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SHIP.NL
SUSTAINABLE HYDROGEN IMPORT PROGRAM

AGENDA
SHIP.NL KICK-OFF 16 FEBRUARI 2022

15:00-15:20 WELKOM EN INTRODUCTIE

15:20-15:50 ACHTERGROND EN KENNISVRAGEN SHIP.NL

15:50-16:10 DEEP DIVE 1: HY3 EN VERVOLG

16:10-16:30 DEEP DIVE 2: INTERNATIONALE ONTWIKKELINGEN

16:30-16:50 ACTUALITEITEN

16:50-17:00 AFSLUITING

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‘HUISREGELS’

- Camera aan, microfoon op ‘mute’
- Vragen?
  - Plaats deze in de meeting chat
  - Steek je hand op

  ⟩ De moderator zorgt ervoor dat je vraag beantwoord wordt (eventueel achteraf).
- Slides worden na de sessie gedeeld
- TNO maakt een verslag van geïdentificeerde kennisvragen en inzichten; het zal geen specifieke informatie of uitspraken bevatten.

- We bespreken uiteraard geen marktgevoelige zaken.

- Chatham hous rules: De besproken informatie mag gedeeld worden, maar zonder de spreker te onthullen.

INTRODUCTIERONDE

Zet teams op ‘together mode’

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ACHTERGROND SHIP.NL

Han Feenstra | Ministerie van Economische Zaken en Klimaat

SHIP.NL PLATFORM VOOR KENNISUITWISSELING WATERSTOFIMPORT

Aanpak

Doel

Versnelling brengen in realisatie H_2-importketens door kennisuitwisseling tussen ketenpartijen

Wat

- Toegepaste kennis, dienend aan lopende initiatieven
- Focus op disseminatie:
  - Behapbaar maken informatie uit publicaties (Sherpa functie)
  - Up-to-speed met actuele ontwikkelingen zoals beleid
  - Delen informatie uit overlegstructuren waarin partijen actief in zijn
  - Stroomlijnen ketenanalyses: juiste aannames, recente technology assessments
  - Specifieke onderwerpen zoals veiligheid
- Groeimodel richting PPS met stevige ambitie: gezamenlijke totstandbrenging ketens, creëren van samenwerkingsverbanden

Hoe

- Geen uitvoerend programma: focus op bestaande kennis uit de keten bij elkaar brengen
- Deelnemers actief betrokken bij formuleren en beantwoorden van kennisvragen
- Coördinatie door TNO & RVO

MEERJARIG KENNISPROGRAMMA MET 5 LIJNEN

1 Technisch economisch	2 Beleid	3 Markt	4 Internationaal	5 Omgeving
▪ Inzicht in importketens productie-conversie-transport-opslag-reconversie-gebruik ▪ Vraagontwikkeling, scenario's ▪ Infrastructuur & systeemintegratie: corridors, benutten bestaande infra ▪ Technology assessments, R&D	▪ Impact van 'Fit for 55', REDII, Delegated acts, ETS/CBAM, etc. ▪ Impact van certificering en CO2 allocatie: emissiefactoren, LCA ketenanalyse, etc. ▪ Financiering en stimulering (EU & NL): IPCEI, PCI, TEN-E, JTF, EIB, Horizon Europe, MOOI, DEI, MIEK, SDE++, etc	▪ Marktmodellen: bilaterale contracten, vrije handel, waterstofbeurs ▪ Internationale handelsstromen: verwachte vraag- en aanbodvolumes en transportstromen ▪ Importtarieven, trade agreements en handelsbeperkingen, WTO, etc.	▪ Samenwerking met omringende EU/niet-EU importlanden om corridors te ontwikkelen ▪ Concurrentie met omringende EU/niet-EU importlanden ▪ Geopolitieke aspecten: strategische voorraden, afhankelijkheid, politieke stabiliteit van exportlanden	▪ Ruimtegebruik van ketenelementen ▪ Veiligheid: brandbaarheid, zorgwekkende stoffen, risicocontouren, etc ▪ Milieu: stikstof, lekkage ▪ Maatschappelijke acceptatie ▪ MVO / samenhang met SDG's in exportlanden
Synthese				

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MEERJARIG KENNISPROGRAMMA MET 5 LIJNEN

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Synthese

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OVERZICHT ORGANISATIES EN GREMIA

Marcel Weeda | TNO

NATIONAL ORGANIZATIONS & RESEARCH PROGRAMMES

PROGRAM	TYPE OF ACTIVITY	TOPIC
Groenvermogen NL	GROWTH FUND	Hydrogen in chemical industry.
HyDelta	RESEARCH PROGRAM	Consortium - Hydrogen infrastructure integration for transport and distribution.
WaterstofLab	SOCIAL PLATAFORM	Connect relevant Parties and Knowledge.
WVIP	INFORMATION PLATAFORM	Hydrogen guidelines, regulations and policies.
WIGO	RESEARCH PROGRAM	Technologies and best practices to increase H_2 uptake: applicability, safety, affordability and availability.
HyWay 27	RESEARCH PROGRAM	Hydrogen national transport network to produce a hydrogen backbone.
HyXchange	RESEARCH PROGRAM	Hydrogen trade in the Netherlands.
Hydrohub ISPT	RESEARCH PROGRAM	Test center for hydrogen production in industrial scale
HEAVENN	SUBSIDY PROGRAM	Demo projects on production, distribution, storage and local end-use of hydrogen
North Sea Energy	RESEARCH PROGRAM	North Sea Energy Potential
Voltachem	INNOVATION PROGRAM	Business innovation program for technological developments from TRL 3-5 (research & innovation) towards TRL 5-7.

MAIN PARTNERS

GOVERNMENT

EZK

BZK

RVO

R&D AND EDUCATION

COMPANIES AND INDUSTRY

NATIONAL ORGANIZATIONS & RESEARCH PROGRAMMES

entsog
european network of transmission system operators for gas

Start date

Project promoter

Search

Filters

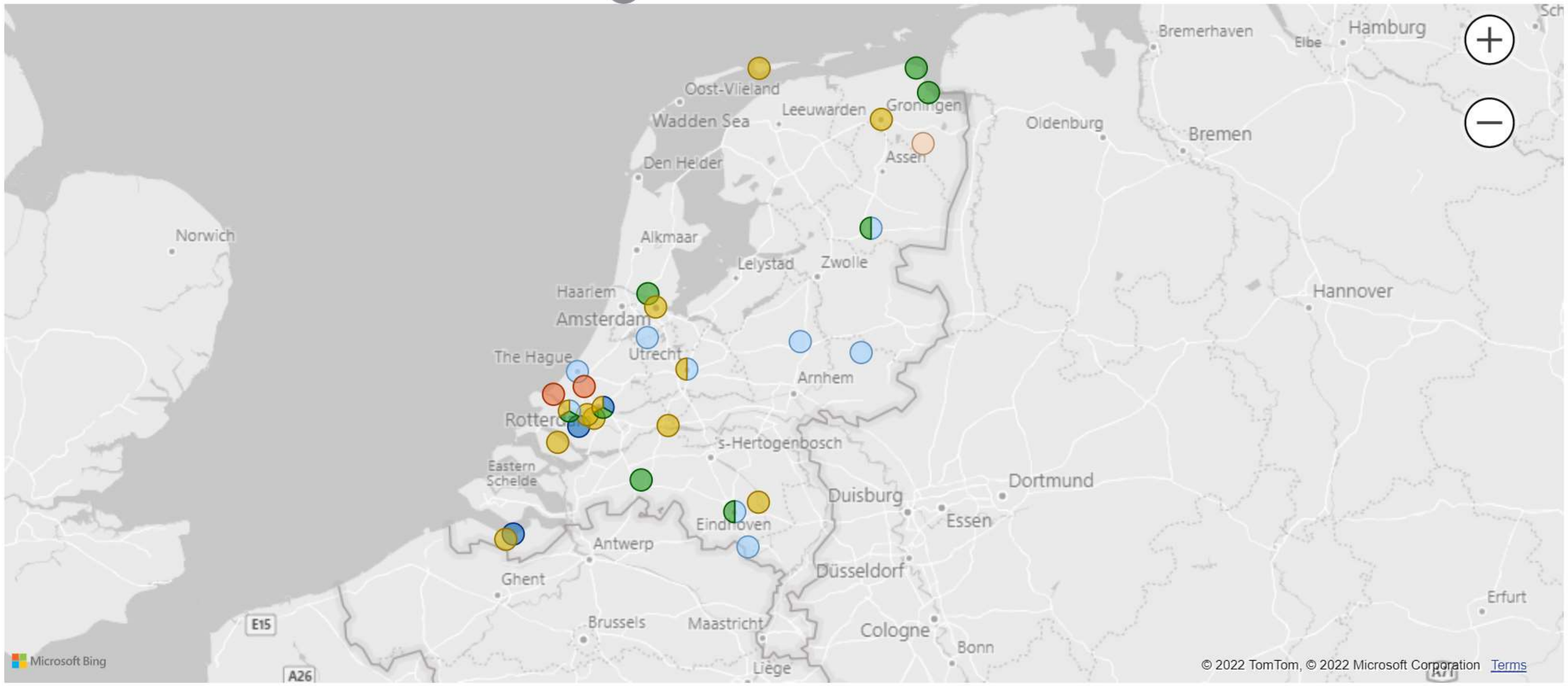
Netherlands

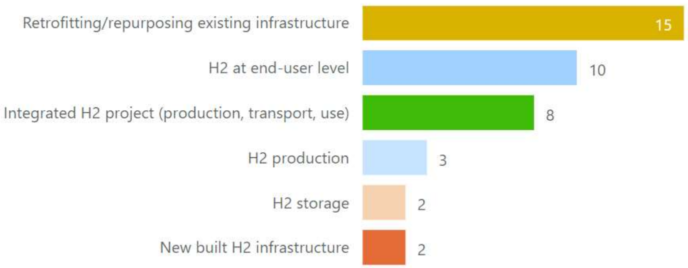
Type of project

Project maturity

Start date

H2 at end-user level · H2 production · H2 storage · Integrated H2 project (production, transport, use) · New built H2 infrastructure · Retrofitting/repurposing existing infrastructure





Project name	Project promoters	Country	Timeline	Project maturity	Scope & goal
Apeldoorn H2 boilers	BDR Thermea group	Netherlands	2021-NA	Project	Main scope of the demo was to confirm the perfect interchangeability with an Natural Gas boiler referring to installation, commissioning and operation.
CAES Zuidwending	Corre Energy BV	Netherlands	2024-NA	Project	CAES Zuidwending will implement a further design step that will allow green hydrogen to fully replace methane, providing a 100% renewable-CAES solution.
Djewels	Nouryon; N.V. Nederlandse Gasunie	Netherlands	2020-NA	Project	McPhy supplies innovative alkaline electrolysers to convert renewable electricity into 3000 tons of green hydrogen per year; BioMCN combines this hydrogen with CO 2 from other processes to produce renewable

SOURCE: ENTSOG, 2021

DUTCH-INTERNATIONAL ORGANIZATIONS & RESEARCH PROGRAMMES

PROGRAM	TYPE OF ACTIVITY	TOPIC
Topsector Energie	RESEARCH PLATFORM	Research accelerator in 5 areas: biobased economy; energy and industry; gas; urban energy; and offshore wind
H2 Platform	KNOWLEDGE PLATFORM	Knowledge exchange between companies, research institutes and governments.
NWBA	KNOWLEDGE PLATFORM	Application of hydrogen and fuel cell technology representing the Netherlands in European initiatives.
KVGN	KNOWLEDGE PLATFORM	Association of Gas Manufacturers. Making the energy supply more efficient and effective.

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INTERNATIONAL ORGANIZATIONS & RESEARCH PROGRAMMES

PROGRAM	TYPE OF ACTIVITY	TOPIC
IEA/CEM – Hydrogen Initiative	POLICY	Clean Energy Ministerial is a global high-level forum that focuses on promoting policies and programs to accelerate the energy transition. The 'Hydrogen Initiative' within the CEM focuses on strengthening international cooperation. CEM has strong links with the IEA HTCP, IPHE and Mission Innovation. (Hydrogen Energy Ministerial (HEM) is a Japanese initiative with the same scope)
Mission Innovation	KNOWLEDGE PLATFORM	Mission Innovation (MI) is a global clean energy initiative, launched at COP21 in Paris. MI aims to accelerate energy innovation. Part of the MI is the 'Clean Hydrogen Mission', which aims for $2/kg for clean hydrogen by 2030.
IPHE	POLICY & REGULATIONS	International partnership of governments. Facilitating and accelerating the energy transition through the application of hydrogen and fuel cells in various sectors.
IEA TCP Hydrogen	RESEARCH & KNOWLEDGE PLATFORM	Global research and innovation collaboration for hydrogen with 40+ year operating history, 26 Contracting Parties(24 countries + European Commission and UNIDO) and 7 Sponsor Members.
FCH JU	IRESEARCH PROGRAM	Public-private partnership. Research, technology development and demonstration of hydrogen technology.
Hydrogen Europe	RESEARCH PROGRAM & KNOWLEDGE PLATFORM	European organization of industry and other stakeholders accelerating European hydrogen industry to make the transition to a CO2 neutral energy system. (Hydrogen Europe Research is separate for research institutes)
Pentalateraal Energy Forum	POLICY & REGULATIONS	Politically driven partnership between governments, regulators, network operators and market parties. Benelux founded the forum together with Germany and France. Austria and Switzerland also joined in 2011.

