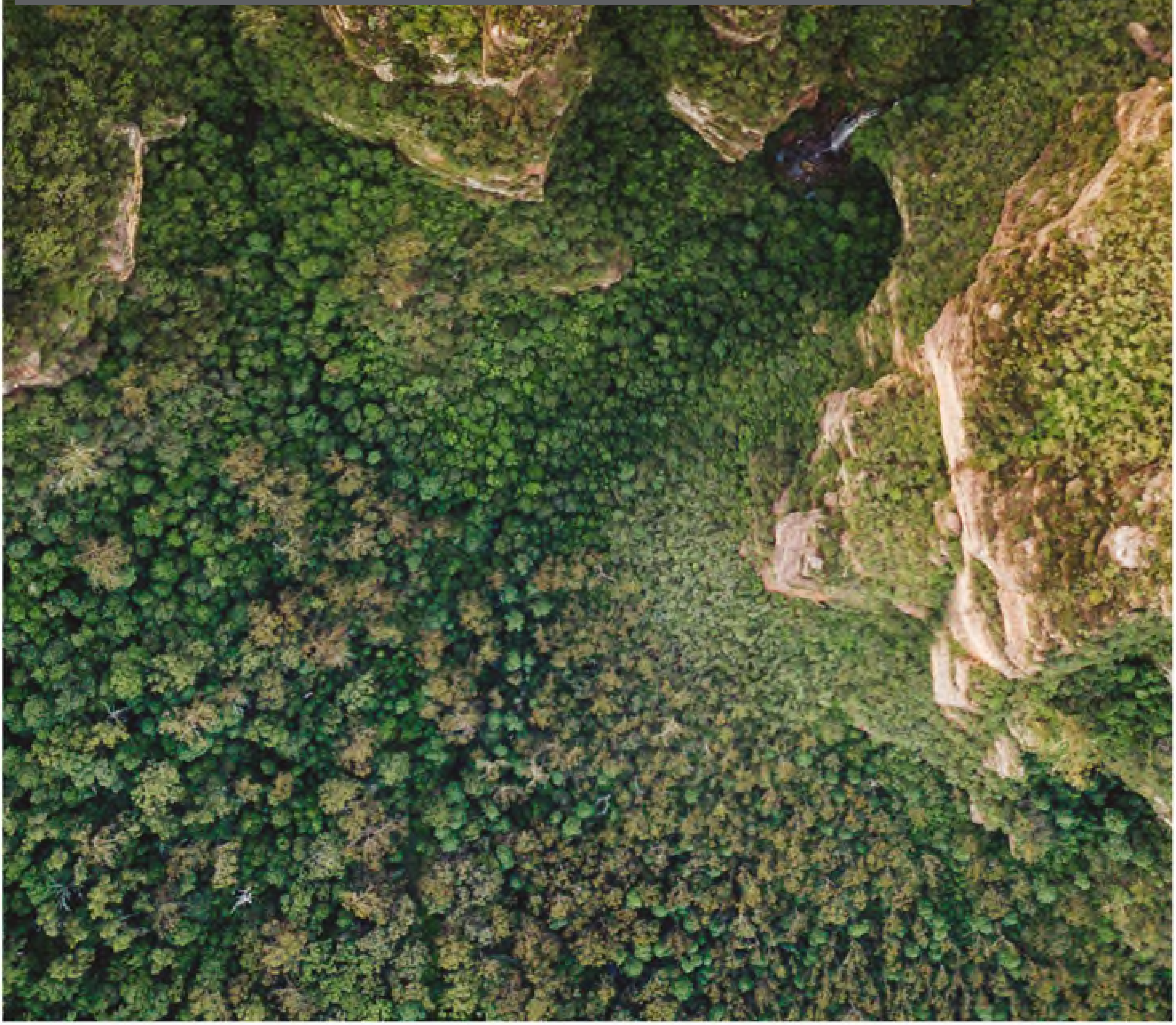
Hydrogen Guarantee of Origins for Australia

Options paper

Department of Industry, Science, Energy and Resources

24 February 2021 | 126043



Executive summary

Hydrogen's current resurgence is reflective of both the global energy transition and hydrogen's potential to deliver greenhouse gas emissions reductions and support renewable energy uptake. Australia is well positioned to capitalise on the hydrogen market opportunities with its abundance of renewable resources, proven experience as a large-scale global exporter of energy commodities and existing trade links with future export markets such as Japan and South Korea.

Australia's *National Hydrogen Strategy* (the Strategy) provides a framework for Australia to develop a sustainable and commercial hydrogen industry to 2030 and beyond.

Hydrogen certification has been identified by the Strategy as a measure of success

The Strategy has outlined the implementation of a robust, internationally accepted Guarantee of Origin (GO) scheme, which sets out a standardised process of tracing and certifying the provenance of hydrogen and the associated environmental impacts such as GHG emissions, as a key measure of success to signpost Australia's progress towards its hydrogen vision and as an action item to support this progress.

The Strategy proposed a minimal domestic scheme could be established – one which verifies and tracks production technology, accounts for scope 1 and scope 2 carbon emissions, and production location. It also flagged Australia's intention to play a leading role in the design and development of an international scheme.

The Department of Industry, Science, Energy and Resources (the Department) is taking the lead on progressing the development of a domestic hydrogen certification scheme.

Energetics' Hydrogen Guarantee of Origins for Australia Study (the Study) aims to provide the Department with options for the development of a scheme

The Department commissioned Energetics to undertake three discrete but interrelated tasks, including a review of international hydrogen certification schemes, with a view to identify any interface/linkage opportunities for a future Australian scheme, review and analysis of the Department's previous stakeholder survey (May 2020) and facilitation of a new stakeholder workshop to understand key stakeholder issues with respect to timing and design elements of a domestic scheme and development of options and pathways for a hydrogen GO scheme in Australia.

Limited number of international hydrogen certification schemes reflect the nascent nature of the market

Our research demonstrated that there are a limited number of established and/or emerging international hydrogen certification schemes. The level of maturity of the schemes varies across the spectrum with Europe's CertifHy and Germany's TÜV SÜD currently operational, while France's AFHYPAC scheme is still in early stages of development. These three schemes differ in terms of their scope and design, including key differences in labelling of hydrogen and setting of system boundaries.

Of existing schemes, the CertifHy scheme provides the most realistic alignment opportunity for Australia

The CertifHy scheme, which commenced in 2014, aims to design and implement Europe's first comprehensive GO certification scheme for 'green' and 'low-carbon' hydrogen. Our research identified it as the most established, dedicated, and comprehensive international hydrogen scheme. The scheme, which is underpinned by the European Union's (EU) Renewable Energy Directive and Renewable Energy Direct Recast (RED I and RED II, respectively), is currently in a pilot stage in anticipation of an EU wide deployment.

Whilst CertifHy does not provide any immediate linkage opportunities (as it doesn't allow for generation of GOs outside Europe), if Australia wished to link in the future, it could choose to adopt elements of the scheme (i.e. partial alignment) so that its domestic scheme is consistent with CertifHy. This could include adoption of key design elements such as system boundary and accounting methodology. However, due consideration is required with respect to some of CertifHy's features, such as labelling approach, which may not align with requirements for a future Australian scheme, meaning that an immediate 'full' alignment is deemed unrealistic at this stage.

Stakeholder survey highlights a clear preference for the scheme to be in place by 2022

Our analysis of the Department's May 2020 stakeholder survey on a hydrogen GO scheme revealed a number of key insights with respect to stakeholder preferences regarding scheme timing and design, including:

- Clear preference for a **scheme to be in place by 2022** to avoid investment delays
- General **preference for a single scheme**, however alignment with international schemes deemed important to enable the export market to develop with some recognition that **full alignment from the outset may delay** a domestic scheme
- A **well-to-gate boundary** system as a starting point with some stakeholders preferring broader/more comprehensive systems such as cradle-to-grave
- Broad agreement on the **benefits of leveraging existing domestic schemes**, particularly the National Greenhouse and Energy Reporting (NGER) Scheme[1]
- Preference for scheme to **allow consumers to distinguish between renewable and non-renewable sources of hydrogen**
- The use of **carbon offsets is likely to be a contentious issue** with divergent positions at either end of the spectrum (i.e. include vs. exclude)
- Importance of a **government led scheme** with the Clean Energy Regulator as a logical administrator
- The need for **credibility, transparency, simplicity and low compliance cost**.

Our stakeholder workshop reinforced stakeholders' preference to accept a minimal scheme with a degree of international alignment to avoid delays

Energetics facilitated an online workshop (the Workshop), involving 56 stakeholders, with representation across the industry, to identify the key issues and priorities with respect to a future Australian hydrogen GO scheme. Three models, including Domestic, Regional and International, which had distinct characteristics in terms of timing and design, including system boundary, accounting methodology, use of offsets and governance, were tested with the stakeholders.

[1] CER. (2019). About the National Greenhouse and Energy Reporting scheme. Retrieved from Clean Energy Regulator: http://www.cleanenergyregulator.gov.au/NGER/About-the-National-Greenhouse-and-Energy-Reporting-scheme

The Workshop results revealed that there was no clear preference for one nominal model. While there was some interest in the Regional model given clear benefits for establishing trade, stakeholders seem to favour the establishment of a simple scheme (i.e. domestic) aligned with key international parameters and leveraging existing Australian carbon accounting frameworks, which can be implemented as soon as possible. There was some interest in the international model, but stakeholders were broadly comfortable in terms of prioritising immediate timing over full international alignment.

Stakeholders demonstrated consensus on some key design elements such as system boundary and accounting methodology

The results of the Workshop showed stakeholder convergence on system boundary and accounting methodology, however the use of offsets proved to be a contentious issue, as detailed below:

- **System boundary** - participants favoured a well-to-gate system boundary, acknowledging the fact that alignment with international schemes may push an Australian scheme to consider a broader boundary, but also noted the consideration of energy carriers such as ammonia would be important.
- **Accounting methodology** - leveraging of the rigorous and well understood NGER accounting framework was preferred by stakeholders. Although, it was broadly recognised that to align with international schemes (including CertifHy), this will need to be supplemented by other data sources and frameworks
- **Carbon offsets** – no convergence on the acceptability of carbon offsets with proponents for inclusion of offsets deeming them as necessary for the early growth of the domestic industry (i.e. allow for the commercialisation or substitution of carbon capture and storage type technologies). If offsets are to be included, stakeholders deemed transparency, in reporting use of any offsets to customers, as an important consideration. Concerns regarding the inclusion of offsets generally seemed to stem from perceived risks to credibility and value of Australian certificates in international markets.
- **Governance** – there was a clear preference for government to lead a future hydrogen GO scheme, to provide the necessary credibility. The Clean Energy Regulator (CER) was nominated consistently as the most logical administrator.

The need for the scheme to evolve over time was recognised by the stakeholders

Stakeholders understand that any initial scheme must evolve over time as the hydrogen market develops, to accommodate market requirements (both domestic and international) and it may include hydrogen derivatives (such as ammonia or various liquid organic hydrogen carriers), related products (such as biomethane) and consideration of broader environmental impacts such as water.

Our work has identified three options and pathways for the development of certification for Australia

Using the insights from our research and analysis of stakeholder positions with respect to the design of a future scheme, we identified three options for the development of a hydrogen certification scheme in Australia, which are detailed in Table 1 below.

Whilst Option 2 ('Partial alignment with CertifHy') and Option 3 ('Minimal domestic scheme that transitions to an international scheme over time') have been presented as standalone options due to how they may be framed and implemented, they do have a number of features in common. We anticipate that over time, they are likely to become increasingly similar as CertifHy becomes more established/advanced and as internationally led work through the International Partnerships for

Hydrogen and Fuel Cells in the Economy (IPHE) progresses a 'universal' scheme, which may include adoption of certain elements of CertifHy.

Section 4 of the report provides a description of each option along with comparative advantages and disadvantages.

Further research, industry engagement, undertaking pilot projects and ongoing international collaboration are recommended as the next steps

Undertake further research to better understand customer needs

To assist in selecting a preferred scheme and an implementation pathway, we recommend for the Department to undertake further research to improve its understanding of the nature and priorities of future hydrogen customers, particularly with respect to industrial domestic customers and those with net zero emissions target as well as international customers, given the lack of representation of this segment of the market in the most recent consultations.

Keep industry informed through targeted engagement

Following the selection of a preferred option or at least the key elements of an option, the Department should re-engage with industry (potentially via a position paper), to provide the initial design parameters for a future scheme, which would provide a degree of certainty to the industry. Such engagement also provides the Department with the opportunity to canvass specific design elements of the scheme, which may benefit from additional industry input.

Undertake further work to assess hydrogen production pathways and options to quantity GHG emissions across each process

The focus of this work will be to assess hydrogen production pathways and to identify appropriate methodologies for estimation and allocation of GHG emissions within a pre-defined system boundary (i.e. guided by the Department's preferred position). Such work will identify applicability/suitability of existing reporting frameworks and methods for quantifying emissions along each production pathway, which can be tested by way of pilot studies.

Undertake pilots to test out key scheme design parameters

Irrespective of the preferred option, we recommend for the Department to undertake pilot project(s) to test the key parameters, methodologies and processes of the scheme. Key learnings from the current CertifHy pilot projects, should also be considered in the design and implementation of any future Australian pilot projects. Any requirements to amend and/or supplement existing frameworks such as NGER, can be undertaken concurrent with such pilots to avoid delays to scheme commencement following the completion of the trials.

Continue to engage and collaborate through international forums

Australia's current engagement in international forums, particularly through the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), provides it with an opportunity to keep abreast of emerging trends, policy directions and future export market expectations, which can be utilised to ensure that our future domestic scheme demonstrates a high degree of international harmonisation and can also shape the direction of international activities.

With the development of a universal hydrogen GO scheme as the ultimate objective, there is potential for a scheme developed by IPHE to achieve significant levels of acceptance, given its collaborative approach and representation, which includes Australia's most likely future trading partners in Japan and South Korea. Given the nature of IPHE's Hydrogen Production Analysis Taskforce (H2PA TF) and expected outcomes with respect to the development of inputs to a standard for an international hydrogen GO scheme, Australia's ongoing contribution to this forum should be prioritised.

Table 1: Key features of initial options

Features	Option 1: Collaborative development of a certification scheme with targeted trade partners[2]	Option 2: Partial alignment with CertifHy	Option 3: Minimal domestic scheme that transitions to an international scheme over time
Outline	Establish a GO scheme reflecting bilateral (or multilateral) negotiations	Establish a GO scheme which partially aligns with select CertifHy principles (full alignment with CertifHy would be subject to the evolution of CertifHy and future preferences for a domestic scheme)	Establish a GO scheme which adopts established international principles (i.e. IPHE)
Indicative timing	2-3 years to implement Timeline is subject to bilateral negotiations and counterparty market developments	1-3 years to implement Timeline is subject to establishment of a scheme for Australia which is aligned with select CertifHy principles as well as the 'evolution' of CertifHy	1-2 years to implement Timeline is subject to establishment of an international GO scheme, particularly through the IPHE
System boundary	Gate-to-gate (emissions for production stage only, with a clearly defined system boundary which can be supported by the NGER scheme's existing factors and methods)	Well-to-gate (in line with the system boundaries specified by CertifHy)	Well-to-gate (in line with system boundaries currently being specified by IPHE)
Accounting methodology[3]	Establish methodology for allocation of emissions to hydrogen product (and relevant co-products) based on ISO 14040/14044 and ISO 14067 and the GHG Protocol *Product Life Cycle Accounting and*	Establish methodology for allocation of emissions to hydrogen product (and relevant co-products) consistent with ISO 14040/14044 and ISO 14067 and the GHG Protocol *Product Life Cycle Accounting and*	Establish methodology for allocation of emissions to hydrogen product (and relevant co-products) consistent with ISO 14040/14044 and ISO 14067 and the GHG Protocol *Product Life Cycle Accounting and*

[2] All parameters subject to approval by key trade partner(s)
[3] Note that any use of NGERS emissions factors and methods is subject to approval from relevant parties (trade partners, CertifHy, IPHE for options 1, 2 and 3 respectively)

	Reporting Standard, covering requirements for comparative assertion (if required) Use NGER emissions factors and methods to support calculation of emissions across gate-to-gate system boundary Prioritise establishment of liquid hydrogen and ammonia certification options (for export to key trade partner)	*Reporting Standard*, covering requirements for comparative assertion (if required) Use NGER emissions factors and methods where possible to support calculation of emissions across well-to-gate system boundary Provide supplementary emissions factors and methods[4] to support calculation of emissions across well-to-gate system boundary, particularly for reporting of upstream (scope 3) emissions Provide methods for market-based and location-based reporting of electricity emissions (refer to Climate Active Electricity Accounting Rules)[5] Potential implementation of an electricity GO scheme which will interface with the hydrogen scheme, or linkage with existing Australian renewable energy certification schemes Potential alignment with Annexes V and VI of the RED II and CEN EN16325 (subject to	*Reporting Standard*, covering requirements for comparative assertion (if required) Use NGER emissions factors and methods where possible to support calculation of emissions across well-to-gate system boundary Provide supplementary emissions factors and methods[4] to support calculation of emissions across well-to-gate system boundary, particularly for reporting of upstream (scope 3) emissions Provide methods for market-based and location-based reporting of electricity emissions (refer to Climate Active Electricity Accounting Rules)[5]

[4] This could include development of new default scope 3 emissions factors and methods using NGER data, broader access to NGER data to support user development of site-specific emissions factors and/or guidance for estimating emissions which does not leverage the NGER scheme

[5] Climate Active. (2021). *Electricity Accounting Rules*.
Copy of rules provided to Energetics by the Department.

		applicability for the Australian landscape, noting that these are European policy and standard) ‘Green hydrogen’ and ‘Low-carbon hydrogen’ labels and thresholds excluded (subject to Australian government’s future position and international acceptance)	
Carbon offsets	Use of selected offsets could be accommodated (in line with Climate Active), subject to approval by trade partner(s) Could include sunsetting provisions within 5-10 years Certification could include emissions intensity with and without use of offsets	Excluded	Use of selected offsets could be accommodated (in line with Climate Active), subject to alignment with IPHE Could include sunsetting provisions within 5-10 years Certification could include emissions intensity with and without use of offsets
Governance[6]	CER to lead in co-operation and engagement with international counterparts	CER to lead scheme, but should be aligned with CertifHy governance frameworks and requirements Ongoing engagement with CertifHy	CER to lead (domestic) scheme. Australian government (through the Department) to continue working closely with IPHE in establishing an international approach for hydrogen certification and align with IPHE’s governance frameworks and requirements (where available/applicable)

[6] Governance here refers to regulation and administration only, with policy development ultimately the responsibility of the Australian Government

			Ongoing engagement within international hydrogen certification landscape including IPHE and also CertifHy

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1. Introduction

While its use as a feedstock for chemical and petroleum industries is well established, the use of hydrogen to support decarbonisation, particularly in hard to abate sectors such as transport, is gaining increasing attention. This is because the burning or oxidation of hydrogen does not generate greenhouse gas (GHG) emissions and because it is a versatile energy carrier which may be generated from zero or low emissions sources. The emerging interest in hydrogen reflects the global energy transition away from fossil-based fuels currently underway and presents a significant opportunity for Australia. Domestically, hydrogen can play a pivotal role in decarbonising Australia's energy systems while improving reliability and security. Internationally, Australia has an opportunity to be a leading exporter of renewable and low emissions energy using hydrogen and its derivatives as energy carriers, harnessing the country's robust infrastructure, significant renewable energy resources, strong track record with key export partners (such as Japan and South Korea) and proven technical experience as a large-scale global exporter of energy commodities.

