DISCUSSION PAPER

LOW-CARBON AMMONIA CERTIFICATION

AMMONIA ENERGY ASSOCIATION

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Background and Purpose

Background

The **Ammonia Energy Association** (AEA) is a global non-profit industry association that promotes the responsible use of ammonia in a sustainable energy economy.

The AEA's mission encompasses both the **decarbonization of ammonia** for existing applications, including fertilizers, chemicals, explosives, and other industrial processes, as well as the **adoption of low-carbon ammonia in new applications**, including direct use as a fuel for electric power generation or maritime transport and indirect use as a hydrogen carrier, enabling a new, global trade in low- and zero-carbon energy.

The AEA is seeking to facilitate the establishment of a globally harmonised Certification Scheme for Low-Carbon Ammonia (the Certification Scheme) to support the development of a market for low- and zero-carbon ammonia. The Certification Scheme will quantify the absolute greenhouse gas (GHG) emissions associated with ammonia production and enable prospective producers and consumers to trade ammonia on the basis of certified, transparent, and verifiable emission reductions.

Established in 2004, the AEA has unrivaled knowledge, networks, and credibility to establish the vision for ammonia as a global, tradable, sustainable energy commodity. **AEA members include over 130 corporations, international and cross-sectoral**, including a significant proportion of current and future ammonia producers, as well as many first-movers in consumer industries for ammonia energy, across maritime, power, fertilizers, chemicals, and other sectors.

The Certification Scheme will be developed by a Steering Group and Working Groups organized by the AEA and led by AEA members. Nonetheless, the success of the Certification Scheme will depend on the participation of many strategic partners (AEA non-members) who will play crucial roles both in informing the design phase and in supporting the adoption phase. **The AEA aims to formalize existing relationships and forge new links with like-minded organizations** – international, regional, and sectoral; governmental, industrial, and academic – in order that relevant parties can be meaningfully integrated into the scheme's development process.

This **Discussion Paper** launches the process with an initial Consultation Phase during which the AEA aims

1. To solicit feedback on the Certification Scheme's proposed objectives, principles, governance, and implementation, as well as
2. To invite expressions of interest in participating in Working Groups and/or
3. To invite expressions of interest in piloting the Certification Scheme.

The AEA invites any interested organization to provide feedback through the **Certification Survey**, which is publicly available at ammoniaenergy.org/certification.

Purpose of this Discussion Paper and Survey

This Discussion Paper and the accompanying Survey are designed to **illustrate initial thinking around a Low-Carbon Ammonia Certification Scheme and stimulate discussion of its potential merits, limitations, and design details**.

During September and October 2021, the AEA is soliciting feedback from its Members and key Stakeholder Organizations on the development of its proposed Certification Scheme. In addition, **the AEA invites any interested party to submit feedback** through the Survey (ammoniaenergy.org/certification).

To be considered within the initial consultation, **feedback must be received by end of day on Sunday, October 31, 2021**. The Steering Group will then oversee the preparation of a work plan and assign participants to our Working Groups. The AEA anticipates that the Working Groups will begin to execute their scopes of work in November.

While the initial Consultation Phase will have concluded in October 2021, the Survey will remain open. The AEA will continue to collect stakeholder input on an ongoing basis, and **expressions of interest in joining a Working Group or proposing a pilot project are encouraged at any time**.

Any information received by the AEA through the Survey will be used for the purpose of informing the development of the Certification Scheme. Survey responses will be shared with AEA staff and other individuals participating in AEA committees, including its Certification Steering Group and Working Groups, and may be made publicly available. Confidential or commercially sensitive information should not be shared through this Survey; please contact the AEA Certification Project Manager (certification@ammoniaenergy.org) if you wish to discuss sensitive information.

Low-Carbon Ammonia Certification Scheme

Strategic Objectives

The AEA is seeking to facilitate the establishment of a globally harmonised Certification Scheme for Low-Carbon Ammonia to support development of the market for low- and zero-carbon ammonia. The Certification Scheme will quantify the absolute greenhouse gas (GHG) emissions associated with ammonia production, and enable prospective producers and consumers to trade ammonia on the basis of certified, transparent, and verifiable emission reductions.