INTERNATIONAL ORGANIZATIONS & RESEARCH PROGRAMMES

entsog
european network of transmission system operators for gas

Start date

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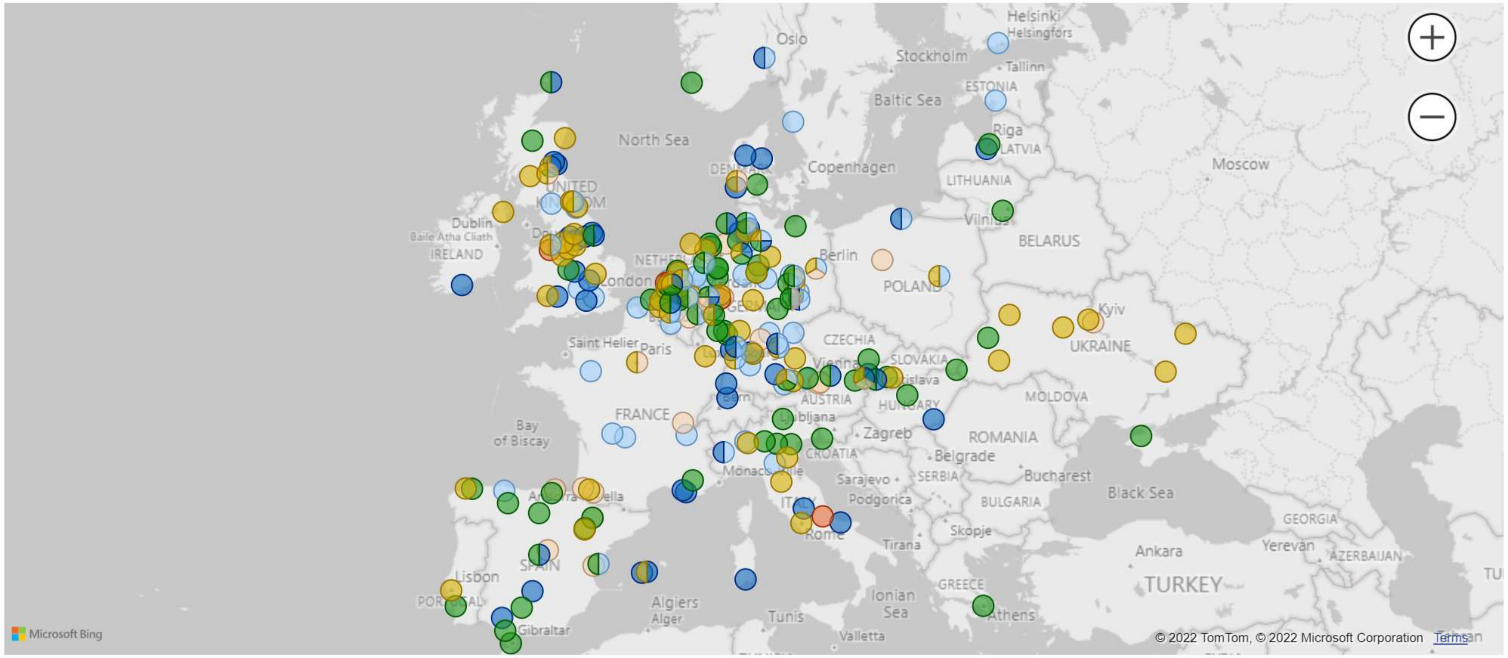
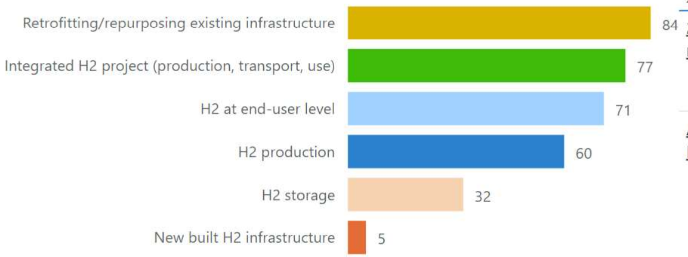
H2 at end-user level H2 production H2 storage Integrated H2 project (production, transport, use) New built H2 infrastructure Retrofitting/repurposing existing infrastructure





Project name	Project promoters	Country	Timeline	Project maturity	Scope & goal
2G's CHP fleet retrofit	2G Energy AG	Germany	NA-NA	Project	Existing natural gas CHP plants can be easily retrofitted for the operation with hydrogen by moderate costs; by this means millions of tons of CO2 can be saved each year
Aberdeen Vision Project	SGN / NG / PBDE / DNVGL	United Kingdom	NA-NA	Project	The focus for the Aberdeen Vision project is the transport and use of hydrogen produced from reformed natural gas from StFergus in North East Scotland. Outline the possibility of using advanced hydrogen production at St Fergus. And to discuss the technology and safety requirements for the transportation and storage of CO2 from hydrogen production.

SOURCE: ENTSOG, 2021

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DEEP DIVE 1: HY3 EN VERVOLG

René Peters | TNO

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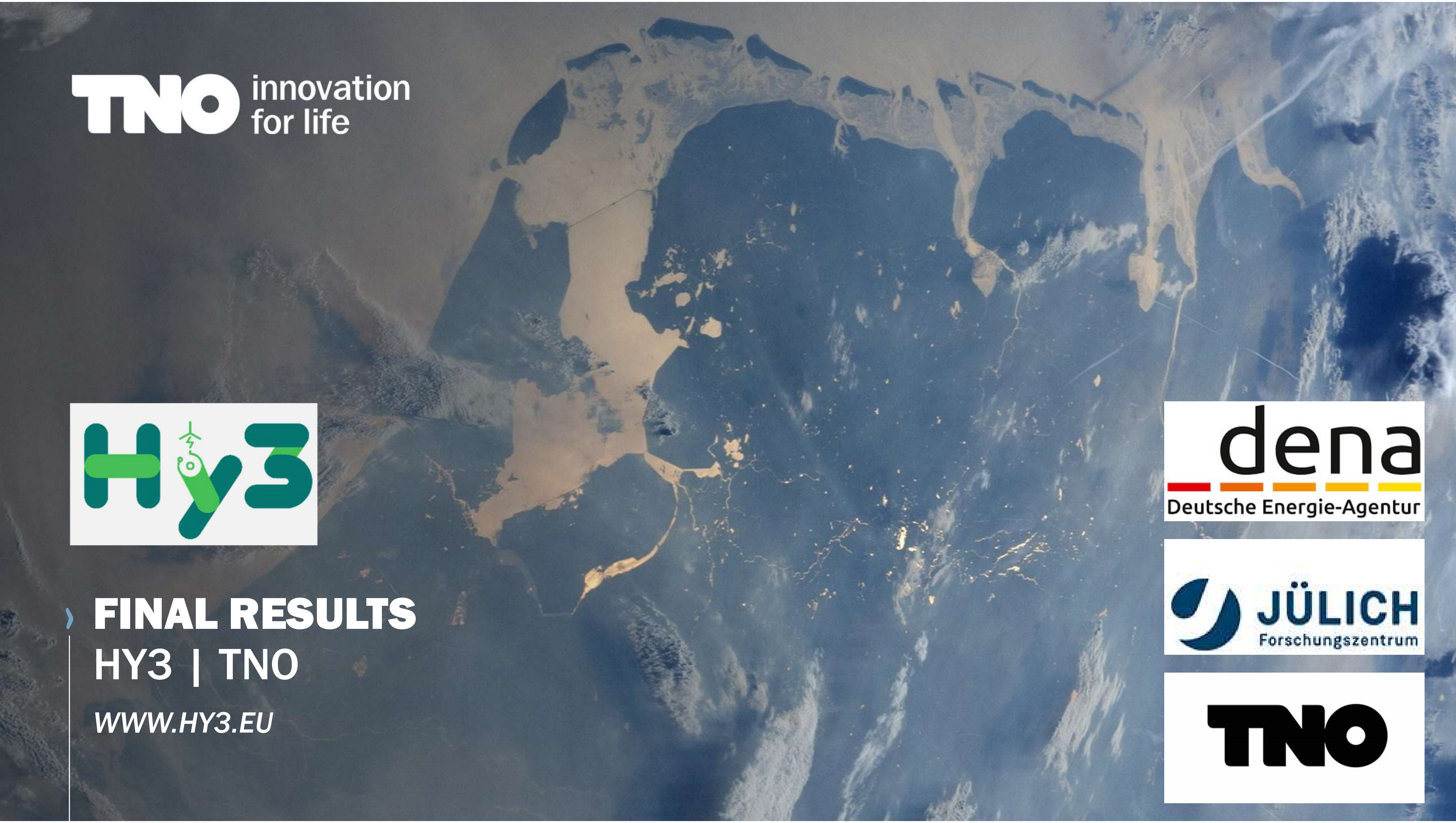

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FINAL RESULTS

HY3 | TNO

WWW.HY3.EU

INTRODUCTION HY3

The Dutch, German and Nordrhein Westfalen governments asked TNO, DENA and FZ Jülich to study the feasibility of a transnational hydrogen economy at the border of the Netherlands and Nordrhein Westfalen.

Project goals are:

- Analyse the feasibility of a **transnational green hydrogen** infrastructure in the border area of the Netherlands and North Rhine-Westphalia
- Examine the **potential of GHG-reduction** and increase of the renewable energy deployment in the industry sector by a transnational green hydrogen infrastructure
- Examine **possible business cases** for future green hydrogen infrastructure by using transnational (Dutch-German) hydrogen production and existing transportation and storage facilities
- Examining **industrial interest** in green hydrogen infrastructure and potential **field of applications** as well as potential synergies with hydrogen applications in other sectors
- Describing the existing **regulatory framework** in the context of green hydrogen production, transport, storage, trading and usage and examining the framework that would be needed to establish transnational green hydrogen infrastructure as well as respective business cases

Die Landesregierung Nordrhein-Westfalen

Bundesministerium für Wirtschaft und Energie

Ministerie van Economische Zaken en Klimaat

SCOPE OF WORK

DEMAND

- Technology assessment hydrogen applications
- Market assessment hydrogen applications
- Market synergies (mobility & industry)
- Expected market entrance

TRANSPORT & STORAGE

- Hydrogen transport scenarios
- Infrastructure modifications
- Hydrogen storage options
- Regulatory framework for transport and storage

PRODUCTION

- Offshore wind regions & capacity potential
- Greenhouse gas emission reduction potential
- Regulatory framework for offshore wind and grid development
- Locations for hydrogen production and grid connections

Knowledge sharing, country-specific input & review

JÜLICH Forschungszentrum

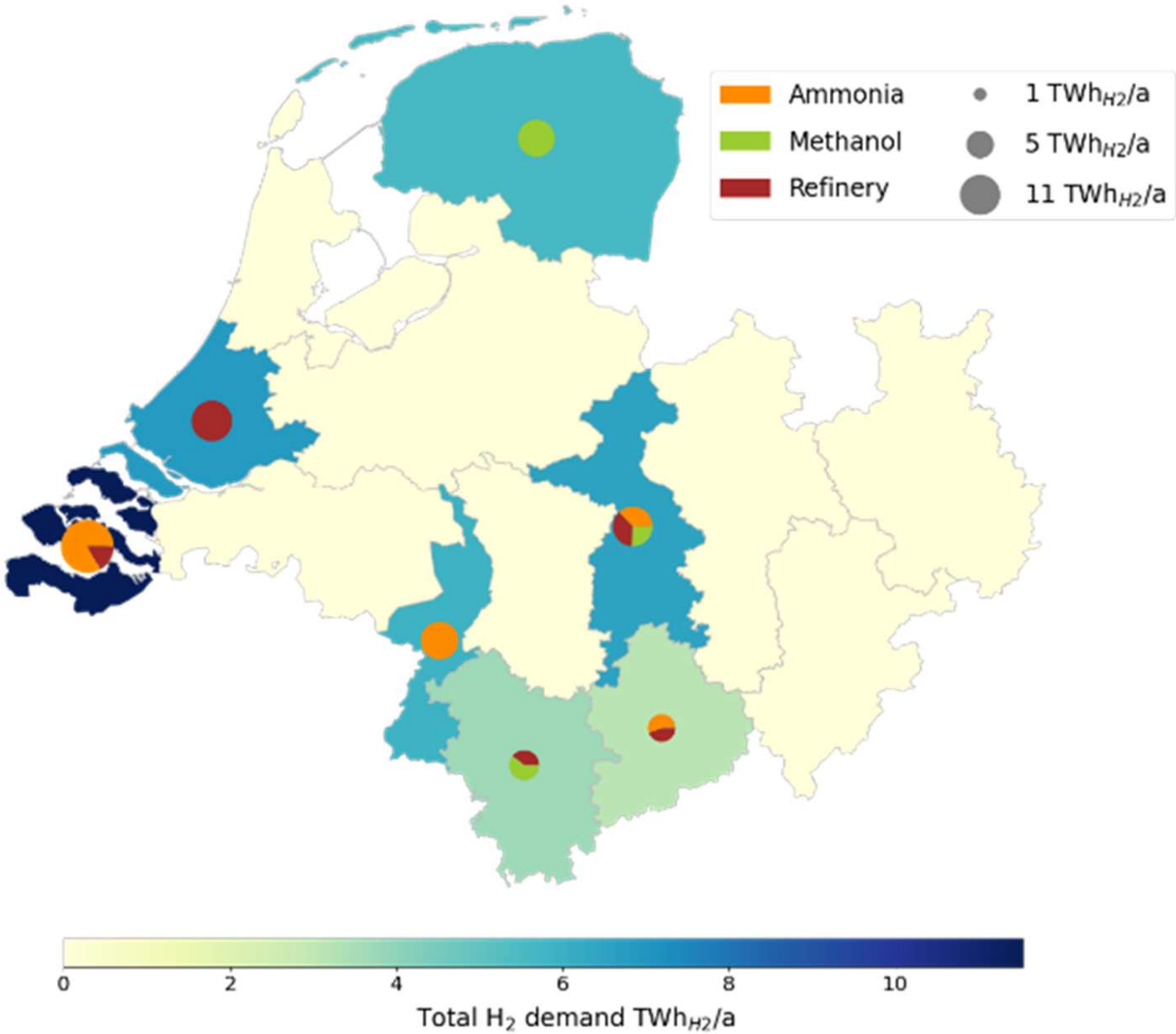
TNO

dena Deutsche Energie-Agentur

SCOPE & RESOLUTION

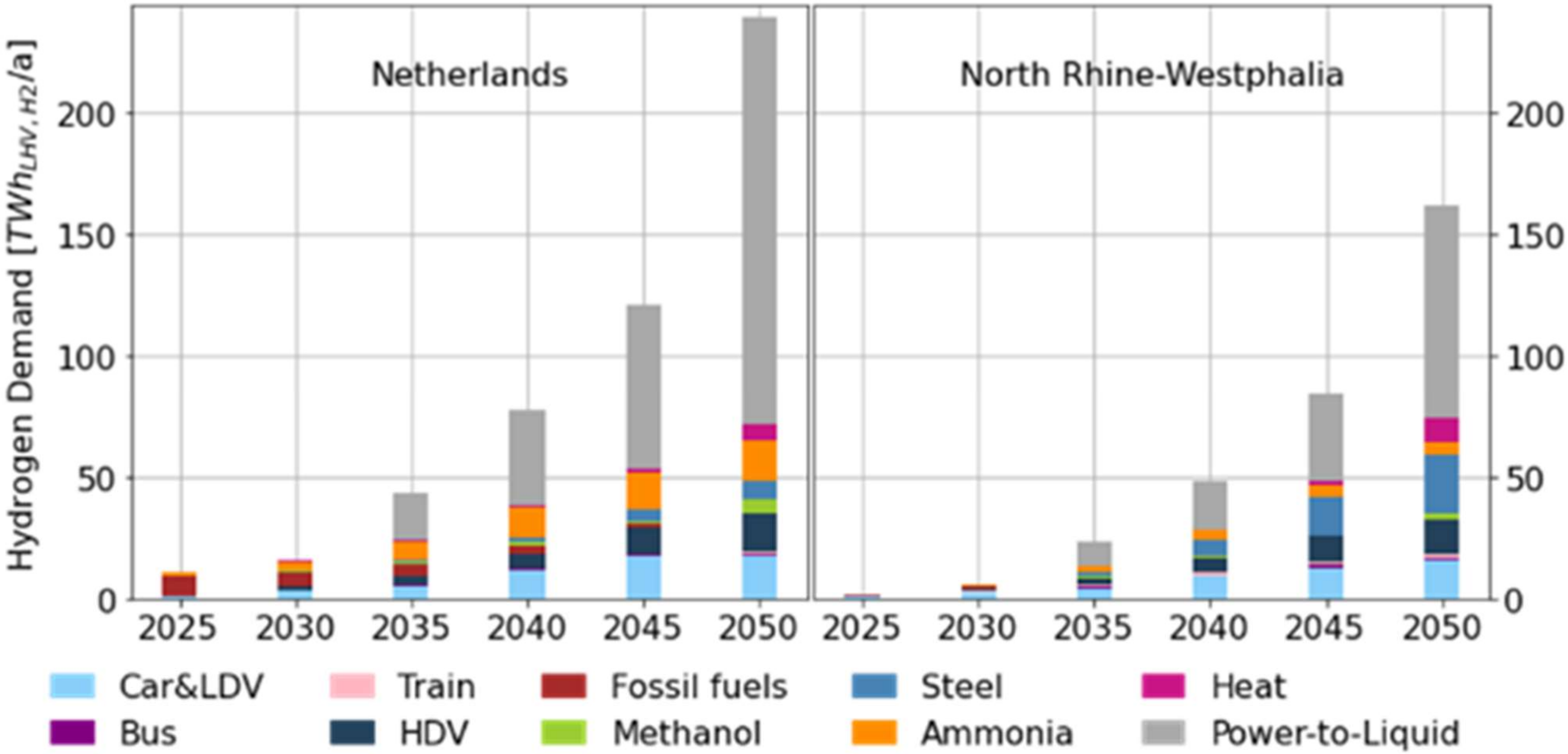
Project goals are:

- Geography: Netherlands and North Rhein Westfalia with main clusters as granularity
- Time: 5 year steps with a hourly resolution per year; up to 2050
- Technology & application:
  - Supply: green hydrogen from offshore wind & import
  - Demand: industry, transport, refinery and PtL
  - Transport: repurposed pipelines and new pipelines
  - Storage: subsurface cavern storage



JÜLICH
Forschungszentrum

DEMAND GROWTH TOWARDS 2050



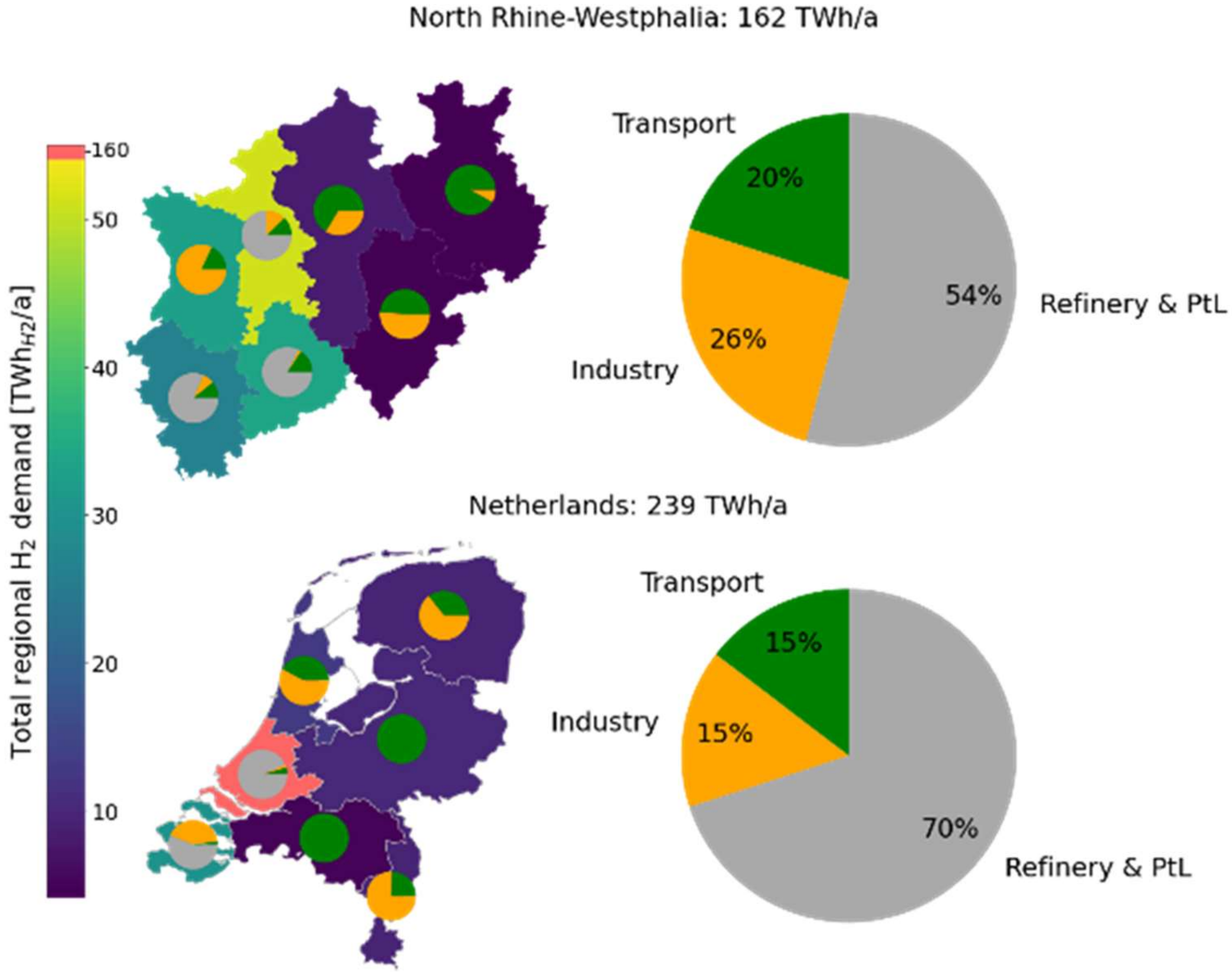
DEMAND BY REGION AND SECTOR 2050

- Towards 162 TWh in NRW
- 239 TWh in the Netherlands

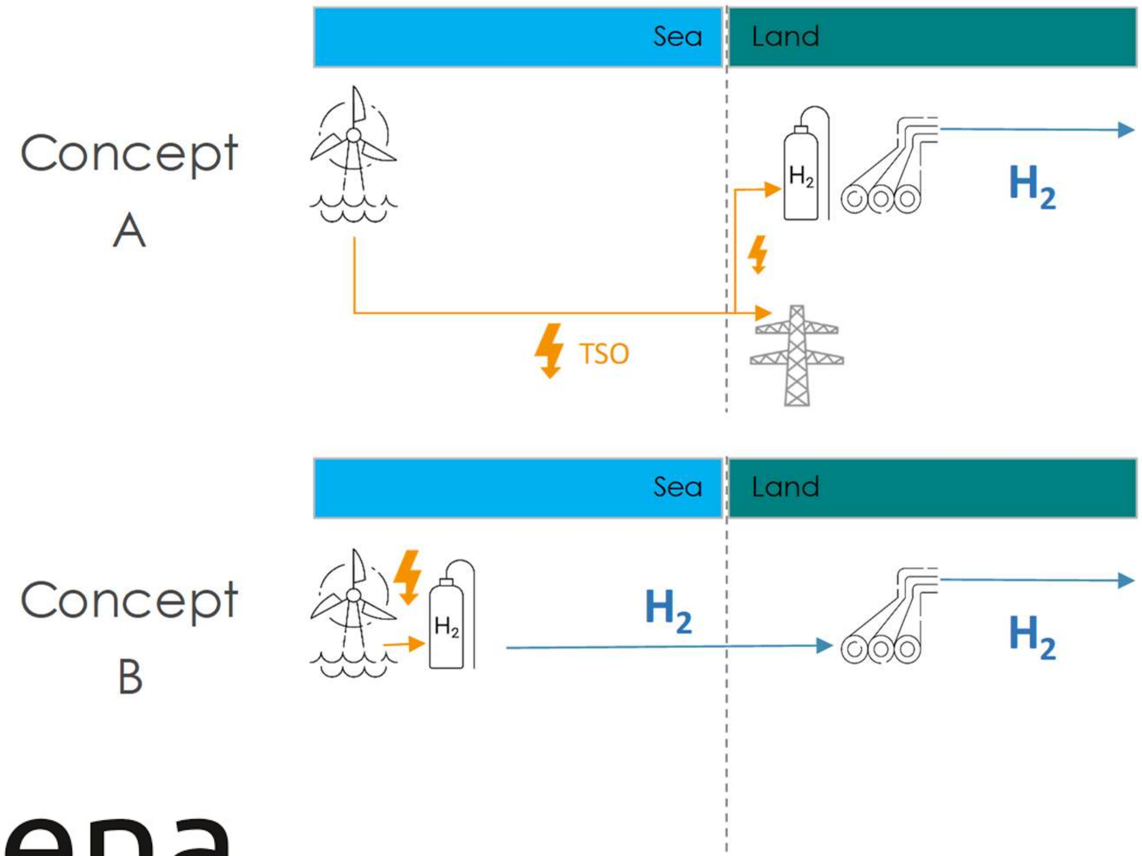
Storyline

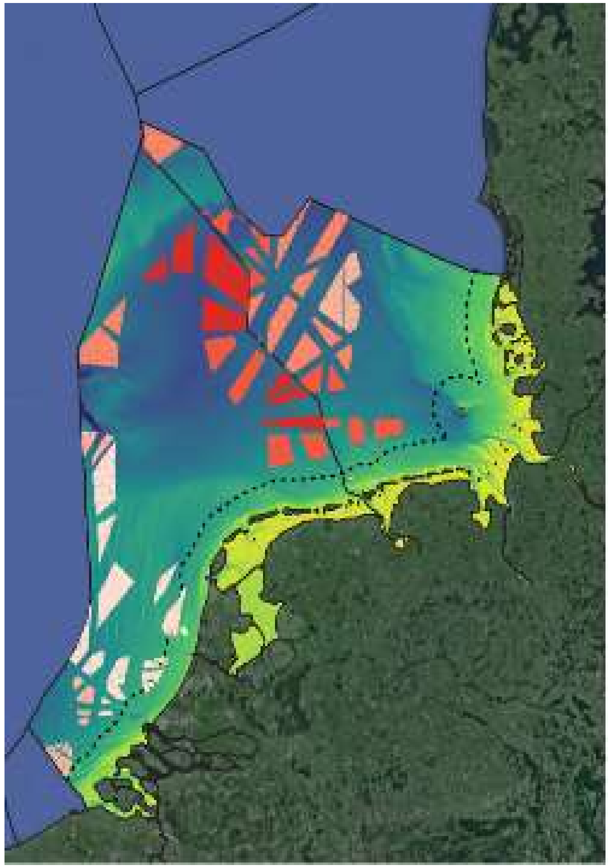
- Initial: Transport and substitution non-energetic
- 2030's: passenger cars, steel and synthetic fuels
- 2040's: high-temperature furnaces and the cement industry

- Role of synfuels: Demand in NRW and the Netherlands could consist of over 54% and 70% for PtL production by 2050.



SUPPLY CONCEPT

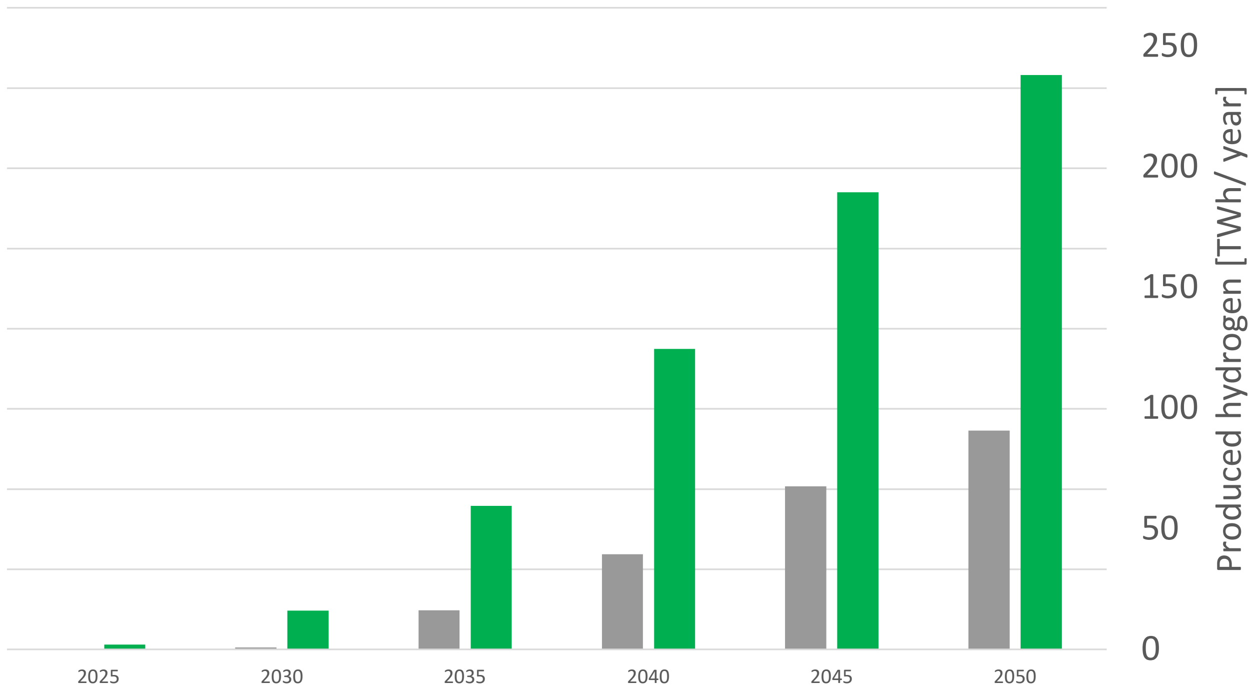




dena
Deutsche Energie-Agentur

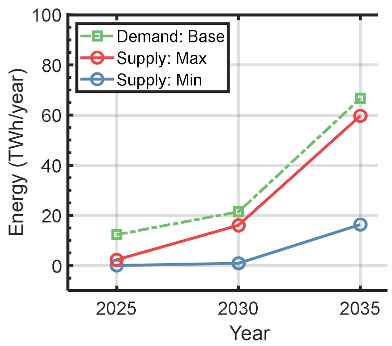
SUPPLY RESULTS

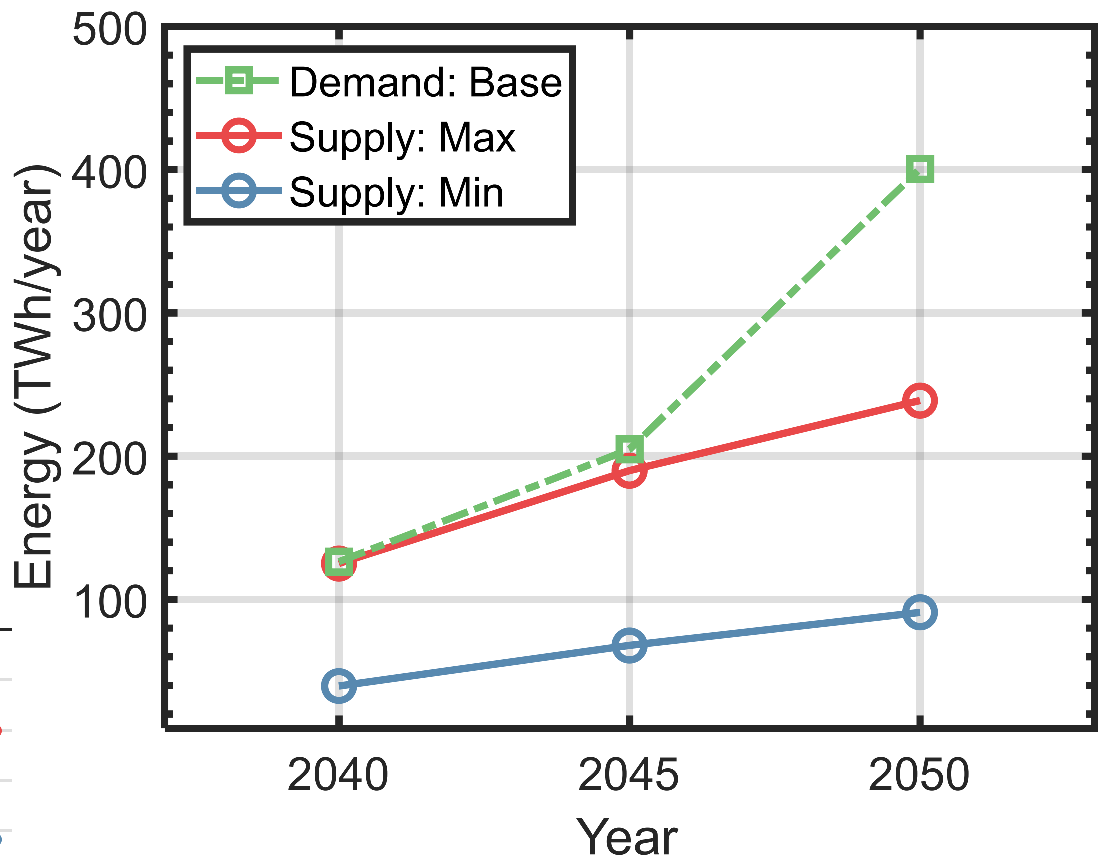
- Offshore wind parks of ca. 68 GW in the Netherlands and ca. 53 GW in Germany by 2050
- Up to 195.5 TWh of electric energy are generated in the German North Sea, and 249 TWh in the Dutch North Sea,
- Min and max scenarios for supply scenarios between 80-230 TWh per year