Australia's *National Hydrogen Strategy* (the Strategy) sets forth a plan to achieve the government's vision for a "clean, innovative, and safe" hydrogen industry, which can scale up to become globally competitive by 2030.[7] The Strategy has identified the implementation of a "robust, internationally accepted" hydrogen Guarantee of Origin (GO)[8] scheme, which sets out a standardised process of tracing and certifying the provenance of hydrogen and its associated environmental impacts such as GHG emissions, as a key measure of success to signpost Australia's progress towards its hydrogen vision and also as an important action item to accelerate progress.

During the development of the Strategy, the COAG Energy Council Hydrogen Working Group released several Issues Papers.[9] The fourth Issues Paper discussed a hydrogen GO scheme, particularly with respect to "the importance of traceability and certification to support regulatory systems and customer choices for hydrogen".[10] The Working Group considered several options, including the adoption of existing international schemes (with the most established being CertifHy[11]) as well as leveraging Australia's Climate Active (carbon neutral) certification program.[12] Limitations with both CertifHy and the Climate Active program prompted the Working Group to recommend that a new scheme be investigated. It also sought further stakeholder feedback on a number of key issues, including timing for a domestic GO scheme, scope, customer preferences, eligibility thresholds and scheme administration.

Ultimately, taking into account stakeholder feedback, the Strategy outlined the potential for a minimal domestic hydrogen GO scheme as a starting point. Several initial design features of such a scheme were proposed, including technology production tracking, inclusion of scope 1 and 2 emissions, and

[7] COAG Energy Council. (2019). Australia's National Hydrogen Strategy. Australia.
https://www.industry.gov.au/sites/default/files/2019-11/australias-national-hydrogen-strategy.pdf
[8] Note that the hydrogen GO scheme is distinct from a hydrogen certificate scheme in that the hydrogen GO is a label which provides information which describes the certified hydrogen, while a hydrogen certificate scheme includes a tradeable certificate which may or may not accompany hydrogen (i.e. separate hydrogen and certificate). The hydrogen certificate scheme may follow on from establishment of a hydrogen GO scheme.
[9] Department of Industry, Science, Energy and Research. (2019). 'National Hydrogen Strategy issues papers: have your say'. Australia.
https://www.industry.gov.au/news-media/climate-and-energy-news/national-hydrogen-strategy-issues-papers-have-your-say
[10] COAG Energy Council. (2019). National Hydrogen Strategy Issue 4: Guarantees of Origin. Australia.
https://consult.industry.gov.au/national-hydrogen-strategy-taskforce/national-hydrogen-strategy-issues-papers/supporting_documents/NationalHydrogenStrategyIssue4GuaranteesofOrigin.pdf
[11] CertifHy. (2021). 'CertifHy'
https://www.certifhy.eu
[12] Climate Active. (2020). 'Australia's collective action'
https://www.climateactive.org.au/

production location. Ensuring that a future domestic scheme can interface with similar international schemes was also identified as an important feature to support Australia's aspirations to be a major exporter of hydrogen.

1.1. Objectives

To progress the development of an Australian hydrogen GO scheme and as a first step, the Department of Industry, Science, Energy, and Resources (the Department) conducted an online survey in May 2020 to better understand stakeholder expectations and/or preferences with respect to the key elements of a future domestic scheme. Energetics was subsequently engaged to undertake a project (the Project) to build on the outcomes of this initial survey and advise on potential pathways for the development of a GO scheme for hydrogen in Australia. The Project had three key deliverables shown in Figure 1-1 and outlined below.

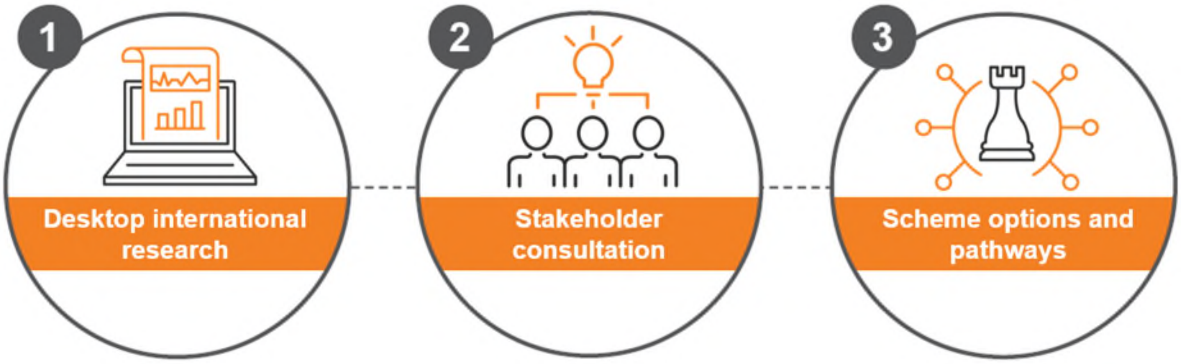

Figure 1-1: Deliverables of the Project

Review international schemes

This task involved a desktop review to identify and assess existing and emerging international hydrogen GO and certification schemes to provide the Department with an understanding of:

- scheme maturity, design, including scope, boundary, emissions accounting, governance, and implementation pathways;
- the interaction of these schemes with related certification schemes for renewable electricity and green products, including hydrogen derivatives; and
- opportunities and potential barriers in relation to Australia adopting or linking with such schemes, particularly with more established schemes such as CertifHy.

As part of this work, Energetics also examined possible engagement strategies for the Australian government to influence the design and the development of any future regional and/or global schemes.

Undertake further stakeholder consultation

Energetics was tasked with the review and analysis of the Department's May 2020 stakeholder survey. Building on these results, the stakeholder consultation's objective was to gain a greater understanding of key stakeholder issues, such as timing, design, including system boundaries, accounting methodologies, carbon offsets and governance, domestic vs international and leverage of existing domestic schemes (e.g. NGER scheme, Climate Active and the Renewable Energy Target (RET)).

Develop options for a domestic GO scheme

Synthesising the findings of the prior two tasks, Energetics was required to provide the Department with options for the design and implementation of a hydrogen GO scheme for Australia.

2. International hydrogen certification schemes

2.1. Overview of the international landscape

Energetics undertook desktop research to identify current and emerging schemes for hydrogen certification. The objective was to identify potential schemes that Australia could adopt or align with, and if neither is possible, to gain a greater understanding of the key learnings and outcomes of these schemes.

Certification via a GO scheme has been used for renewable electricity and is now considered as the most appropriate solution for hydrogen. However, our research has shown that with hydrogen as an energy commodity to support decarbonisation still in its infancy, associated certification schemes are in a similarly nascent state.

Clearly leading in development and implementation amongst these is the European hydrogen GO project, CertifHy.[13] Recognising that CertifHy is most relevant to this work, Energetics focused predominantly on this scheme (further information on the evolution of this scheme is available in Appendix A).

Outside of CertifHy, Energetics identified several other programs that involve the tracking of hydrogen emissions. This includes pure hydrogen certification schemes and also frameworks that identify and quantify emissions across a range of feedstocks, including hydrogen (Appendix B provides a summary of the key features of these schemes).

The use of renewable energy to produce zero-emissions hydrogen is of particular interest. Important relationships may exist between hydrogen certification schemes and broader renewable energy certification schemes, including renewable gas GO schemes (i.e. biogas), and renewable electricity schemes. Our research was expanded to consider broader certification schemes, which are summarised in Appendix C.

Overall, many of the schemes identified as part of our research are still in early stages of development and as such, it is difficult to understand and evaluate these schemes with high granularity. However, Energetics has undertaken extensive research to identify the key mechanisms underpinning these schemes so that the key/relevant insights can be utilised in developing options for the design of future GO scheme in Australia.

The following sections provide an overview of the existing and emerging hydrogen certification schemes, beginning with an overview of CertifHy.

[13] Energetics notes that at this stage CertifHy is a GO scheme, but there are current efforts to extend this into a certificate scheme (certificates as a tradeable commodity).

2.2. CertifHy

2.2.1. Description

CertifHy, founded in 2014 by a consortium of industry stakeholders, has become the most developed hydrogen GO scheme in the world today.[14] It is an EU-wide hydrogen certification project, supported by the Fuel Cells and Hydrogen Joint Undertaking (FCH-JU) and the EU.[15]

The project aims to design and implement Europe's first comprehensive GO certification scheme for green and low-carbon hydrogen. The objective is to ultimately provide a central certification scheme for premium hydrogen across Europe.

CertifHy has been implemented through a phased approach as summarised below and shown by Figure 2-1.

- **Phase 1** – established the definition of green and low-carbon hydrogen through extensive stakeholder consultation, while outlining a design and implementation framework for the GO scheme.

- **Phase 2** – CertifHy's governance infrastructure was developed, including its Stakeholder Platform and steering group. Four pilot projects commenced to test the scheme's design.

- **Phase 3** – As of 2020, over 76,000 GOs have been issued across the four pilot projects. The scheme is aiming to consolidate its learnings and prepare for EU wide deployment.

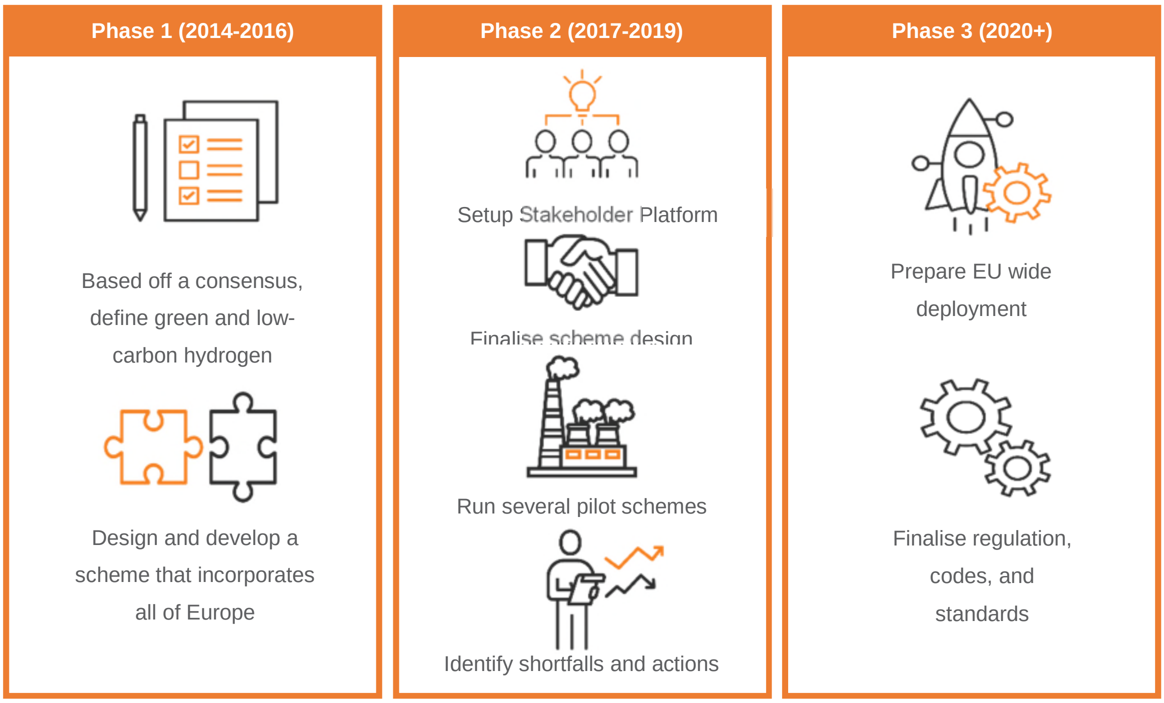

Figure 2-1: CertifHy Roadmap[11]

[14] HINICIO, Grexel, Ludwig Bölkow Systemtechnik (LBST), TNO and TÜV SÜD
[15] FCH JU is made up of the European Commission, industry body Hydrogen Europe and the research community represented by Hydrogen Europe Research

2.2.2. Key features

The following provides a brief summary of the key aspects of CertifHy. Further details are provided in Appendix A.

System boundary

CertifHy's system boundary is 'well-to-gate' which, as shown in Figure 2-2, includes all upstream emissions associated with supply of feedstocks (including extraction of fossil fuels) as well emissions incurred during hydrogen production. CertifHy's well-to-gate boundary excludes capital goods, and downstream emissions (hydrogen transport, supply, handling, consumption, and end-of-life). This boundary encapsulates all the production stages needed to reach a hydrogen purity level of at minimum, 99.9% (volume basis) and a pressure of at least 3 MPa.[16]

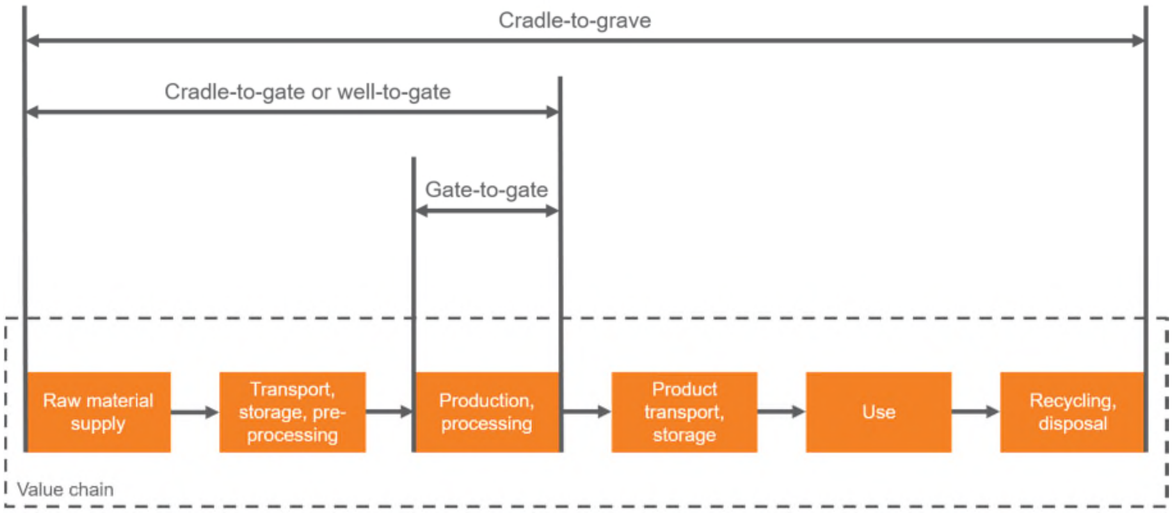

Figure 2-2: System boundaries

Greenhouse gas threshold

CertifHy's GHG emissions intensity threshold is defined by EU's Renewable Energy Directives (RED I and RED II). Eligibility for certification under CertifHy hinges on achieving an emissions intensity below 60% of the emissions intensity associated with traditional Steam Methane Reforming (SMR) hydrogen production (fossil fuel based).[16]

Carbon accounting

CertifHy calculates the GHG footprint within its system boundary via application of the International Organisation for Standardisation's (ISO) 14040 (Life cycle assessment – principles and frameworks)[17], ISO 14044 (Life cycle assessment – requirements and guidelines)[18] and ISO 14067 (Carbon footprint of products — Requirements and guidelines for quantification)[19] standards.[16,20]

[16] CertifHy. (2019). 'CertifHy-SD Hydrogen Criteria'. https://certifhy.eu/images/media/files/CertifHy_2_deliverables/CertifHy_H2-criteria-definition_V1-1_2019-03-13_clean_endorsed.pdf
[17] ISO 14040 (Life cycle assessment – Principles and frameworks) (https://www.iso.org/standard/37456.html)
[18] ISO 14044 (Life cycle assessment – Requirements and Guidelines) (https://www.iso.org/standard/38498.html)
[19] ISO 14067 (Carbon footprint of products – Requirements and guidelines for quantification) (https://www.iso.org/standard/71206.html).
[20] ISO. (2020). About us. Retrieved from ISO: https://www.iso.org/about-us.html

Annex V and Annex VI of the RED II provide default GHG emissions values and calculation rules for liquid biofuels, and solid and gaseous biomass for power and heat production, respectively.[21] CertifHy applies these analogously to hydrogen.

CertifHy also complies with European Committee for Standardization (CEN) EN16325, which specifies requirements for creation of standardised, transferable GOs in line with EU directives. As per the RED II implementation, a revision of the standard is underway subject to the RED II and other relevant European policy and law.[22]

Governance

The governance framework setup by the CertifHy design team includes several bodies with specific roles and responsibilities. This de-centralised organisation is maintained through an overarching Certification Body, that is managed by the CertifHy Stakeholder Platform (or at least has been during the initial development stage). See Appendix A for further details.

Regulatory framework

CertifHy draws its emissions thresholds, legislative backbone, and other regulatory guidance from the European Union's policies. Specifically, the RED I and RED II. Any changes in these directives may result in changes within the CertifHy scheme.

Overall, CertifHy's transparent planning and implementation process (detailed extensively, including stakeholder meetings and presentation), allowed examination of the development of the scheme in some detail. Intricate details on the development of scheme, highlighted stakeholder tensions with respect to key issues such as timeline, tracking methodology, leveraging of existing infrastructure and the use of a relative threshold versus an absolute one.

2.3. Other, less developed international schemes

2.3.1. Technischer Überwachungsverein Munich (TÜV SÜD)

TÜV is an Austro-German company that provides inspection and certification services. TÜV SÜD, the Munich branch of the multinational specifically offers conventional 'ecopower' and 'ecogas' certification services, generation of renewable certificates and certification of the sustainability of biofuels and renewables-derived hydrogen.

