

Definition project hydrogen exchange "HyXchange"

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Definition Study

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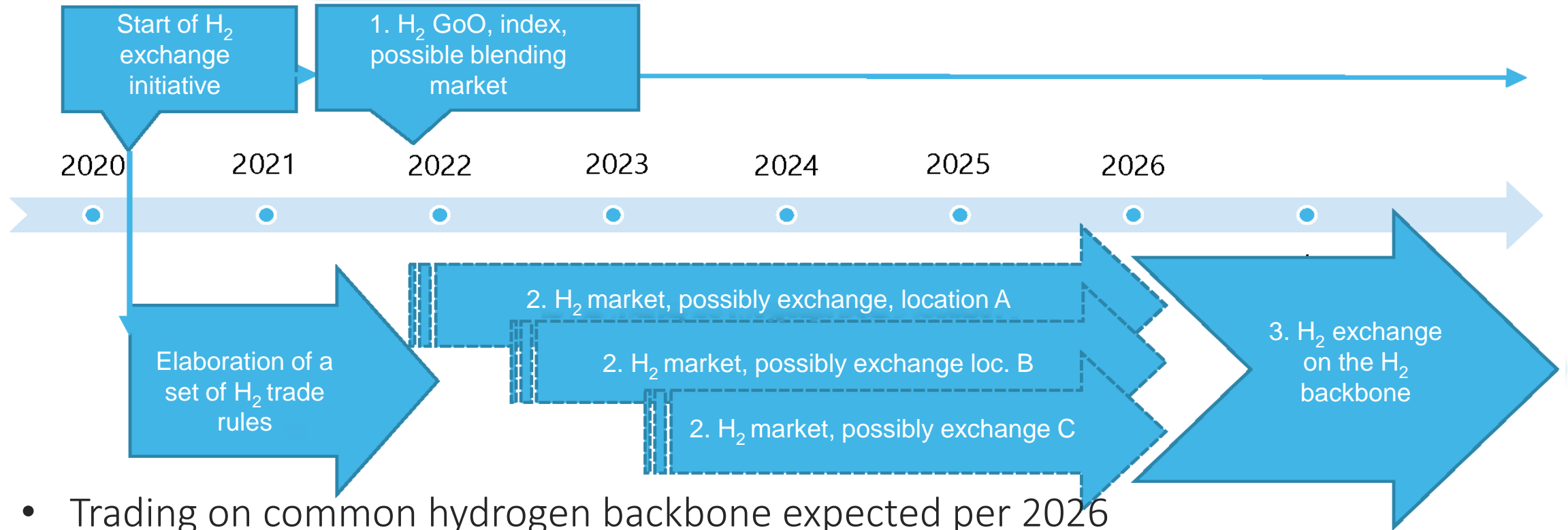


CEO of Energy Exchange APX-ENDEX (1999 – 2013)

- Pioneer of the “market coupling”, the Target Model to integrate the EU electricity markets
- CWE Market Coupling France, Germany and Benelux, Market coupling BritNed interconnector
- Operator On the day Commodity Market UK NBP
- Growing liquidity on the Dutch TTF gas market, now the most liquid in Europe.

Summary “A Hydrogen Exchange for the Climate”

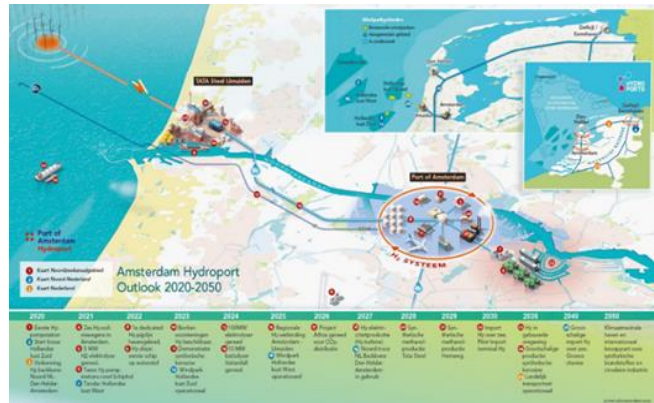
<https://www.government.nl/documents/reports/2020/09/24/a-hydrogen-exchange-for-the-climate>



- Trading on common hydrogen backbone expected per 2026
- Before that moment, trading may be established at regional level
- Launch of an index as a step-up to a full-fledged exchange
- Definition of rules and regulation for infrastructure access, GoO's and trading