Question: Do you agree that the long-term aim of the Certification Scheme should be to develop a "globally harmonised" standard (acknowledging that early / pilot projects may require regional or bilateral agreements)?

Question: Do you agree that the primary purpose of the Certification Scheme should be to lower the barriers to international trade of low- or zero-carbon ammonia?

Question: Do you agree that the Certification Scheme must begin by quantifying absolute emissions (carbon intensity of production)?

Question: Are there any critical aspects of low-carbon ammonia certification that are omitted or excluded by our proposed "Strategic Objectives"?

Submit your feedback at
ammoniaenergy.org/certification

Design Principles

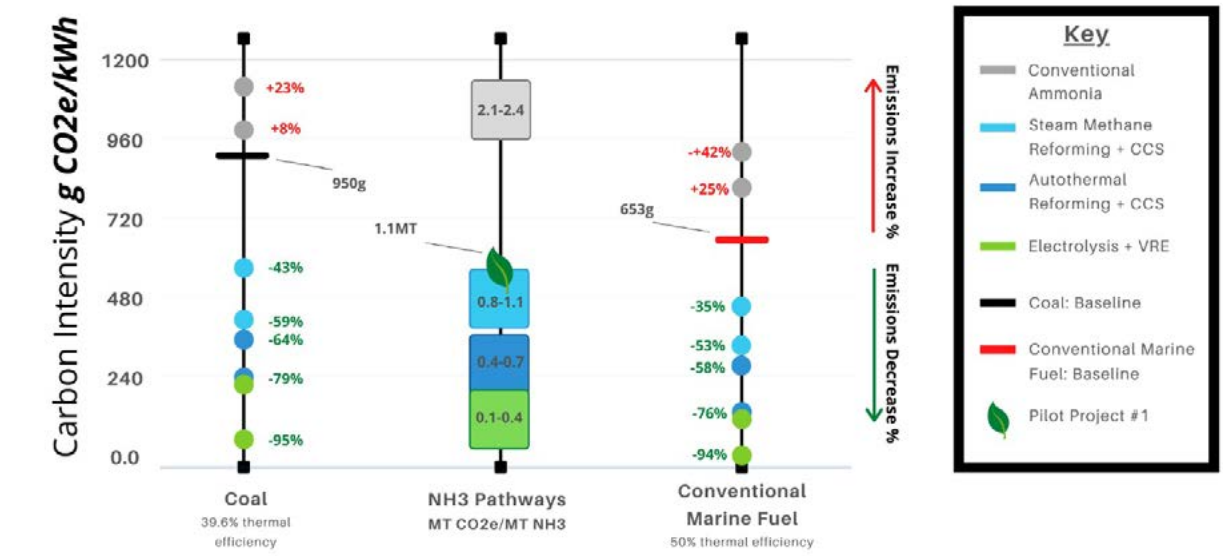
General

The proposed Certification Scheme aims to support the adoption of a globally harmonised framework for the **accounting, reporting, and verification of the carbon intensity of ammonia** (tCO_2e/tNH_3) as the basis for **certification of emission reductions** associated with the implementation of low-carbon ammonia initiatives, through the following reporting and certification activities:

- **Ammonia Projects—Registration and Reporting**: the registration of Ammonia Projects under the Certification Scheme, against approved project design, accounting, monitoring, reporting and verification methodologies; and
- **Ammonia Product—Certification**: the issuance of Low-Carbon Ammonia Certificates for verified emission reductions arising from the implementation of Low Carbon Ammonia Projects registered under the scheme.

During Registration and Reporting, the Scheme will **quantify an absolute carbon intensity for ammonia** produced at a specific site. In addition to carbon intensity, other metrics will be critical to report, including origin, inputs, co-products, technology pathway, and date of manufacture.