Description

Standard CMS 70 (CMS70) relates to hydrogen that is produced using renewable energy sources (also known as 'green hydrogen') by TÜV SÜD. Its production pathways include, electrolysis via renewables, steam methane reforming (SMR) of biomethane, and pyro-reforming of glycerine (i.e. by-product of biodiesel).[23] CMS70 is awarded if the GHG reduction is at least 50% less compared to fossil fuels/conventional hydrogen and at least 75% from electrolysis.[24]

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[21] European Commission. (2019). 'Renewable Energy – Recast to 2030 (RED II)'. https://ec.europa.eu/jrc/en/jec/renewable-energy-recast-2030-red-ii
[22] REGATRACE. (2020). 'Revision of CEN- EN 16325 and the development of a multi-energy carrier GO system'. https://www.regatrace.eu/revision-of-cen-en-16325-and-the-development-of-a-multi-energy-carrier-go-system/
[23] TÜV SÜD (2020), 'Standard CMS 70 Erzeugung von Grünem Wasserstoff (GreenHydrogen)', https://www.tuvsud.com/de-de/-/media/de/industry-service/pdf/broschueren-und-flyer/is/energie/standard-cms-70-greenhydrogen-ts-is-ut.pdf?la=de-de&hash=73E98931F8657D0313E27ED725C6B45D
[24] Jensterle et al (2019, 'The role of clean hydrogen in future energy systems of Japan and Germany', https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2019/The_role_of_clean_hydrogen_in_the_future_energy_systems.pdf

To ensure that the production of ‘green hydrogen’ avoids the use of electricity derived from fossil fuels, TÜV SÜD also provide renewable electricity GOs through their ‘Generation EE’ standard. This GO is tradable on the European market, but more importantly can be specifically used in the production of ‘green hydrogen’. TÜV SÜD have created a system whereby the GO certificates associated with the portion of renewable energy (electricity, biofuel or other) used in the production of ‘green hydrogen’ are subsequently used and retired.

Key features

CMS70 is ‘well-to-tank’, covering the entire supply chain of the hydrogen being certified, from production of relevant feedstocks through to the delivery of hydrogen at a station (refuelling), or for stationary applications, the end customer.[25] However, any embedded GHG emissions from waste streams, end-of-life, or capital investments are excluded from the scope of the certification.

CMS70 has a minimum threshold for hydrogen produced from renewables. It requires that at least 30% of the renewable electricity must come from plants no older than 3 years at the time of first certification.[26] This is not particularly burdensome in practice; however, it is interesting to note it as the only scheme to address the issue of ‘additionality’.

Relevance to the Australian context

TÜV SÜD, through the CMS 70 standard have established several key elements of a hydrogen certification scheme which could be of relevance to an Australian scheme, including:

- treatment of additionality
- flexibility to incorporate biogas and renewable certificates into the hydrogen production pathway,
- well-to-tank emissions accounting.

2.3.2. Association Française pour l'Hydrogène et les Piles à Combustible[27] (AFHYPAC)

AFHYPAC is an industry body that promotes hydrogen and fuel cell technologies throughout France. It is in the process of developing a GO scheme for hydrogen produced from renewables in France, with the hope to operate in tandem with current French renewable electricity and biomethane schemes.

Description

There is currently limited available information on the development of this scheme. Additional information is expected to become available in the next 12 months as the French Government begins developing a national hydrogen strategy.[28]

Key features

Based on currently available information, this scheme features a well-to-gate boundary (like CertifHy), limiting accounting at the point of production in contrast to the more expansive boundaries of the TÜV

[25] Velazquez, A & Dodds, P (2020), *‘Green hydrogen characterisation initiatives: Definitions, standards, guarantees of origin, and challenges’*, <Accessed: *https://doi.org/10.1016/j.enpol.2020.111300*>
[26] ibid
[27] The French Hydrogen Association for Hydrogen and Fuel Cells
[28] S&P Global Platts (2019), ‘French hydrogen rules progressing to autumn deadline: industry lobby AFHYPAC’, <Accessed: https://www.spglobal.com/platts/es/market-insights/latest-news/electric-power/072820-french-hydrogen-rules-progressing-to-autumn-deadline-industry-lobby-afhypac>

SÜD scheme (well-to-tank). AFHYPAC has indicated the GO certificates will expire after 24 months in contrast to other European schemes which feature a 12-month validity period as standard.[25]

Relevance to the Australian context

Due to the limited information available on this scheme, it is not possible to draw any material conclusions on its relevance to a future Australian scheme. This is particularly true given the scheme appears to be tailored for the French market, which impedes interlinkage opportunities.

2.3.3. Low Carbon Fuel Standard (LCFS) California (Air Resources Board)

Description

The LCFS is designed to reduce the GHG intensity of transport fuels (via minimum carbon intensity specifications) and to encourage the uptake of cleaner low-carbon transportation fuels in California, including hydrogen.

LCFS standards are expressed in terms of the 'carbon intensity' (CI) of petrol and diesel fuels and their respective alternatives. The CI for each fuel is based on its life cycle emissions, including direct emissions associated with producing, transporting, and using the fuels, as well as significant indirect emissions, such as changes in land use for some biofuels. The carbon intensity scores assessed for each fuel are compared to a declining CI benchmark for each year. Low carbon fuels below the benchmark generate credits, while fuels above the CI benchmark generate deficits.

Key features

Since 2018, renewable hydrogen, defined as hydrogen produced via electrolysis powered by renewable electricity, SMR of biomethane, and/or the thermochemical conversion of biomass, has been included in the program.

The CI for hydrogen produced from on-site reforming with renewable feedstocks is significantly higher (76.1g CO_2e/MJ hydrogen produced) than in other schemes, particularly the European CertifHy scheme.[25] This makes any interlinkage with schemes outside its jurisdiction unlikely in the immediate term.

The specific well-to-tank system boundary (which includes emissions from well through to point of combustion) and higher threshold for carbon intensity places the LCFS as an outlier amongst other pure hydrogen certification schemes analysed in this report.

Relevance to the Australian context

In the context of a future domestic Australian scheme, linking with California's LCFS would require a significant political and legislative effort to secure and the benefits of such a linkage remain unclear. However, this scheme is of interest for the Australian audience in its merging of emissions trading and minimum performance standards (carbon intensity thresholds), across a range of different fuel products.

2.3.4. Green-e® Energy/Renewable Fuels (USA/Taiwan/Singapore)

Description

Green-e® Energy is a North American independent certification and verification program for renewable energy. It has been operating in the United States for twenty years and has recently expanded to local initiatives in Taiwan and Singapore.[29] The program has had significant volume pass through it in recent years, certifying 1.6% of the total US electricity mix in 2017.[30]

Key features

Green-e® Energy is stricter than other certification bodies, requiring renewable energy to come from renewable energy systems constructed within the last 15 years. These certificates are not eligible for use in meeting state renewable energy goals.[31]

In recent years, Green-e® has begun developing a renewable fuels certification. So far, only a survey has been released to interested parties, and limited information has been disclosed around specifics of boundaries, accounting methodology or definitions. At this point the scheme is focused on biomethane but it is noted that in the future the scheme “will consider expansion of the program to address other renewable fuels and renewable thermal energy products, including solar thermal, geothermal, and hydrogen”.[32]

Relevance to the Australian context

At this early stage, the value of this scheme is not immediately clear; however, tracking the incorporation of Green-e® Energy’s current electricity certificate scheme into a parallel renewable fuels program is of value, considering its leading position in the North American market.

2.3.5. The Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) Model

Description

The GREET Model was initially designed as an Excel based tool for full life-cycle emissions modelling. It was created by the Argonne National Laboratory (an extension of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy). In recent years, the model has been modernised; transformed into a standalone free-to-use computer program for researchers and analysts.

Key features

This program facilitates full evaluation of energy and emissions for transport fuels, and the vehicle cycle (i.e. vehicle recovery). This program is readily available from their website and can provide significant detail around full life-cycle-emissions for select technologies/fuels. In respect to hydrogen, GREET considers several production methodologies (i.e. dark fermentation of lignocellulosic

[29] These schemes do not speak to one another. They were set up irrespective of each other and were supported in their foundation by strong corporate demand in the respective countries (i.e. Apple Corporation in Taiwan).
[30] Centre for Resource Solutions (2017), ‘2017 Green-e Verification Report’, <Accessed: https://resource-solutions.org/g2017/>
[31] Green-e® (2013), ‘National Standard’, <Accessed: https://www.ourenergypolicy.org/wp-content/uploads/2013/09/Appendix-D_Green-e-Energy-National-Standard.pdf>
[32] Green-e® (2021), ‘Green-e® Renewable Fuels: Frequently Asked Questions’, Center for Resource Solutions, https://www.green-e.org/programs/renewable-fuels/faq

biomass, high-temperature steam electrolysis with solid oxide electrolysis cell, & SMR), allowing for a full Life-Cycle Assessment (LCA) for Fuel Cell Vehicles (FCV).[33]

Relevance to the Australian context

The GREET Model is not designed to certify hydrogen and does not present immediate opportunities for Australia to use it in this capacity. It does however provide value in its comprehensive LCA of hydrogen. This value could potentially be harnessed by the Department in the later stages of a domestic scheme design when further detail around emissions thresholds, system boundaries, methodological choices and assumptions and input data (quality, type) is required.

2.4. What Australia can learn from the international certification schemes

2.4.1. What are the key differences between the existing schemes?

Across the three specific hydrogen certification schemes (i.e. CertifHy, AFHYPAC, TÜV SÜD), there are a number of key differences in terms of design, including:

- **Labelling** – a common standard for the labelling of the hydrogen product does not currently exist. Each of the three schemes categorise hydrogen differently and use different thresholds for the carbon intensity of production within different categories.
- **System boundaries** – vary across the schemes, with CertifHy and TÜV SÜD having a well-to-gate and well-to-tank approach, respectively.

2.4.2. Are there any current schemes which Australia can link to or align with?

Overall, there are a limited number of established and/or emerging international hydrogen certification or GO schemes, with CertifHy as the only hydrogen-focused certification scheme currently producing GOs. The maturity level of these schemes varies, with CertifHy and TÜV SÜD currently operational, while AFHYPAC's prospective scheme is still in early stages.

Linkage opportunities for Australia are currently limited, given the lack of established schemes and potential compatibility barriers. However, these international schemes remain models for GO certification with which Australia could align.

For now, CertifHy is the most advanced scheme, which provides alignment/interface opportunities for a future Australian scheme. If Australia wishes to align itself with CertifHy or adopt certain elements initially, the Australian government could design its domestic scheme such that its underlying principles and frameworks are compatible with CertifHy. This could include alignment across several key elements including system boundaries and accounting methodologies.

As highlighted in Table 2-1, alignment with CertifHy in its current form has a number of implications, including potential compliance with the scheme's system boundary (i.e. well-to-gate as defined by CertifHy) and its GHG emissions accounting approach (as defined by ISO 14040/14044 and ISO 14067, as well as Annex V and Annex VI of the RED II).[16] CertifHy also includes standardisation of

[33] Argonne National Laboratory (2019), 'Updates of Hydrogen Production from SMR Process in GREET®2019', https://greet.es.anl.gov/publication-smr_h2_2019
Argonne National Laboratory (2016), 'Life Cycle Analysis of Hydrogen Production from Non-Fossil Sources' https://greet.es.anl.gov/publication-h2-nonfoss-2016

transferable GO certificates in line with CEN EN 16325. In addition, an Australian scheme which is targeting alignment with CertifHy may require (or benefit) from interaction with a GO scheme for renewable electricity, equivalent to the EU's green electricity GO system (and in line with CEN EN16325).

Certain features of CertifHy, particularly its labelling approach and use of eligibility thresholds, are unlikely to be acceptable from an Australian scheme perspective, given the government's preference to focus on carbon accounting methodology rather than labels and hydrogen 'colours'. Whilst full alignment opportunities with CertifHy are likely to require a change in the government's position, partial alignment and/or adoption of certain elements of CertifHy may be more practical in the near term (see Section 4).

Table 2-1: Potential alignment of an Australian hydrogen GO scheme with CertifHy

Design element	CertifHy requirement	Implications if Australia fully aligns with CertifHy
Timeline	Currently in final pilot stage	Aligns with Australian industry and government desire for a scheme to commence as soon as practically possible
System boundary	Well-to-gate	Australian scheme will need to adopt a well-to-gate boundary, which is not aligned with the gate-to-gate boundary of our NGER scheme
Accounting methodologies	ISO 14040/ ISO14044 and ISO 14067	Application of ISO 14040/ISO 14044 and ISO 14067 (as used by CertifHy), which define principles, frameworks, requirements and guidelines for determining GHG emissions (within a specific system boundaries) associated with a given product (facilitating product comparison)
	Annex V and Annex VI of the RED II CEN EN16325	Considering the NGER scheme is based on a gate-to-gate boundary and is unlikely to be amended to accommodate a broader boundary,[34, 35] alignment with CertifHy is likely to require the establishment of a new scheme including accounting methodologies, which can align with ISO standards (i.e. ISO 14040/14044 and ISO 14067) and where possible, leverage NGER methods, emissions factors and/or resultant data. Further work is required to consider the alignment of NGER methods and emissions factors with those outlined or referenced under CertifHy (including Annex V and Annex VI of the RED II)[36]
Governance	Industry led, but some interface with	A diminished role for the Australian government in terms of ownership of the scheme, though it may be possible for the government to administer a scheme aligned with CertifHy without actually joining it

[34] As per the Department's feedback
[35] Climate Change Authority. (2018). *Review of the National Greenhouse and Energy Reporting Legislation* https://www.climatechangeauthority.gov.au/sites/default/files/2020-06/ngers_final_report_pdf.pdf

	national governments Subject to EU policy	The Australian government will likely need to interface with private/industry organisation (CertifHy Stakeholder Platform), and/or local industry will need to take on greater responsibility
Labelling	'Green' and 'Low-carbon' labels	Conflicts with government preference to avoid labels or categories for hydrogen Australian government may need to alter its position or negotiate with CertifHy and/or other parties to avoid explicit labelling
Thresholds	Initially set at 60% below benchmark, tightening in line with RED II	May conflict with government preference to avoid labels or categories for hydrogen CertifHy thresholds deemed insufficient to encourage emissions reductions in the COAG Energy Council's *National Hydrogen Strategy Issue 4: Guarantees of Origin*[37]
Carbon offsets	Not accepted	May limit domestic business models
Handling of electricity use	Market-based and location-based calculations	Include market-based (potentially in addition to location-based) calculations for electricity emissions (reflecting the approach taken by CertifHy and highlighted as best practice within the GHG Protocol[38] *Corporate Accounting and Reporting Standard* and the supplementary *Scope 2 Guidance.*[39] This is also the approach outlined in Climate Active's recently released Electricity Accounting Rules paper[40] The above will likely need to be established outside of the NGER scheme
Interaction with other schemes	EU electricity GO scheme	Development of Australian electricity GO scheme (note that this is already of interest given future sunsetting of Australia Renewable Energy Target (RET) and limitations of the RET and the Australian Emissions Reduction Fund (ERF)), or interlinkage with existing renewable energy schemes (if applicable) As detailed above, CEN EN16325 may be relevant in establishing a new Australian electricity GO scheme or modifying existing Australian renewable energy schemes, which might interlink with an Australian hydrogen GO scheme

[37] COAG Energy Council. (2019). *National Hydrogen Strategy Issue 4: Guarantees of Origin*. Australia. https://consult.industry.gov.au/national-hydrogen-strategy-taskforce/national-hydrogen-strategy-issues-papers/supporting_documents/NationalHydrogenStrategyIssue4GuaranteesofOrigin.pdf
[38] GHG Protocol. (2020). About us. Retrieved from GHG Protocol: https://ghgprotocol.org/about-us
[39] GHG Protocol. (2004). *GHG Protocol Corporate Accounting and Reporting Standard*. USA: World Resources Institute and World Business Council.
GHG Protocol. (2015). *GHG Protocol Scope 2 Guidance*. USA: World Resources Institute and World Business Council.
[40] Climate Active. (2021). *Electricity Accounting Rules*.
Copy of rules provided to Energetics by the Department.

2.5. International engagements

This section of the report reviews multilateral and bilateral arrangements and partnerships that may provide an opportunity for Australia to lead in the development of a global and/or regional scheme. There are several initiatives currently underway, including with potential hydrogen export markets such as Japan and the Republic of Korea, which are described below.

2.5.1. Multilateral engagements

Clean Energy Ministerial Hydrogen Initiative (CEM HI)

The CEM HI is an International Energy Agency (IEA) co-ordinated initiative that brings together 9 countries (including Australia) and the EU to further hydrogen & fuel cell technology and its increasing important in the clean energy transition.[41] Its essential tasks are to drive collaboration on policies, programs, and projects to accelerate the use of hydrogen and fuel cell technologies and their commerciality.

International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

The IPHE is a multilateral organisation whose goal is to promote the advancement of technical hydrogen industry standards and protocols that are expected to underpin future trade and investment. Issues around safety standards, regulation development, certification, trading, intellectual property, and education are all covered.

The Department is the representative of the Australian Government to IPHE, including its Hydrogen Production Analysis Taskforce (H2PA TF). H2PA TF aims to develop a “mutually agreed upon methodology for determining the greenhouse gas and other emissions associated with the production of hydrogen”.

This is an important membership for Australia as it provides Australia with an opportunity to shape the development of a future hydrogen scheme, ensuring that this is aligned with its principles and cognisant of the requirements of domestic industry. IPHE H2PA TF includes representation from numerous nations, including key trade partners, and is progressing in several areas, hosting webinars and conferences around current and future issues.

Energetics understands that the Department has been engaging with IPHE and to date has had direct involvement around defining key hydrogen issues such as production systems and boundaries. In addition, work is underway with respect to accounting methodologies.

2.5.2. Bilateral partnerships

Australia-Japan Joint Statement on Cooperation on Hydrogen and Fuel Cells

Australia and Japan signed the Joint Statement on Cooperation in January 2020, confirming the importance of cooperation, both bilaterally and internationally, on harmonisation of hydrogen policies, market regulations, codes and standards. It also confirmed the role of the Hydrogen Energy Supply

[41] CEM. (2020). ‘Hydrogen initiative’. http://www.cleanenergyministerial.org/initiative-clean-energy-ministerial/hydrogen-initiative

Chain (HESC) project in establishing an international hydrogen supply chain between Australia and Japan.

Supported by the Australian, Japanese, and Victorian governments, the HESC project, which is currently in a pilot stage, is aiming to export liquefied hydrogen to Japan using innovative transport technology. The project will be a significant knowledge amplifier for Australia (both industry and government), showcasing for the first time how a global hydrogen supply chain may operate (i.e. logistically, commercially, and operationally). Subject to the success of the pilot, the project has the potential to pave the way for Australia to establish itself as a future exporter to Japan.

Australian-German Joint Hydrogen Feasibility Study

Australia signed a Joint Declaration of Intent with Germany in September 2020 to undertake a co-funded feasibility study to investigate a potential hydrogen supply chain between the two countries. This study will investigate the potential for the production, storage, transport and use of hydrogen produced from renewable energy along a supply chain between Australian and Germany, including an assessment of economic and regulatory requirements for trade in hydrogen and hydrogen-based energy carriers. The role of certification in the development of bilateral arrangements may be examined as part of this work.

Australia-Republic of Korea Hydrogen Action Plan

Australia and the Republic of Korea committed in September 2019 to develop a comprehensive hydrogen action plan. This plan will promote bilateral hydrogen cooperation to accelerate the development of each countries' hydrogen economies out to 2025.

Australia-Singapore low emissions technology MOU

Australia and Singapore agreed in March 2020 to pursue a bilateral Memorandum of Understanding to drive cooperation on low emissions technology, including hydrogen.