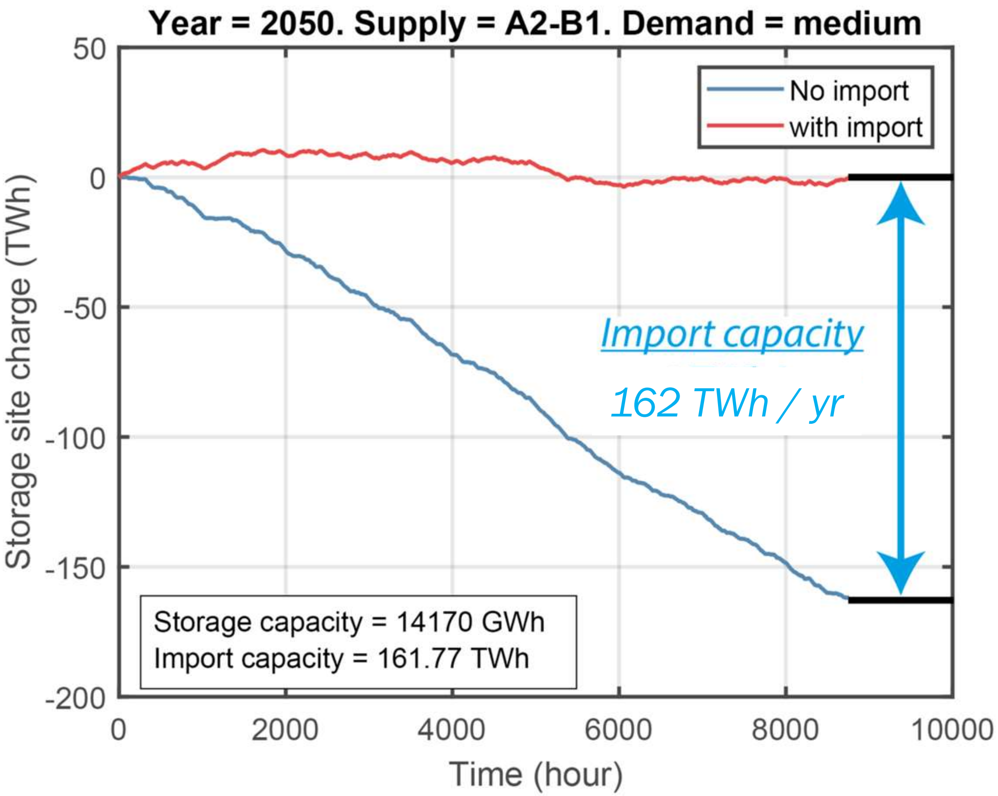
SUPPLY & DEMAND MATCH

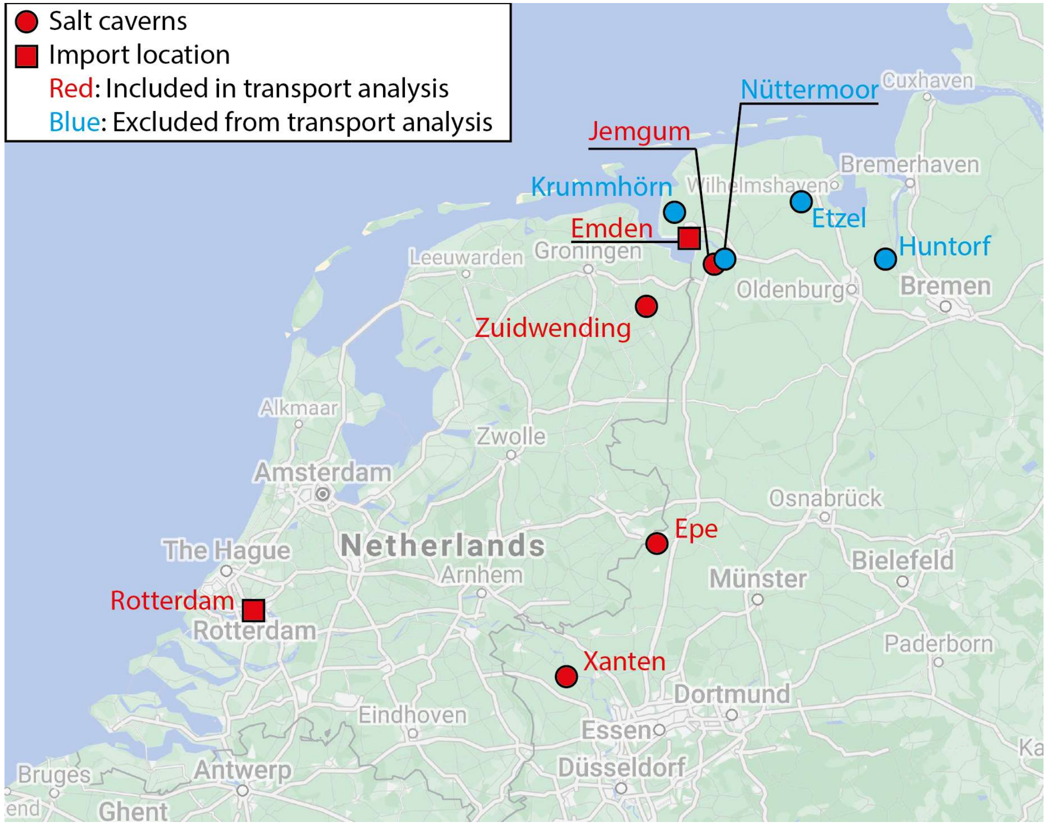
- For most supply & demand scenario combinations, green H2 supply scenarios cannot meet the demand.
- annual hydrogen demand is higher than supply by 6 – 21 TWh in 2030 and by 162 – 310 TWh in 2050.
- Linear growth supply
- Fast(er) growth demand
- In order to meet the projected demand, either additional supply will be necessary or H2 will have to be imported.





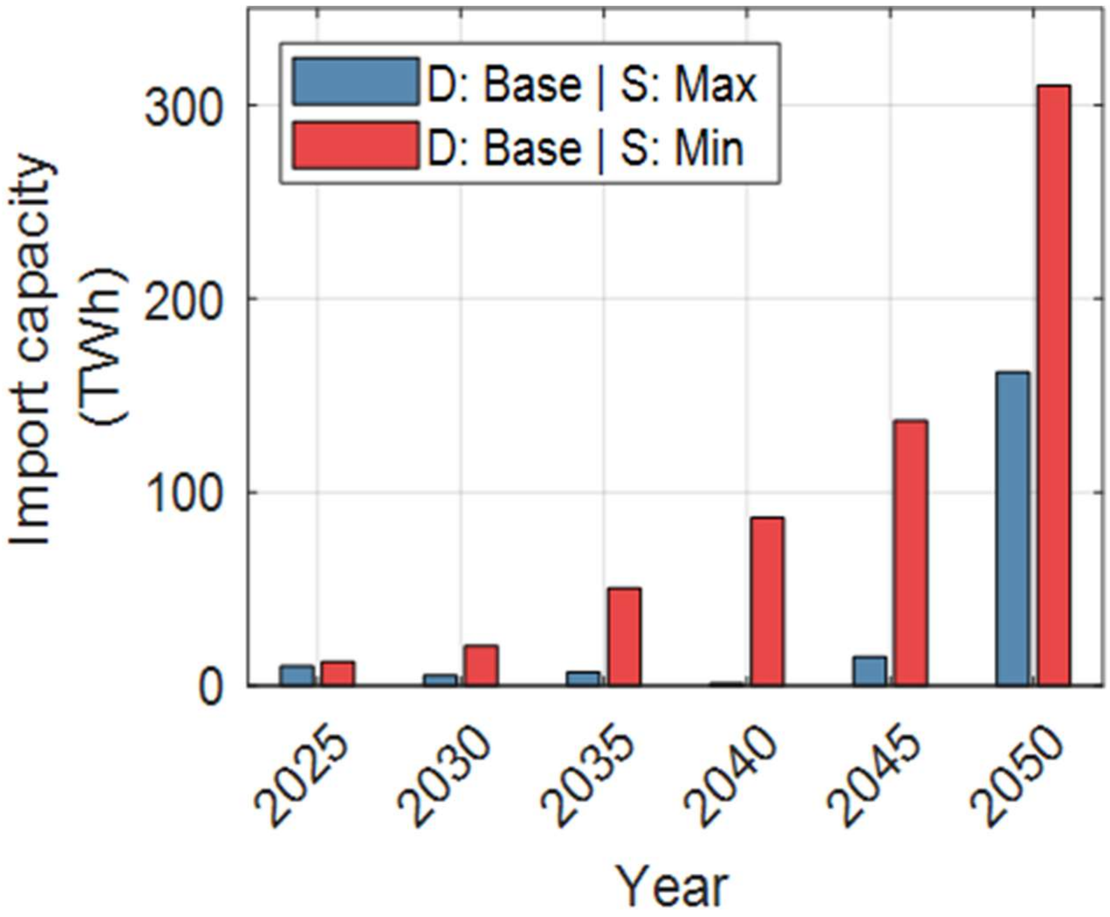
YEARLY MATCHING: IMPORT





IMPORT RESULTS

- Import need in scenarios: 162 – 310 TWh/yr in 2050.
- Port of Rotterdam vision 600 TWh/yr by 2050
- Assumed equal split Netherlands and Germany



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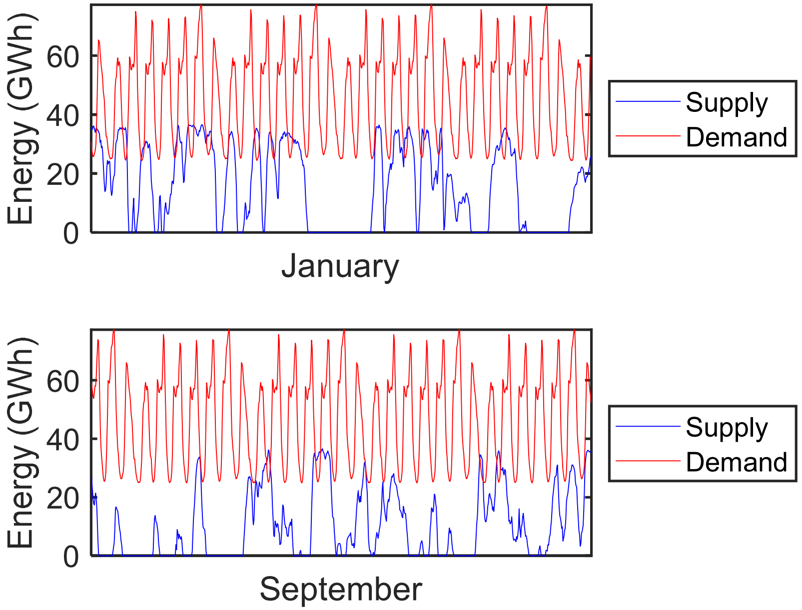
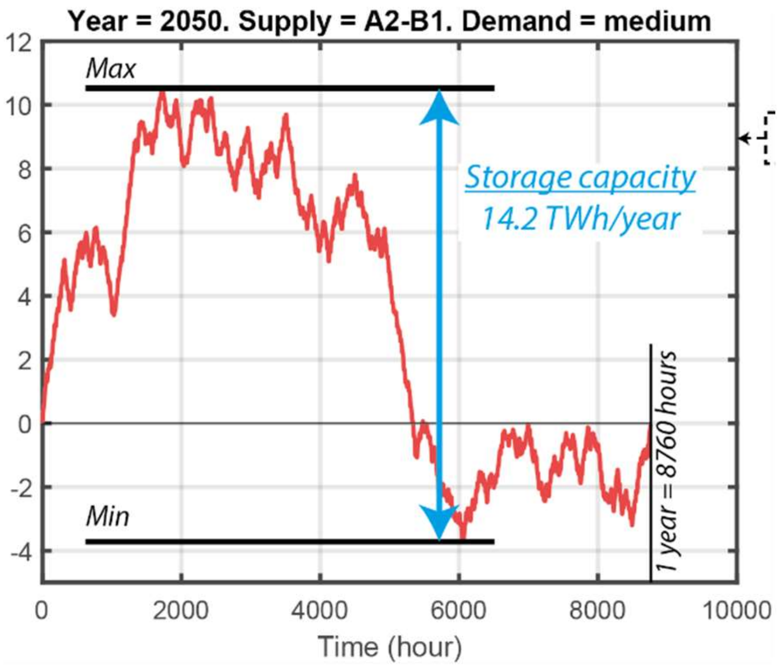
CALCULATING STORAGE NEEDS

- Storage capacity is calculated to balance the supply and demand fluctuations for NL + NRW over 1 year.
- Flat import rate is used to meeting annual deficit between supply and demand.





