

Advancing the trade of clean hydrogen in the Netherlands

Experiences from the HyXchange pilot on Dutch hydrogen Guarantees of Origin

DRAFT VERSION – NOT FOR DISTRIBUTION

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1. The first Dutch hydrogen Guarantees of Origin

On April 11th 2022 the first Dutch hydrogen (H₂) Guarantee of Origin (GO) was handed over to Dutch Minister for Climate and Energy, Rob Jetten by HyXchange and Vertogas. This moment kicked-off the start of an operational pilot initiated by HyXchange in which companies along the H₂ supply chain explored how GOs can be issued and traded as a first step towards a more diversified and liquid market for clean H₂.



Figure 1 Hand-over of the first H₂ Guarantee of Origin to Minister Rob Jetten by Bert den Ouden (HyXchange) and Roelf Tiktak (Vertogas) on April 11th 2022

With the pilot, HyXchange aims to further accelerate H₂ trading by enabling the exchange of certificates, more specifically GOs for low carbon and renewable H₂. In total 18 companies were actively participating in this pilot, supported by the ICT platform developed and operated by Vertogas, the government mandated GO issuing body.



Towards a more diversified and liquid hydrogen market

Existing hydrogen (H₂) value chains are organised around a relatively small number of large scale producers of (petro)chemicals. Many of these are large scale H₂ consumers, which typically have their own on-site H₂ supply or have close links with specialised industrial gas suppliers on premises or close-by who produce large volumes of H₂, typically from fossil sources.

The emergence of new H₂ applications in industry, mobility, power and the built environment is however changing these historic value chains. Next to an increasing variety in demand, also the upstream market complexity is increasing, with new plans for hydrogen supply from decarbonised hydrogen sources, electrolysis and international imports being regularly launched. Expectations are that the market for H₂ will develop from its current bilateral trade mode, more and more into a commodity market in which H₂ can be traded freely between multiple suppliers and consumers. HyXchange aims to facilitate that development by setting up a commodity exchange, similar to those existing for natural gas and electricity.

An important difference between commodity markets and the future H₂ market is the expectation that a large part of the emerging hydrogen demand will be driven by compliance targets. These compliance targets can either be mandatory, derived from EU or Dutch policies, such as from the EU Renewable Energy Directive¹ or from the Wet Milieubeheer², or can be voluntary as set by companies' corporate social responsibility (CSR) strategy.

Companies are willing to pay premium prices for H₂ that has the specific environmental attributes that allows them to meet the compliance targets, such as having a low greenhouse gas footprint, or being produced with renewable electricity. In fact, it is the premium value from specific H₂ attributes that is driving the current development of new clean H₂ supply chains.

For the market to recognise and verify such environmental attributes, certification is a proven approach. Guarantees of Origin (GO) certificates for instance, allow markets to verify the production origin of H₂, while other types of certificates allow markets to verify whether the H₂ meets eligibility requirements from mandatory policy targets.

The objective of the HyXchange GO pilot was to test with real companies and realistic assets whether GO processes and definitions are ready for implementation in the Netherlands.

2. Use of H₂ Guarantees of Origin (GOs) in the Netherlands

Through the purchase of Guarantees of Origin (GOs), Dutch companies can provide evidence that their H₂ is produced from renewable sources and/or has a low carbon footprint. GOs can be traded freely, allowing the consumption of renewable hydrogen to be administratively separated from the consumption of the actual

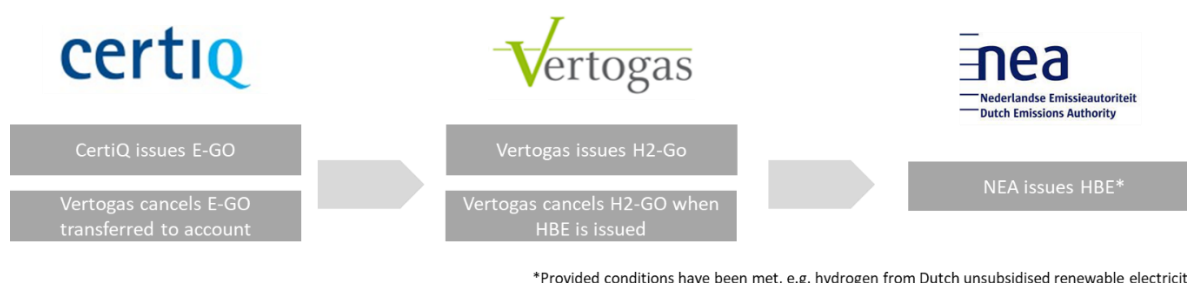
¹ RED, DIRECTIVE (EU) 2018/2001, On the promotion of the use of energy from renewable sources (recast)