Definition project: investigating / discussing practical steps

Gasunie and four Dutch sea ports funded the preparation work of a Hydrogen Exchange

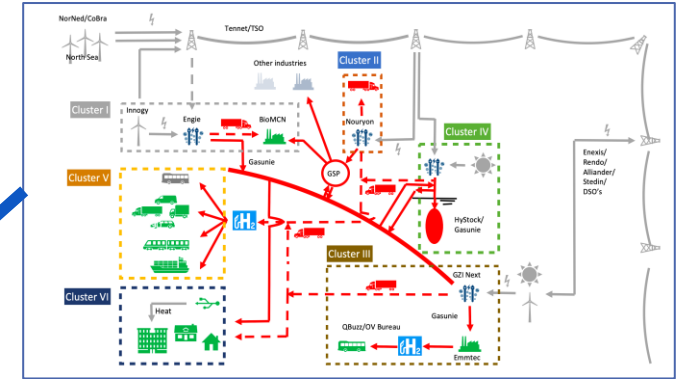


Port of Amsterdam



North Sea Port

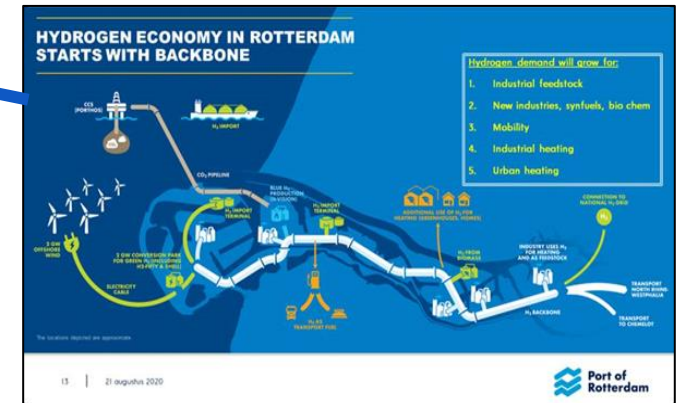
Grid infrastructure	Grid infrastructure specifications										
	<table border="1"> <thead> <tr> <th>Pipeline</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Dow-Yara Hydrogen</td> <td>Current operation for H₂ in a divergent quality; able to facilitate regional demand to 2030⁵</td> </tr> <tr> <td>ZR-Dow Naphtha</td> <td>Possibilities for converting, but competing interest for CO₂ transport⁵</td> </tr> <tr> <td>Zebra network Hydrogen Backbone</td> <td>Option to convert for H₂ transport & backbone connect, facilitate regional demand to 2030. Compete with CO₂⁵</td> </tr> <tr> <td>Midden Zeeland pipeline</td> <td>Possibilities to convert from gas to H₂. A possible new route can be developed if market commitment exists</td> </tr> </tbody> </table>	Pipeline	Availability	Dow-Yara Hydrogen	Current operation for H ₂ in a divergent quality; able to facilitate regional demand to 2030 ⁵	ZR-Dow Naphtha	Possibilities for converting, but competing interest for CO ₂ transport ⁵	Zebra network Hydrogen Backbone	Option to convert for H ₂ transport & backbone connect, facilitate regional demand to 2030. Compete with CO ₂ ⁵	Midden Zeeland pipeline	Possibilities to convert from gas to H ₂ . A possible new route can be developed if market commitment exists
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Groningen Seaports