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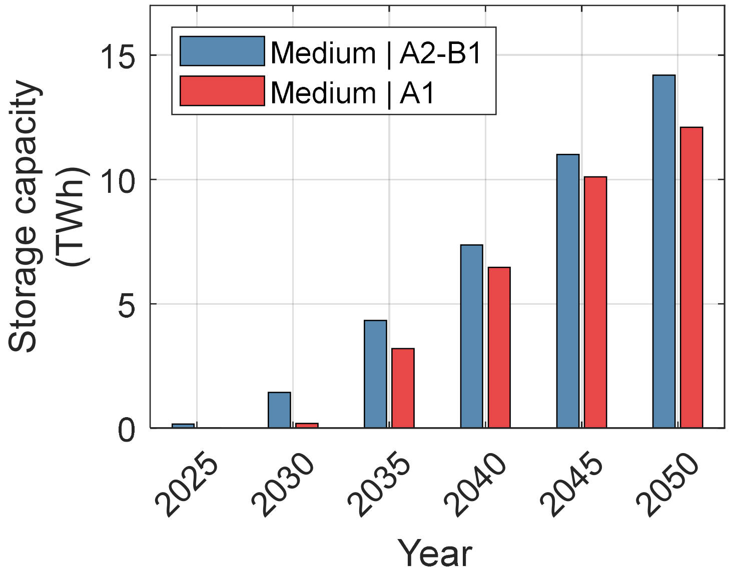
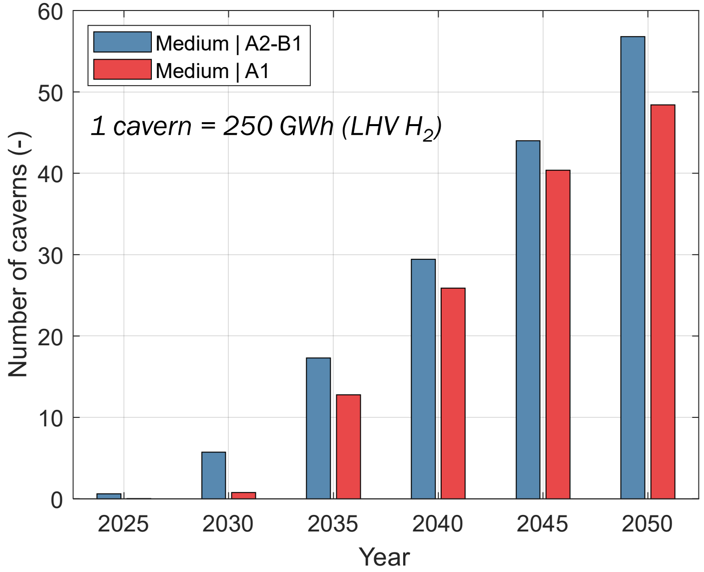
TOTAL STORAGE CAPACITY

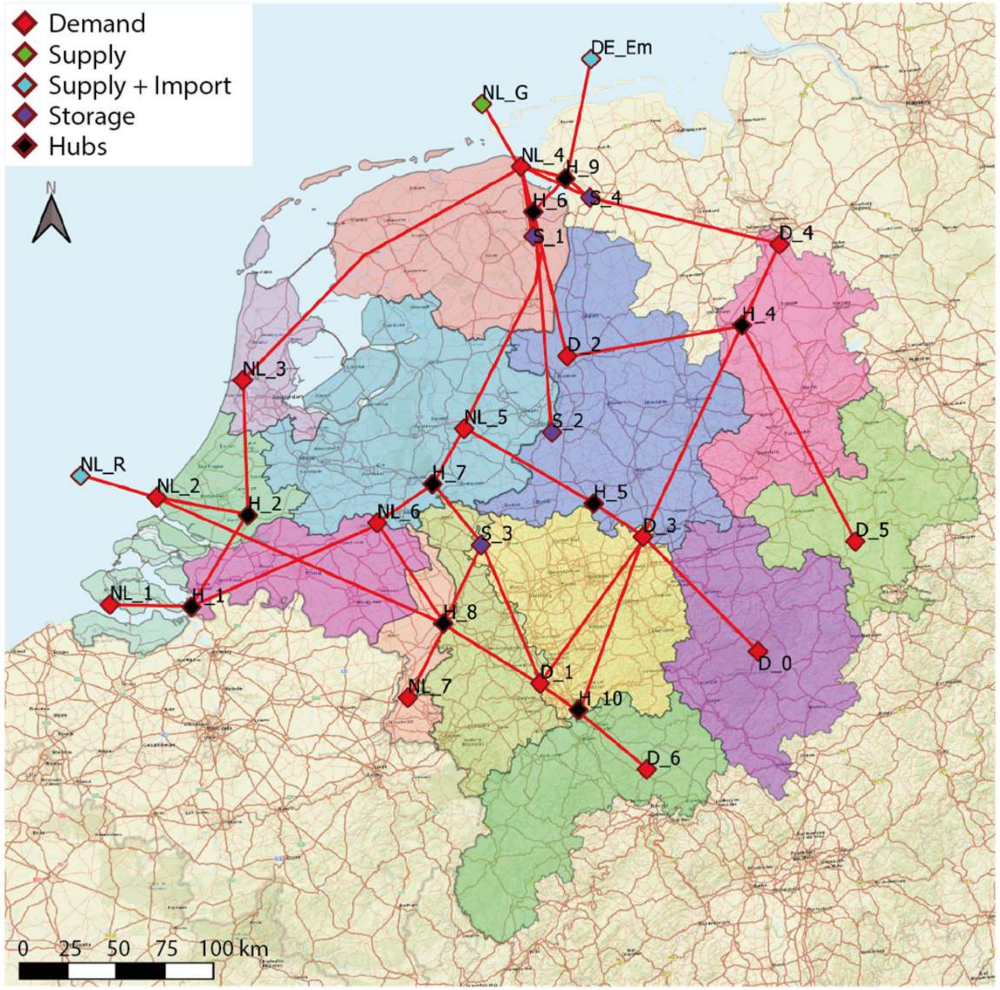
- Storage capacity and number of caverns shown for the Netherlands and the NRW (DE) region combined.
- We assumed storage capacity is spit equally across the 4 sites –
  - Zuidwending (NL), Epe (DE), Xanten (DE), Jemgum (DE).





BACKBONE ROUTING WITH NODES

- Using existing NL & DE H_2 backbone visions, we model the integrated network of demand, supply and storage nodes.
- The model employs non-linear programming technique to balance network flow while minimizing the product of flow and distance.
- H_2 flows are balanced hourly to identify backbone utilization and bottlenecking.
- Results provide insight into capacity bottlenecks, inventory of needed pipeline and storage infrastructure



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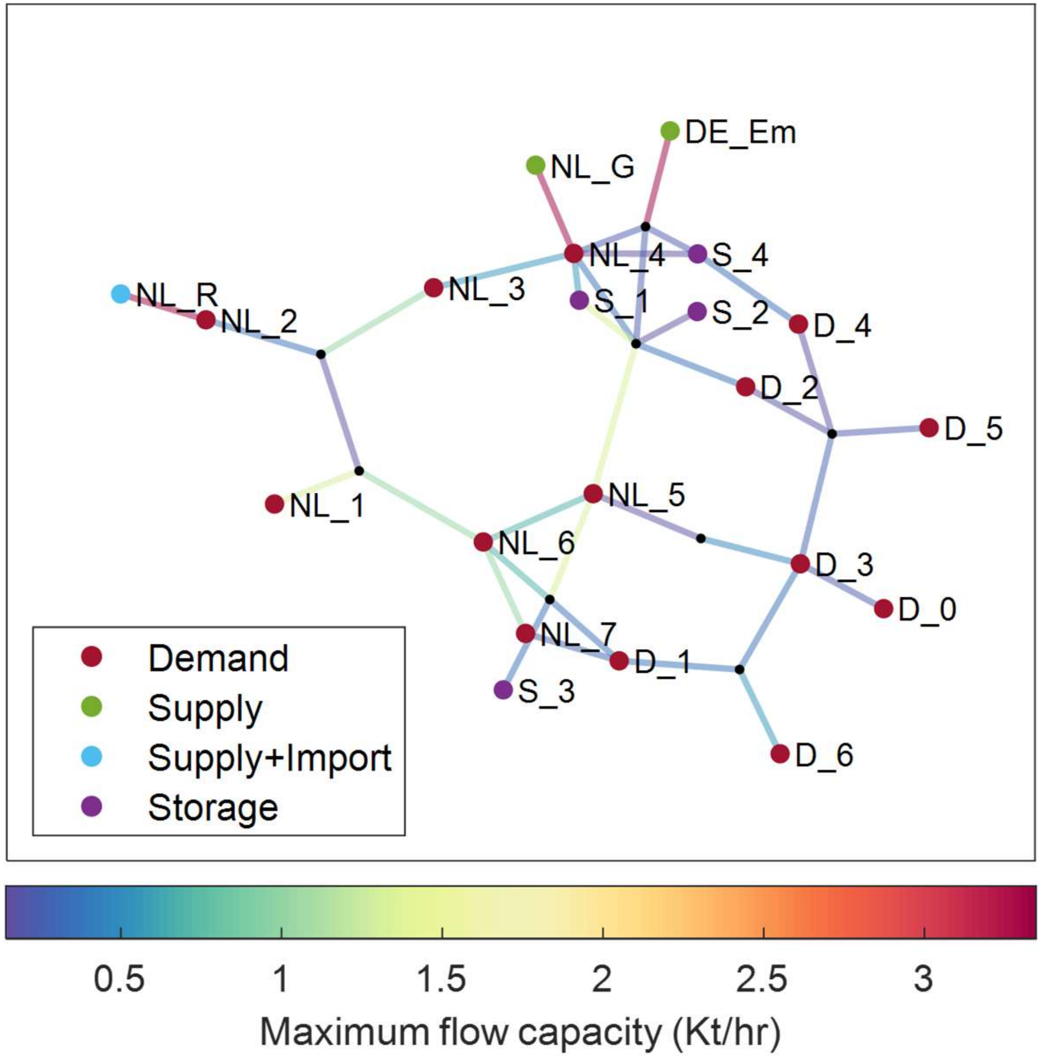
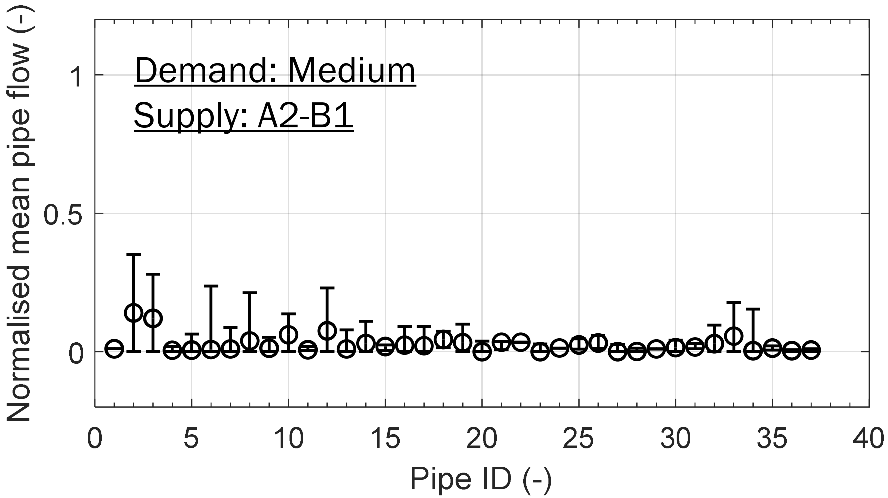
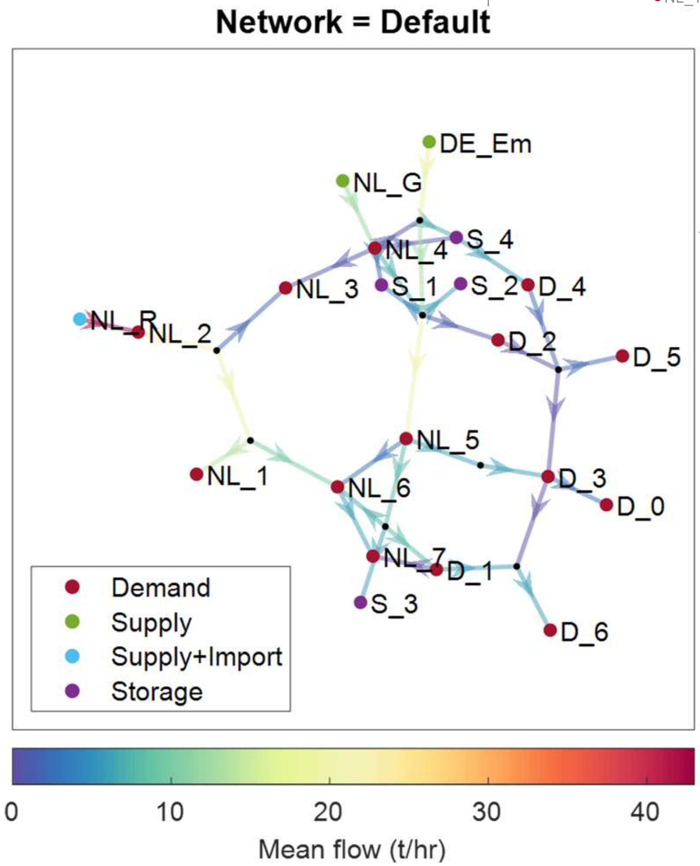
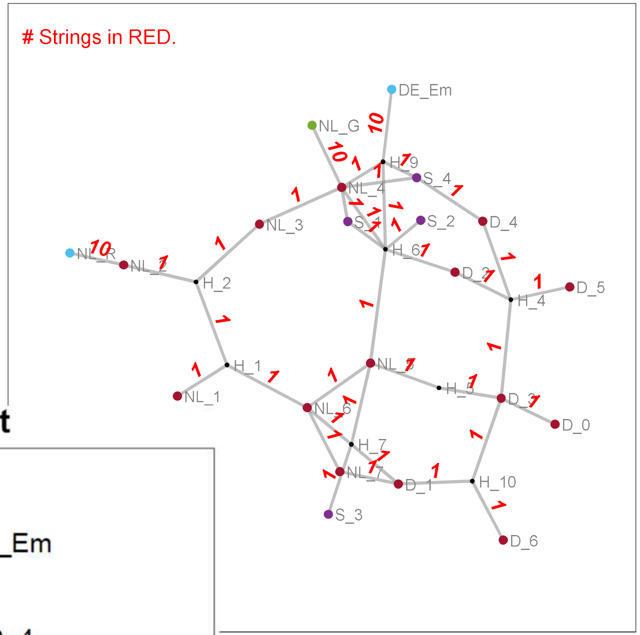

DE_Em
NL_G
NL_4
S_4
NL_R
NL_3
S_1
S_2
NL_2
D_4
D_2
D_5
NL_1
NL_5
NL_6
D_3
D_0
NL_7
D_1
S_3
D_6
Demand
Supply
Supply+Import
Storage
0.5
1
1.5
2
2.5
3
Maximum flow capacity (Kt/hr)

2030 – SINGLE STRING NETWORK

- Transition pathway – free 1 string for hydrogen network, while leaving the rest of the strings for legacy natural gas user support.
- So can we assume 1 string will be available for H2 in 2030?