² Wet Milieubeheer, <https://wetten.overheid.nl/BWBR0003245/2022-05-01>

molecule with its own physical supply chain. GOs are therefore effective in demonstrating compliance with CSR targets or demonstrating clean product properties to end-customers.

Renewable hydrogen (H₂) GOs and HBEs

The biggest interest in Dutch hydrogen GOs however comes from transport fuel suppliers that need to comply with renewable fuel targets as set out in the Wet Milieubeheer via certificates called Hernieuwbare Brandstof Eenheden (HBEs, Renewable Fuel Units). The mandatory compliance targets these companies face, results in a strong willingness to pay for HBEs. Hydrogen can also be classified as an eligible renewable fuel as long as it is produced by Dutch, unsubsidised, renewable electricity, as demonstrated by Electricity GOs. Hydrogen GOs that meet the specific eligibility criteria in the Wet Milieubeheer can be converted into HBE certificates, effectively transposing the premium value of the HBE onto the Hydrogen GO.



The ability to use GOs to issue HBEs is a specific, temporary Dutch transposition of the EU Renewable Energy Directive. In the future, Hinicio expects that HBEs will no longer be issued from GOs, but more complex voluntary certification schemes will replace the role of GOs. These voluntary schemes will also better facilitate international trade.

Low carbon H₂ GOs

In this pilot, we also introduced GOs for hydrogen that does not come from renewable sources. Depending on the greenhouse gas (GHG) footprint of the hydrogen, it can be classified as low carbon. In that case the GHG footprint will need to be lower than a threshold at 3 gCO₂/kgH₂, in line with our current interpretation of the proposal by the European Commission published in December 2021.³ Hydrogen with a higher GHG footprint than the threshold will have no classification.

The GHG footprint of hydrogen has been determined via methodologies developed in the EU Clean Hydrogen Partnership funded programme CertifHy. A more detailed description of the CertifHy GO scheme can be found on www.certifhy.eu. The Dutch law does not allow low carbon hydrogen GOs to be converted into HBEs.

³ EU proposal for the recast of EU Directive 2009/73/EC concerning common rules for the internal markets in renewable and natural gases and in hydrogen (2021)

International trading of H₂ GOs

GOs can only be issued for production facilities that are located in the geographical domain of the Issuing Body. Physical imports of GO-certified hydrogen from a different domain requires cancellation of the GO for the imported H₂ and issuing a similar, Dutch GO with a non-NL origin or vice versa. Implementation of cross-border H₂ GO trade will require a level of standardisation or mutual recognition of the data fields on the GOs, such as energy content, classification of sustainability, GHG footprint etc. Currently, no EU Member State or states outside the EU have yet implemented GO schemes for H₂, which hinders international trade of green hydrogen. Import of green hydrogen is also not incentivised by existing Dutch policies and regulations. For instance, it is not possible to issue an HBE for imported hydrogen as it is produced using non-Dutch electricity. This effectively removes one of the key incentives for trade.

Hinicio remarks that, outside of the Netherlands, GOs are mainly intended for consumer disclosure to end-customers of hydrogen-based products. Renewable and low carbon hydrogen GOs have a clear marketing value and possibly provide the evidence companies need to demonstrate them meeting their CSR targets. For this reason we see a benefit for international recognition of hydrogen GOs, also beyond EU Member States.

3. Lessons learned from the HyXchange GO pilot

As currently the volumes of Renewable and Low-carbon H₂ in the Netherlands are still limited, the GO pilot was designed to accept both existing hydrogen production and consumption assets and future, planned assets using simulated data. Requirements on the need for production plant audits were relaxed in line with the use of virtual assets and production and consumption data. Only a sanity check was done on the realism of hydrogen production data.

The pilot built on a developed Vertogas online GO registry by implementing and testing the GO lifecycle processes that have been developed by CertifHy.

