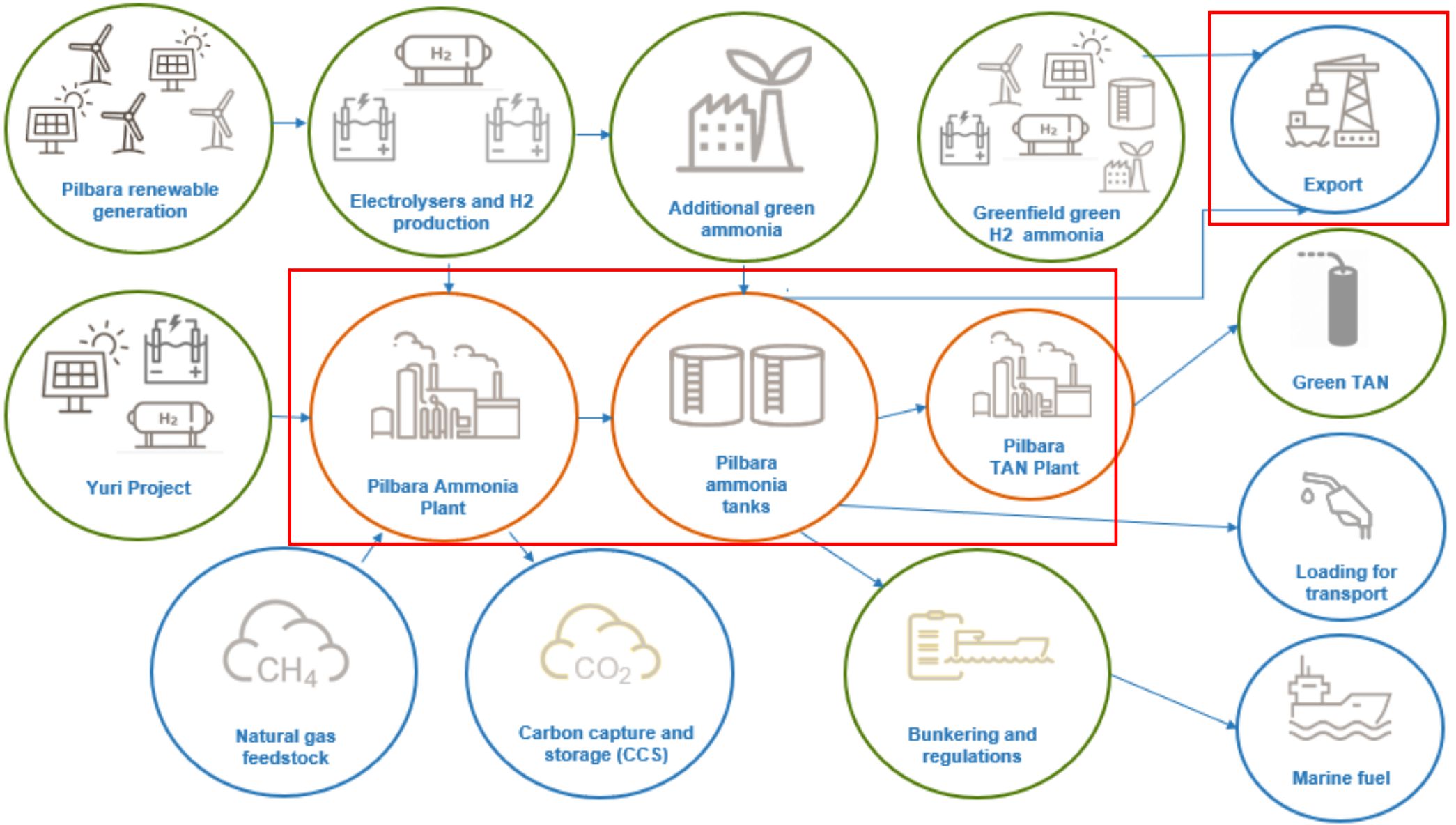
ENGIE

MITSUI & CO.