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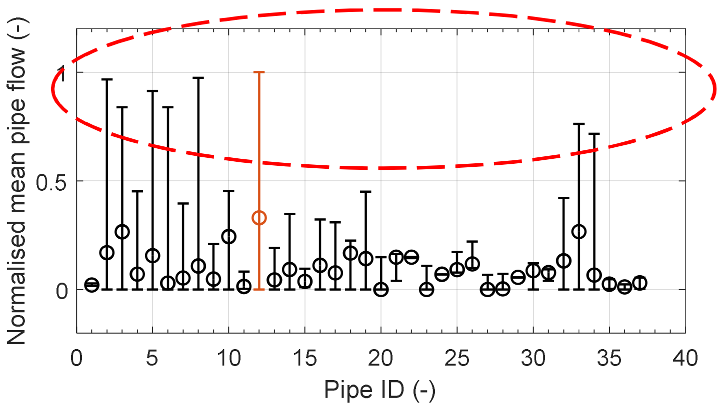
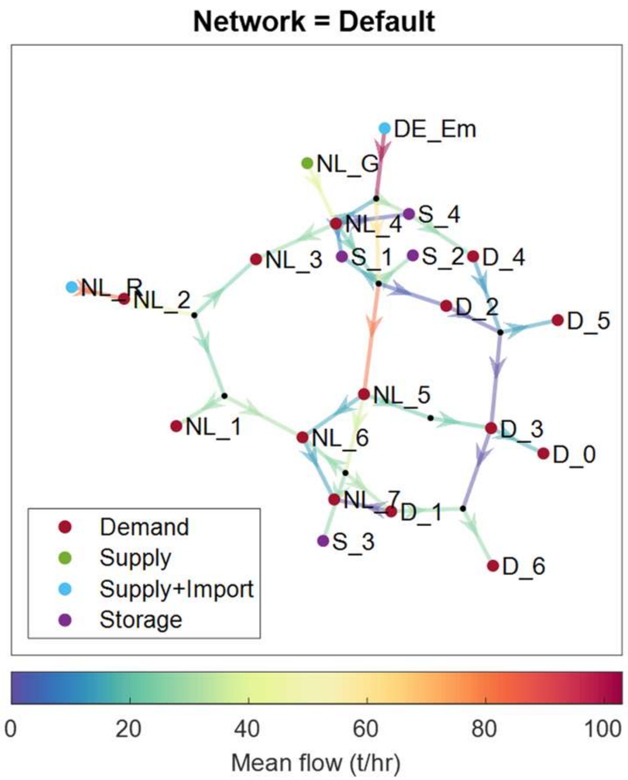
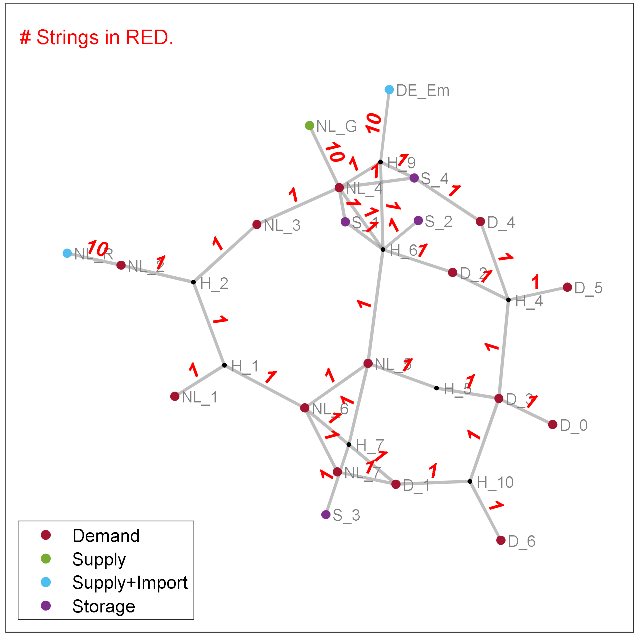
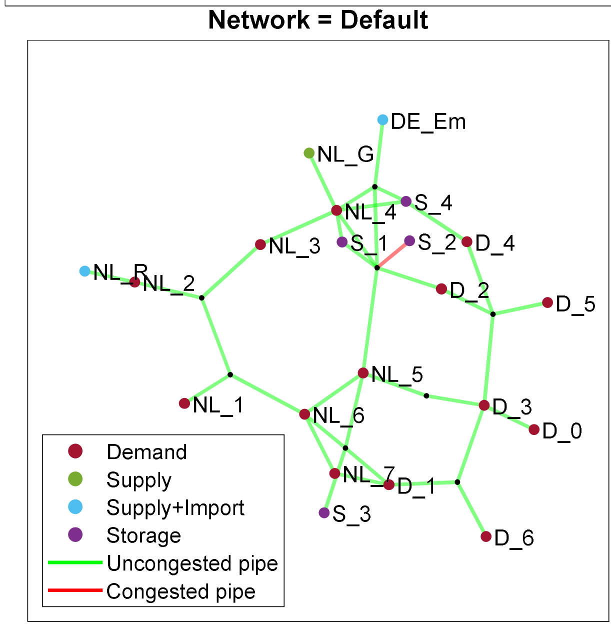
2035 – SINGLE STRING NETWORK

- Transition pathway – free 1 string for hydrogen network, while leaving the rest of the strings for legacy natural gas user support.
- More bottlenecks appear from 2035 onwards.



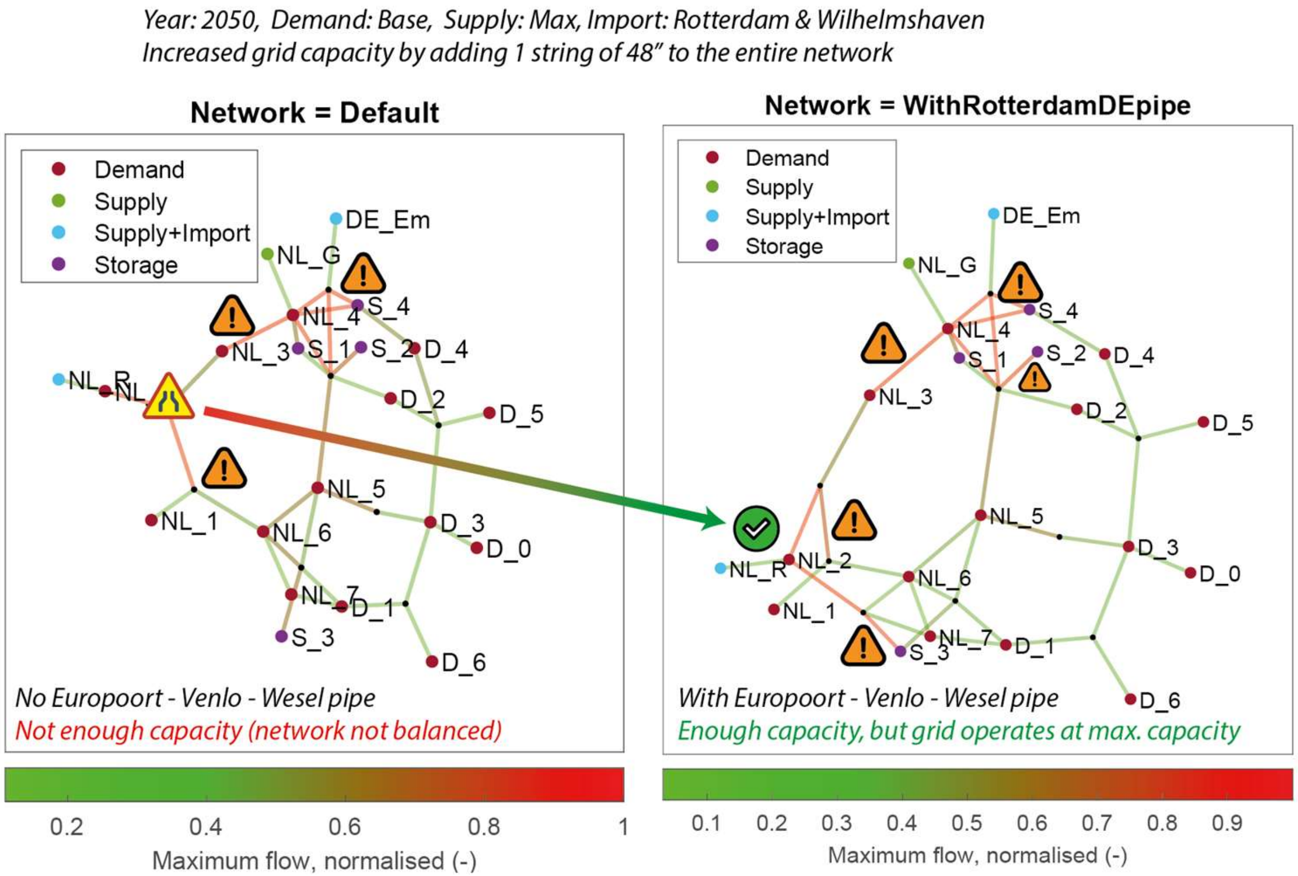






RESULTS 2050

- Bottlenecks identified, especially around the import connections in these scenarios.
- Some of these debottlenecking approaches are explored (adding strings, pipeline connections, import points)
- More approaches should be examined to work towards a more optimal roll-out of the hydrogen infrastructure.



KEY MESSAGES

- Green hydrogen produced from offshore wind in the North Sea has vast production potential, but it is still insufficient for meeting the projected hydrogen demand. This deficit in hydrogen production capacity grows exponentially from 2025 to 2050.
- Other sources of hydrogen, beyond green hydrogen produced from offshore wind will be needed in the future. These other sources can include domestic production of green hydrogen from solar, domestic production of blue hydrogen and import of low carbon hydrogen.
- Repurposing of parts of the existing gas infrastructure for hydrogen transport in the Netherlands and Germany yields sufficient transport capacity until 2030. After 2030, bottlenecks could occur in certain regions (near storage or import).
- In 2030, 1-5 caverns will be needed, with this number increasing to 49-57 caverns by 2050. These estimates only consider storage capacity needed to balance supply and demand fluctuations for a normal weather year. Factoring in strategic reserves and yearly variations in supply and demand would likely increase the storage need
- Gas storage sites currently using caverns for gas storage offer a large technical potential for hydrogen storage. However, in order to support new hydrogen infrastructure new caverns will likely be needed during transition phase where both natural gas, and hydrogen storage capacity will be necessary.

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THANK YOU FOR YOUR ATTENTION

(FULL REPORT ON WWW.HY3.EU)

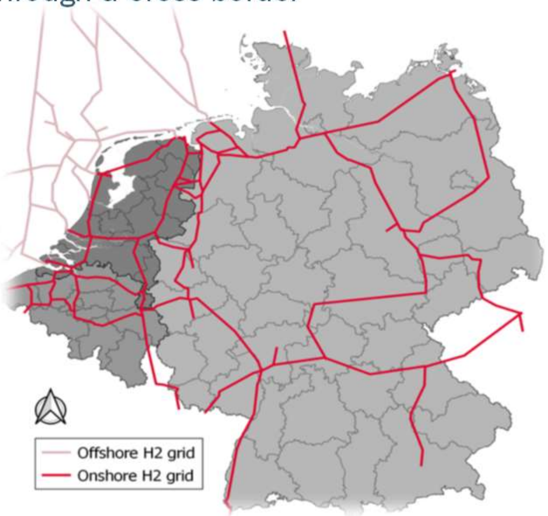
TOWARDS A CROSS-BORDER INFRASTRUCTURE   HY3+

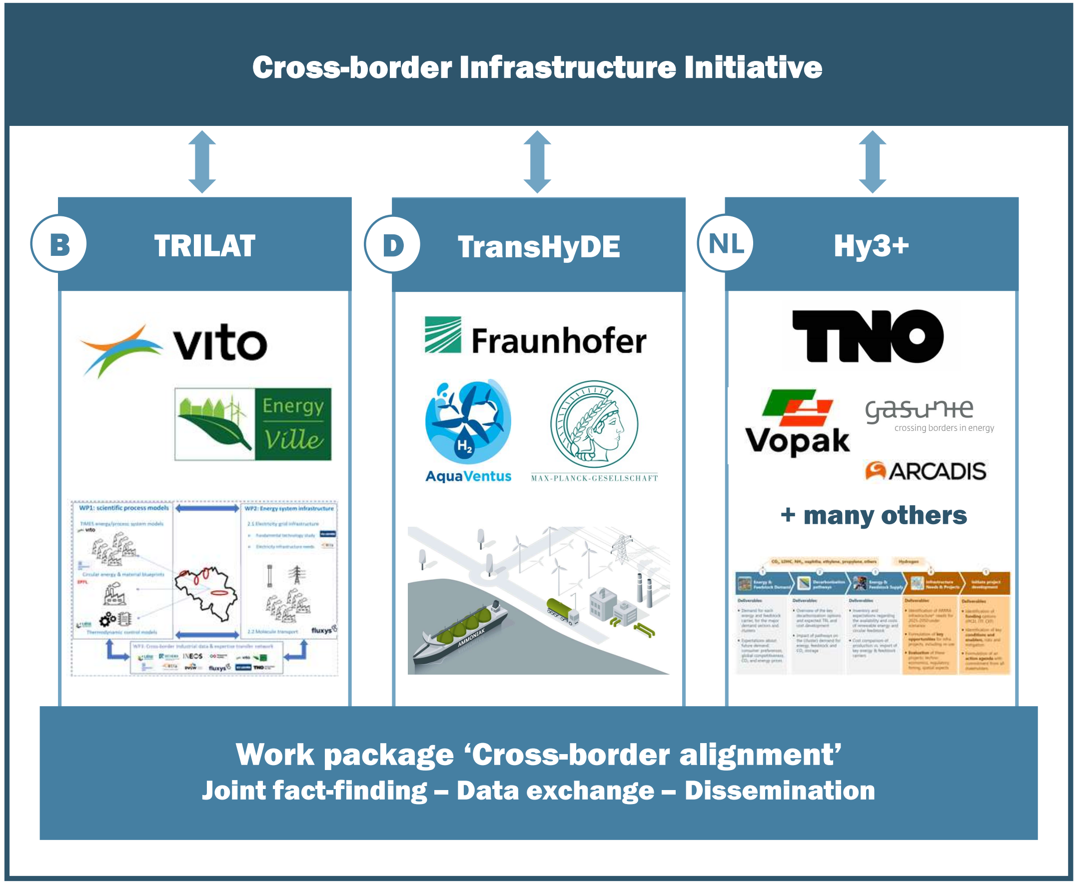
FOR HYDROGEN(-DERIVATIVES), CO_2 AND POTENTIALLY OTHER COMMODITIES

The cross-border infrastructure initiative allows for alignment over investment decisions in Belgium, Germany and the Netherlands.

Separate sub-projects will be set-up in each country. Research institutes should receive funding from their own respective governments. Industry partners contribute in cash and in kind.

Joint fact-finding, data exchange and dissemination processes will take place through a Cross-border Alignment work package.





SUMMARIZING: NEW IN HY3+

More commodities	| CO_2, LH2, MeOH, NH3, LOHC (import)
Larger geographical scope	| Belgium, rest of Germany
More details in import and local storage	| H2 import and storage in harbours
More detail in infrastructure impact	| PESTLE, integrated network modelling, CO2 transport model
More infrastructure options	| train, road
Concrete investment project evaluation	| Regional hydrogen infrastructure and storage projects: - HyTransPort.RTM: backbone on H2 – Port of Rotterdam - H2 storage project NL (Gasunie – Zuidwending) and D (EWE) - H2 tank storage pilots (VOPAK, PoR, PoA) - Delta corridor (H2 + CO2 R'dam – Chemelot and NRW) - CO2 transport (Antwerp@C) - Antwerp – R'dam
GIS based visualisation of energy streams	

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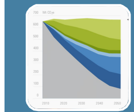
PROJECT ORGANIZATION HY3+

Commodities: H_2, CO_2, LOHC, NH_3, MeOH

X Cross-border alignment: industrial data and expertise exchange network

1 Pathway and scenario definitions

2 Commodity Demand
under different pathways



Deliverables:

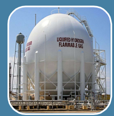
- Energy transition & industry transformation **pathways**, based on TRL and cost development of different low-carbon technologies
- Future **demand scenarios** for H_2 and other commodities for the major demand sectors and clusters

3 Energy & Feedstock Supply
production and import

Deliverables:

- Inventory of **supply potential**, given cost development, availability and planned rollout of renewable power and low-carbon H_2
- Cost comparison of **production vs. import**
- Future **supply scenarios** for H_2 and other commodities

4 Infrastructure Requirements
Transport, storage, imports



Deliverables:

- Identification of **infrastructure needs** for 2025-2050 under the demand and supply scenarios from 1 and 2
- **Gap analysis**: existing infrastructure and re-use potential + need for new
- **System integration aspects:** landing wind, sector coupling industry

Deliverables:

- PESTLE analysis: Performance and critical challenges:
  - Technical: dimensioning, losses, compression, integrity, quality, purity
  - Economic: cost-benefit analysis, existing vs new infra, uptake in markets
  - Regulatory: standards, norms, safety, environment, spatial planning/permitting
- De-risking: technology, market, policy

5 Infrastructure Roadmap
Key projects & actions

Deliverables:

- Cross-border **infrastructure roadmap** with strategic projects
- Identification of key **conditions and enablers,** risks and mitigation options
- **Action agenda** with commitment from all stakeholders