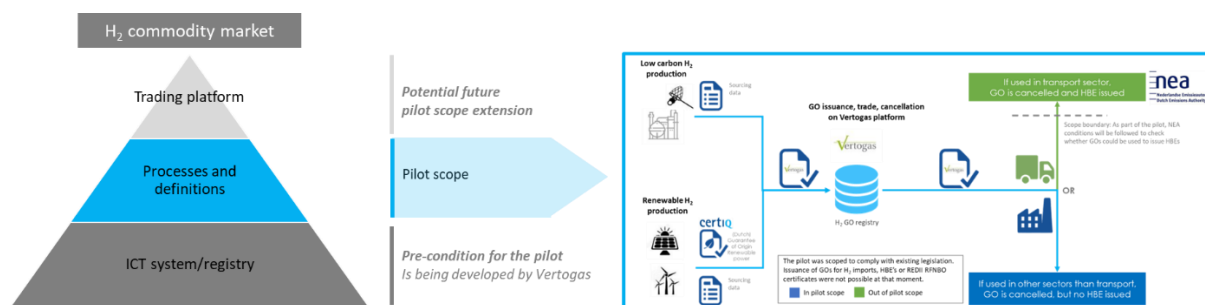


Figure 2: Schematic overview of the pilot scope focused on the implementation and testing of GO processes and definitions, building on the Vertogas GO registry platform. No trading platform has been implemented as trades were handled Over the counter (OTC).

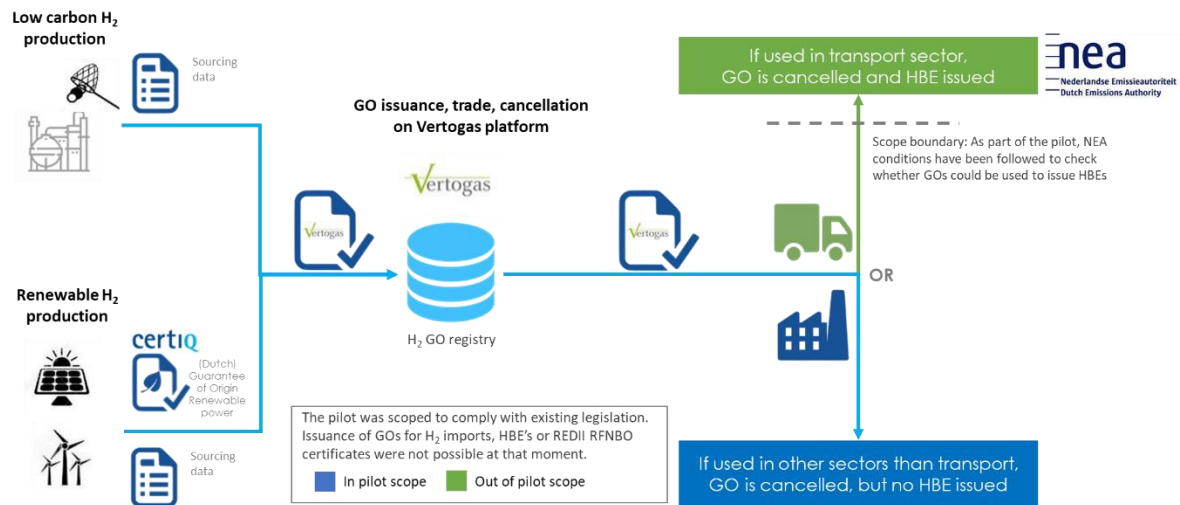


Figure 3: Schematic representation of the scope of the GO pilot.

In these processes, participating companies had one or multiple roles, ranging from hydrogen producer, trader, consumer or a combination of these roles.