Figure 1. Illustrative Comparison of Technology Pathways



During Certification, these data are verified and attached to tradable volumes of ammonia. The carbon accounting undertaken during Registration and Reporting becomes the basis for **transparent demonstration of emission reductions** at the production site (well-to-gate) or, optionally, across the broader value chain (well-to-tank, well-to-wheel).

To satisfy different markets in different jurisdictions, the Certification Scheme may need to provide metrics that satisfy a range of categories or taxonomies that may not be harmonized.

Question: Do you agree that the certification process should focus on product tons, creating a basis for trade, as opposed to verifying plant/site or corporate emissions?

Question: Do you agree that the basis for certification should be absolute life-cycle emissions, as opposed to categories (eg, technology pathways, blue/green)?

Question: Do you agree that the Certification Scheme should extend to a CDM approach (emission reductions—use cases) and not restrict itself only to quantification of absolute emissions (carbon intensity—production sites)?

Question: Do you agree that the Certification Scheme should be open to all ammonia plants and not restricted to low-carbon production sites (eg, certifying baseline emissions in advance of decarbonization)?

Question: Do you agree that it would be beneficial to design low-carbon ammonia certificates to be fungible, i.e., able to be traded independently from the physical ammonia product (assuming that there is a robust, transparent, and trusted system for managing the full certificate lifecycle including resale and retirement)?

Submit your feedback at
ammoniaenergy.org/certification

Key Methodological References

Key methodological references consulted for the design and implementation of the scheme include the following:

- Key References, including UNFCCC guidelines and other key publications
- Standards, including ISO 1406X standards, and GHG Protocol
- National-level accounting and reporting guidelines

Figure 2. Key Methodology References

References	2006 IPCC guidelines for national greenhouse gas inventories IFI TWG – AHG-003 International Financial Institutions Guideline for a Harmonised Approach to Greenhouse Gas Accounting, v0.2.0 INTERIM, June 2021
Standards	ISO 14064-1:2018 Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals
	ISO 14064-2:2019 Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements
	ISO 14064-3:2019 Greenhouse gases – Part 3: Specification with guidance for the verification and validation of greenhouse gas statements
	ISO 14066:2011 Greenhouse gases – Competence requirements for greenhouse gas validation teams and verification teams
	ISO 14067:2018 Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification
	ISO/CD 14083 Greenhouse gases – Quantification and reporting of greenhouse gas emissions arising from operations of transport chains
	ISO 19694-1:2021 Stationary source emissions – Determination of greenhouse gas emissions in energy-intensive industries – Part 1: General aspects
	ISO 20951:2019 Soil Quality – Guidance on methods for measuring greenhouse gases (CO2, N2O, CH4) and ammonia (NH3) fluxes between soils and the atmosphere
	ISO/TR 27912:2016 Carbon dioxide capture – Carbon dioxide capture systems, technologies and processes
	ISO/TR 27915:2017 Carbon dioxide capture, transportation and geological storage–Quantification and verification

Question: Are any significant references missing from "Key Methodology References" on page 10?

Question: Are there any existing or anticipated conflicts between the Key Methodological References that would make it challenging to pursue global harmonization?

Question: Even with these existing standards and references, there can be a large variance in the outcome based on accounting boundaries, data sources, baselines, and allocation decisions. How prescriptive should the Certification Scheme aim to be?