BL(1

Visualization of results in GIS-based application

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Slide 38

BL(1 mention this at previous slide
Buijs, L.J. (Lennert); 31-1-2022

Core research partners

vito
TNO
DECHEMA
ARCADIS
JÜLICH Forschungszentrum

Hydrogen import harbours

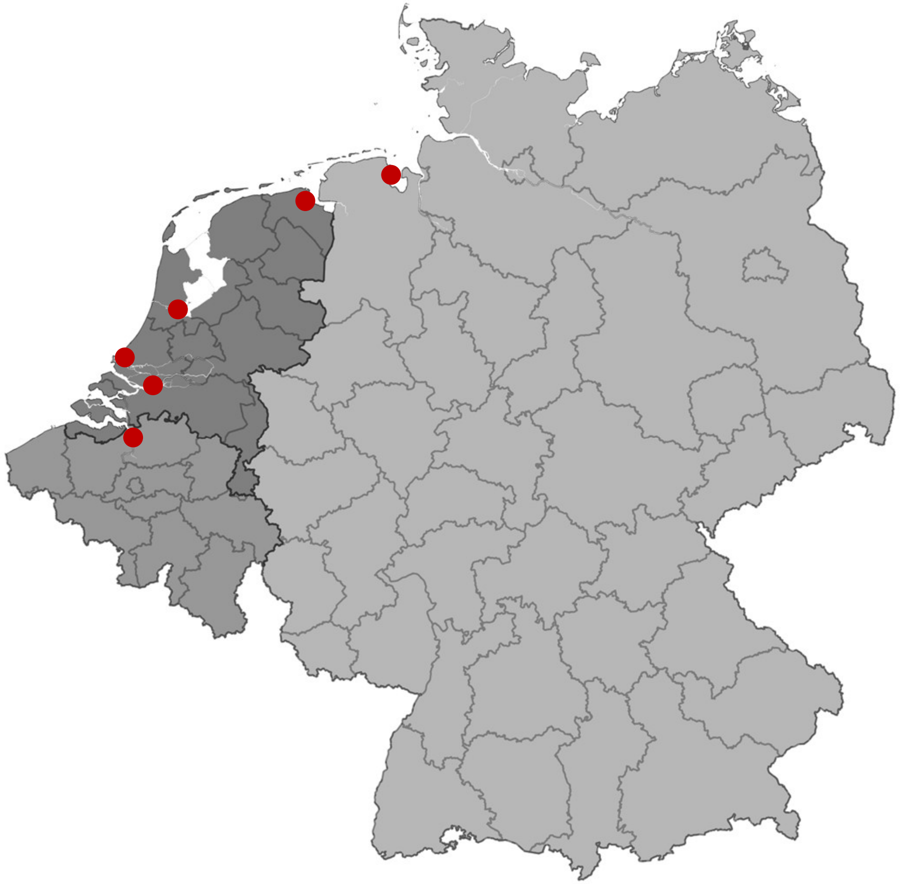
Port of Wilhelmshaven — PORT OF WILHELMS HAVEN

Groningen Seaports — GRONINGEN SEAPORTS

Port of Amsterdam — Port of Amsterdam

Port of Rotterdam — Port of Rotterdam

Port of Antwerp — Port of Antwerp



Cross-border infrastructure

DELTA CORRIDOR CONNECTING INDUSTRIES
HyWay27
Hy3
Leitprojekt TransHyDE
vito

CO2 transport & storage

ARAMIS
Antwerp@C
Porthos CO₂ TRANSPORT & STORAGE

Strategic energy infrastructure

NorthH2
AquaVentus
HEAVENN
H2 Gateway
SeaH2Land

CROSS-BORDER COMMITMENT

Cross-border projects are inherently complex, since they involve a broad collection of stakeholders from different countries.

Identifying, evaluating and initiating cross-border infrastructure projects requires alignment over key conditions / enablers, which include:

- **Financing and risk allocation**
- **Energy regulation**
- **CO_2 allocation policy**
- **Industry policy**
- **Decarbonisation incentive schemes**
- **Spatial planning**
- **Environment and Safety**

Note: Discussion with partners is on-going. The final list of partners along with their role will be available after discussions are over.

TNO
Forschungszentrum Jülich
DENA
BASF
BP
Equinor
Fluor
Gasunie
INES
Mitsubishi
Open Grid Europe
Port of Amsterdam
Port of Rotterdam
Provincie Groningen
RWE
Salzgitter AG
Shell
Siemens
Thyssengas
ThyssenKrupp
Uniper Energy Storage
Vopak
Westnetz
Solvay
Ministerie van Economische Zaken & Klimaat
Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen

WANT TO KNOW MORE/QUESTIONS?

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DEEP DIVE 2: VERKENNINGEN EXPORTLANDEN POR

Wilco van der Lans | Port of Rotterdam

TNO innovation for life

PROGRAMME

INTERNATIONAL HYDROGEN SUPPLY CHAINS

Wilco van der Lans, Monica Swanson, Martijn Coopman

16 feb 2022

Port of Rotterdam

NIEUWE WAARDEKETENS

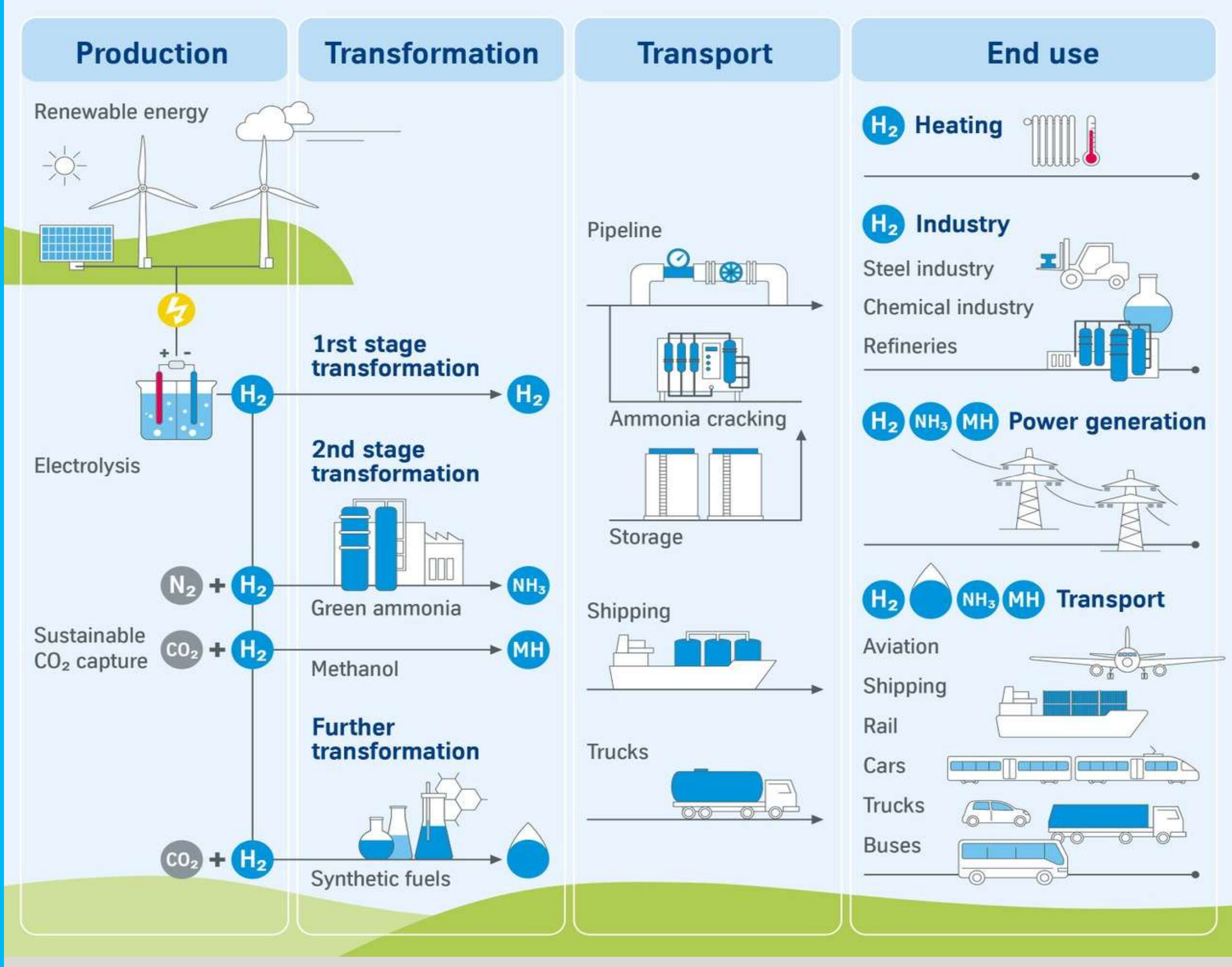
Doel: CO_2 reductie & groen verdienvermogen

Basis: hernieuwbare of low carbon energie in H_2 of derivaten

Direct gebruik of conversiestappen nodig

Ontwikkelpaden zijn bepalend voor waterstof productie en import

Overheid is medebepalend o.a. Fit-for-55, coalitieakkoord en instrumentatie (EU-ETS, RED etc)



Bron: https://www.thyssenkrupp.com/en/stories/sustainability-and-climate-protection/the-revolution-of-green-methanol

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HYDROGEN ECONOMY IN ROTTERDAM VALUE CHAIN

The locations depicted are approximate.

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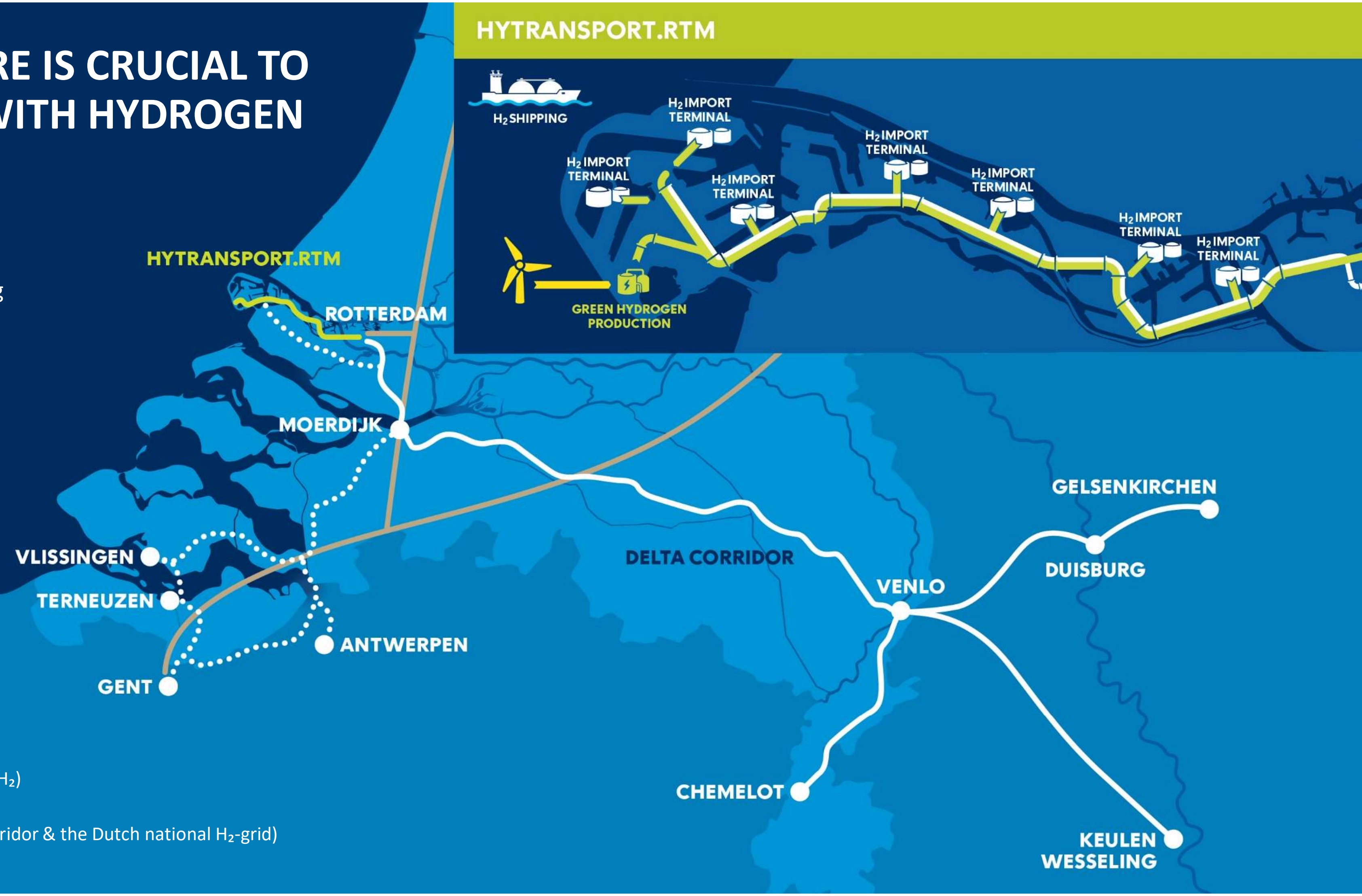
NEW INFRASTRUCTURE IS CRUCIAL TO SUPPLY INDUSTRIES WITH HYDROGEN

Right now, Rotterdam supplies a large part of NW-Europe's industries, including North Rhine-Westphalia, with fossil fuels and feedstock.

To supply these with the vast quantities of sustainable energy and feedstock needed to decarbonize, new infrastructure like the Delta Corridor has ta be developed.