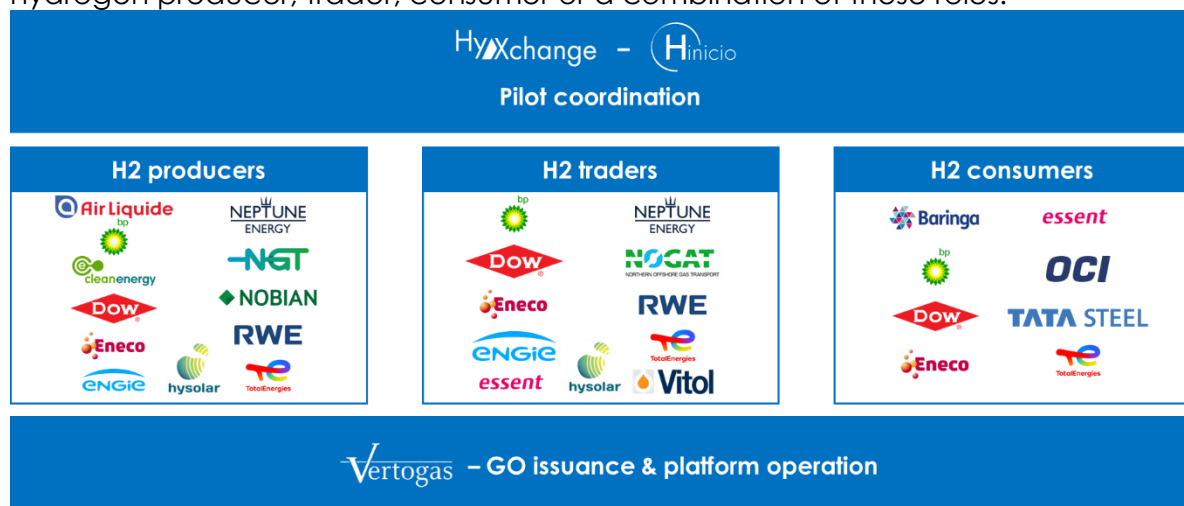
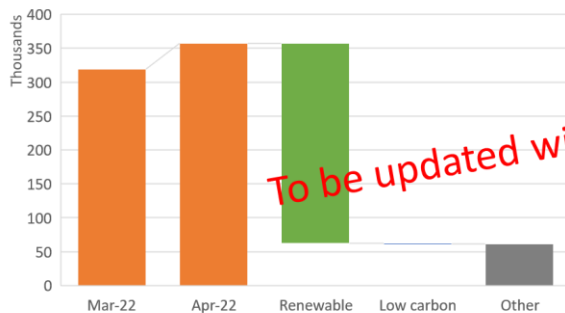


Figure 4: Overview of the different roles of companies in the pilot.

Together the 18 companies produced **XX** GHh of hydrogen over a 3-month period, corresponding to **XX** thousand GOs that have been issued, of which in the last month, **YY** were renewable and **ZZ** were low carbon.

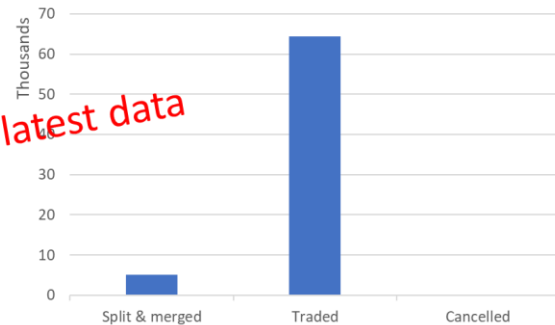
Trades were negotiated Over-the-counter (OTC) between participants based on existing or future supply chain relationships, or facilitated by a list of account holders. Registration of the trades was done on the Vertogas platform. In total **XX** GOs have been traded between companies, **YY** have been manipulated (split into smaller parts or merged into larger) and **ZZ** have been cancelled after consumption.

12 companies issued GOs over April totalling 357k hydrogen GOs, of which 294k renewable and 1.5k low carbon



The second GO batch resulted in more activity on the Vertogas platform

- GOs manipulated (split & merged): 5k
- GOs traded: 65k
- GOs cancelled: 1



To be updated with latest data

Figure 5: Figure to be updated with latest data

General lessons learned

The HyXchange GO pilot resulted in several general learnings as summarised in Figure 6.



Figure 6: Overview of the lessons learned in the pilot, summarising what worked well and identifying some points of attention.

Point of attention 1: Clarifying GO definitions

During the pilot, points for improvements and clarifications were identified in the GO data field definitions, as listed in Figure 7. None of these points of improvements present barriers to the implementation of GOs in the Netherlands, they merely are to clarify GO definitions and correct some minor technical aspects.