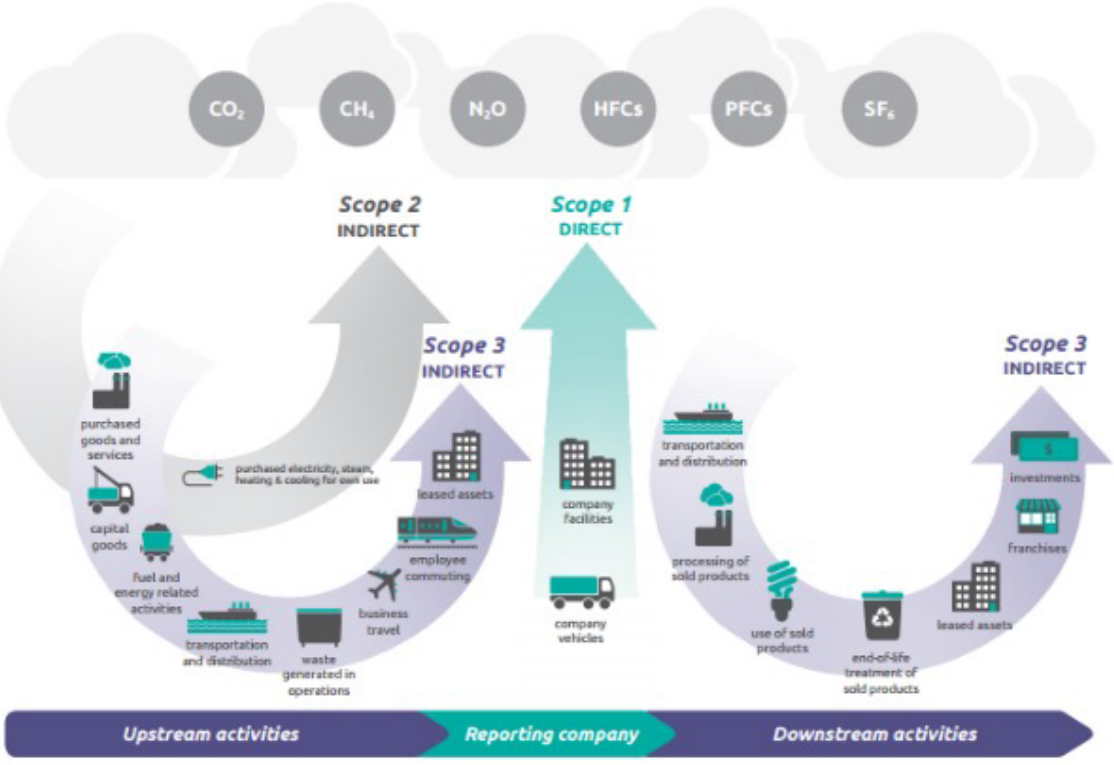
Submit your feedback at
ammoniaenergy.org/certification

GHG Emissions—Scope

The Certification Scheme adopts the definitions of GHG Emissions Scope, introduced by the WRI/WBCSD *GHG Protocol*, as follows:

- **Scope 1 GHG Emissions**, including direct emissions
- **Scope 2 GHG Emissions**, including indirect emissions from purchased electricity, steam, heating and cooling
- **Scope 3 GHG Emissions**, including indirect emissions from upstream, downstream and end-use activities

Figure 3. Emissions Pathways



Well-to-Gate (mandatory)

Well-to-Tank (optional)

Well-to-Wheel/Wake (optional)

The Certification Scheme aims to certify absolute well-to-gate emissions (Scopes 1, 2, and upstream 3), with optional Well-to-Tank or Well-to-Wheel/Wake certification. The AEA proposes this minimum boundary (Well-to-Gate), with optional boundary expansions, in order to develop a certification that is fit-for-purpose across multiple customer types (producers, traders, retailers, end users) in different and possibly conflicting sectors or jurisdictions.

Question: Do you agree that the Certification Scheme should include well-to-gate emissions (scopes 1+2 and upstream 3) as opposed to limiting measurement to emissions within the plant boundary (scopes 1+2 but not 3)?

Question: Do you agree that the Certification Scheme should only measure and track GHG emission intensity (CO_2e/tNH_3) and not other sustainability metrics (e.g., water intensity, energy intensity, biodiversity impacts, environmental justice, etc.)?