Port of Rotterdam



HyXchange: Involvement of market parties and traders

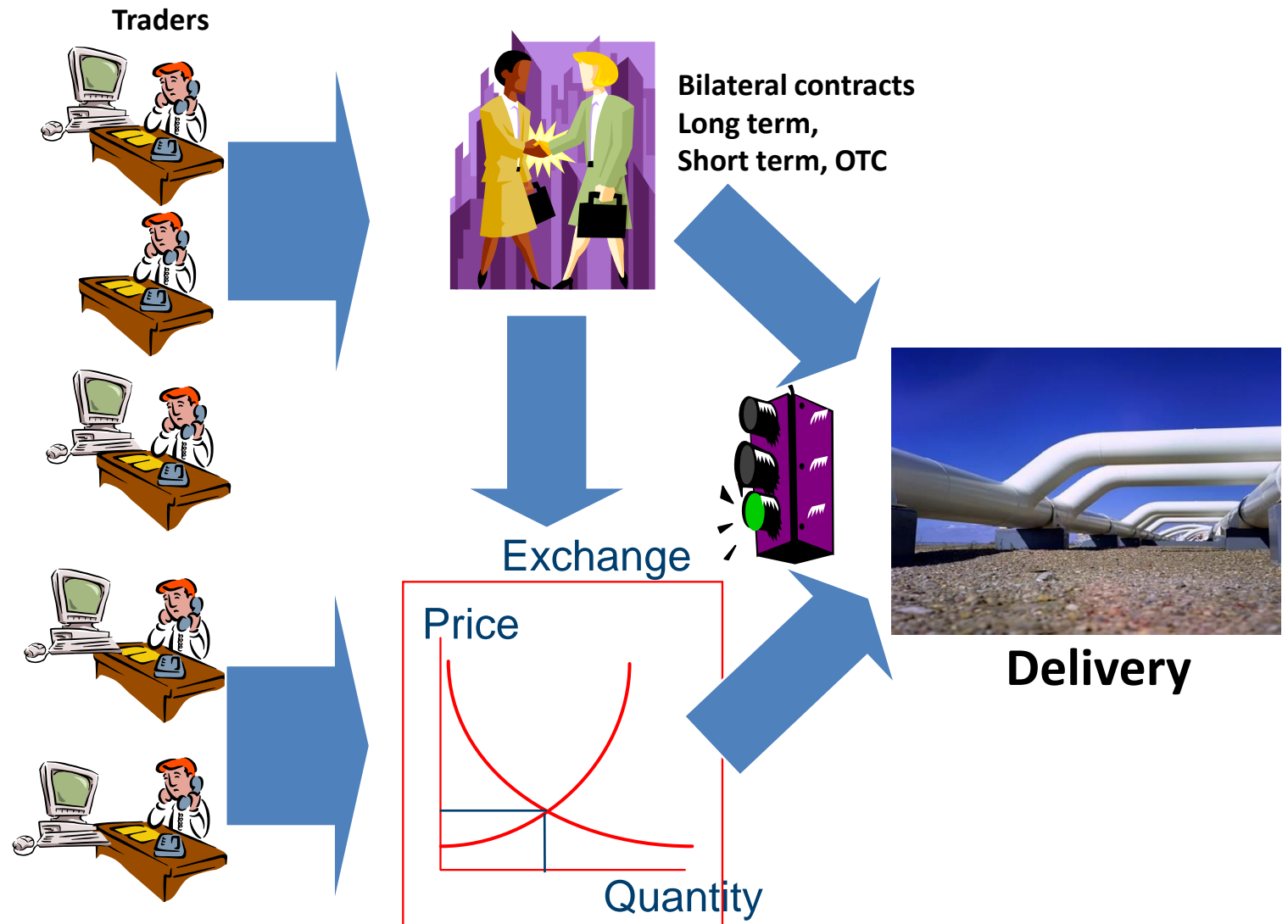
We foresee a market with both Bilateral contracts (Long term, Short term, OTC) and exchange trading.

During the study, the key topics for a hydrogen exchange were discussed with market parties in several stages:

- Discussion with market parties in the harbour regions, involved in hydrogen initiatives
- A broad consultation meeting on a nationwide level with European involvement
- Two product committee meetings:
 - Regarding hydrogen certificates
 - regarding hydrogen spot market/index
- Another broad consultation meeting