Detail Garantie van Oorsprong

1 Certificaatgegevens

Serienummer	2022.04.001.000084
Productiemaand	04-2022
Duurzame energiebron	F01050000 - Renewable: Electric
Schema duurzame energiebron	NTA8003: 2017
Netto energiewaarde (MWh)	666
2 Bruto energiepercentage	100,0 (%)
Status	Actief
Uitgiftedatum	25-05-2022
Verlooptdatum	01-05-2023
Uitgever GvO	Vertogas
Land van uitgifte	Nederland
3 Subsidie	Geen
Bestemming	Netlevering

Productie-installatie gegevens

Naam van de productie-installatie	Hidden for confidentiality
EAN-code	
Adres	
Postcode	
Plaats	
Land	Nederland
Nominale capaciteit in kW per uur	2500
Type productie-installatie	Water electrolysis (T01010100)
Ingebruiknamedatum	01-04-2022
4 Duurzaamheidsgegevens biomassa	
Duurzaamheidsschema	H2PILOT
Geldig van	01-04-2022
Geldig tot	01-05-2023
Land van herkomst	Nederland
Identificatie duurzaamheidsschema	Certify Green
5 Broeikasgasemissie keten (g CO ₂ /MJ)	0,1

Figure 7: Identified GO data fields that require clarification or a revision

#	Issue	Recommendation
1	Currently it is not clear what volume of energy a hydrogen Guarantee of Origin is referring to.	We recommend to clarify that the GO value is expressed in Lower Heating Value (LHV) in line with common industry practice and definitions by the European Commission. This is in contrast to biogas GOs that are expressed in Higher Heating Values (HHV).
2	Current data field is used in biogas GOs and not required for H ₂ GOs.	We recommend to remove this data field.
3	Subsidy data field should only consider whether or not any subsidies have been granted that excluded it for HBE applicability.	We recommend to at least include the subsidy data used to assess HBE compliance, i.e. to validate whether no subsidies have been given to the electricity used in H ₂ production.
4	Some references on the GOs (and in the Vertogas platform) are still linked to biogas applications.	We recommend to update all instances to refer to hydrogen and hydrogen production processes.
5	Currently, the Vertogas system does not accept values lower than 0.1 g CO ₂ /MJ.	We recommend to change this in the system so it also accepts zero value as an input.

Point of attention 2: Working towards a real asset pilot

The HyXchange GO pilot accepted hydrogen production data from participants without independent, third-party verification. In some cases, the data was simulated based on expected performance of assets to be developed in the future. For real issuance of GOs, only production from existing assets can be accepted. It is important that the data provided to issue these GOs will be verified by an independent body.

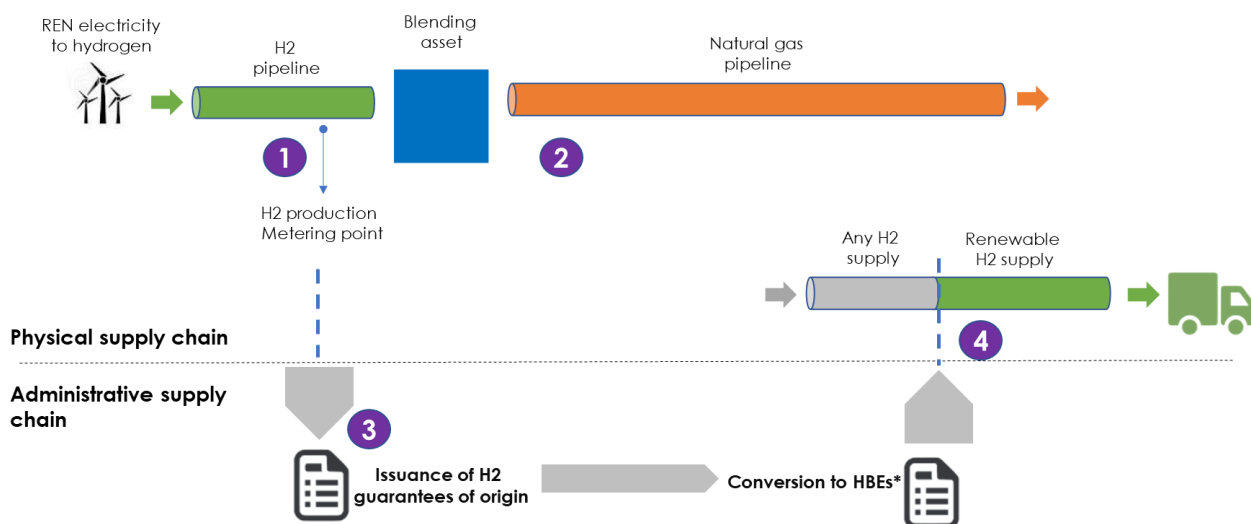
We identified two aspects where such independent verification will be necessary:

1. Measurement and verification of the H₂ production data, at least on a monthly basis. Typically this is done by an independent metering company.
2. Verification of the plant setup to classify the type of hydrogen produced from the feedstocks used and the greenhouse gas footprint of the hydrogen. Typically such verification is done by an independent auditor.

At this point, guidance on how such companies or activities would be accredited is still lacking. We expect that the Ministry of Economic Affairs and Climate will need to develop such guidance over the course of next months, prior to implementation of the GO to HBE route.

4. Case study: HBEs for blended H₂

One of the advantages Guarantees of Origin (GOs) have compared to other certificates, is that H₂ GOs can be traded freely, separated from the physical supply of the molecule (book&claim system). This means that in the Netherlands, any suitable H₂ GO can be converted into an HBE, irrespective of what happens to the H₂ molecule further on in the downstream H₂ supply chain. This also means that production plants supplying H₂ through blending into natural gas grids will be able to benefit from the price premiums HBEs and HBE-compliant GOs are expected to present. In addition, the opportunity to blend H₂ into natural gas grids may reduce the cost or lead times for dedicated H₂ transport or distribution infrastructure.



*Provided conditions have been met, e.g. hydrogen from Dutch unsubsidised renewable electricity

Figure 8: Schematic overview of Guarantees of Origin issued and converted to HBEs for hydrogen that is blended with natural gas after renewable hydrogen production

1. Hydrogen is injected into a H₂ pipeline where production is metered. Based on the metered data, H₂ GOs are issued.
2. The hydrogen is further blended with other gas streams, for instance with natural gas or with raw gas/production gas.
3. The H₂ GO is registered on the Vertogas platform and can be traded between companies

4. The H₂ GO can be converted into an HBE linked to a physical H₂ supply to a transport application. The physical H₂ supply does not need to be connected to the original H₂ production asset.

5. Conclusions & recommendations

The HyXchange pilot resulted in the successful implementation and testing of processes and definitions around the hydrogen (H₂) Guarantee of Origins (GO) lifecycle. Next to HyXchange and Vertogas, 18 companies have been successfully issuing, trading and cancelling H₂ GOs. Hydrogen producers have provided their H₂ production data, based on which the Vertogas system incorporated their production plants into the system with different feedstocks and energy inputs.

For the H₂ GO lifecycle to function optimally, interfaces with CertiQ and NEA have been clarified and tested. Vertogas platform and interfaces to CertiQ and NEA are in place and ready for full implementation of H₂ GO processes and Hernieuwbare Brandstof Eenheden (Renewable Fuel Units, HBEs).

During the pilot some minor operational improvement points have been identified, but no major showstoppers or barriers were encountered. The operational improvement points will be incorporated into Vertogas' platform development roadmap.

Recommendations:

Based on the learnings from the pilot, we have defined recommendations to further support the implementation of hydrogen Guarantees of Origin in the Netherlands:

1. The Ministry of Economic Affairs and Climate to provide further guidance on the development of the full GO supply chain

Clarity is required on what are the requirements for:

- Metering companies to provide validated H₂ production data for GO issuance
- Auditing companies to validate the H₂ production plant setup, including consumption of electricity and other feedstocks to classify the renewability of the hydrogen produced and its carbon footprint.

2. The Guarantees of Origin (GO) and the platform to be further optimised

- A translation of the GO platform and an user manual to also include English will better facilitate the internationally oriented hydrogen market
- Longer registration link expiry times will allow users to complete their registration process with less registration link resets
- The definitions of some GO data fields need to be further clarified
- In the future as the number of hydrogen GOs and HBEs issued will increase, we foresee the need to move from a manual handling of interfaces with CertiQ and NEA to an automated system. Such automation could potentially also lower the risk for human error.