2.6. Moving forward

Energetics' research has shown that the international hydrogen certification landscape is in a nascent stage with CertifHy as the only established and dedicated scheme. This presents Australia with an opportunity to leverage international partnerships and engagements to play a leading role in the design and development of a future international scheme.

Australia's current engagement in international forums such as IPHE and IEA CEM HI provides the Australian Government with an opportunity to keep abreast of emerging trends, policy direction and future export market expectations, which can be utilised to ensure that our domestic scheme includes a high degree of international harmonisation. Further, these forums can also be used for Australia to showcase its considerable experience in managing environmental and energy schemes such as the NGER scheme in case there is an opportunity for elements of these schemes to be adopted for a future global scheme.

Australia's starting principles with respect to certification (i.e. production technology, scope 1 and 2 emissions associated with production and production location) as outlined in the Strategy, provide a robust basis for international engagement. There may be a need for the Australian government to expand on these starting principles depending on the extent of alignment required with international schemes (and subject to the preferences of the broader international hydrogen certification landscape). For instance, it is worth noting that the focus on scope 1 and 2 emissions associated with production is not aligned with the broader international hydrogen certification landscape, which is incorporating a broader scope of emissions (i.e. including upstream supply chain emissions which are commonly referred to as scope 3 emissions).

Following establishment of a hydrogen GO scheme, hydrogen storage and transport, hydrogen carriers and products are likely to become areas of market interest, requiring a potential expansion of the GO scheme. Prioritisation of these items will be subject to hydrogen technology developments, emerging hydrogen markets and establishment of customer preferences.

With the development of a universal hydrogen GO scheme as the ultimate objective, there is potential for a scheme developed by IPHE to achieve higher degree of acceptance and potential uptake, given its collaborative approach and representation, which includes Australia's most likely future trading partners in Japan and South Korea. Given the nature of IPHE's Hydrogen Production Analysis Taskforce (H2PA TF) and expected outcomes with respect to the development of an international hydrogen GO scheme, Australia's ongoing contribution to this forum should be prioritised.[42]

[42] IPHE. (2020).*Terms of Reference: Hydrogen Production Analysis Task Force*. https://1fa05528-d4e5-4e84-97c1-ab5587d4aabf.filesusr.com/ugd/45185a_3d98ff47736643c080434e4453058ab0.pdf

3. Stakeholder consultation

To progress the establishment of an Australian hydrogen certification or GO scheme, in May 2020 the Department surveyed domestic stakeholders, seeking their views on key issues related to a hydrogen GO scheme. A further virtual stakeholder workshop was run in September 2020 as part of this Project.

3.1. Summary of the online survey outcomes

The online survey (the Survey) sought views on scheme timing, carbon accounting methodologies and linkages with existing regulatory frameworks, along with prioritisation of domestic and/or international schemes. The Department received feedback from 110 respondents, which comprised of 80 domestic, 15 international stakeholders in addition to 15 respondents who elected not to provide a location. These respondents covered a broad range of stakeholders as outlined in Figure 3-1, including investors, hydrogen users and producers (international and domestic).

Energetics was tasked with analysing stakeholder responses to distil key insights, which were used in design of a follow up stakeholder workshop (as discussed in Section 3.2 of this report). It should be noted that Energetics' analysis covers all non-confidential responses (approximately 60% of response), as well as summaries of the confidential responses provided by the Department.

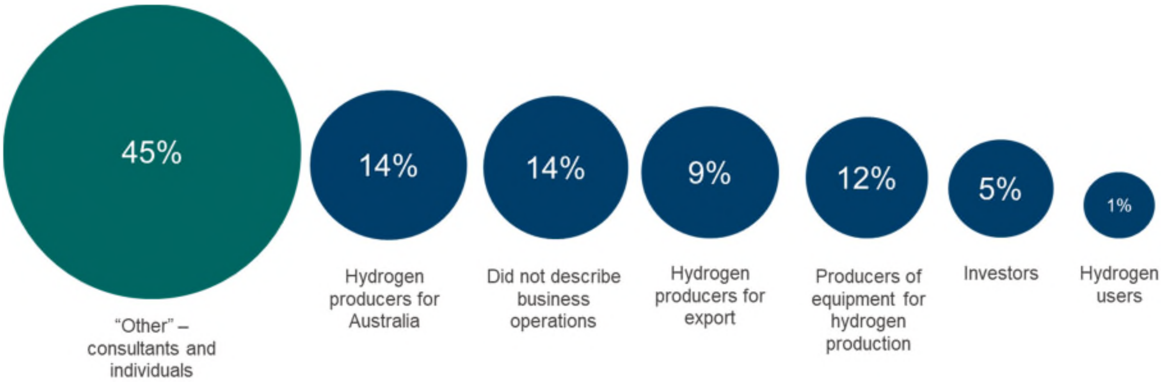

Figure 3-1: The Department's hydrogen certification survey response

Energetics' analysis of the Survey results is described below, focusing on four key 'focus areas' for a future scheme, including system boundaries, accounting methodologies, application of carbon offsets and governance models, which are discussed in the following sections. But first, Energetics considers the key outcome, which is the tension between timing and international alignment.

3.1.1. Tension between timing and international alignment

Most Survey respondents preferred a scheme to be in place by 2022 as an earlier start provides the desired certainty to support investment decisions. Most respondents did not see a need for two separate schemes (i.e. one for domestic customers and another to align with international requirements), and had a clear preference for a domestic scheme to, as much as possible, align with international schemes (either initially or over time).

These priorities with respect to timing and international alignment cannot both be realised as the process to develop a scheme which is highly compatible with existing/emerging international schemes will take time, as all international negotiations do. Balancing these competing stakeholder priorities is a challenge to the development of a GO scheme and this was not necessarily acknowledged in the survey response.

3.1.2. Four key focus areas

System boundary

The broader the system boundary, the greater the coverage of emissions associated with the product or process under review (see Figure 2-2 for an overview of typical classifications of system boundaries). System boundaries vary from gate-to-gate (limited to production only), through to cradle-to-grave (entire value chain).

While the Survey did not include a specific question relating to system boundaries, over 25% of respondents indicated some level of interest in a cradle-to-gate or well-to-gate system boundary, which would better align with the system boundaries established under the CertifHy and AFHYPAC schemes (i.e. well-to-gate or more comprehensive).

There was also minor interest in a cradle-to-grave system boundary, more traditionally associated with LCA, possibly due to stakeholder perception that such a comprehensive boundary may enhance the environmental credentials of the scheme as well as accommodating future customer expectations. However, there was some recognition by the stakeholders that such comprehensive coverage may not be ideal as it would increase the complexity and cost of the scheme for the participants.

The complexity associated with setting an equitable system boundary across different production pathways was also raised by stakeholders, particularly with respect to technology neutrality (as per Australian Government's neutral position with respect to technology used to produce hydrogen).

A number of respondents highlighted the importance of considering hydrogen derivatives (such as ammonia and methanol) and renewable gas (biomethane or green gas) products in the development of a hydrogen GO scheme, noting their potential role as carriers of zero or low-emissions hydrogen in clean hydrogen supply chains.

Accounting methodologies

Approximately 40% of survey respondents favoured alignment with the NGER scheme's accounting methodology, reflecting its robustness and strong stakeholder familiarity (this scheme has been in place since 2008). Using existing NGER framework and/or building on this framework was recognised by stakeholders as an appropriate starting point.

Whilst there was broad support for leveraging NGER, some respondents did recognise limitations associated with NGER, including accounting for renewable energy generation as well as the possible need to align with established ISO standards (particularly ISO 14040/14044) and the GHG Protocol's suite of standards and supplementary material[43] which may provide more detailed guidance.

Another issue raised by stakeholders with respect to accounting methodologies related to the definition of hydrogen categories and establishment of appropriate eligibility thresholds or differentiating between these categories. That is, if one nation defines 'green hydrogen' differently to another, the products are not the same and should not be valued the same. This could result in confusion and uncertainty for customers.

[43] Including the GHG *Corporate Accounting and Reporting Standard (*https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf*)*, the *Corporate Value Chain (Scope 3) Standard (*https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf*)* and the *Product Life Cycle Accounting and Reporting Standard* (*https://ghgprotocol.org/sites/default/files/standards/Product-Life-Cycle-Accounting-Reporting-Standard_041613.pdf*)

While international compatibility was identified as an important consideration, some stakeholders acknowledged the risks associated with waiting for an international scheme to be established, including Australian industry being constrained by the lack of certainty, which could impact its early competitive advantage.

Carbon offsets

While the Survey did not specifically ask respondents to comment on the inclusion of carbon offsets in a hydrogen GO scheme, divergent views were raised on this issue in response to a query around what stakeholders deem to be “important features” of a future scheme.

Citing the need to provide flexibility for different business models and production pathways to ensure market development, a number of respondents supported the inclusion offsets. Others deemed their inclusion as ‘risky’, noting they may undermine international credibility and the value of Australian hydrogen products, and impact the long-term development of Australia’s hydrogen economy.

Other issues identified by stakeholders included the tracking of carbon offsets, particularly with respect to leverage opportunities (i.e. existing offset registries) or development of a dedicated registry for hydrogen certification. Accounting for the life cycle emissions of offsets was also raised as an important consideration by respondents. These issues may present additional complexity in developing and operating a future hydrogen GO scheme in Australia; particularly with respect to international alignment, given that in its current form, the most established international scheme, CertifHy, does not permit the use of offsets.

Governance models

There are various models for development and administration of certification and/or GO schemes. These are broadly classified as industry and government led models.

Whilst the survey did not explicitly ask for preferred governance models for a certification scheme, it did ask stakeholders to consider existing Australian regulatory frameworks which might interact with a hydrogen certification scheme. In response, many respondents suggested ownership should sit with a domestic government, with several nominating the Clean Energy Regulator as a suitable entity for administration of such a scheme.

Some respondents also suggested the scheme should be industry-led; others noted the importance of industry input into a government led scheme. Stakeholders also noted the potential requirement for additional input from international government and industry.

The governance approach for an Australian hydrogen GO scheme, is subject to priorities and decision-making across the focus areas of system boundaries, accounting methodologies and carbon offsets.

Other issues

In response to nominating “important features” of the scheme as well as “features” the scheme should avoid, the respondents identified several key aspects, which are summarised in Table 3-1.

Table 3-1: Important features and features to avoid

Important features	Features to avoid
• Transparency • Credibility	• Significant compliance cost • Complexity • Lack of connection to existing schemes • Self-certification

• Transferability of certification (ability to readily transfer GOs from hydrogen producer to hydrogen buyer) • Low compliance costs • Simplicity • Third party verification • International acceptance • Technology agnostic • Unambiguous metrics • Flexibility • Ability to distinguish between renewable and non-renewable sources of hydrogen • Consistency with other reporting requirements (i.e. minimise compliance burden)	• Hydrogen colours • Fragmentation of the scheme into State based schemes.

3.1.3. Summary of key insights from the online survey

- Clear preference for a **scheme to be in place by 2022** to avoid investment delays
- General **preference for a single scheme**, however **alignment with international schemes** deemed important to enable the export market to develop with some recognition that **full alignment from the outset may delay** a domestic scheme
- A **well-to-gate boundary** system could be a good starting point; however, some stakeholders do prefer a broader/more comprehensive system such as cradle-to-grave or LCA based
- Broad agreement on the **benefits of leveraging existing domestic schemes**, particularly the NGER scheme
- Preference for the scheme to **distinguish between renewable and non-renewable production of hydrogen**
- The use of **carbon offsets is likely to be a contentious issue** with divergent positions at either end of the spectrum (i.e. include vs. exclude)
- Importance of a **government led scheme** with the Clean Energy Regulator as a logical administrator
- Stakeholders identified **credibility, transparency, simplicity and low compliance cost** amongst important features of a future scheme.

3.2. The stakeholder workshop

In September 2020, Energetics facilitated a virtual stakeholder workshop (“the Workshop”), to better understand stakeholder preferences with respect to the development of a hydrogen GO scheme in Australia. Issues explored were scheme timing, international alignment, leverage of existing frameworks and the four focus areas - scheme boundary, accounting mechanism, use of offsets and governance.

The virtual workshop was attended by a total of 56 stakeholders, most of whom had already responded to the earlier online survey. In terms of representation, the workshop included a diverse mix of stakeholders including industry associations, hydrogen producers and/or suppliers, research and consulting groups, oil and gas industry, energy supply and generation and hydrogen equipment manufacturers. In addition, there were several attendees from Australian Government agencies such as ARENA and the CER.

The Workshop was implemented using Mural[44] (a digital workspace for online collaboration). The views of workshop participants were captured in the Mural board.

It should be noted that the only market segment that was not directly represented at the Workshop was the future customer segment such as large energy users or businesses with net zero targets, which may be considering hydrogen opportunities to meet their carbon targets.

The development and outcomes for the Workshop are detailed below.

3.2.1. Framing the workshop discussions – three nominal models

The design of the Workshop was informed by the outcomes of the earlier online survey. The survey highlighted conflicts (tensions) between preferences within the four key focus areas and with preferences for the nature of the scheme, particularly the degree of international alignment, and the timing of the development of the scheme (as outlined in Figure 3-2).

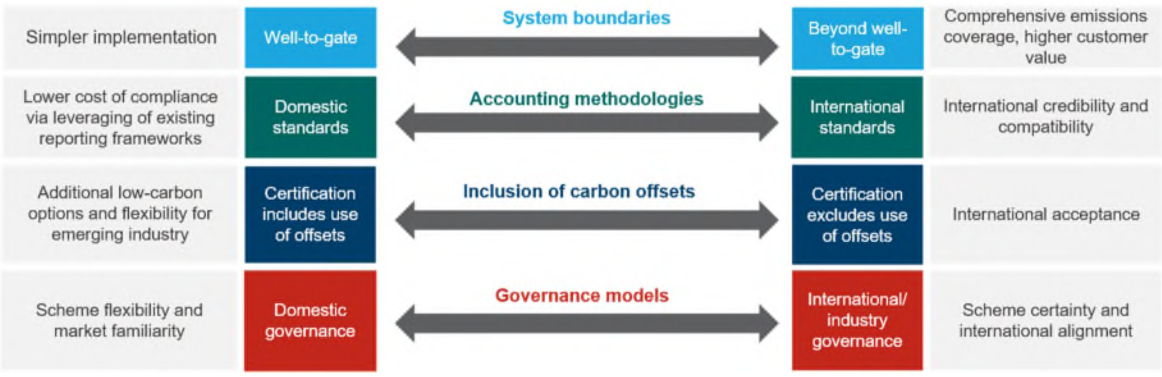

Figure 3-2: Underlying tensions and key trade-offs

For the purposes of the workshop, participants were presented with three nominal models for a future Australian GO scheme, referred to as 'strawman' models. Workshop respondents were asked to consider their preferences for the nominal models, considering tensions/trade-offs and nominate their preferences for the characteristics that made up the models. The nominal models were as follows:

1. **Domestic** – to be established in a timely manner to support the growth of the Australian market. Such a scheme would evolve over time to interface with international over time.
2. **Regional** – led by Australia in partnership with key export markets such as Japan and other regional counterparts with interest in developing a hydrogen economy such as New Zealand. Based on establishment of bi-lateral agreements from the outset.
3. **International** – underpinned and driven by multilateral collaboration with a long-term goal of developing a single global scheme to facilitate international hydrogen trade.

The facilitated discussions within the Workshop centred on the key characteristics of these models along with potential risks which are listed in Table 3-2 and Table 3-3, respectively.

[44] https://www.mural.co/

Table 3-2: The characteristics of the nominal models

Key features	Domestic focus	Regional leadership	Multilateral collaboration
System boundaries	Well-to-gate or narrower to start	Well-to-gate system boundary to start, possible expansion	Well-to-gate system boundary to start, possible expansion
Accounting methodologies	Leverage NGER program and frameworks	Potentially adapted from NGER framework with some compromises Potentially based on ISO standards	To be developed collaboratively Could be based on ISO standards
Carbon offsets	Use of offsets to encourage domestic markets in the short term	Use of offsets uncertain	Use of offsets unlikely
Governance models	Governance by the Clean Energy Regulator (CER)	May leverage CER to start, but evolve to incorporate international stakeholders	Governance by international governance body or peer review process
International linkage	No international linkage	Targeted international linkage	Broader multilateral international linkage
Timing	1-2 years for implementation	2-3 years for implementation	Up to 5 years for implementation

Table 3-3: The risks associated with the nominal models

Key risks	Domestic focus	Regional leadership	Multilateral collaboration
Credibility	Poor international credibility if scheme fails to align with internationally accepted standards	Poor broader international credibility if scheme fails to align with internationally accepted standards	Broader international credibility may be at risk if scheme fails to adapt quickly enough to support industry development (complex scheme requirements and governance)
Cost of compliance	Cost of shift to align with international requirements	Cost of shift to align with broader international requirements	Potentially higher cost of compliance reflecting alignment with broader multilateral requirements
Agility	Simpler governance likely to make it	Multiple stakeholders at play in governing the	Complexity of scheme and its potential governance involving

	easier for scheme to evolve	scheme, may make adaptation more difficult	multiple stakeholders could hinder evolution
Access to value markets	Fastest access to short term value via expansion of domestic industry but inconsistencies with international development could limit long-term industry growth	Access to significant market value in key trading partners but could limit long-term growth of the domestic hydrogen industry outside of key trading partners	Time cost to develop and implement broader international scheme could hinder development of domestic industry

Appendix D shows the final Mural boards and consolidated summary board. The key insights from the Workshop are summarised below.

3.2.2. The outcomes of the Workshop – the preferred model

The online survey showed that stakeholders favoured a scheme that could be implemented immediately, with a preference for some degree of international alignment. The Workshop results indicated that there was no clear preference for a single strawman (nominal) model. While there was some interest in the Regional model given clear benefits for establishing trade, stakeholders seem to favour establishment of a simple scheme (i.e. domestic) aligned with key international parameters, which can be implemented as soon as possible. There was some interest in the international model, but similar to the Survey results, stakeholders were broadly comfortable in terms of prioritising immediate timing over full international alignment with a view that international trends should be monitored for any future linkage/alignment opportunities.

We note that there was no representation by international customers (and limited representation from domestic customers) so this preferred model may not align with their preferences.

3.2.3. The outcomes of the Workshop – the key characteristics

Stakeholders provided a range of views on the key characteristics as captured in the workshop's Mural board Appendix D and summarised below.

System boundary

Participants generally favoured the well-to-gate boundary (see Figure 2-2 for an overview of system boundaries), at least in the short term. It was acknowledged that alignment with international schemes may push an Australian scheme to consider a broader boundary.

There was some interest in a simple scheme focused on scope 1 and scope 2 emissions in the short term based on stakeholder perception that such approach could maximise the ability of an Australian hydrogen GO scheme to leverage the existing NGER framework and enable more timely implementation.

While some participants recognised the value of a broader/more comprehensive boundary to include scope 3 emissions, they also acknowledged the challenges and complexities associated with tracking these emissions.