Submit your feedback at
ammoniaenergy.org/certification

Figure 4. Summary of Design Principles

General			
	Applicability	Project Registration and Reporting Product Certification	
	Approach	Life-cycle (Value-chain)	
	Functional Units	Primary: one metric tonne of Ammonia (tNH_3)	
		Co-products: e.g. hydrogen,carbon black	
	Reporting Unit	Primary: tonnes of CO_2-e per tonne of of ammonia (tCO_2-e/tNH_3)	
		Co-products: tonnes of CO_2-e per tonne of co-product (tCO_2-e/tco-product)	
	Methodology References	See "Figure 2. Key Methodology References" on page 10	
Coverage			
	GHG species and Global Warming Potentials (GWP, 100-year horizon)		
		Carbon dioxide (CO_2)	1
		Methane (CH_4)	21
		Nitrous Oxide (N_2O)	265
		Hydrofluorocarbons	
		Fluoroform (HFC-23)	11,700
		Tetrafluoroethane (HFC-134a)	1,300
		Perfluorocarbons	
		Carbon tetrafluoride (CF_4)	6,500
		Hexafluoroethane (C_2F_6)	9,200
		Sulfur Hexafluoride (SF_6)	22,800
		Nitrogen trifluoride (NF_3)	16,100
Scope			
	Well-to-gate (Mandatory)	Scope 1 emissions	
		Scope 2 emissions	
		Scope 3 emissions (upstream)	
	Well-to-tank (Optional)	Well-to-gate scope, plus: Scope 3 emissions (downstream)	
	Well-to-wheel (Optional)	Well-to-tank scope, plus: Scope 3 emissions (end-use)	

Production Pathways (not exhaustive)	
Conventional	Natural-gas reforming
	Coal gasification
Conventional + Abatement	with Carbon Capture and Sequestration
	with Carbon Capture and Utilization
Electrolysis-based	Electrolysis from grid electricity (no PPA)
	Electrolysis from grid electricity (with PPA)
	Electrolysis from dedicated renewables
	Electrolysis from nuclear power
Novel pathways	Biogenic gas reforming
	Methane pyrolysis
	Ammonia stripping from waste/water
	Direct synthesis pathways
Utilization Pathways (not exhaustive)	
Feedstock	Manufacturing of Basic Chemicals
	Manufacturing of Fertilizers
	Manufacturing of Explosives
	Manufacturing of Hydrogen
Industrial Use	Mineral Processing
	Refrigeration
	DeNOx
	Wastewater treatment
Fuel	Power Generation
	Shipping

Pathways—Production and Utilization

In order to establish trust in the certified ammonia, **any ammonia production or utilization pathway will require a specific methodology that clearly identifies a consistent and transparent approach for the calculation of lifecycle carbon intensity**. A set of initial pathways will be identified and developed by the Pathways Working Group; additional pathways can be defined during the operational phase of the Certification Scheme. In addition, a "default pathway" may also be required, providing a near-term route to certification for projects that fall outside of the initial set of defined pathways.

We expect that the initial pathways defined during the development of the Certification Scheme will be paired with a commitment from AEA member companies to pilot the protocol for each pathway.

Question: With reference to the "Figure 4. Summary of Design Principles" table above, listing 12 ammonia production pathways, are we overlooking any critical production technologies?

Question: Which of these production pathways are the most critical to define in the initial phase?

Question: Should any production pathways be excluded from the Certification Scheme?

Question: With reference to the "Figure 4. Summary of Design Principles" table above, listing 10 ammonia utilization pathways, are we overlooking any critical technologies or use-cases?

Question: Which utilization pathways are the most critical to define in the initial phase?

Question: Should any of these utilization pathways be excluded from the certification scheme?

Submit your feedback at
ammoniaenergy.org/certification

Regulations

Another Working Group, focused on Regulations, will conduct **a global review of existing and under-development regulatory measures and standards** or certifications for products or processes that are relevant to low-carbon ammonia, either because the regulations, standards, or certifications apply directly to ammonia and/or hydrogen, or because they incorporate analytic methods and approaches that may be used in a low-carbon ammonia certification scheme. The working group will determine how the Certification Scheme will complement, conflict with, or otherwise relate to existing and under-development regulations, standards, or certifications.