Around 35 market parties and organizations involved

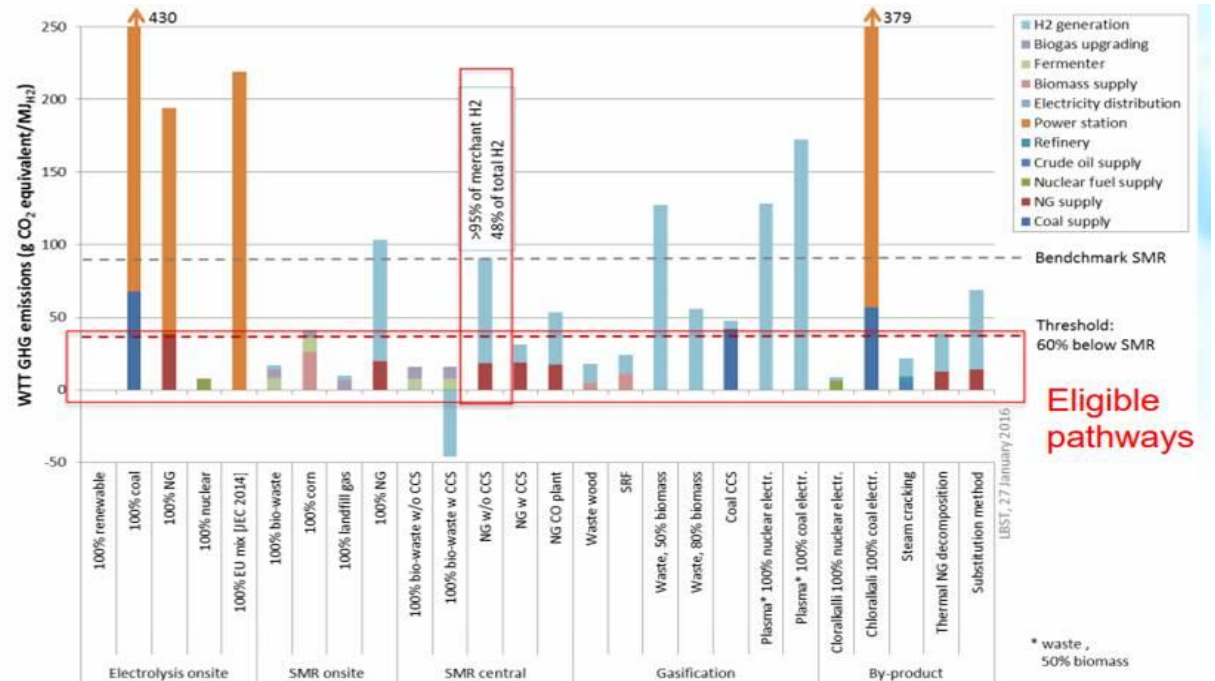
You're welcome to join!



Different sources of hydrogen

Green or Low carbon H₂ can be many things:

- H₂ from Electrolysis from wind power, solar or other renewables
 - Gas reforming with partial or full CCS/CCU (retrofitted to existing facilities, or new) or
 - H₂ as a by-product from chemical industries (e.g. crackers), or from electrochemical industry, either based on grey or green electricity
 - Other like H₂ from pyrolysis, etcetera
- These sources can have various CO₂ emissions according to Certifhy project



Various CO₂ emissions of green and low-carbon H₂ sources (source: Certifhy)

There should be one GoO design for all H₂, whereby the GoO specifies the CO₂ emissions.

H₂ market: larger, more actors, variety, time variations

Traditional H₂ market: Grey Hydrogen industry demand/production, fully continuous and localized.