Accounting methodologies

Workshop participants noted that Australia has rigorous and well understood carbon (NGER) and renewable energy (RET) accounting systems, and these should be leveraged in Australia's hydrogen GO scheme. However, it was also noted that:

- NGER does not address scope 3 emissions and does not allow for claims of off-site renewable energy consumption
- NGER is focused on estimating organisational and/or facility scope 1 and 2 emissions rather than attributing emissions to a process or product
- Elements of NGER do not align with the international GHG Protocol's suite of standards and guidance which could be favoured by international hydrogen GO schemes (i.e. NGER electricity emissions accounting uses location-based methods only)
- 'Below baseline' renewable generation does not receive certificates under the RET, so an additional mechanism for tracking below baseline generation may be required.

Carbon offsets

The acceptability of carbon offsets in the short and long term remains highly contentious. The Workshop results demonstrate varying levels of support for inclusion of carbon offsets within the hydrogen GO scheme.

Stakeholders agreed transparency was important, irrespective of whether offsets were permitted or not (i.e. prioritise disclosure of carbon footprint with and without certification). In particular, stakeholders indicated that it was very important for there to be clear requirements and disclosure around the use of offsets. This was similarly raised for with respect to carbon capture and storage (CCS) and CCUS technologies.

Proponents for inclusion of offsets viewed their inclusion as a necessary requirement for the early growth of the domestic industry (while CCS and CCUS technologies are still being commercialised), which can improve Australia's cost-competitiveness internationally.

Concerns regarding the inclusion of offsets seemed to stem from perceived risks to credibility and value of Australian certificates in international markets, which may ultimately limit expansion of Australia's hydrogen industry. Stakeholders noted that inclusion of offsets within a hydrogen certification scheme may increase the complexity of the scheme and require additional time for development of an appropriate approach (in addition to any systems or processes which might need to be put in place).

Energetics notes that there is a degree of uncertainty here around international and domestic customer preferences regarding use of carbon offsets. There is also uncertainty around the definition and treatment of Internationally Transferred Mitigation Outcomes (ITMOs) under the Paris Agreement (Articles 6 rules).[45]

Governance

There was a clear preference for government to lead a scheme to provide the necessary credibility. Industry input in the development of the scheme was recognised as critical, though industry

[45] International Institute for Sustainable Development. (2019). *Current Status of Article 6 of the Paris Agreement: Internationally Transferred Mitigation Outcomes (ITMOs)*.
https://www.iisd.org/system/files/publications/status-article-6-paris-agreement.pdf

ownership and operation of scheme was not favoured (due to concerns around credibility, costing and administration).

There was a high degree of consensus that the Clean Energy Regulator (CER) is a suitable agency for administration of a hydrogen GO scheme given this sits within their energy and emissions domain.

Stakeholders also highlighted that government should ensure industry input is incorporated into the development of a scheme to ensure industry buy-in (supply and demand sides).

Stakeholder priorities and scheme evolution

The nominal scheme models were constructed based on the four key focus areas (as per Table 3-2). Priorities across these focus areas largely align (at least initially) with the domestic model, reflecting stakeholder preferences for a scheme to be implemented quickly. However, the Workshop highlighted that while stakeholders are unwilling to wait for a broad international scheme (from the outset), they are seeking international alignment and harmonisation wherever possible reflecting interests in both domestic and international markets. In particular stakeholders expected that carbon accounting methodologies would be consistent with broadly accepted international approaches.

Broadly, stakeholders recognised that a GO scheme will evolve and change with time as markets mature and consumer preferences change. Therefore Australia’s hydrogen GO scheme must be developed in a way that allows it to transition as the domestic and international hydrogen markets evolve and, ideally, as an international scheme emerges.

4. Options

This section details the development of three distinct options for an Australian hydrogen GO scheme.

4.1. Summary of key insights

The development of three options for a future hydrogen GO scheme was guided by the key insights from our international research, stakeholder consultation results and our analysis, particularly with respect to emission reporting frameworks and offset markets, as detailed below.

Key starting principles outlined in Australia's National Hydrogen Strategy

- Desire to establish a minimal certification scheme including tracking of production technology, scope 1 and scope 2 carbon emissions and production location
- Water and other factors can be included as the market and scheme evolve
- Where possible, build on or harmonise with existing international approaches to hydrogen certification
- Australia to play a leading role in establishing an international hydrogen GO scheme.

CertifHy provides linkage opportunities, however there are challenges to consider

- CertifHy is the most relevant/established international hydrogen certification scheme and potentially the most realistic near-term linkage opportunity
- Given EU's global significance and CertifHy's status as the best available example of a robust framework for hydrogen certification scheme, this is expected to have some influence on the certification landscape (i.e. the scheme's definitions and parameters may become prevalent)
- CertifHy definitions and parameters are not necessarily fit-for-purpose for a global or Australian scheme given the use of eligibility thresholds and definition of colours/labels may be contentious nationally and/or globally, downstream scope 3 emissions associated with transport may be of interest for a global scheme but not covered under CertifHy and hydrogen energy carriers are not considered under CertifHy but likely to be of interest to global export markets
- Potential compatibility issues with a future Australian GO scheme related to the Strategy's preference to avoid definition of hydrogen categories and thresholds such as those set by CertifHy
- CertifHy's thresholds deemed to be too low to drive emissions reductions.[46, 47]

Strong stakeholder preference for immediate scheme commencement

- Clear stakeholder preference for a minimal scheme to be in place by 2022 with stakeholders prepared to accept a lower level of compatibility with international schemes (from the outset) as a trade-off
- Initial scheme must be sufficiently robust to appease and/or transition to appease both domestic and export market requirements.

Stakeholder recognition that a 'minimal' scheme will evolve over time

- Stakeholder understanding that initial scheme must evolve over time (as the market develops) to accommodate market requirements (both domestic and international) and it may include

[46] Given that this scheme could set an international precedent Australia may need to align with these in the longer term
[47] CertifHy thresholds are set to tighter as per the RED II (this EU policy includes mandated increases in the ambition level of CertifHy's eligibility thresholds for GOs.

hydrogen derivatives (such as ammonia), related products (such as biomethane) and environmental impacts such as water
- Significant uncertainty exists with respect to industrial customer preferences and further work is required to understand the needs of industrial customers with respect to a GO scheme.

Well-to-gate system boundary provides an equitable starting position for discussion

- Demonstrated stakeholder preference for well-to-gate system boundaries, characterised as "scope 1 and 2 emissions across each stage" (i.e. scope 3 emissions upstream of production)[48]
- Priority for a segment of stakeholders (i.e. exporters) for scheme boundary to include ammonia certification, given its significance for hydrogen export markets. However, generally stakeholders do not want inclusion of hydrogen derivative products and/or associated products (including ammonia, methanol and biomethane products) to delay delivery of the scheme.

Leverage NGER where possible but recognise its limitations with respect to a GO scheme

- The NGER scheme has distinct goals to that of a future hydrogen certification scheme, which is reflected in its design
- NGERS was designed to support national emissions and energy reporting and:
    - Focuses on calculating scope 1 and 3 emissions under the control (operational) of a defined corporation and/or facility (site)
    - Does not consider scope 3 emissions occurring outside of the control of a defined corporation and/or facility (site)
    - Includes provisions for location-based accounting of GHG emissions associated with electricity consumption.
- A future hydrogen certification scheme will instead seek to attribute emissions within a defined boundary (may include scope 1, 2 and 3 emissions with respect to the entity seeking certification) to a given product (functional unit). This might include:
    - Consideration of emissions outside of the control of a defined corporation and/or facility (site)
    - Definition of a clear system boundary covering the product life cycle (above and beyond the definitions of corporations and facilities (sites) used for NGER purposes)
    - Allocation of emissions across the product and any relevant co-products
    - Requirements to support comparison of different products
    - Alignment with international reporting guidance around electricity emissions, including the GHG Protocol *Corporate Reporting and Accounting Standard*, require reporting of electricity using location-based and market-based accounting approaches
- While the NGER scheme is not fit-for-purpose for hydrogen certification, it contains many of the underlying methods and emissions factors, which can be leveraged to support a future hydrogen scheme.
- The NGER scheme as it stands may be appropriate in providing methods and emissions factors (along with the NGA Factors) to support a hydrogen GO scheme with a clearly defined[49] gate-to-gate boundary, it is not fit-for-purpose for the calculation of emissions associated with a hydrogen

[48] Note that use of the terms 'scope 1' and 'scope 2' is somewhat confusing in the context of product emissions analysis
[49] Note that Energetics does not consider NGER facility definitions sufficient to facilitate direct product comparison required for a hydrogen GO scheme

product across a well-to-gate boundary (i.e. need to consider attribution of emissions to a product)
- Any use of domestic emissions factors and methods (such as NGER and NGA Factors) would be subject to international comparability and/or acceptance.

Consider established international frameworks for attributing emissions to a product

- The definition of scope 1, 2 and 3 emissions (relevant in relation to an organisation or site) is not pertinent in attributing emissions to a product (where emissions are incurred along a broader value chain)
- Standards such as ISO 14040/14044 and 14067 and the GHG Protocol *Product Life Cycle Accounting and Reporting Standard* are focused on attributing emissions to a functional unit of product (this includes establishing system boundaries, using allocation methods and defining requirements for comparison)
- Other frameworks such as the RED I and II, Intergovernmental Panel on Climate Change (IPCC) *2006 Guidelines for National Greenhouse Gas Inventories*[50] and other GHG Protocol content[51] are additional points of reference
- The above analysis indicates that a future Australian GO scheme would need to establish a framework for allocation of emissions to the hydrogen product and relevant co-products, which might be based on the internationally accepted principles and frameworks (such as those established under the GHG Protocol *Product Life Cycle Accounting and Reporting Standard* and specific ISO standards for LCA), but also leverage additional guidance, and methods and emissions factors from NGER, NGA Factors and the IPCC Guidelines for National Greenhouse Gas Inventories
- As above, use of domestic emissions factors and methods (such as NGER and NGA Factors) would be subject to international comparability and/or acceptance.

Consider outstanding areas of uncertainty around the potential impacts of hydrogen

- Domestic and international methodologies for estimating hydrogen's climate impacts remain unclear
- Potential limitations in existing accounting methodologies including the injection of hydrogen in the gas grid, whereby nuances around gas quality and fugitive emissions need to be considered (hydrogen can act as an indirect greenhouse gas, taking part in atmospheric reactions which contribute to climate change; this represents a gap in current understanding as there is some uncertainty around hydrogen's (indirect) contribution to global warming though available results indicate impacts are likely to be small).[52,53,54]

The CER as the preferred vehicle to administer scheme

- Stakeholders perceive government led schemes to have a higher degree of credibility

[50] IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Retrieved from Task Force on National Greenhouse Gas Inventories: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[51] Particularly the *Corporate Accounting and Reporting Standard* and the *Corporate Value chain (scope 3) standard*
[52] Derwent R., Simmonds, P., O'Doherty, S., Manning, A., Collins, W. and Stevenson, D. (2006). *Global Environmental Impacts of the Hydrogen Economy.* UK.
https://www.geos.ed.ac.uk/~dstevens/Presentations/Papers/derwent_ijhr06.pdf
[53] Derwent, R., Stevenson, R., Utembe, S., Jenkin, M., Khan, A. and Shallcross, D. (2020). *Global modelling studies of hydrogen and its isotopomers using STOCHEM-CRI: Likely radiative forcing consequences of a future hydrogen economy*, International Journal of Hydrogen Energy, Volume 45, Issue 15,
https://doi.org/10.1016/j.ijhydene.2020.01.125.
[54] UK Department for Business, Energy and Industrial Strategy. (2018). *Hydrogen for heating: atmospheric impacts*.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760538/Hydrogen_atmospheric_impact_report.pdf

- The CER is well recognised by stakeholders as the most appropriate administrator for a future scheme.

Use of offsets in a hydrogen certification scheme is proving to be a contentious issue

- Offsets proved to be a contentious issue amongst stakeholders
- The divergent views on use offsets relates to stakeholders' preferred production pathways (fossil fuel vs. renewables) and their understanding of export market expectations
- Considering the use of offsets in a domestic scheme will require careful balancing of supporting early market development (i.e. through a portfolio of hydrogen generation pathways) and ensuring scheme credibility
- Stakeholder preference for GO to include emissions reported with and without offsets, where offsets are included in the scheme
- Offsets are a topic of clear contention globally[55]
- Article 6 rules covering definition and treatment of ITMOs are yet to be established (the inclusion of offsets before these are settled represents a significant risk)
- Ultimate alignment and/or linkage with international schemes which do to allow the use offsets, may require Australia to sunset the use of offsets in its domestic scheme.

4.2. Development of options

Using the insights from Energetics' research and analysis of stakeholder positions with respect to the design of a future scheme, we identified three options for the development of a hydrogen certification scheme in Australia, which are summarised in Table 4-1 with further information provided below.

Energetics notes that **all three options likely require the establishment of a new domestic scheme** outside of NGER, for the purpose of hydrogen GO generation. Appropriate legislation and regulations are expected to be required to underpin this new scheme, although it could be implemented via some alternative mechanism noting that the scheme would be voluntary.

Given that a hydrogen GO scheme implies some level of comparison, it is expected that it will need to fulfil specific requirements to enable equitable comparison at a product level. A hydrogen GO scheme **would need to establish a framework** for attributing emissions across a clearly defined system boundary to a functional unit (of product).

Whilst there is domestic interest in using NGER as much as possible, given stakeholder familiarity and confidence, potential to minimise compliance burden and potential to support fast-tracked implementation of a hydrogen GO scheme, as highlighted in this report, there are a number of shortcomings, which mean that NGER may not be 'fit for purposes' for a hydrogen GO scheme.

Based on Energetics' research and IPHE H2PA TF's approach, ISO standards 14040/14044 and ISO 14067 and/or the GHG Protocol *Product Life Cycle Accounting and Reporting Standard* are deemed to be appropriate international reference points, but these may be supplemented via different sources. As outlined in this report's Recommendations section, further work is required to identify the most appropriate approach to account for GHG emissions across different production pathways.

[55] We note that land and agricultural offsets are not permitted in the EU, and thus use of these kinds of offsets in a domestic scheme represents a problem in terms of export to the EU

Table 4-1: Key features of initial options

Features	Option 1: Collaborative development of a certification scheme with targeted trade partners[56]	Option 2: Partial alignment with CertifHy	Option 3: Minimal domestic scheme that transitions to an international scheme over time
Outline	Establish a GO scheme reflecting bilateral (or multilateral) negotiations	Establish a GO scheme which partially aligns with select CertifHy principles (full alignment with CertifHy would be subject to the evolution of CertifHy and future preferences for a domestic scheme)	Establish a GO scheme which adopts established international principles (i.e. IPHE)
Indicative timing	2-3 years to implement Timeline is subject to bilateral negotiations and counterparty market developments	1-3 years to implement Timeline is subject to establishment of a scheme for Australia which is aligned with select CertifHy principles as well as the ‘evolution’ of CertifHy	1-2 years to implement Timeline is subject to establishment of an international GO scheme, particularly through the IPHE
System boundary	Gate-to-gate (emissions for production stage only, with a clearly defined system boundary which can be supported by the NGER scheme’s existing factors and methods)	Well-to-gate (in line with the system boundaries specified by CertifHy)	Well-to-gate (in line with system boundaries currently being specified by IPHE)
Accounting methodology[57]	Establish methodology for allocation of emissions to hydrogen product	Establish methodology for allocation of emissions to hydrogen product (and	Establish methodology for allocation of emissions to hydrogen product (and

[56] All parameters subject to approval by key trade partner(s)
[57] Note that any use of NGERS emissions factors and methods is subject to approval from relevant parties (trade partners, CertifHy, IPHE for options 1, 2 and 3 respectively)

	(and relevant co-products) based on ISO 14040/14044 and ISO 14067 and the GHG Protocol *Product Life Cycle Accounting and Reporting Standard*, covering requirements for comparative assertion (if required) Use NGER emissions factors and methods to support calculation of emissions across gate-to-gate system boundary Prioritise establishment of liquid hydrogen and ammonia certification options (for export to key trade partner)	relevant co-products) consistent with ISO 14040/14044 and ISO 14067 and the GHG Protocol *Product Life Cycle Accounting and Reporting Standard*, covering requirements for comparative assertion (if required) Use NGER emissions factors and methods where possible to support calculation of emissions across well-to-gate system boundary Provide supplementary emissions factors and methods[58] to support calculation of emissions across well-to-gate system boundary, particularly for reporting of upstream (scope 3) emissions Provide methods for market-based and location-based reporting of electricity emissions (refer to Climate Active Electricity Accounting Rules)[59] Potential implementation of an electricity GO scheme which will interface with the hydrogen scheme,	relevant co-products) consistent with ISO 14040/14044 and ISO 14067 and the GHG Protocol *Product Life Cycle Accounting and Reporting Standard*, covering requirements for comparative assertion (if required) Use NGER emissions factors and methods where possible to support calculation of emissions across well-to-gate system boundary Provide supplementary emissions factors and methods[4] to support calculation of emissions across well-to-gate system boundary, particularly for reporting of upstream (scope 3) emissions Provide methods for market-based and location-based reporting of electricity emissions (refer to Climate Active Electricity Accounting Rules)[5]

[58] This could include development of new default scope 3 emissions factors and methods using NGER data, broader access to NGER data to support user development of site-specific emissions factors and/or guidance for estimating emissions which does not leverage the NGER scheme
[59] Climate Active. (2021). *Electricity Accounting Rules*.
Copy of rules provided to Energetics by the Department.

		or linkage with existing Australian renewable energy certification schemes Potential alignment with Annexes V and VI of the RED II and CEN EN16325 (subject to applicability for the Australian landscape, noting that these are European policy and standard) 'Green hydrogen' and 'Low-carbon hydrogen' labels and thresholds excluded (subject to Australian government's future position and international acceptance)	
Carbon offsets	Use of selected offsets could be accommodated (in line with Climate Active), subject to approval by trade partner(s) Could include sunsetting provisions within 5-10 years Certification could include emissions intensity with and without use of offsets	Excluded	Use of selected offsets could be accommodated (in line with Climate Active), subject to alignment with IPHE Could include sunsetting provisions within 5-10 years Certification could include emissions intensity with and without use of offsets

Governance[60]	CER to lead in co-operation and engagement with international counterparts	CER to lead scheme, but should be aligned with CertifHy governance frameworks and requirements Ongoing engagement with CertifHy	CER to lead (domestic) scheme. Australian government (through the Department) to continue working closely with IPHE in establishing an international approach for hydrogen certification and align with IPHE's governance frameworks and requirements (where available/applicable) Ongoing engagement within international hydrogen certification landscape including IPHE and also CertifHy

[60] Governance here refers to regulation and administration only, with policy development ultimately the responsibility of the Australian Government

1. Collaborative development of a certification scheme with targeted trade partners

Description

Australia works with one (or more) key trade partners to collaboratively develop a GO scheme, via bilateral (or multilateral) agreements, which is fit-for-purpose domestically but also accepted in strategic export markets. It could take shape as a 'regional' model in the case that our regional counterparts and established trading partners choose to move at the same pace as Australia.

