Australian Government
Clean Energy Regulator

Guarantee of Origin trials

Phase 2 Final Report

v1.0 - December 2023

CLEAN ENERGY REGULATOR

Executive summary

The Clean Energy Regulator (CER), jointly with the Department of Climate Change, Energy, the Environment and Water (DCCEEW), conducted the Guarantee of Origin (GO) trials to support scheme development and facilitate effective co-design. The trials were conducted with producers of hydrogen and its derivatives, as well as stakeholders involved in the carrying, storage and transport of these products.

Phase 2 of the trials saw an increase in the number of participants compared to phase one, including new participants from ammonia producers and other hydrogen carrier projects. Results of the previously completed phase one of the trials are published in the GO Trials Midway report.

Phase 2 considered the updated International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) 2022 guidelines and confirmed that commercialisation of products such as hydrogen and ammonia would be aided by a high integrity government-backed GO scheme. The trials highlighted topic areas in need of further discussion. These topics included the implications of physical and economic characteristics and the complexity of product transport and storage as part of the emissions lifecycle.

Background

The GO scheme is a foundational policy to underpin the development of clean energy markets and international trade in renewable energy and low-emissions products. The scheme is planned to be an internationally aligned, certificate-based emissions accounting framework. This framework will measure, track and verify the carbon emissions and other attributes of Australian clean energy products (including hydrogen and hydrogen energy carriers) and certify renewable electricity, with the intent to expand to other clean energy products over time.

Phase one of the GO trials, focusing on the design for a hydrogen GO, ran from February 2022 to August 2022 across 6 trial workshops and 4 stakeholder forums.

Phase 2 workshops

Phase 2 of the trials saw an additional 10 participants join the trial group, taking the total number of participants to 28. Participants and projects are listed on the CER website.

Phase 2 of the trials ran from December 2022 to April 2023 with four workshops focused on the production of ammonia as a downstream product of hydrogen and activities beyond the cradle-to-gate system boundary, such as transport and storage. The content for the phase 2 workshops was developed in broad alignment with the IPHE 2022 guidelines document.

Phase 2 trial workshop topics

1. Introduction, GO overview, policy design and consultation to date.
2. Ammonia
   - » Overview of currently understood practices.
   - » Uses and markets for ammonia.
   - » Application of the IPHE methodology scope and scale - building on National Greenhouse and Energy Reporting (NGER), Safeguard and emissions-intensive trade-exposed (EITE) implications.
   - » Storage, transport and looking ahead.
3. Hydrogen carriers
   - » Production, usage and properties.
   - » Carrier GO emissions accounting and application of IPHE methodologies.
4. Transport and storage
   - » Emissions boundary, provenance and domestic transport.
   - » Emissions accounting approaches and application of IPHE methodologies.
   - » Custody model for GO certificates and consideration of losses.

Phase 2 findings

- Participants representing ammonia production and carrier projects indicated strong support for a GO scheme. This is further confirmation that commercialisation would be aided by a high integrity government-backed GO scheme that can demonstrate emissions credentials to low emission product buyers, providing market certainty and underpinning commercial arrangements.
- As the low emissions ammonia market develops, it is important to decide how to categorise the emissions intensity of ammonia made from various inputs. Developing a robust and flexible methodology for applying GO certificates to ammonia and its inputs is desirable.
- The inclusion of transport and storage increases the complexity and reporting requirements of product GO certificates. Participants are keen to minimise this complexity but are open to emissions accounting methodologies that cover transport. Questions were raised on how reporting requirements and custody transfer of certificates might influence the way they align with the physical movement of the product.
  - » Participants noted that transport is usually completed by third party providers, and including their data and emissions may be administratively burdensome. The fuel consumption method would require detailed knowledge about vehicles, trip routes and cargo, to either be acquired by producers or provided directly by freight companies.

- The CER and proponents discussed the need to meter and measure relevant quantities and flows. Consistent with phase one trials, metering and measurement may be more important for the GO scheme due to the potential to have certificate generation and consumption on a tighter timeframe. For example, NGER reports emissions on an annual basis, while GO data may potentially have hourly-level granularity.
  - » In line with the outcomes of the phase one GO trials, there is strong stakeholder support for metering and measurement approaches for ammonia production to be based on the NGER scheme requirements.
- Some carriers have reusable components (for example, carrying agents can be recycled and returned), which adds complexity to the emissions accounting for certain carriers. Visibility of some of the cyclic processes will be limited from an assurance perspective, particularly if international, and may require special attention.
- Participants confirmed that it was important that any GO methodology be aligned with IPHE methodology to ensure regulation is consistent with international markets. The CER confirmed that transport and storage methods were being worked on by the IPHE and would be included in subsequent revisions to the IPHE guidelines.
- Detailed findings from each workshop are included in Appendix A.