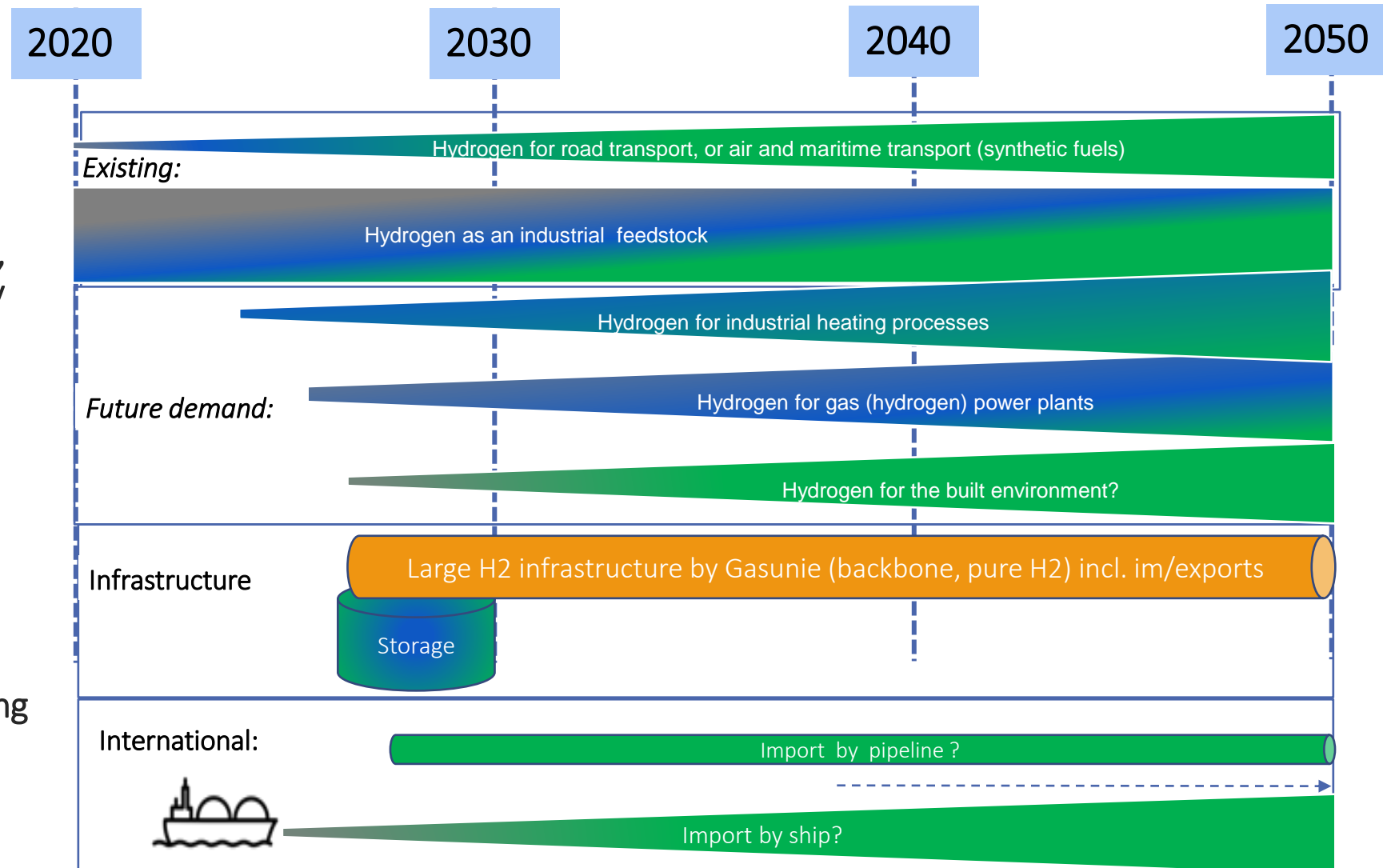
New H₂ market will bring change:

- Blue H₂ + Green H₂ (+ byproduct H₂, pyrolysis H₂) towards CO₂ neutrality
- More diverse supply / demand

More time variations / imbalances:

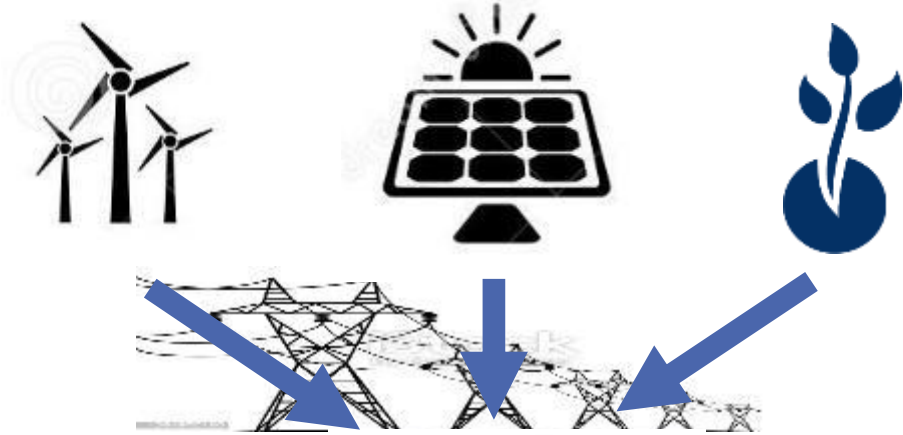
- Electrolysers with fast weather-dependent variations daily/hourly
- Hydrogen power plants as back-up for renewable power
- H₂ for built environment could bring seasonal variation.