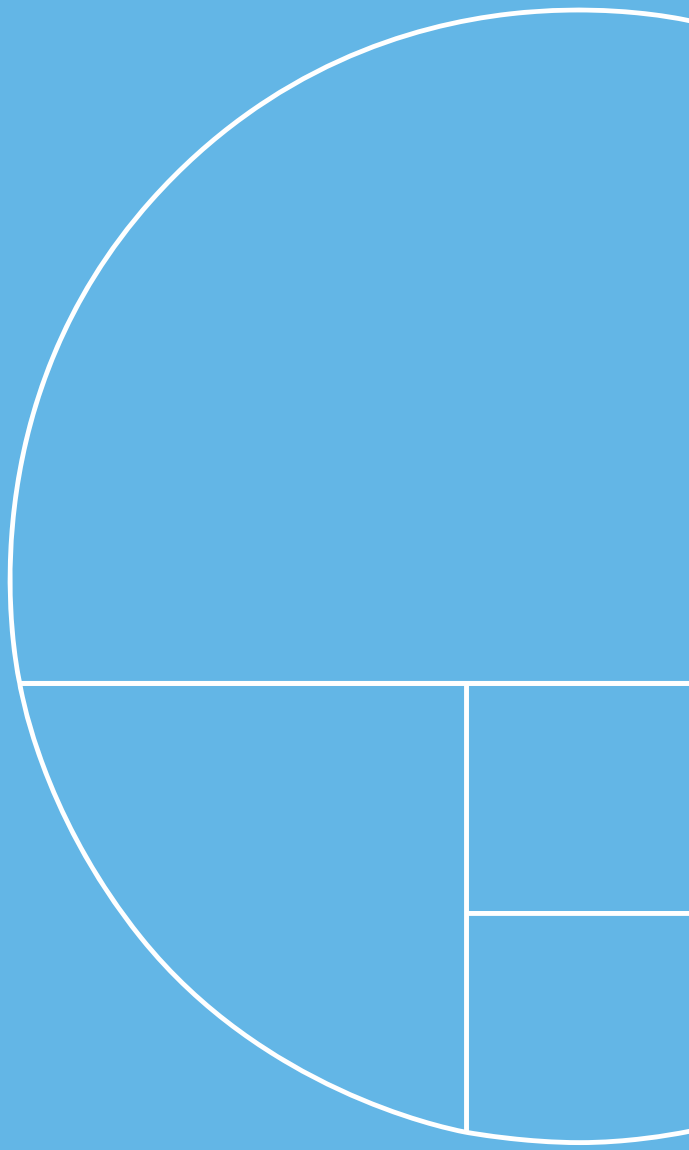
T.EN TECHNIP ENERGIES

MONFORD

Pilbara Strategy



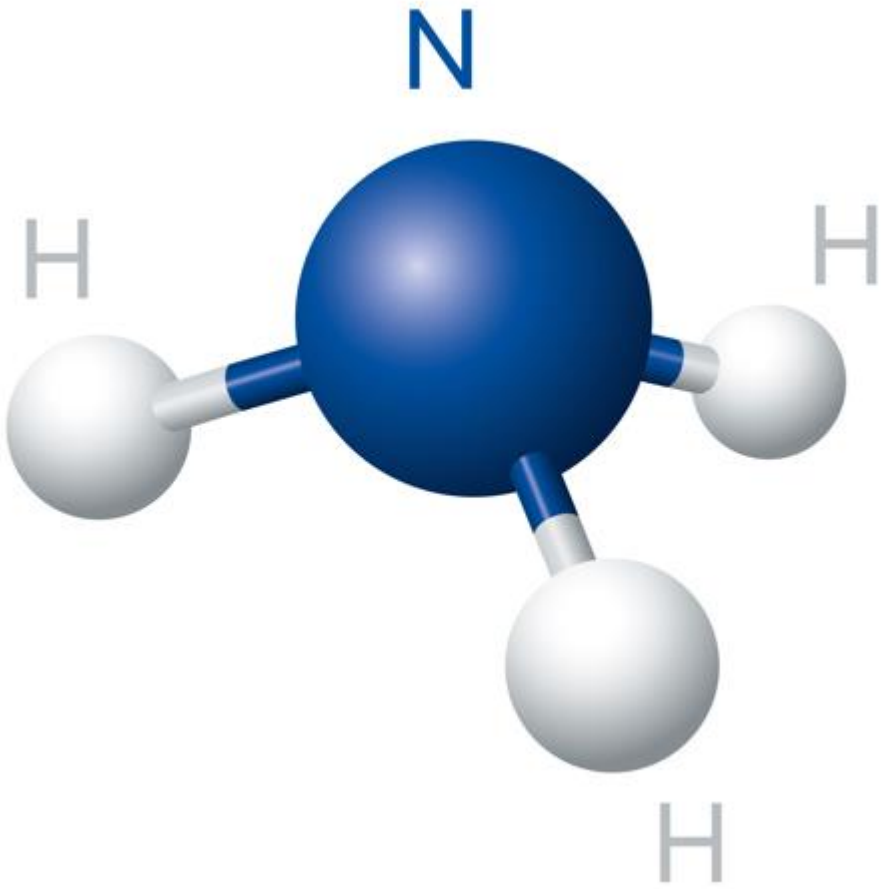
“Clean” Ammonia



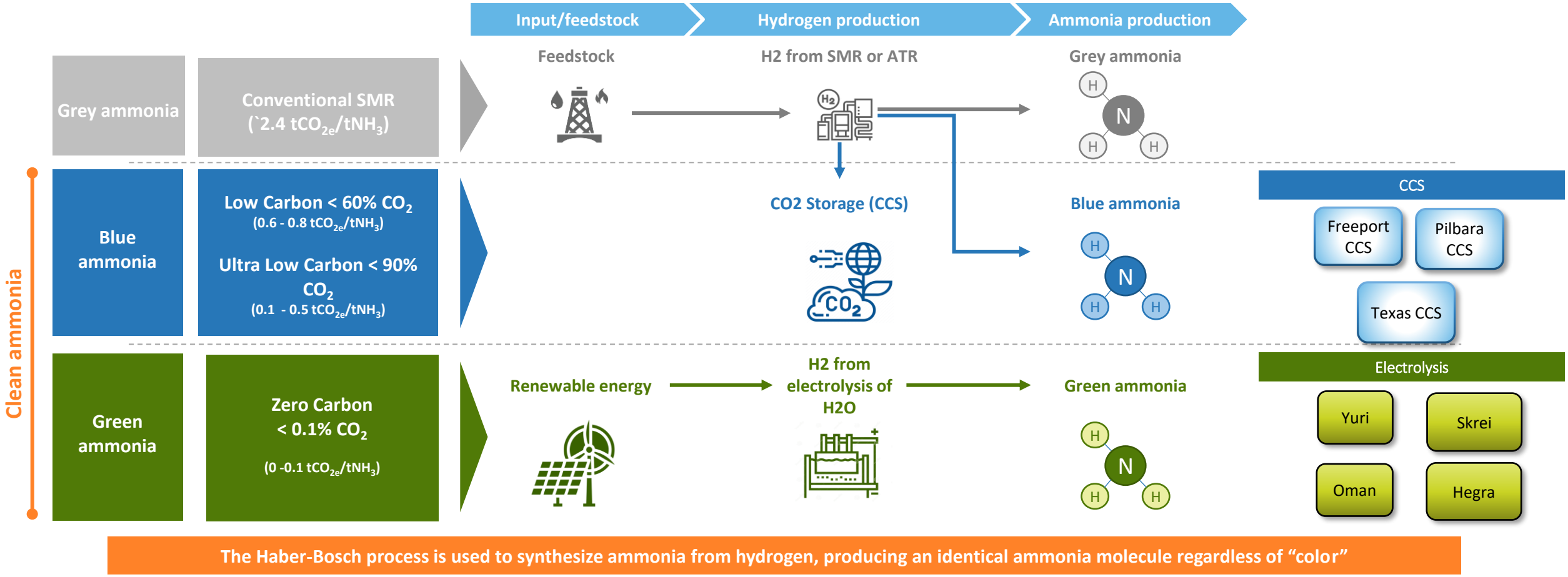
What is clean ammonia, and how to be sure that the ammonia you receive is truly clean?

- Today there is no globally agreed definition of what constitutes clean ammonia, but a color code based on production pathways linked to the hydrogen is widely used (blue, green, yellow, turquoise etc.)