In terms of scheme implementation and timelines, Australia can commence engagement with key trade partners from early 2021. However, this option could take up to 2-3 years to implement (including a six-month pilot), subject to the nature and pace of international negotiations and establishment of scheme via legislation, regulation and/or other mechanisms.

This scheme is based on a gate-to-gate boundary system, which with strong potential for leveraging the NGER scheme. A gate-to-gate system boundary may be defined such that it does not require development of emissions factors and/or methods to cover upstream emission (i.e. can be supported by existing NGER emissions factors and methods). As such, this option could be expedited subject to acceptance by trade partner(s). Australia may need to pivot to a broader boundary in case this is the preferred approach by its trade partner(s).

A gate-to-gate boundary enables Australia to maximise use of its existing carbon accounting frameworks (i.e. NGER), hence minimising the work required to establish a new hydrogen GO scheme. However, while this scheme aims to leverage NGER as much as possible, at a minimum, there may be a need to refer to some of the methods outlined in ISO 14040/14044 and ISO 14067 (and potentially the GHG Protocol *Product Life Cycle Accounting and Reporting Standard*) to support definition of a system boundary, support comparison of products and emissions allocation. The definition of equitable system boundaries across the different hydrogen production pathways is critical to the integrity of this option.

The Australian government and the CER take a leading role in development of this scheme, leveraging frameworks and systems in place within the respective countries.

Evolution of the scheme will need to be reflective of the requirements of key trade partners and their respective hydrogen markets. Given that these export markets may including shipping of liquid hydrogen and/or ammonia, certification options for these energy carriers are likely to be prioritised.

The advantages and disadvantages of this option are summarised in Table 4-2.

Rationale

This option is based on Australia leveraging its existing engagement (including MOUs) with strategic trade partner(s) and emerging hydrogen markets such as Japan or South Korea, to develop a mutually agreeable scheme.

The rationale for this approach is as follows:

- By identifying key international target market(s) and prioritising their requirements, it is possible to develop a streamlined, fit-for-purpose scheme

- Collaboration with key trade partners can provide additional confidence in terms of future acceptance and east of investment and trade
- Australia can influence the design of such scheme to ensure the domestic market is positioned favourably and domestic interests are prioritised
- The development of a broad international hydrogen GO scheme will take a long time (beyond what is acceptable to the domestic industry).

Assumptions:

- Australia doesn't need to achieve universal acceptance in the short to medium term
- Future trade partners are prioritising the development of a fit-for-purpose hydrogen certification scheme
- Initial use of offsets could be accommodated to support domestic industry development (business model flexibility) and sunsetting of offset usage will not hinder the development of the domestic market
- There is alignment in scheme design with Australia's key trade partners accepting gate-to-gate system boundary, leveraging of existing Australian carbon accounting frameworks (i.e. NGER), use of offsets in the near to medium-term (to 2030) and governance led by Australian government bodies (i.e. the CER).

2. Partial alignment with CertifHy

Description:

Australia aligns with select CertifHy principles (partial alignment)[61], including a well-go-gate system boundary and ISO 14040/14044 and ISO 14067 compliant accounting methodology to position itself for future linkage with the scheme.

Indicative timing of 1-3 years for implementation, including a six-month pilot, is reflective of the additional time required to develop a new hydrogen GO scheme via legislation, regulations and/or other mechanisms, and potential development of a new electricity GO scheme.

This scheme aims to interlink with CertifHy and/or other countries who have implemented compatible schemes in the medium to long-term. However, Energetics notes that this could equally interlink with a broader international hydrogen GO scheme such as that currently under development by IPHE given the similarity in established parameters (system boundaries, references to ISO and GHG Protocol).

This scheme is based on a well-to-gate boundary consistent with CertifHy and compliant with ISO 14040/14044 and ISO 14067, and the GHG Protocol *Product Life Cycle Accounting and Reporting Standard*. NGER emissions factors and methods may be leveraged wherever possible, noting that this might require discussion with CertifHy to confirm the acceptability of this approach.

Whilst compliance with CertifHy's boundary and accounting regime is deemed necessary to support a partial alignment, such an approach could increase the complexity of the scheme and the associated compliance burden, which may include (i) adherence to specific requirements outlined in these ISO

[61] Given the Federal government's current position on the use of eligibility thresholds, and CertifHy's specific eligibility thresholds and colour labels, Energetics does not consider full alignment to be a realistic option at present

standards with respect to comparative assertions, (ii) the level of rigour and analysis required, including calculation of upstream (scope 3) emissions and (iv) audit requirements.

Other important considerations in facilitating partial alignment with CertifHy include:

- Ensuring electricity emissions reporting under the scheme is aligned with CertifHy (and the GHG Protocol) and includes market-based and location-based approaches
- Consistent definition of product system boundaries and methods for emissions allocations
- Possible need for the implementation of an electricity GO scheme or linkage with Australia's existing renewable energy certification schemes (i.e. RET) or any future schemes (such as the proposed below baseline scheme).

The Australian government and the CER take a leading role in development and implementation of a domestic scheme, which is partially aligned with CertifHy. This requires engagement and collaboration with CertifHy from the outset.

The Australian government's current position to avoid eligibility thresholds and colour labels, is incompatible with full alignment with CertifHy from the outset. As such, a 'full' alignment with CertifHy from the outset is not considered a realistic option. A 'full' alignment as part of any transition pathway will be subject to the evolution of CertifHy and its underpinning directives as well as the Australian governments preferences for the development of its domestic scheme.

The advantages and disadvantages of this option are summarised in Table 4-2.

Rationale

This option allows for a domestic scheme to be modelled on elements of a robust and recognised scheme (i.e. CertifHy). It meets stakeholder preference for a scheme to be established which achieves a degree of international alignment (prioritising international alignment over timing), which positions Australia favourably from an international acceptance (particularly Europe) perspective.

The rational for this approach can be further summarised as follows:

- CertifHy is the leading hydrogen certification scheme and sets a strong and robust example for Australia to align with from the outset and later interlink with
- The development of a broad international hydrogen GO scheme will take a long time (beyond what is acceptable to the domestic industry)
- Partial adoption avoids the need for the Australian government to change its initial position with respect to avoiding colours and thresholds
- Provides a domestic scheme with some security in terms of international alignment but also provides some flexibility in terms of scheme implementation and consideration of domestic priorities (i.e. position outlined in the Strategy).

Assumptions:

- CertifHy will expand to allow linkage in the future and that its parameters will become prevalent and broadly accepted by Australia's future export partners
- CertifHy represents the best current option to evolve into a global certification scheme and is accepted by Australia's trading partners
- CertifHy will amend its scheme to accommodate international linkage

- Australia can move to align with internationally accepted carbon accounting methods (i.e. ISO 14044 and ISO 14067, GHG Protocol *Product Life Cycle Accounting and Reporting Standard*)
- Australian government accepts these select elements of the CertifHy scheme
- CertifHy's position in excluding offsets will not change
- Alignment with CertifHy is likely to position Australia to readily transition (or pivot) to a broader international scheme (such as that currently being developed by IPHE), given that this scheme leverages internationally accepted carbon accounting standards and aligns with indicative trends in the hydrogen GO space (including a well-to-gate boundary, exclusion of offsets, ISO alignment).

3. Minimal domestic scheme that transitions to an international scheme over time

Description:

Australia prioritises the implementation of a 'minimal' domestic scheme, which adopts certain established (or likely) features of the standard/framework under development by IPHE (with input from Australia), so it addresses stakeholder requirements for an urgent start and a degree of international harmonisation from the outset. This scheme intends to provide some level of certainty around scheme parameters and their international acceptance, without compromising on domestic interests while the international landscape firms up. This should give Australia move flexibility to evolve in line with domestic and international progress.

This option is expected to take the shortest time to implement with indicative timing of 1-2 years, including a 6-month pilot subject to the timing required to establish a new domestic scheme via legislation, regulation and/or some other mechanism and progress by IPHE in firming up the proposed international scheme.

This scheme aims to start establishing a domestic hydrogen GO scheme signposted by IPHE's direction in progressing an international scheme, with the expectation that Australia will shape the development of the scheme and ultimately be part of this scheme.

Similar to Option 2, this scheme is based on a well-to-gate boundary specified in line with those established by CertifHy and compliant with ISO 14040/14044 and ISO 14067, and the GHG Protocol *Product Life Cycle Accounting and Reporting Standard*. This compliance is a key component of international alignment and will support Australian linkage with IPHE's future international scheme. Similar to aligning with CertifHy (Option 2), there may be a higher level of complexity and compliance burden for the domestic market.

From an emissions accounting perspective, NGER emissions factors and methods may be leveraged wherever possible.

Other important considerations in aligning with the future IPHE scheme might include:

- Ensuring electricity emissions reporting under the scheme is aligned with IPHE direction which is likely to include market-based and location-based approaches (this could be achieved by leveraging Climate Active's *Electricity Accounting Rules*)
- Consistent definition of product system boundaries, comparable emissions factors and methods for emissions estimations, and consistent emissions allocation methods

- Possible need for the implementation of an electricity GO scheme or linkage with Australia's existing renewable energy certification schemes (i.e. RET) or any future schemes (such as the proposed below baseline scheme).

The development of this option involves the Australian government and the CER taking a leading role to establish a domestic GO scheme, which incorporates known elements of the IPHE framework, such as a well-to-gate boundary system and compliance with select ISO standards. This option will likely include ongoing engagement with IPHE to feed into development of the future international scheme and to ensure insights are reflected in the development of a domestic scheme.

The advantages and disadvantages of this option are summarised in Table 4-2.

Rationale:

This option aims to provide a domestic scheme in a relatively short timeframe, which can gradually evolve to align with a broad international scheme (IPHE's future international hydrogen GO scheme) that emerges in the future.

The rationale for this scheme is as follows:

- It enables Australia to establish a minimal scheme whilst it works with its international counterparts to shape the development of an universal scheme
- This option achieves a balance between early development of the domestic industry (as the international market firms up) and desire for broader international compatibility and acceptance.
- The development of a broad hydrogen GO scheme will take a long time (beyond what is acceptable to the domestic industry).
- Addresses strong stakeholder feedback that the development of a international scheme should not hinder domestic progress
- IPHE has a broader representation than CertifHy and may provide Australia with an advantage in terms future recognition/acceptance

Assumptions:

- Elements of the IPHE standard currently under development will be accepted in the short term both domestically and internationally, particularly the establishment of a well-to-gate boundary and alignment with internationally accepted carbon accounting methods
- Global scheme will take some time to be developed and the implemented, noting that international negotiations could prove to be a lengthy process
- A minimal scheme which is based on established IPHE design principles will experience a high level of acceptance by our future export partners
- Initial use of offsets could be accommodated to support domestic industry development (business model flexibility) and sunsetting of offset usage will not hinder the development of the domestic market
- Australia plays on ongoing role in development of a global certification scheme (via engagement with IPHE).

Advantages and disadvantages of the options

The table below provides and overview of the advantages and disadvantages for each of the options, reflecting the core aims of each scheme and associated parameters.

Table 4-2: Advantages and disadvantages for each option

	Option 1: Collaborative development of a certification scheme with targeted trade partners[62]	Option 2: Partial alignment with CertifHy	Option 3: Minimal domestic scheme that transitions to an international scheme over time
Advantages	• Focus on developing a scheme for Australia and key trade partners to avoid future trade barriers • Minimises requirements for emissions factors and methods beyond NGER • Minimise compliance cost and administrative burden • Australia can drive development of scheme (ownership/control) • Leverages existing frameworks • Could consider certification of ammonia products from commencement of scheme to support early trade with key trade partners • Flexibility for domestic market business models (facilitate industry growth) via use of carbon offsets (for a fixed time period) while CCUS technologies are developed • Establishes Australia as a leader within the hydrogen certification space • Aligns with the Strategy's preference to avoid definition of hydrogen categories	• Partial alignment with the most advanced hydrogen certification scheme (CertifHy) with potential for full alignment over time • Positions Australia for linkage with any other countries that have also sought to align with CertifHy • Positions Australia for trade with the EU and/or any other countries that have also sought to align with CertifHy • Minimises risk that Australia's hydrogen and hydrogen certification will be rejected by international markets • Minimises risk that Australia may need to pivot in a significantly different direction • Aligns with the Strategy's preference to build on or harmonise with existing certification schemes • Aligns with the Strategy's preference to avoid definition of hydrogen categories and labels and set associated thresholds (subject to approval from CertifHy/acceptance from international market)	• Likely the shortest timeframe for implementation • Aligns with the Strategy's preference to establish an initially minimal scheme as well as stakeholder preferences for some level of international alignment • Aligns with the Strategy's preference to avoid definition of hydrogen categories and labels and set associated thresholds • Aligns with the Strategy's and stakeholder preference to build on or harmonise with existing certification schemes • Positions Australia to influence development of global hydrogen GO scheme and evolution of the scheme (i.e. inclusion of ammonia). • Positions Australia for linkage with future global hydrogen certification scheme ('IPHE designed' future scheme with Australian government input and direction)

[62] Subject to preference of bilateral (and/or multilateral) partners

	and labels and set associated thresholds	• Potential for Australia to play an important role in the expansion of CertifHy to a global GO scheme	• Positions Australia for trade with the EU and/or any other countries that have also sought to align with IPHE's GO scheme (including members of IPHE) • Reduces risk of Australia's hydrogen and hydrogen certification being rejected by international markets • Builds on frameworks and processes already in place in Australia • Minimises risk that Australia may need to pivot in a significantly different direction • Australia continues to focus on work with international counterparts to develop a unified scheme (via IPHE)
Disadvantages	• While this option aims to streamline implementation by seeking agreement with a single trade partner, the timeline could prove lengthy as it is subject to international negotiation and progress by key trade partner(s) • Scheme design is subject to the preferences of trade partner(s). Uncertainty with respect to this option ultimately being aligned with the government and stakeholder preference for a minimal scheme • Does not necessarily align with the Strategy's preference to build on or	• Requires the longest amount of time to implement (subject to time required to develop a new scheme which aligns with ISO 14040/14044, ISO 14067 and potentially Annexes V and VI of the RED II and CEN EN 165325 (pending applicability) • Does not necessarily align with the Strategy's preference to establish a minimal scheme as a starting point • Supplementation of NGER likely to be required to support accounting of upstream (scope 3) emissions, emissions allocation and direct product comparison	• Supplementation of NGER likely to be required to support accounting of upstream (scope 3) emissions, allocation and direct product comparison • Higher scheme complexity and compliance burden for participants of the scheme, particularly the potential use of ISO standards • Uncertainty around how Australia's scheme might evolve to fully align with IPHE or some international scheme, and associated challenges with eventual alignment or linkage

	harmonise with existing certification schemes • Does not align with the Strategy's preference accommodate the broader international commodity environment • Risk that Australia may be less visible and have less influence in the potential development of a broader international hydrogen certification scheme • Risk that Australian certification and associated hydrogen may not be valued or accepted by broader international markets • Risk that Australian hydrogen may be subject to international carbon pricing mechanisms (such as the proposed EU carbon border tax) • May become difficult to market and compare Australian hydrogen with international hydrogen if another scheme dominates internationally • Risk that key trade partners may move away from Australian certification and associated hydrogen if another scheme dominates internationally • Risk that Australia may need to pivot in a significantly different direction (trade partners shift in a different direction, or Australia seeks participation in broader export markets)	• Higher scheme complexity and compliance burden for participants of the scheme, particularly the use of ISO standard and potential linkage with electricity GO or other renewable energy certification scheme • CertifHy is subject to the EU's complex policy environment and could be subject to rapid/unexpected changes • Australia has less control over evolution of the scheme • Risk that CertifHy's evolution will not align with Australia's future priorities (which might include items such as certification of hydrogen derivatives including ammonia and biomethane, inclusion of water within the certification and inclusion of downstream transport emissions) • CertifHy may not be accepted by our export markets such as Japan and South Korea • Does not include ammonia certification from the outset, and uncertainty around evolution of the scheme to include this item flagged as a key priority by segments of the market • Risk that Australia may be less visible and have less influence in the potential	• Uncertainty around parameters of scheme, given no real commitment to future trajectory • Risk around acceptance of offsets if used, by broader international markets, particularly in the EU • Does not include ammonia certification from the outset, and uncertainty around evolution of the scheme to include this item flagged as a key priority by segments of the market • The pace of international scheme development could hinder broader export opportunities (i.e. Australia could be stuck with a minimal scheme for longer than expected) • Risk that the evolution of an international scheme may not be aligned with Australia's future priorities (which might include items such as certification of hydrogen derivatives including ammonia and biomethane, inclusion of water within the certification and inclusion of downstream transport emissions) • Compliance costs and complexity may increase over time

	• Risk around acceptance of offsets (if permitted) to broader international markets • Not fully aligned with broadly accepted international carbon accounting methods	development of a broader hydrogen certification scheme • Limits flexibility for domestic market business models (facilitate industry growth) via exclusion of carbon offsets • CertifHy and/or international markets may not be willing to accept hydrogen without a label (i.e. 'green hydrogen', 'low-carbon hydrogen')	

Evolution of a hydrogen GO scheme

There is significant overlap across the options and some commonalities, particular with respect to accounting methodology, reflecting common points of consensus identified amongst domestic stakeholders and within the emerging international market. These options all acknowledge some level of transition or evolution, reflecting the nascent nature of the Australian and international hydrogen markets, the emerging state of customer preferences and priorities and significant uncertainty around the future role of hydrogen in decarbonisation (including the scale of this role and potential use of hydrogen across a variety of different applications).

Any scheme should aim to be sufficiently robust that it can respond to changes in the hydrogen market and international certification space (including progress by IPHE in developing an international scheme and potential evolution/expansion of CertifHy). Energetics expects that alignment with international standards (including but not limited to ISO 14040/14044 and ISO 14067, and the GHG Protocol *Life Cycle Accounting and Reporting Standard*) will become a key component of global hydrogen GO schemes, given that these are well established international frameworks which provide for allocation of emissions to products (including for the purposes of comparison). Broader changes such as changes in the global warming potential of methane, technological advances in carbon capture, utilisation and storage (CCUS) and the associated accounting and reporting, establishment of international carbon markets and additional recommendations for greenhouse gas reporting (such as those outlined in the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*[63]) are also expected to impact evolution of a hydrogen GO scheme.

System boundaries may be required to expand over time to provide more comprehensive emissions coverage, particularly if this becomes a priority and/or preference of future customers. For Option 1, whereby a gate-to-gate boundary excludes upstream scope 3 emissions, evolution to expand to at least a well-to-gate boundary, may become a key priority to align with future market expectations. However, system boundaries may also expand beyond well-to-gate to consider downstream processing, storage, transport and other downstream emissions.