→ Need for optimization, requiring infrastructure (transport and storage)
...a market -> Hydrogen Exchange

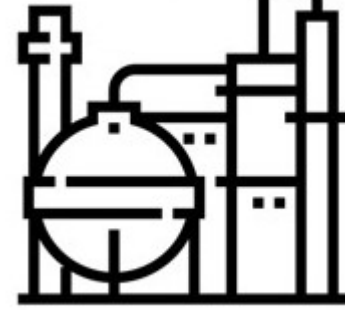


Markets needed for optimization of threefold Hydrogen sourcing

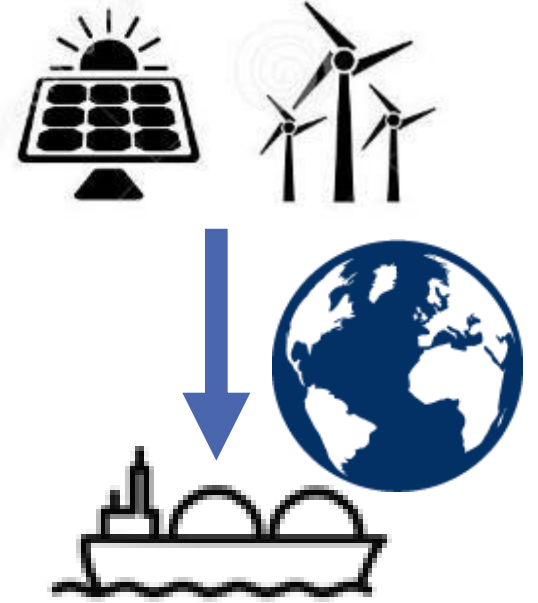
1. Renewable



2. Low carbon

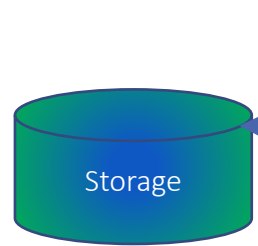
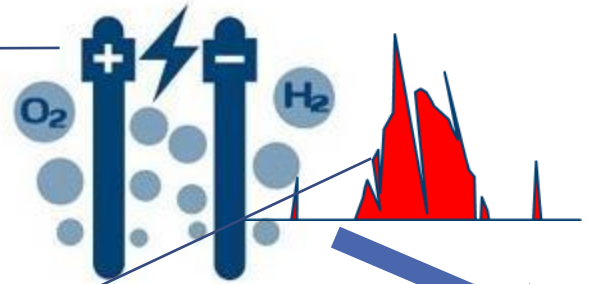


3. Global renewable



Multiple Renewable sources, for maximum operating hours of electrolyzer

Still, electrolyzer output varying in time; part-time production



Balancing varying electrolyzer H2 output with flexible H2 output of low-carbon SMR+CCS: market pilot

To be explored in a spot market simulation

Secure Baseload Climate Neutral Hydrogen

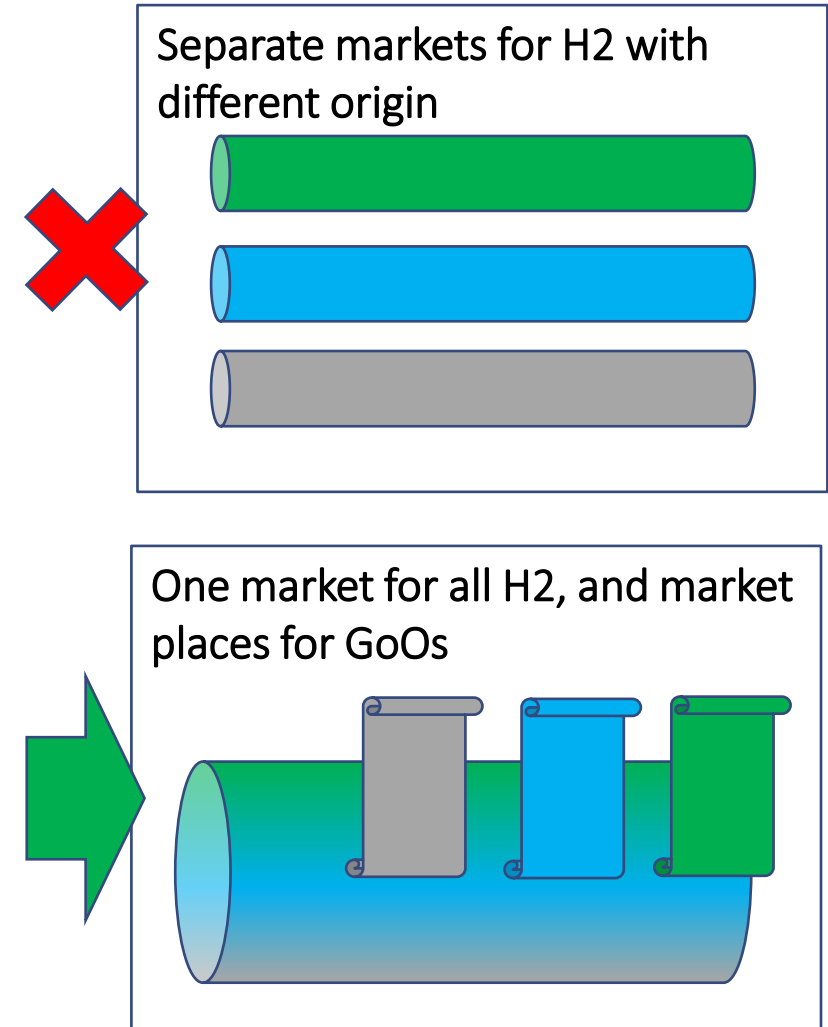
One infrastructure and market place for all hydrogen