- What is clear is that for ammonia to be termed clean, it will need to have a significantly lower carbon intensity/ footprint than today's “grey” ammonia.



Product portfolio, by hydrogen production pathway



The Haber-Bosch process is used to synthesize ammonia from hydrogen, producing an identical ammonia molecule regardless of "color"

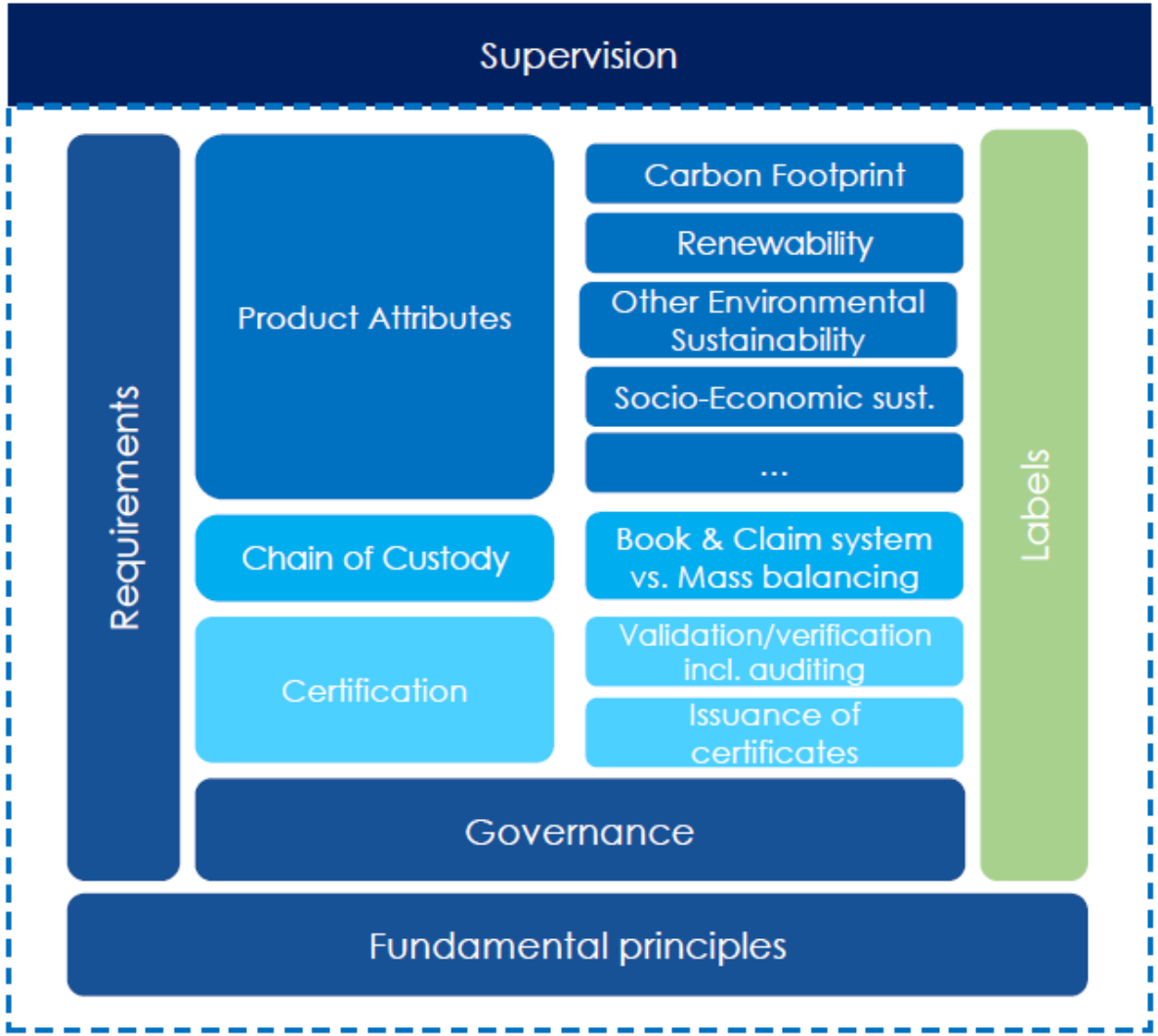
1) Combining hydrogen with nitrogen from the air
2) SMR = Steam Methane Reforming, ATR = Autothermal Reforming

Certification is only way to document clean ammonia

- A certificate is the provision by an independent body of written assurance (the certificate) that a product, service or system in question meets specific requirements.