This work will create opportunities to promote cohesion and reduce friction between the Certification Scheme and other regulations, standards, or certifications. This will require extensive relationship-building with international regulatory organizations relevant to the AEA scheme.

Ultimately, this work stream will lead to the **characterization of ammonia and definitions of key terms and classifications**, according to the taxonomies or thresholds required by end users and the policies under which they operate.

Question: Which existing or developing regulations, standards, or certifications are critical for initial harmonization with the Certification Scheme?

Question: Are there any existing or developing regulations, standards, or certifications that are NOT appropriate for harmonization with the Certification Scheme?

Question: Do you agree that the Certification Scheme should aim to characterize ammonia (i.e., defining terms like "blue" or "low-carbon")?

Question: Do you agree that characterization of ammonia (i.e., defining "blue" or "low-carbon") should be driven by insight into major end-use cases (e.g., thresholds in markets for emission reductions) rather than by insight into production pathways (e.g., thresholds inherent in synthesis technology)?

Submit your feedback at
ammoniaenergy.org/certification

Proposed Implementation Strategy and Governance

Proposed Governance for the Implementation Phase

The AEA's Board of Directors has authorized a Certification Committee to act as the Steering Group for implementation of the Certification Scheme. The Steering Group reports to the AEA Board of Directors and ultimately to the members of the AEA. This is the industry group.

Alongside the Steering Group, the AEA proposes to invite key partners to form an Advisory Group consisting of non-member organizations and stakeholders. This will include **Global partners** who will be critical for international harmonization and adoption. **Regional partners** may play a critical role in developing, piloting, and implementing the scheme, and this includes both government agencies and trade associations. Additionally, certain kinds of **Commercial partners** may also play a critical role in delivering the scheme, such as certification bodies, verification agents, or trading platforms. This is the non-industry group.

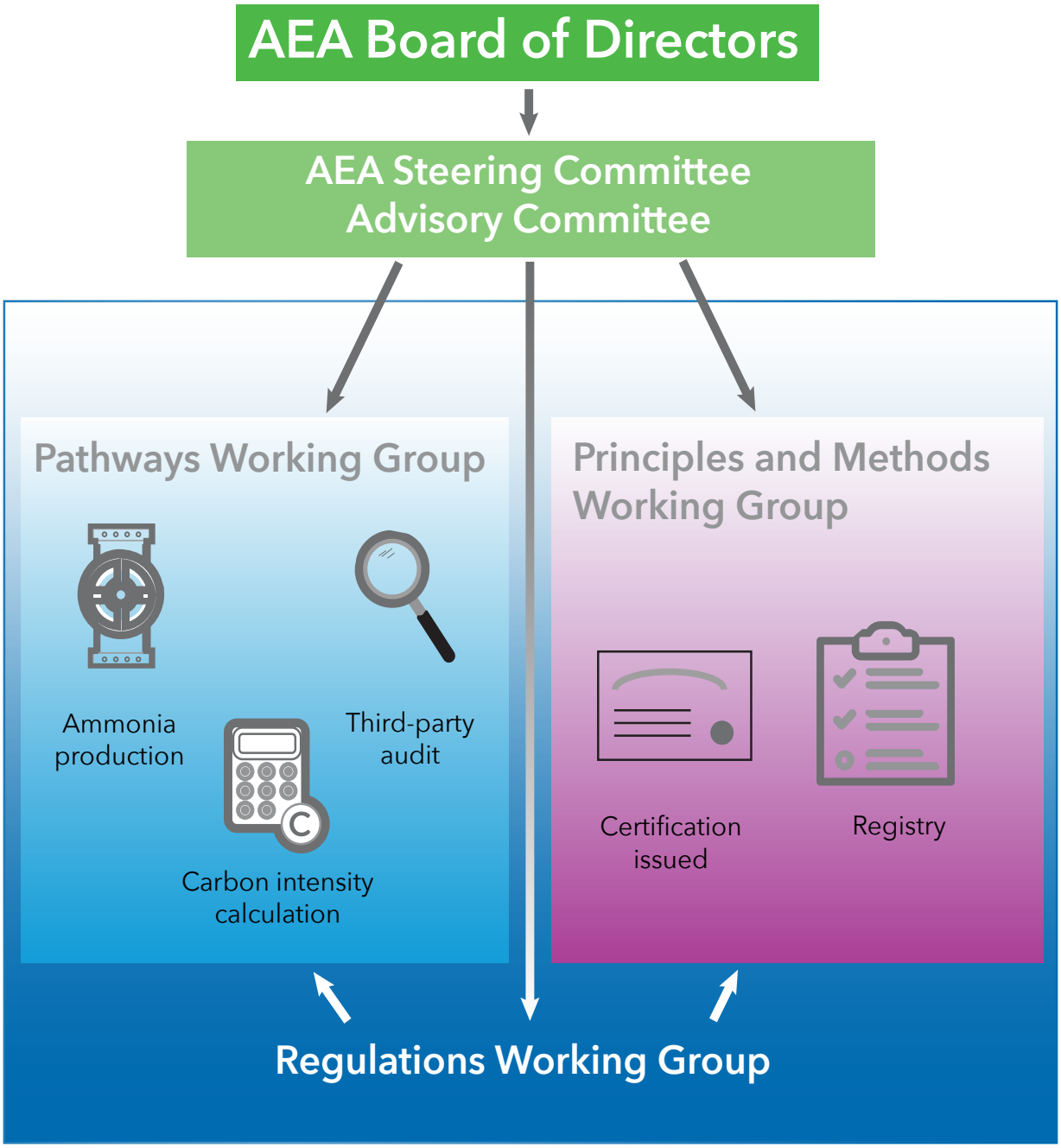
The Steering Group and Advisory Group will together oversee the development and execution of the Certification Scheme workplan by three Working Groups: "Principles and Methods," "Pathways," "Regulations."