Separate markets for each hydrogen origin

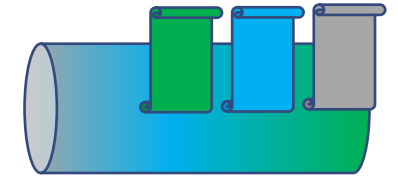
- Fragmentation of market liquidity
- Sub-optimal use of infrastructure
- No optimization of variations physical hydrogen
- Higher cost, lower speed of introduction

One market for all hydrogen (all origins) and market places for H₂ Guarantees of Origin (CO₂ related)

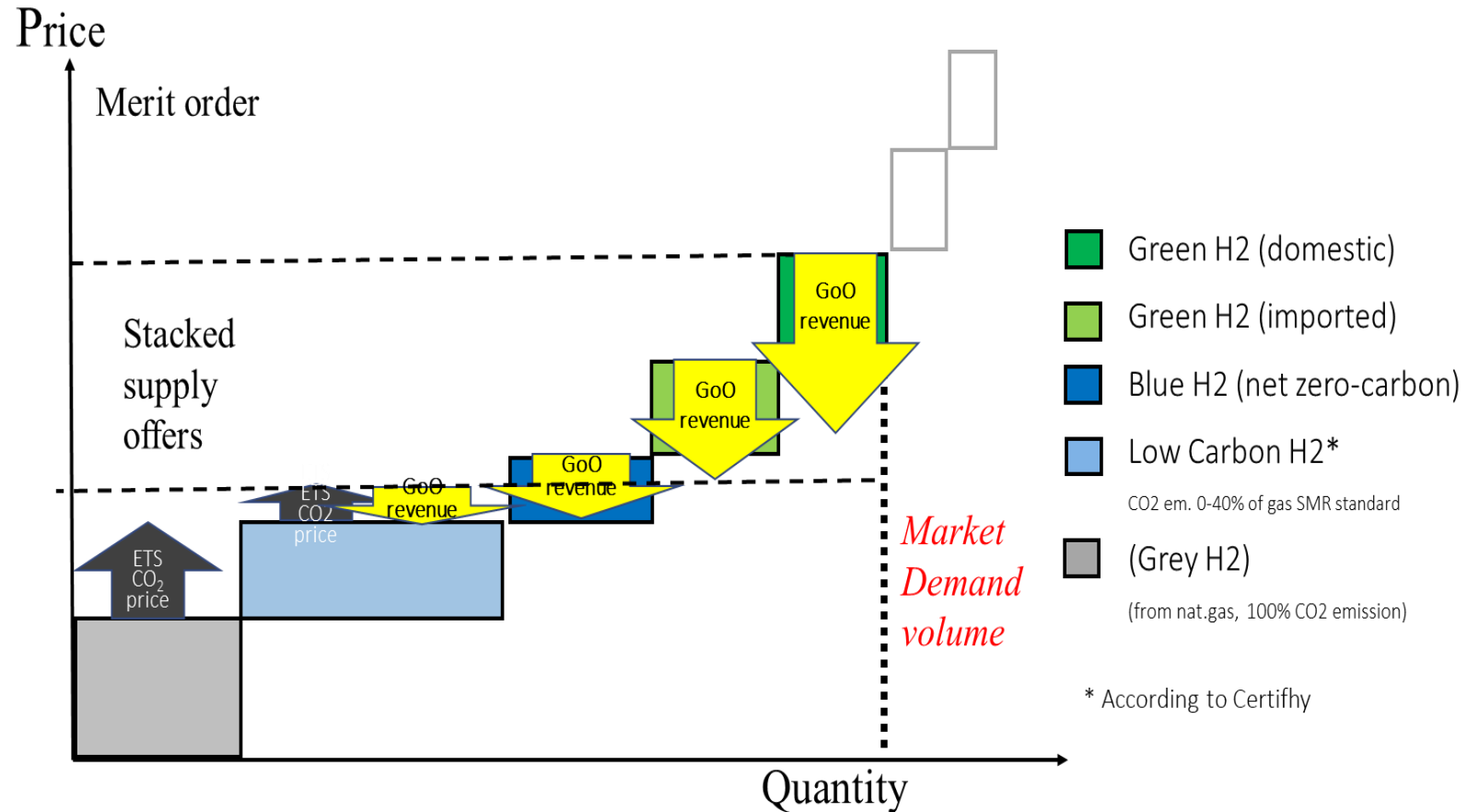
- Integration and sharing of liquidity
- Optimal use of infrastructure
- Optimization of variations in physical hydrogen
- Lower cost, higher speed of introduction