LEGEND
- Delta Corridor (LPG/propene, butane, CO_2 en H_2)
- Possible extension Delta Corridor
- HyTransPort.RTM (connected to the Delta Corridor & the Dutch national H_2-grid)
- Dutch national H_2-grid (HyWay27)

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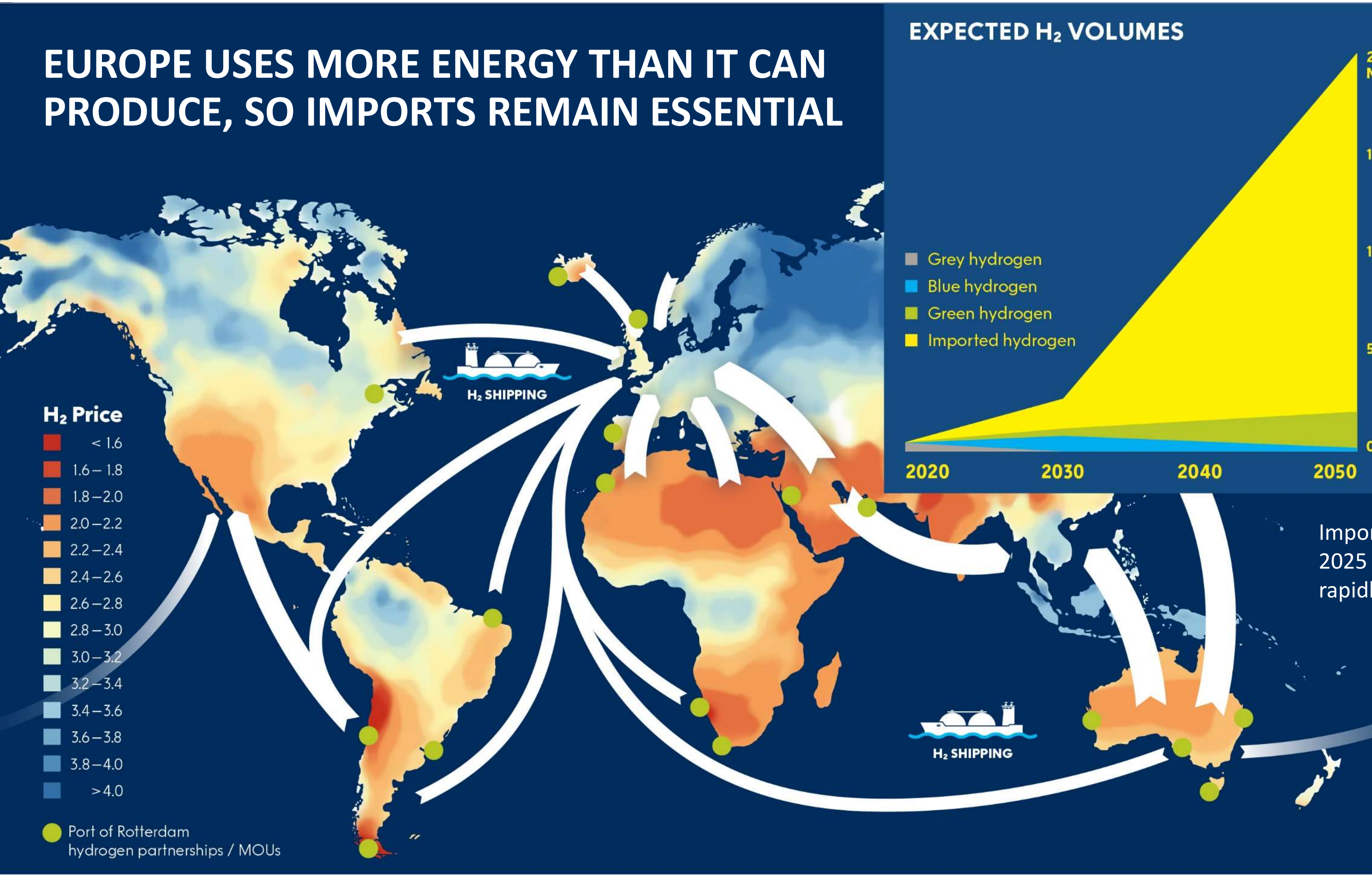
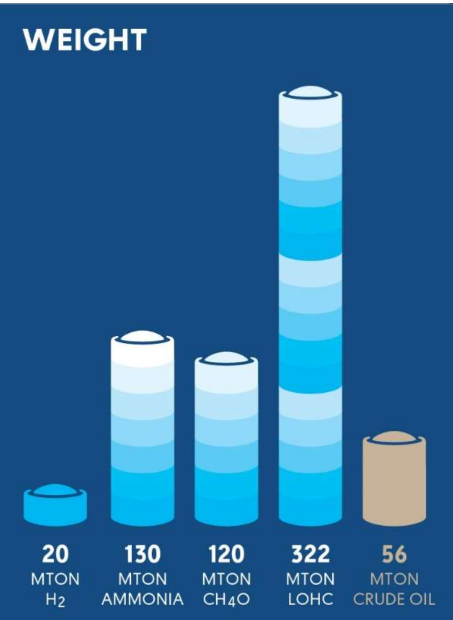
EUROPE USES MORE ENERGY THAN IT CAN PRODUCE, SO IMPORTS REMAIN ESSENTIAL





Imports are expected to start around 2025 in Rotterdam, ramping up rapidly after 2030.

Hydrogen will come in a range of forms, with different weights and volumes.

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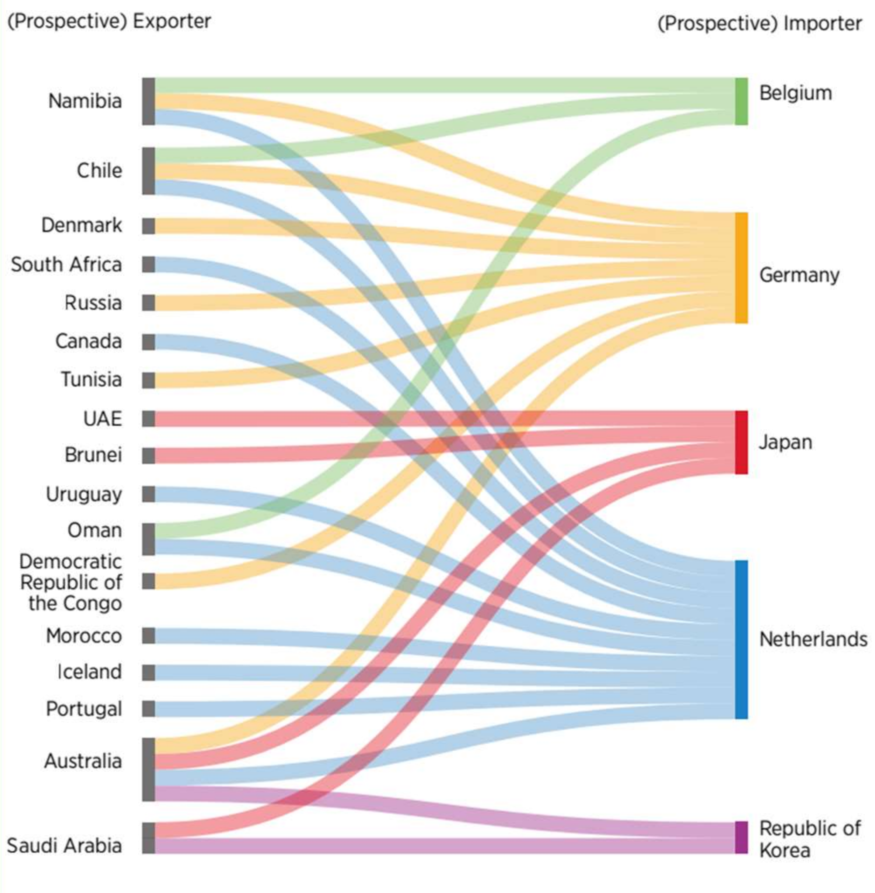
Figure 4.5 **Selected country bilateral trade agreements and MOUs, announced as of November 2021**



Note: Figure covers hydrogen trade related agreements only, based on public announcements and is not exhaustive. Private agreements and those that focus exclusively on technology co-operation are not included. MOU = Memorandum of Understanding.

EXPORTLANDEN, ENKELE KENMERKEN

Australië	Zeer groot ontwikkelpotentieel; gelijkwaardige handelspartner
Brazilië	Veel Groene Hydro; veel H2 interesse in Pécem/Ceará
Canada	Kansen met surplus hydro aan Oostkust; gelijkwaardige handelspartner
Chili	Zeer goed zon (N) en wind (Z) conditie; veel projecten
IJsland	Dichtbij en goedkoop door hydro en wind
Noorwegen	Goede wind & hydro & CCS, veel ambitieuze projecten
Namibië	Ambitieus en voortvarend
Saudi/UAE	Veel zon en wind potentieel & CCS; snel opschaalbaar; politiek complex
Spanje / Portugal	Intra EU, goede zon/wind condities; export discussie
Z-Afrika	Groot land, moet decarboniseren, powercuts, ambitieus project in Boegoebaai

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IMPORT COMPETITIEF

Meerdere projecten (ca 90 geïdentificeerd)

- Combi wind, zon, hydro (load factor)
- Carrier vooral NH_3; aandacht voor reconversie

Capex onzekerheden:

- Prijs grondstoffen en productiemiddelen?
- WACC?
- Kost reductie door opschaling?

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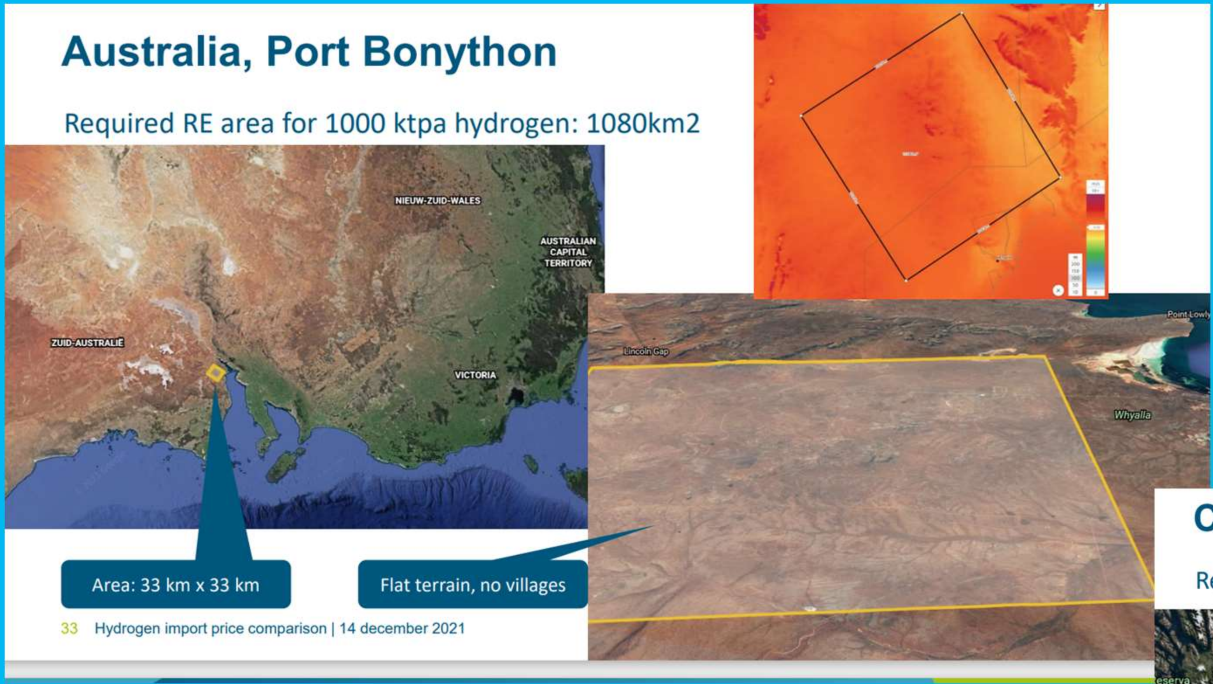
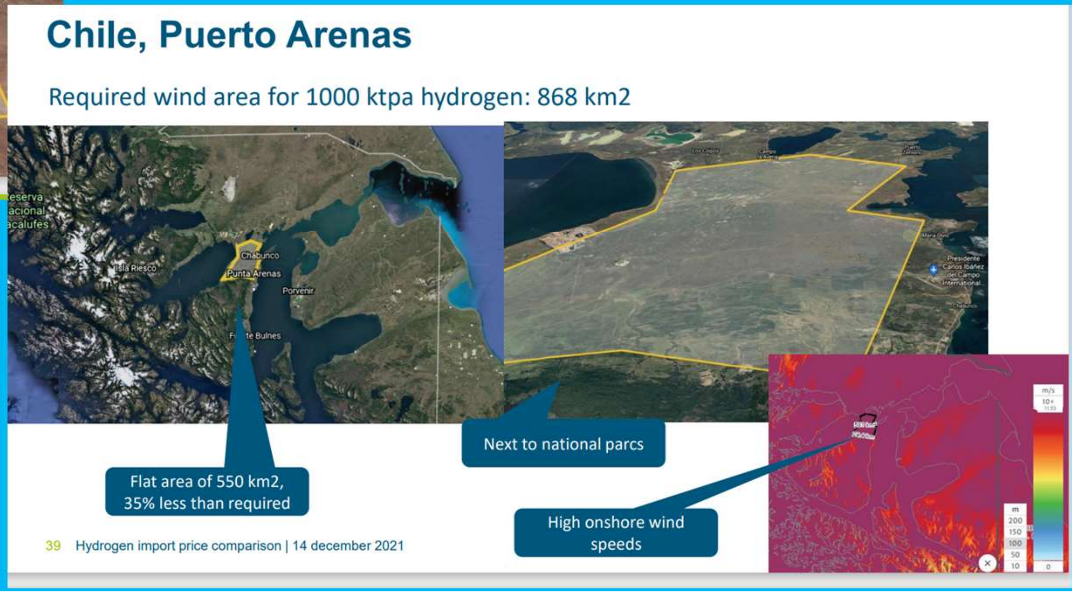


TWEE VOORBEELDEN:

- Circa 10-15 GW renewable power nodig (combi van zon en wind)
- Ruimtebeslag voor productie 1 Mton H2
- https://energymining.sa.gov.au/__data/assets/pdf_file/0012/402600/RELEASE_FINAL_SA_-_Rotterdam_H2_Supplychain_pre-FS_report_-_exec_summary_presentation.pdf



Focus nu op:
- 'doability'
- partners voor ontwikkeling van waardeketens

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WAT ZIJN BELANGRIJKE RANDVOORWAARDEN?

- Opbouwen relaties (BtB; GtG; R&D)
- Gezamenlijk optrekken mede ivm strategie leveringszekerheid duurzame energievoorziening en de rol van import uit meerdere landen, rekening houdend met geopolitieke dimensies
- Duidelijkheid over reguleringskader (GvO, Certificering, RED, CBAM, HBE), inclusief afspraken met leverende landen
- Passend Contract for Difference Schema (bijvoorbeeld H2GlobalFund, SDE++,…)
- Infra-ontwikkeling starten (uitrol H2 netwerk en marktordening)
- Ontwikkelen passend veiligheidskader en maatschappelijk draagvlak voor H2 en carriers

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ACTUALITEITEN

Tour de table

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AFSLUITING

Programmering volgende kennissessie woensdag 16 maart 2022

- Vaste dag kennissessies: 3e woensdag van de maand van 15,00 – 17,00 uur
- Uitnodiging volgt.

1 Technisch economisch	2 Beleid	3 Markt	4 Internationaal	5 Omgeving
▪ Inzicht in importketens productie-conversie-transport-opslag-reconversie-gebruik ▪ Vraagontwikkeling, scenario's ▪ Infrastructuur & systeemintegratie: corridors, benutten bestaande infra ▪ Technology assessments, R&D	▪ Impact van 'Fit for 55', REDII, Delegated acts, ETS/CBAM, etc. ▪ Impact van certificering en CO2 allocatie: emissiefactoren, LCA ketenanalyse, etc. ▪ Financiering en stimulering (EU & NL): IPCEI, PCI, TEN-E, JTF, EIB, Horizon Europe, MOOI, DEI, MIEK, SDE++, etc	▪ Marktmodellen: bilaterale contracten, vrije handel, waterstofbeurs ▪ Internationale handelsstromen: verwachte vraag- en aanbodvolumes en transportstromen ▪ Importtarieven, trade agreements en handelsbeperkingen, WTO, etc.	▪ Samenwerking met omringende EU/niet-EU importlanden om corridors te ontwikkelen ▪ Concurrentie met omringende EU/niet-EU importlanden ▪ Geopolitieke aspecten: strategische voorraden, afhankelijkheid, politieke stabiliteit van exportlanden	▪ Ruimtegebruik van ketenelementen ▪ Veiligheid: brandbaarheid, zorgwekkende stoffen, risicocontouren, etc ▪ Milieu: stikstof, lekkage ▪ Maatschappelijke acceptatie ▪ MVO / samenhang met SDG's in exportlanden
Synthese				

Onderwerp	Organisatie
H2A (groene waterstofimportproject d.m.v. veilige en inerte waterstofdragers)	Port of Amsterdam
Ontwikkelingen first mover landen Japan en Duitsland	TNO
Delegated act	n.n.t.b.

HARTELIJK DANK VOOR UW AANDACHT

Vragen? Neem gerust contact met mij op:

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