Figure 5. Proposed Governance for the Implementation Phase

Steering Group	*Chair* (2021–2022): Nicholas Cook, CF Fertilisers *Members*: AEA Platinum Member Organizations Representatives and Working Group Chairs
Advisory Group	Partner Organizations and Key Institutional Stakeholders
Secretariat	AEA Certification Project Manager: Eman Al-Rabi AEA Executive Director: Trevor Brown 3rd Party Consultant Support (tbc)
WG 1. Principles and Methods	*Chair* (2021–2022): Attilio Pigneri, The Hydrogen Utility *Members*: AEA Member and Partner Organization Representatives
WG 2. Pathways	*Chair* (2021–2022): Blake Adair, Nutrien *Members*: AEA Member and Partner Organization Representatives
WG 3. Regulations	*Chair* (2021–2022): Jonathan Lewis, Clean Air Task Force *Members*: AEA Member and Partner Organization Representatives

The AEA proposes to develop the Certification Scheme under the direction of these three working groups, each consisting of representatives from AEA Member companies, partner organizations, and key institutional stakeholders. These three working groups will be established and begin in earnest in November 2021.

Figure 6. Governance and Working Groups



Proposed Governance for the Operational Phase

The three Working Groups will be active during the Implementation Phase (2021–2023) and the scope of work for each group has been designed to mirror the roles for different groups in the Operational Phase (2024–), supporting the evolution of the Certification Scheme from implementation to operation.

- WG1: Principles and Methods—relates to Verification Bodies
- WG2: Pathways—relates to Verifiers/Assessors
- WG3: Regulations—ultimately relates to Proponents/Participants

Figure 7. Proposed Governance for the Operational Phase

Certification Body (new entity)	Composition	AEA and Partner Organizations
	Responsibilities	Guidelines Development
		Verification Body Accreditation
		Methodology Approval
		Project Registration
		Registration and Issuance of Certificates
Accredited Verification Bodies	Organizations	Verification Bodies (Global Registries)
	Responsibilities	Methodology Review
		Verifiers/Assessors Accreditation
		Verification of Project Reports
Accredited Verifiers/Assessors	Organizations	Service Providers
	Responsibilities	
Proponents/Participants	Organizations	Owner/Operators
		Financial Institutions
		Trading Organizations
		Customers
	Responsibilities	Project Design
		Project Implementation
		Monitoring, Verification, and Reporting