Certificates and market drivers, hydrogen market



- Hydrogen producers will get revenue from hydrogen sales as well as the guarantees of origin
- Therefore GoOs are needed for sorts of H2 from different origins to ensure a business case for producers.
- Also important for this:
 - CO2 pricing
 - Subsidies for renewable & low carbon H2
- Demand from sectors and applications where hydrogen has premium value: transportation, feedstock, synthetic fuels, housing



Source: Hydrogen Exchange definition Project

Needed*: a carefully balanced system of Guarantee of Origin, for all Hydrogen, including passporting, imports, CO2 footprint info

We urge the European Commission and all member states to implement.

- A. Renewable GOs including EU /global passporting and non-EU imports: specifying CO2 footprint of production (if any), and standard rules for imports from non-EU countries.
- B. GOs for all Low carbon Hydrogen, specifying CO2 footprint of production

Both applicable for all demand sectors.

Build a policy, initiative (to be tested in a pilot project) based on:

- Build on the EU-funded CertifHy project: industry standard
- Monitoring injected / withdrawn certified hydrogen consignments
- Sustainability (Renewable and Low-Carbon) verification / certification (prior to grid injection) and cross-border transfer of sustainability claims.
- Suggest “full disclosure” within the H2 grid. Experience in power market NL, others.

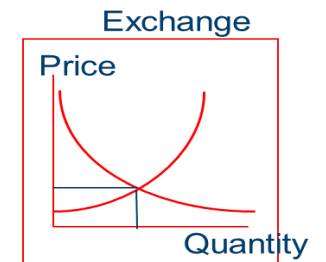
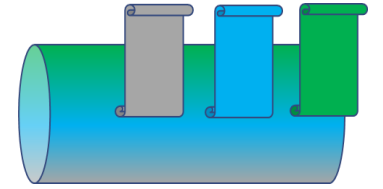


*https://ec.europa.eu/info/sites/default/files/energy_climate_change_environment/events/presentations/2.06.03_mf35_presentation-hydrogen_exchange_initiative-preconditions_for_establishing_a_hydrogen_exchange-den_ouden_v2.pdf

Outcome of definition project: next phase “HyXchange”*

Out of this study and input from market parties, four preliminary products were selected:

- A. **Certificate product:** a wish of many market parties. Can be developed doing a pilot in advance, awaiting the hydrogen infrastructure. Is a precondition for all other products.
- B. **Index product:** this provides a value to the certificate product. This can be developed in anticipation of a hydrogen infrastructure. The index product is also a precursor for spot and futures and swaps.
- C. **Spot market product:** needed, due to intermittent output of electrolyzers. Start by doing a market simulation. To be launched at sea port locations readiness of infrastructure, market parties. To be migrated towards the backbone when that is (partly) ready.
- D. **Products for grid balancing and storage:** develop the market design together with infrastructure developers. To include in the market simulation.



HyXchange: a hydrogen exchange for Europe, with global role

- North Sea region as one of the starting points for a European Hydrogen backbone
- Parties in the initiative (Gasunie, Sea Ports, certifying body, Hydrogen Exchange initiative) ready to discuss models/ideas
- Prepare implementation with Pilots and Simulations
- We invite all parties to discuss further
- **You're welcome to join!**



Source: Guidehouse, "Extending the European Hydrogen Backbone"

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