Further revision/expansions to an initial scheme (across the three options) may need to occur, to include coverage any of the following, but where practicable should be consistent with international direction and market preferences:

- Water is likely to be an increasingly important sustainability parameter for Australia, but unlikely to be of international concern. Australia will need to consider whether this should be handled within a future certification scheme.
- Ammonia and other hydrogen carriers (of particular interest for export)
- Other hydrogen derivative products (methanol, nickel, steel)
- Related products (biomethane)
- Other relevant environmental impact factors.

Given the sunsetting of Australia's RET and limitations of the NGER scheme with respect to handling of electricity, development of an electricity GO scheme which interacts with the hydrogen certification scheme or interlinkage with existing Australian renewable energy certification schemes is of interest.

The evolution of CertifHy could potentially have implications for all three options, but particularly for option 2 where there is partial alignment with CertifHy. Option 2 will need to include a high degree of

[63] IPCC. (2019). *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Retrieved from Task Force on National Greenhouse Gas Inventories: https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

agility in case changes are made to CertifHy as that scheme evolves. This may include updates to thresholds (for Option 2, if thresholds and labels are implemented), definitions and boundaries. This will require ongoing engagement with CertifHy and the broader international market. For options 1 and 3, the potential evolution/expansion and broad uptake of CertifHy could ultimately lead to a pivot to CertifHy.

If offsets are permitted, treatment may need to evolve to reflect the broad international position. This may involve extension of timelines for and/or inclusion of offsets within the scheme, or changes to the types of offsets which are admissible. At this stage, given there is significant uncertainty around offsets, inclusion should be carefully considered.

In implementing a hydrogen GO scheme, the Department may favour use of a modular format (for any of the three options). This approach might include establishment of a module for direct production, a module for upstream transport, a module for feedstock extraction and a model for downstream transport. These modules could be mandatory or optional, as a way to provide flexibility for hydrogen suppliers in meeting the varying demands of hydrogen consumers. However, Energetics notes that the boundaries of these modules must be selected very carefully if the Department wishes to support standalone comparison of modules.

Finally, as the market establishes itself, it may be beneficial for a hydrogen GO scheme to evolve into a hydrogen certificate scheme. This might facilitate easier interaction with other schemes (including the RET, NGER) and support ongoing growth of the market, particularly if emissions reductions emerge as a priority.

5. Recommendations

Energetics has presented three options for the development of an Australian hydrogen GO scheme for the Department's consideration. To assist in selecting a preferred scheme, we recommend the Department to undertake further industry consultation and to test the key parameters, methods and processes of the scheme through pilot project(s). Key learnings from the current CertifHy pilot projects, such as the importance of clear and transparent instructions with respect to transparency and ease of use of certification processes as well as ensuring adequate equipment is installed and/or available for pilot participants, should be considered in the design and implementation of any future Australian pilots.

Also, to better understand the nature and priorities of future hydrogen customers, particularly those with net zero target ambitions, we recommend the Department to undertaken further research and engagement with both domestic and international customers. Insights from this work will also help guide the development of a future certification scheme to ensure it is aligned with customer drivers and value sets.

Next steps:

Options analysis, research, and consultation (Q1-2 2021)

Select a preferred option or at least key elements of an option for presentation to industry via a position paper, which synthesis previous stakeholder insights and international analysis to provide initial design parameters, highlighting any outstanding decision points and a roadmap for implementation of a GO scheme in Australia.

Establish a framework for emissions accounting associated with hydrogen production to underpin the scheme. This should include definition of system boundaries, specific methods and data requirements. Seek feedback from industry stakeholders covering the proposed scheme.

Consider options for expanding a future hydrogen GO scheme to include other 'green' gas products such as biomethane/biogas and hydrogen carriers such as ammonia, subject to progress of international markets and domestic priorities.

Undertake a review of emerging domestic and international customer preferences and priorities for uptake of hydrogen, particularly with respect to their requirements and expectations for a GO scheme as well as key design parameters such as use of offsets and inclusion of value chain carbon emissions.

Undertake detailed analysis of hydrogen production processes to better understand pathways in order to develop methodologies for GHG emissions accounting across the relevant system boundary, including options to leverage NGER where possible.

International engagement (commencing in 2020 and progressing throughout 2021)

Ongoing participation in international hydrogen forums, particularly IPHE, will ensure that Australia's position is aligned with its international counterparts (including future trade partners). In addition, such involvement is critical in ensuring that Australia's interests/preferences are considered as work continues to develop a universal scheme.

Targeted engagement with key international trade partners will also increase Australia's understanding of customer preferences, particularly with respect to certification (initially and over time), ensuring that any initial scheme can evolve accordingly to accommodate market requirements.

Active assessment of emerging international hydrogen markets, including trends in customer preferences, policy direction, emissions accounting principles and requirements and technological considerations such as the development of new electrolyser technology and implementation of CCUS, is also recommended as Australia looks to implement and evolve its domestic scheme.

Pilot design, implementation and evaluation (Q2 – Q4 2021)

Subject to stakeholder feedback and the selection of a preferred option and or the key elements of a preferred scheme, as per our recommendation above, the Department should develop a pilot framework, which outlines pilot objectives, design, timelines, potential partners, underpinning regulation and evaluation.

The pilot or trial should be focused on testing key aspects of the scheme, including production pathways, appropriateness of defined system boundaries, accounting methodologies as well as processes and systems for certification to the extent possible.

Potential mechanisms for implementation of a new scheme, including instruments to underpin any GO pilots or trials (i.e. legislation, regulation and other) also need to be considered in the early stages of the pilot design process.

Subject to the pilot's underpinning legislative and/or regulatory mechanism, the CER is deemed as the appropriate agency to manage the pilot program domestically (even in the case that some international scheme/program emerges, CER will need to manage this domestically). The Department may also consider the option to undertake 'voluntary' pilots in conjunction with industry (potentially involving ARENA, which is supporting a number of hydrogen pilot/demonstration projects), in case of lengthier than expected process to establish the required regulatory mechanism to support the pilots.

In discussion with industry and ARENA, the Department can identify suitable pilot projects and confirm delivery plans and steering groups (combination of government and industry partner representation).

Following the completion of pilot project(s), which can ideally be completed within a six-month period, the Department may undertake evaluation, and use the insights to refine the GO scheme design.

Scheme launch (2022-23)

Based on the findings of the pilot, any ongoing stakeholder input, customer studies and the IPHE work, the Department can then finalise the key principles of a hydrogen GO scheme for a potential launch in 2022 to 2023.

Appendix A CertifHy development

Phase 1 (2014-2016)

Phase 1 (2014-2016) brought together industry participants to formulate a common European-wide definition of green and low-carbon hydrogen, design a deployable GO scheme, and develop an implementation roadmap.

Definition of 'green hydrogen'

During the consultation and development stage of CertifHy, the consortium identified several key criteria for a potential definition of 'green hydrogen':

- Methods of validating the origins of the renewable energy sources (i.e. share or renewables vs exclusive renewables)
- Consideration of ancillary environmental impacts (e.g. water)
- Comprehensive identification of all hydrogen production pathways
- Appropriateness of the differing greenhouse gas thresholds already in the regulatory environment and methodologies to benchmark low greenhouse gas emissions
- Handling of losses associated with transport and storage.

An online survey was issued to relevant stakeholders detailing two hypothetical approaches. The first approach centred on the share of renewable energy and sustainability of feedstock. The second approach used LCA of GHG emissions to define any hydrogen produced at an emissions intensity under a state-based threshold as 'green hydrogen'. Respondents favoured the share-based approach (i.e. 65% renewables equals 65% 'green hydrogen'), and indicated that all energy sources should be allowed for the non-renewable feedstock portion (i.e. the remaining 35%)[64]. The findings of the survey indicated respondents desire proportionality vis-à-vis low-GHG feedstock, and that any reference point should be associated with traditional SMR. This survey highlighted industry's desire for a scheme which allocated value (i.e. clear 'green' labelling) to any share of hydrogen made from renewables.

[64] CertifHy (2015), 'Technical Report on the Definition of 'CertifHy Green' Hydrogen', <Accessed: https://www.certifhy.eu/images/project/reports/Certifhy_Deliverable_D2_4_green_hydrogen_definition_final.pdf>

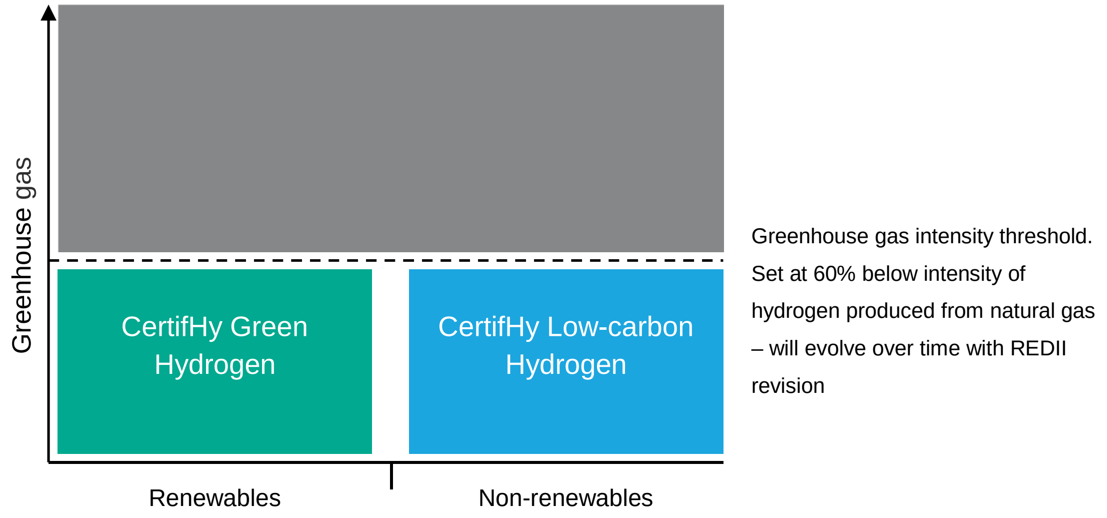

Figure 5-1: Hydrogen definitions according to CertifHy (source: CertifHy[65])

In line with the outcomes of this survey, CertifHy defined ‘Green Hydrogen’ as that produced from renewable sources (with 1MWh equalling 1 GO). CertifHy ‘Low-carbon Hydrogen’ is hydrogen that is produced with an emissions intensity of 60% below the benchmark emissions intensity threshold of hydrogen produced from natural gas (i.e. 36.4g CO_2e/MJ hydrogen produced).[66] CertifHy Green Hydrogen can also be CertifHy Low-carbon Hydrogen, as the proportion of renewable energy used will define the amount of green hydrogen certified (as illustrated in Figure 5-1). The CertifHy standard is required to be amended to increase the GHG savings threshold to 70% below benchmark by 2021 and 80% below benchmark by 2026 to align with RED II definitions[67].

As long as the thresholds outlined above are met, CertifHy maintains a *technology neutral* approach to hydrogen certification. Any technology that can support its claim for certification under the defined criteria are included in CertifHy’s scope.[68] The Strategy has indicated a preference for a technology neutral approach, and CertifHy have illustrated a practical pathway that allows for such.

Platform creation

In Phase 1, the CertifHy consortium worked in tandem with global bodies including Shell, Linde, Air Liquide, BMW, EDF, and Total, to establish a preliminary outline for the scheme. A four-pillar framework was established to guide the group in developing this outline; consisting of the Stakeholder Platform (a forum that brought together organisations and individuals interested, constituting the logistical vehicle for management of the project including delineation of roles and responsibilities), the Steering Group (a decision making and conflict resolution body), four Working Groups (focused around scheme and procedures, GO issuing, commercialisation and use, and the regulatory framework, respectively), and the Secretariat (responsible for logistical organisation of the Steering Group and Stakeholder Platform sessions). Further detail is provided in Table 5-1.

Table 5-1: CertifHy platform (source: CertifHy[69])

[65] ibid
[66] CertifHy (2019), ‘CertifHy-SD Hydrogen Criteria’
[67] Velazquez, A & Dodds, P (2020)
[68] CertifHy (2019), ‘CertifHy-SD Hydrogen Criteria’
[69] CertifHy (2018), ‘Stakeholder Platform Governance Rules’, https://www.certifhy.eu/images/180118_SP_Governance_Rules_Draft.V.2.1_CL.pdf>

Pillar	Roles and responsibilities
The Stakeholder Platform	Brings together those organisations and individuals (800+ March 2019) interested in Green and/or Low-carbon Hydrogen Guarantees of Origin (GO) in Europe and have voluntarily adhered to the platform. The Platform is open to all interested stakeholders that represent companies and are based in the EU.
The Steering Group	The Platform's decision-making and conflict resolution body. It is made up of, the Chair and co-Chair of each Working Group, and an institutional college that consists of representatives of The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) and the European Commission.
Four Working Groups	The four Working Groups provided the driving force of the Stakeholder Platform. Their role was to provide input to the project. WG 1: GO Scheme and Procedures WG 2: GO Issuing WG 3: GO Commercialisation and Use WG 4: Regulatory Framework.
The Secretariat	The Secretariat looks after the logistical organisation of the Steering Group and Stakeholder Platform Plenary Sessions. The Secretariat is responsible for ensuring Stakeholders may apply to the Stakeholder Platform and that Working Group Coordinators are regularly made aware of Stakeholders wishing to join their Working Group.

Once the four pillars were established, and appropriate definitions for 'Green Hydrogen' and 'Low-carbon Hydrogen' were defined, CertifHy migrated to Phase 2 of its project development.

Phase 2 (2017-2019)

The second phase of CertifHy began in October 2017. Three milestones were laid out for CertifHy to achieve over the next 24 months. These milestones are as follows:

- Establish the scheme's governance model
- Determine the CertifHy scheme would operate throughout the GO's lifecycle
- Ensuring the oncoming change in the REDII was accounted for and compatibility continued (i.e. potential updated thresholds and GO requirements by Member States was in line with the projects direction)

Pilot Schemes

To explore the logistics and test the efficacy of the program, CertifHy developed and ran several pilot or trial schemes. As seen in Figure 5-2, the issuance of a CertifHy GO's had several pathway milestones needing to be met before final issuance. This process, set out in the design stage of the scheme, is expected to be the final process moving forward once CertifHy is formally established in the EU.

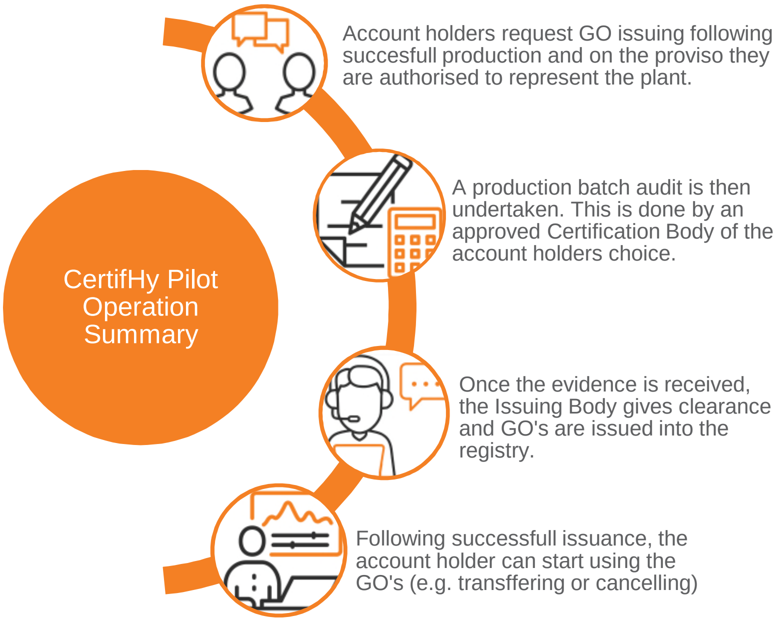

Figure 5-2: Pilot summary (source: CertifHy[70])

Four different hydrogen projects leveraging different production pathways were chosen to lead the first issuances of CertifHy compliant GO's in Europe. These projects were selected to test out different aspects of the scheme including items such as: auditing the plants, verifying production, confirming the methodology for GHG allocation, and issuance of the GOs themselves. As part of the scheme, CertifHy also set up a registry and a body to handle the insurance, transfer and cancellation of created GOs. The four projects chosen for the pilot are outlined in Table 5-2 below.

Table 5-2: CertifHy pilot schemes (Source: CertifHy[71])

	Pilot Project Air Liquide	Pilot Project Colruyt	Pilot Project Air Products and Akzo Nobel	Pilot Project Uniper
Project	SMR Porte Jerome	Hydrogen by water electrolysis	Chlor Alkali Process	Windgas Falkenhagen
Country	France	Belgium	Netherlands	Germany
Organisation	Air Liquide	Colruyt Group	Nouryon/Air Products	Uniper
Technology	Steam methane reforming	Water electrolysis	Chlor Alkali	Electrolysis
Renewables	Biomethane	Solar & wind	N/A	Wind energy
CCS	Yes	N/A	N/A	No
H2 utilisation	Refining	Transportation fuel	Steam generation	Natural gas substitute (grid)

[70] CertifHy (2019), 'Procedure 1.1 – GO Issuing', <Accessed: https://www.certifhy.eu/images/media/files/CertifHy_2_deliverables/CertifHy_P1.1_GO-Issuing_V1-0_2019-03-11_endorsed.pdf>
[71] CertifHy (2020), 'Pilot project', <Accessed: https://certifhy.eu/project-description/pilot-projects.html>

Capacity	~4500kg/h	Storage: 85kg Fuel cell: 120kW	18kt p.a. (200MW)	360 Nm³/h of hydrogen

The first GOs from these four production facilities began being issued in late 2018. By early March 2019, over 75,000 (75GWh) Green and Low-Carbon GOs had been issued. Of these, 2.8GWh of renewable derived hydrogen were issued, with the remaining 73.4GWh coming from fossil-generated hydrogen[72].

Establishment of the Stakeholder Platform, and governance framework

Once the technicalities of the scheme were defined following Phase 1, Phase 2 allowed for the Stakeholder Platform to establish the governance framework for the GO program. As shown in Figure 5-3 the framework includes four key bodies (the Issuing Body, Accreditation Body, Registry, and Certification Body). Phase 1 identified several schemes that they had leveraged in formulating a coherent and legally abiding framework. Schemes such as the European Energy Certificate System (EECS) for renewable electricity GOs and Member States' national renewable gas (i.e. biomethane) schemes for issues around gas GOs were highlighted as core knowledge sources.

The Accreditation Body sits above all other participants, performing the role of accreditor of accreditors. Currently, no individual organisation or body has been designated for this core role. The Stakeholder Platform has been chosen as acting Competent Authority in the interim. The main tasks of this body are to approve the Certification Bodies, and Registry, and ensure the system runs smoothly.