Establishment Timeline

Consultation Phase Sep 2021–Oct 2021	Targeted AEA Membership and Stakeholder Consultation Public Consultation (AEA Australia Conference) Working Group Establishment Scheme Workplan Announcement (November 2021)
Design Phase Oct 2021–Sep 2022	Scheme Governance Principles and Methods Pathway Methodologies Interplay with Regulations and Market Mechanisms
Scheme Launch—November 2022	
Establishment Phase Dec 2022–Nov 2023	Development and validation of an initial portfolio of methodologies Registration, validation and certification of an initial portfolio of pilot projects Issue of the first-year certificate for Pilot Projects registered under the scheme
Operation Phase 2024–ongoing	Ongoing management of the scheme New methodologies development and validation New projects registration and validation Monitoring reporting and verification of projects registered under the scheme, ongoing issue of certificates (annually)

Ammonia Energy Association Members

as of October 2021

PLATINUM: CF Industries*, The Hydrogen Utility*, InterContinental Energy*, KBR*, LSB Industries, Monolith Materials, Mitsui & Co., Nutrien*, OCI*, Yara*. GOLD: Acron, AFC Energy, Airgas, Aker Clean Hydrogen, Asian Renewable Energy Hub, Casale*, Enaex, Engie, Equinor, Fortescue Future Industries, FuelPositive, Haldor Topsøe*, Hamilton Locke, Hydrofuel, Mitsubishi Heavy Industries, Origin Energy*, Proton Ventures*, Ridley Terminals, Starfire Energy*, Syzygy Plasmonics, thyssenkrupp Industrial Solutions*, Trammo, Tri-State Generation & Transmission. SILVER: AES Gener, Air Products, Ammonigy, AmmPower, Amogy, Argus Media, BASF, Black & Veatch, Bureau Veritas, Burns & McDonnell, Casa dos Ventos, CDI Engineering, Consorcio Eólico, CRU Group, CS Combustion Solutions, Cummins, EIFER, Enterprize Energy, Fertiberia, GenCell Energy, GTI, Gunvor Group*, H2Site, Horisont Energi, HyFuels Holdings, Intecsa Industrial, Linde, Lotte Fine Chemical, Maersk*, Mercuria, MineARC Systems, Nel Hydrogen*, OGS Global, Organics Group, Pacific Green Technologies, SagaPure*, Schoeller-Bleckmann Nitec, Shell, Sperre Industri, Stamicarbon, Thorium Energy Alliance*, TotalEnergies*, Tsubame BHB, Wabash Valley Resources, Wonik Materials, Woodside Energy. MEMBERS: AHMON, Air Liquide, Airthium, Apex Clean Energy, Ark Energy, Arizona Public Service, Arranged, AustriaEnergy, BLG, Brittany Ferries, C-Job Naval Architects, Carbon-Neutral Consulting*, CHZ Technology, Cozairo, Cura IT, Danaos Shipping, Duiker Combustion Engineers, Energy Estate, Eneus Energy, ESNA, Exmar, Gaztransport & Technigaz, George Propane Inc, GESCA, Greenfield Nitrogen, Idemitsu Kosan, Incitec Pivot, Ingenostrum, IT Power Australia, JGC Holding Corporation, John Cockerill, Jupiter Ionics, MAN Energy Solutions, MicroEra Power*, Nebraska Public Power District, Netsco, New Energy Technology, Nordex, Northern Nitrogen, NYK Energy Transport (USA), Oceanic Vessels, Osaka Gas USA, Renewable Hydrogen Corporation Canada, SAFCell, SBM Schiedam, Syntex, Terrestrial Energy, Unconventional Gas Solutions, UPC\AC Renewables, Varo Energy, Vopak.

* indicates representation on Board of Directors

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