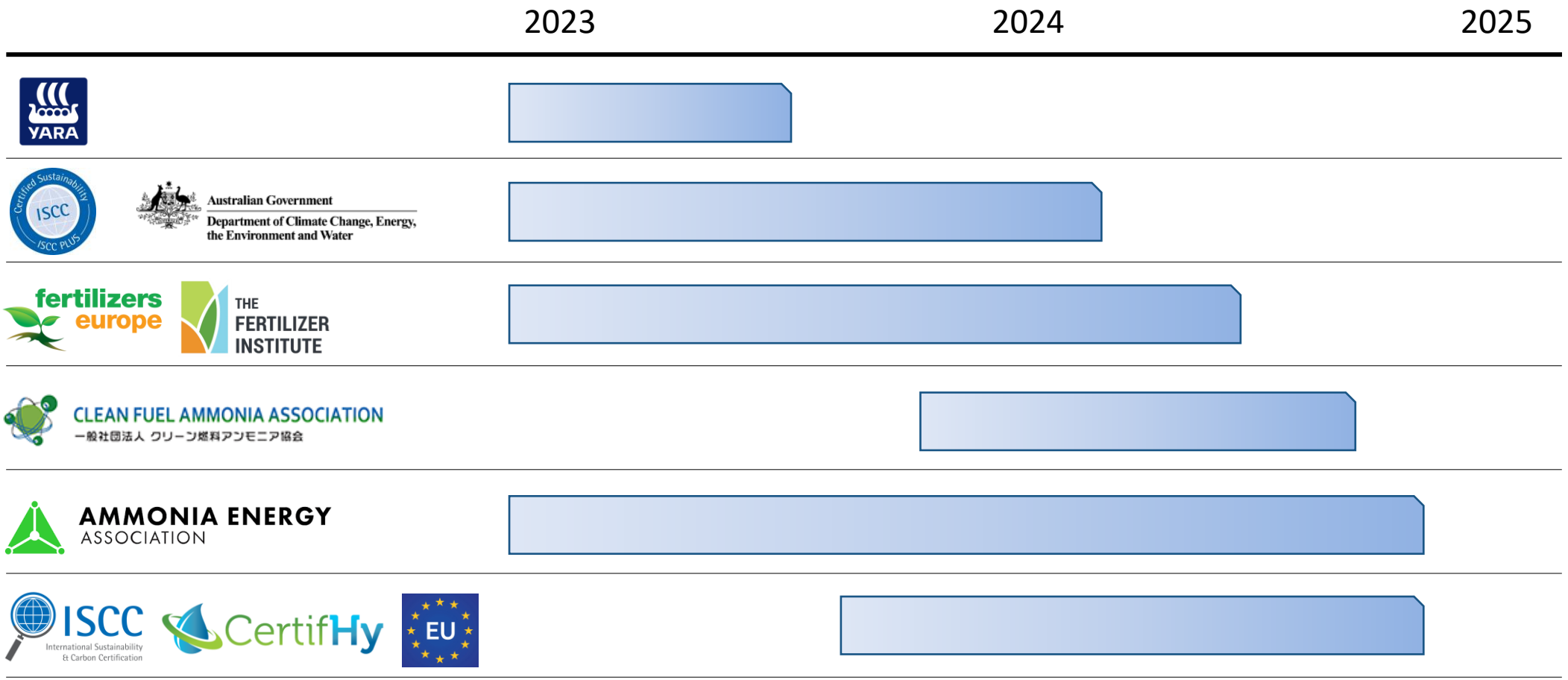
- It is the formal attestation or confirmation of certain characteristics verified through an assessment or audit.

Certification consists of many elements



Source: Hinicio, 2022

YCA certification roadmap – 2023 & Beyond




YARA
Yara Clean Ammonia