The Certification Body's role is to determine the eligibility of production equipment via a system audit, in addition to the attributes of the batches that stem from this plant. This is all conducted within a contractual arrangement between the Body and the CertifHy account holder. Currently, TÜV SÜD is acting as the sole Certification Body until the scheme is formally implemented. An entity can apply to be a certification body if it meets a list of requirements and knowledge in the following areas:

- LCA;
- GHG verification processes, requirements and methodologies;
- Quantification, monitoring and reporting;
- Hydrogen production process;
- Hydrogen delivery conditions and it effect on the total GHG emissions

The Issuing Body acts as the de facto gatekeeper of the scheme, ensuring the issue, transfer and cancellation of GOs in accordance with the scheme constitution. This includes supervision of the Registry. Grexel is the current acting Issuing Body and administrator of the Registry. The goal of CertifHy is to offer a central European issuing body and registry, and if this cannot be met, then to be capable of interfacing with national registries as well as other energy carriers.

[72] CertifHy (2019), 'Main Achievements', <Accessed: https://www.certifhy.eu/images/media/files/Certifhy_2_Other_publications/CertifHy_Main_achievements.pdf>

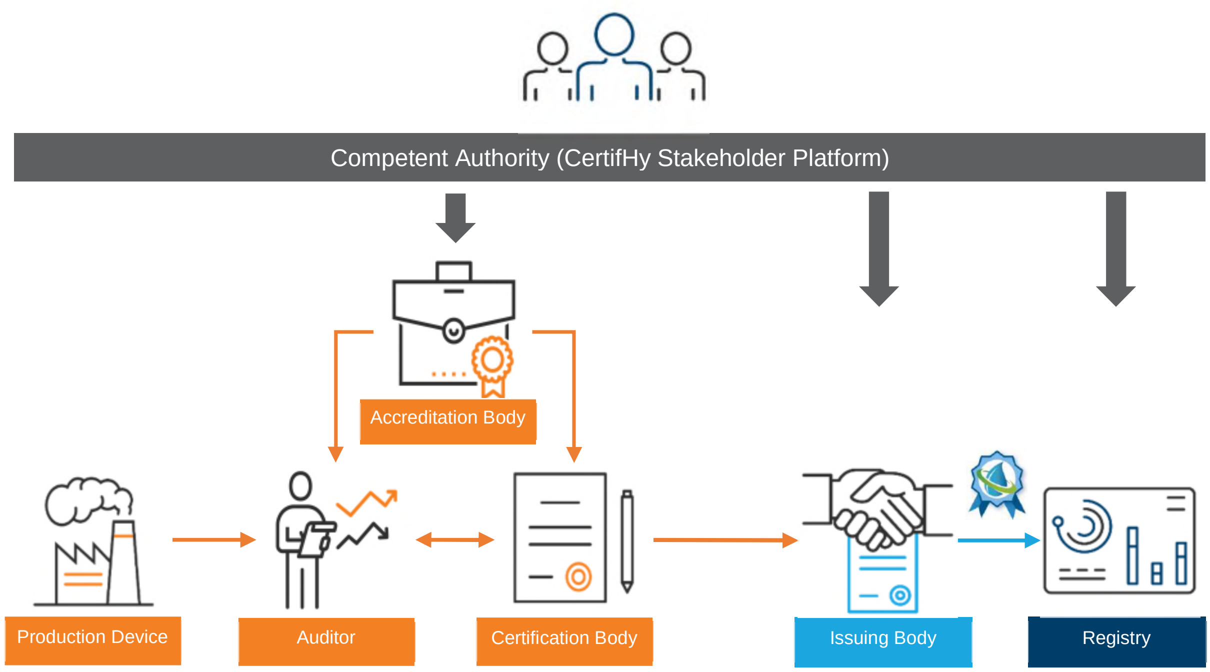

Figure 5-3: CertifHy governance framework[73]

Ensure compatibility with EU legislation (in particular RED II)

The EU's RED II is the foundation of the CertifHy scheme, providing it with the legislative backbone to operate. RED II will take effect January 1, 2021 and is currently the most relevant EU legislation to cover hydrogen across its various end-uses. The EU RED II is also the foundation from which EU GOs are supported and implemented.

During Phase 2, the Stakeholder Platform found it challenging aligning the scheme with REDII because of country implementation issues in the act which have not been committed too and are expected to arise in 2021; items such as a methodology for assessing GHG emission savings from renewable transport fuels of non-biological origin, and creation of an additionality framework.[74]

In addition, CertifHy emphasised that a tracking system for hydrogen which extends beyond GOs should be the next step; a broader system that tracks hydrogen and accounts for the contribution from renewable energy sources towards national targets is something the CertifHy scheme has hoped to achieve. Firstly, the scheme is intended to inform consumers and enable choice. CertifHy then wants to evolve to allow for its certificates to identify energy products that can contribute to meeting regulatory requirements (e.g. country emission targets), which it cannot currently be used for. By having a dual-purpose, it will allow for both disclosure and facilitate meeting EU/national obligations.

Phase 3 (2019-Present)

Following the completion of the pilot schemes, CertifHy entered Phase 3. This stage, currently underway, is focused on consolidating learnings and ensuring harmonisation across a rapidly

[73] CertifHy (2017), 'Creating the 1st EU-wide Guarantee of Origin for Green Hydrogen', <Accessed: https://www.certifhy.eu/images/180612-CertifHy_Webinar.final.pdf>
[74] Additionality is the issue of whether the purchase of a GO leads to an increase in renewable energy production capacity in comparison to the situation without such purchase.

evolving regulatory space. In addition to the fast approaching entry into force of REDII in 2021, the European Committee for Standardisation (CEN) are in the process of formulating and revising several hydrogen standards that will impact CertifHy directly. Phase 3 will focus on tracking development within the space and ensuring compliance internationally (CEN) and regionally (EU RED II). If the department is interested in aligning with CertifHy it will be important for the Department to closely follow any movement in this space.

Key challenges

Industry led

CertifHy is a predominantly industry led project. A certification program run by those being certified has the potential for its credibility and integrity to be brought into question. With increasing levels of ambition in emissions reduction being demanded by the public at large, concerns around whether the project leaders are best suited to regulate themselves arises.

Cost of compliance

CertifHy has several layers of auditing, which combined with data capture and registry fees can increase the complexity and resulting costs of the scheme.

Internal disagreements

It’s important to note that there was no consensus for best practice emissions reporting in the production of hydrogen via SMR with Carbon Capture and Storage (CCS). Issues around life-cycle-analysis, international standards coverage (including ISO 14067), and uncertainty around alignment with EU’s regulatory frameworks (e.g. ETS) were polarising for the stakeholder platform

Appendix B Renewable gas GO schemes examined

Scheme	Region	Type	Regulation	Benchmark	System Boundary	Governance	Offsets	Accounting
CertifHy[75]	Europe	GO scheme	RED I & II	60% below SMR benchmark	Well-to-Gate	Stakeholder Platform	N/A	ISO 14044
CFP - JEMAI Environmental Label Program[76]	Japan	Eco-label	N/A	N/A	LCA	JEMAI	Not allowed	N/A
CFP (Carbon Foot Printing) [77]	South Korea	Eco-label	Self-regulation	Class 1 (raw materials and durable goods) & Class 2 (energy-consuming durable goods)	LCA	Ministry of Environment	N/A	ISO 14025, ISO 14040 series, and ISO 14064 series.
Green Gas Certification Scheme[78]	UK	GO scheme	REDI & II	UK Gas regulations	Well-to-Gate	Renewable Energy Assurance Ltd	N/A	N/A
Bio-Methane Certification Scheme (BMCS)[79]	UK	Bio-Methane certification	RED I & II	UK Gas regulations	Well-to-gate	Green Gas Trading Limited	N/A	N/A

[75] CertifHy, (2020), <Accessed: https://www.certifhy.eu/>
[76] CFP Program (2020), <Accessed: https://cfp-japan.jp/english/>
[77] CFP Korea, (2020), <Accessed: http://www.epd.or.kr/eng/main.do>
[78] GreenGas Certification Scheme (2020), <Accessed: https://www.greengas.org.uk/>
[79] GreenGas Trading (2020), <Accessed: http://greengastrading.co.uk/biomethane-certification-scheme>

The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) [80]	USA	Techno-economic impact model	GHG Protocol	N/A	LCA	Argonne National Laboratory	N/A	GREET
AFHYPAC81	France	GO scheme	N/A	100% renewable	Well-to-Gate	AFHYPAC/French Government	N/A	N/A
Californian Low Carbon Fuel Standard[82]	USA	Regulation (active)	Californian law	30%> lower GHG & 50%> NOX	Well-to-Tank	California Air Resources Board	Allows for under the Compliance Offset Program	California GREET (CA-GREET)
TÜV SÜD Standard CMS 70, Version 01/2020 “Generation of Green Hydrogen”[83]	Germany	National Standard (active)	CertifHy GO & RED I & II	35-75% reduction from SMR	Well-to-Tank	TÜV SÜD Industrie Service GmbH	Allows for under the Corporate Carbon Footprint Certification	ISO 14064

[80] Argonne National Laboratory (2020), <Accessed: https://greet.es.anl.gov/>
[81] Association Française pour l'Hydrogène et les Piles à Combustible (2020), <Accessed: https://www.afhypac.org/>
[82] California Air Resources Board (2020), <Accessed: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard>
[83] Velazquez, A & Dodds, P (2020),
‘Green hydrogen characterisation initiatives: Definitions, standards, guarantees of origin, and challenges’, https://doi.org/10.1016/j.enpol.2020.111300

Appendix C Renewable electricity GO schemes examined

Scheme	Region	Type	Regulation	Benchmark	Coverage	Governance	Accounting
Renewable Energy Guarantees of Origin[84]	UK	Renewable electricity GO	EU Renewable Energy Directive	EU Renewable Energy Directive	Electricity	Office of Gas and Electricity Markets	UK Climate Change Act 2008/ GHG protocol/ISO 140664-1 and the Carbon Trust Standard.
Environmental Product Declaration[85]	International	Renewable electricity GO	ISO 14025 & EN 15804	N/A	Lifecycle Assessment	EPD International AB	ISO14021/14040/14044/14046/19011
European Energy Certificate System	Europe	Electricity GO	EU Renewable Energy Directive	Supports all types of electricity	Electricity European Union	Association of Issuing Bodies	REDI&II
Green-e Energy[86]	North America, Taiwan & Singapore	Renewable electricity GO	State regulations	Must come from projects 15 years old or younger	Electricity	Green-e® Governance Board	GHG Protocol
EcoPower[87]	Germany	Renewable electricity GO	EU Renewable Energy Directive	ISO/IEC 17065 and EN ISO 19011 Includes Offset module	Electricity Offsetting	TÜV SÜD Industrie Service GmbH	ISO: 19011/14067/14044/GHG Protocol

[84] Office of Gas and Electricity Markets (2020), <Accessed: https://www.ofgem.gov.uk/>
[85] The International Environmental Product Declaration System (2020), 'What is an EPD', <Accessed: https://www.environdec.com/What-is-an-EPD/>
[86] Association of Issuing Bodies (2020), 'EECS Rules', <Accessed: https://www.aib-net.org/eecs/eecsr-rules>
[87] TÜV SÜD CMS Standard 80 (2019), <Accessed:https://www.tuvsud.com/en/-/media/global/pdf-files/brochures-and-infosheets/energy-certification/tuvsud-product-ee01.pdf?la=en&hash=3EB82CBD544C9CE4EA3BF9828453DF31>

Appendix D Mural boards (including Mural summary board)

Subsequent pages include final Mural boards across Groups 1-4 from the stakeholder engagement workshop and the Mural summary board consolidating all items.

Breakout group 1

Breakout group 2

Breakout group 3

Breakout group 4

Mural summary board

Glossary of terms, abbreviations, and acronyms

Accounting methodology – methods by which emissions within the system boundary are measured and accounted for, this includes the IPCC Guidelines for National Greenhouse Gas Inventories

ACCUs – Australian carbon credit units, units earned under Australia's ERF each equivalent to one tonne of carbon dioxide equivalent (tCO_2-e) stored or avoided by a project

AFHYPAC - Association Française pour l'Hydrogène et les Piles à Combustible; French industry body promoting hydrogen and fuel cell technology; in the process of developing hydrogen GO scheme

ANREU – Australian National Registry of Emissions Units; supports the issuance, holding, transfer, and acquisition of Australian Carbon Credit Units (ACCUs) issued under the Australian Government's Emissions Reduction Fund

Carbon offset – generated by activities which prevent, reduce or remove greenhouse gas emissions from being released into the atmosphere for the express purpose of offsetting emission released elsewhere

CCUS – carbon capture, use and storage

CEN – European Committee for Standardization (Comité Européen de Normalisation)

CER – Clean Energy Regulator; Australian Government vehicle responsible for administration of various carbon and energy programs

CertifHy – The EU's private/industry hydrogen certification system

COAG – Council of Australian Governments

EECS – European Energy Certificate System

ERF – Emissions Reduction Fund; voluntary Australian Government scheme to incentivise adoption of new practices and technologies to earn Australia carbon credit units (ACCUs); enacted through *Carbon Credits (Carbon Farming Initiative) Act 2011*, the *Carbon Credits (Carbon Farming Initiative) Regulations 2011* and the *Carbon Credits (Carbon Farming Initiative) Rule 2015*

EU – European Union

GHG – Greenhouse gas

GHG Protocol – comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains and mitigation actions

GO – Guarantee of Origin; tracking instrument formally defined under the European Union's (EU) Renewable Energy Directive (RED) to provide information around renewable electricity to end-users; of interest for Australia in the context of hydrogen

Governance model – approach to governance of scheme including vehicle for implementation and administration and other items such as international collaboration and audit requirements

Green-e® Energy – North American independent certification and verification program for renewable energy; currently working on renewable fuels certification including hydrogen

HEM – The IEA's Hydrogen Energy Ministerial

HESC – Hydrogen Energy Supply Chain project; collaboration between Australia (Victoria) and Japan; demonstration of the feasibility of international hydrogen export; currently in pilot phases

IPCC – Intergovernmental Panel on Climate Change; United Nations body for assessing the science related to climate change

IEA – International Energy Agency

IPCC Guidelines for National Greenhouse Gas Inventories – methodologies guidelines for preparation of national greenhouse gas inventories

IPHE – International Partnerships for Hydrogen and Fuel Cells in the Economy; international partnership working to develop hydrogen markets; partnership the Department is currently engaged with in the development of an international hydrogen certification scheme

IPHE H2PA TF – IPHE's Hydrogen Production Analysis Taskforce; taskforce for development of methodology for hydrogen certification

ISO – International Organization for Standardization

LCFS California – Low Carbon Fuel Standard California; California's Air Resources Board's transport fuel emissions reduction scheme; includes hydrogen as a transport fuel

NGER Act – *National Greenhouse and Energy Reporting Act 2007*; legislative framework underpinning the NGER scheme

NGER scheme – National Greenhouse and Energy Reporting scheme; Australia's national framework for reporting company greenhouse and energy information established by the NGER Act

REC Registry – Secure online system for all transactions under the Renewable Energy Target including creating, registering, selling, trading and surrendering certificates

RECs – Renewable Energy Certificates; certificates representing renewable electricity generation including small-scale technology certificates (STCs) and large-scale generation certificates (LGCs) generated under the RET

RED I – The EU's Renewable Energy Directive; superseded in 2018; sets rules for the EU to achieve 20% Renewable Energy sources consumption target by 2020

RED II – The EU's Renewable Energy Directive - Recast to 2030; in force since 2018; sets rules for the EU to achieve 32% Renewable Energy sources consumption target by 2020

RET – Renewable Energy Target; Australian Government scheme established via the *Renewable Energy (Electricity) Act 2000*; aims to reduce greenhouse gas emissions from electricity generation

SMR – Steam methane reforming; most common production pathway for generation of hydrogen; uses natural gas

System boundary – the boundary around the components of the value chain included in the emissions inventory for certification

The Department – Department of Industry, Science, Energy and Resources

The Strategy – *Australia's National Hydrogen Strategy*

The Survey – The Department's May 2020 survey around hydrogen certification

TÜV SÜD – Technischer Überwachungsverein Munich; Austro-German company that provides inspection and certification service; currently offers certification for renewables-derived hydrogen

About Energetics

Working with ASX200 and all levels of government, Energetics is a specialist energy and climate change risk management consultancy.

Our services include:
- Strategy, policy and financing
- Climate risk and adaptation
- Renewables and energy efficiency
- Energy accounting and data management
- Energy and carbon markets
- Reporting, compliance and program audit

We're more than carbon neutral.

Sustainability is core to Energetics' business.

In June 2008, Energetics became one of Australia's first consulting firms to achieve carbon neutrality through the Australian Government's Greenhouse Friendly Program.

Since the FY19 reporting year, our carbon neutrality has been certified under the Climate Active Carbon Neutral Standard (formerly the National Carbon Offset Standard – NCOS) for Organisations. Climate Active is a partnership between the Australian Government and Australian businesses to drive voluntary climate action. www.climateactive.org.au

This approach aligns with Energetics' commitment to best practice calculation of our complete emissions profile and with how we have assisted some of our clients with becoming carbon neutral. We offset 100% of the greenhouse gas emissions associated with the complete lifecycle of our organisation. Our offsets are sourced from projects that are Verified Carbon Standard (VCS) or Gold Standard accredited and contribute to Sustainable Development Goals 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure) and 13 (Climate Change).

In keeping with our Sustainability Policy, we drive continuous improvement by identifying and implementing internal carbon mitigation, sustainable procurement and behavioural change projects. Being a sustainability role model is one of our core business values. Every employee is given two days personal development time to volunteer in environmental or social sustainability activities within their communities.

Document Control

Description	Prepared by	Reviewed by	Approved by	Approval date
Version 1	Joeb Northey Hannah Palma	Bahador Tari Gordon Weiss	Bahador Tari	9/10/2020
Version 2	Hannah Palma	Bahador Tari	Bahador Tari	20/11/2020
Version 3	Hannah Palma	Bahador Tari	Bahador Tari	3/02/2021
Version 4	Hannah Palma	Bahador Tari	Bahador Tari	24/2/2021

What we do

We have been creating value for ASX200 for more than 35 years	An Australia-first, we worked with CSIRO to conduct a risk and profitability assessment for CBA of climate change impacts on agriculture to 2060	We are energy markets advisors to leading renewable power purchase agreements: MREP, Sydney Metro, City of Adelaide
We procure more than $2b in energy annually for our clients	We provided advice on the application of TCFD framework to Telstra and Coca-Cola Amatil	We advised on science-based emissions targets for Woolworths, Dexus, Ausgrid, Brisbane and NT Airports, Southern Cross Station
We employ over 70 specialists. 2.8 is the average number of tertiary qualifications per employee	As a trusted advisor to government, we understand regulations, compliance and grant funding programs	Our energy accountants support 27 businesses, 6500 sites, 1800 utility accounts, $910m annual utility spend
Our consultants support more than 35 companies with NGER and NPI compliance	Our data management processes undergo annual reviews by external auditors	We help corporates and Governments identify, develop and implement renewable energy and energy efficiency projects

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