Next steps

The conclusion of phase 2 completes the GO trials initiative. This wraps up 12 months of workshops, meetings, and information sharing to test and support the design of a Guarantee of Origin scheme for Australia.

The co-design approaches and format used in the trials may be reused as new products and methods are consulted on and the GO scheme expands its coverage of new product types over time.

Please see the CER and DCCEEW websites for information on upcoming consultation on the detailed design of the GO scheme:

Guarantee of Origin (cleanenergyregulator.gov.au)

Guarantee of Origin scheme - DCCEEW

Appendix A – Detailed Findings

Topic	Detailed findings
Ammonia	• The ammonia industry in Australia is mature, with a number of long-standing operational commercial-scale ammonia producers. Low-carbon pathways to ammonia production include carbon capture and storage in conjunction with carbon-based feedstocks, and pathways that use low emissions hydrogen. • Several production configurations exist to produce ammonia, including potentially cleaner feedstocks into the production chain. When considering GO certification, prioritising 'in-use' production methods for ammonia is critical to enabling efficient scheme participation. • Hydrogen is a key input of ammonia, and hydrogen and ammonia are often produced by the same company or even in the same facility. Participants discussed the best way to account for upstream or intermediary GO certificates in their production. Multiple approaches were considered, including creating hydrogen GO certificates and then consuming them to produce ammonia, or recording upstream input emissions (from hydrogen) and applying directly for an ammonia GO. Participants stressed that flexibility was desirable so that facilities could choose to create GO certificates for either the hydrogen production or ammonia output, or have the choice to create GO certificates for both. This flexibility would allow participants to respond to changing market conditions as needed. • Emissions accounting measurement methods were discussed. A key issue was how ammonia produced from a mix of inputs of varying emissions intensities (e.g. a mix of high emissions and low emissions hydrogen) would be classified. Participants discussed whether a certain percentage of resultant ammonia could be classified as low emissions, in line with the percentage of low emissions input. Alternatively, ammonia produced from varied inputs could be assigned an average emissions intensity. • As an existing commodity and internationally traded chemical, international and national standards exist for the storage and transport of ammonia. There are likely to be emissions that may be material to the emissions intensity of the product. • Ammonia production may result in co-products. Emissions allocation methods for co-products under the GO scheme are being finalised for hydrogen and other products.

Topic	Detailed findings
Hydrogen carriers	• Hydrogen carriers are different molecules or forms of hydrogen that have attributes that enable more efficient transport. Hydrogen carriers such as liquid hydrogen, ammonia, and liquid organic hydrogen carriers (LOHCs) have varying characteristics, meaning that different carriers may require different approaches. • Like ammonia, other forms of hydrogen carriers are likely to require their own GO certificate types (referred to here as 'carrier GO certificates'). Some carrier types, particularly liquid organic hydrogen carriers (LOHCs), are proposed to be cyclical in nature, where the unloaded carrier would return to the loading site. • Chemical processing requirements affect emissions profiles, adding to the complexity of carrier GO certificates. Additionally, availability and costs of carriers and their related industrial infrastructure will have significant influence on the prominence of carriers in any future hydrogen market. Long distance transport of hydrogen is likely to require conversion to carrier forms to overcome hydrogen's low density. • Other hydrogen carrier types are being explored by participants, including methanol and methanation. These options may be considered in further development of the GO scheme. Hydrogen carriers are an evolving space and industry input was sought on the complexity and maturity of each, particularly for round-trip systems in which part of the carrier is returned to the producer from the end consumer. • Other carrier considerations discussed were dehydrogenation methods, carrier storage, safety, co-products and preferred allocation methods. • Co-products are varied and may occur at several stages during the conversion, transport and re-conversion of hydrogen carriers, mainly to do with impurities in the hydrogen feed stream and compound stability under high temperatures. Vented and lost vapours are counted as emissions and are also required to be monitored.
Transport and Storage	• The transport of goods between suppliers and customers is a critical part of business supply chains and can be a substantial source of emissions. The emissions boundary defined in the November 2022 IPHE guidelines specify emissions in the cradle-to-user system boundary. Within the IPHE definition, transport emissions associated with the movement of goods both upstream and downstream of the production site are to be included in the supply chain emissions accounting. • Participants suggested that freight providers may be hesitant to provide their details and that doing so may be administratively burdensome. There were concerns that this requirement may diminish participation in the scheme. • A simplified distance method for transport emissions was raised as an option to resolve the questions of complexity and was broadly acceptable to participants. It was noted that methodology for upfront reporting and consistency regarding handover points are important to establishing boundaries of custody and responsibility for GO certificates. • Participants suggested that it would be valuable to be able to choose between cradle-to-gate or cradle-to-user system boundaries. In relation to IPHE guidelines, GO methodology will align with the cradle-to-user system boundary. However, the

Topic	Detailed findings
	information captured in a GO certificate is likely to show a breakdown of emissions between parts of the system boundary, including a cradle-to-gate emissions value.