THE ENGINE FOR FUTURE-PROOF LIVING

STORK
A Fluor Company

KIVI Lustrumcongres: Op weg naar een Waterstofland

Willem D. Hazenberg EUR ING MBA RI
Stork - HYDROGREENN

WATERSTOFWIJK HOOGEVEEN

WATER STOF WIJK

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Interreg North Sea Region Northern Connections

EUROPEAN UNION

eit Climate-KIC

NL Netherlands

Climate-KIC is supported by the EIT, a body of the European Union

Interreg North Sea Region Stronghouse
European Regional Development Fund

EUROPEAN UNION

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Stuurgroepslid NEN NP-H_2-IGO

Gastdocent – Waterstof
veiligheid HanzePro

Agenda

Stork and Renewable

Start HYDROGREENN and Hoogeveen project

Wicked problem

Vision on House heating

Social acceptance challenge

Technology Challenge

Implementation

Challenges to creating a Hydrogen future

H_2 Production Roadmap.

FLUOR STORK
A STRONG COMBINATION

with a revenue of

partnering with
4,000 clients

operating continuously
for a total of

in a wide range of sectors

STORK
A Fluor Company

STORK VALUE PROPOSITION - HOW WE OPTIMIZE CLIENT ASSET PERFORMANCE

STORK IN THE CLOUD

STORK ADVISORY

- Ready
- Assess
- Comply
- Improve
- Digitize
- Decarbonize

New plant | Existing plant | End-of-life

Subject Matter Experts

Knowledge Online

Digitization & Innovation

STORK NEARBY

- Specialists
- Planners & schedulers
- Safety /skills certification
- Technician training
- Equipment manufacturing & overhaul
- Equipment / tools
- Innovation labs

Stork centers

- Production center
- Service center
- Support center
- Solution center

Stork partners

- Engineering
- Fabrication
- Local Supply Chain
- Innovative suppliers

STORK @ SITE

MANAGEMENT & EXECUTION

- Operations
- Maintenance
- Turnarounds
- Construction
- Equipment repair

Multi-skilled, connected technician

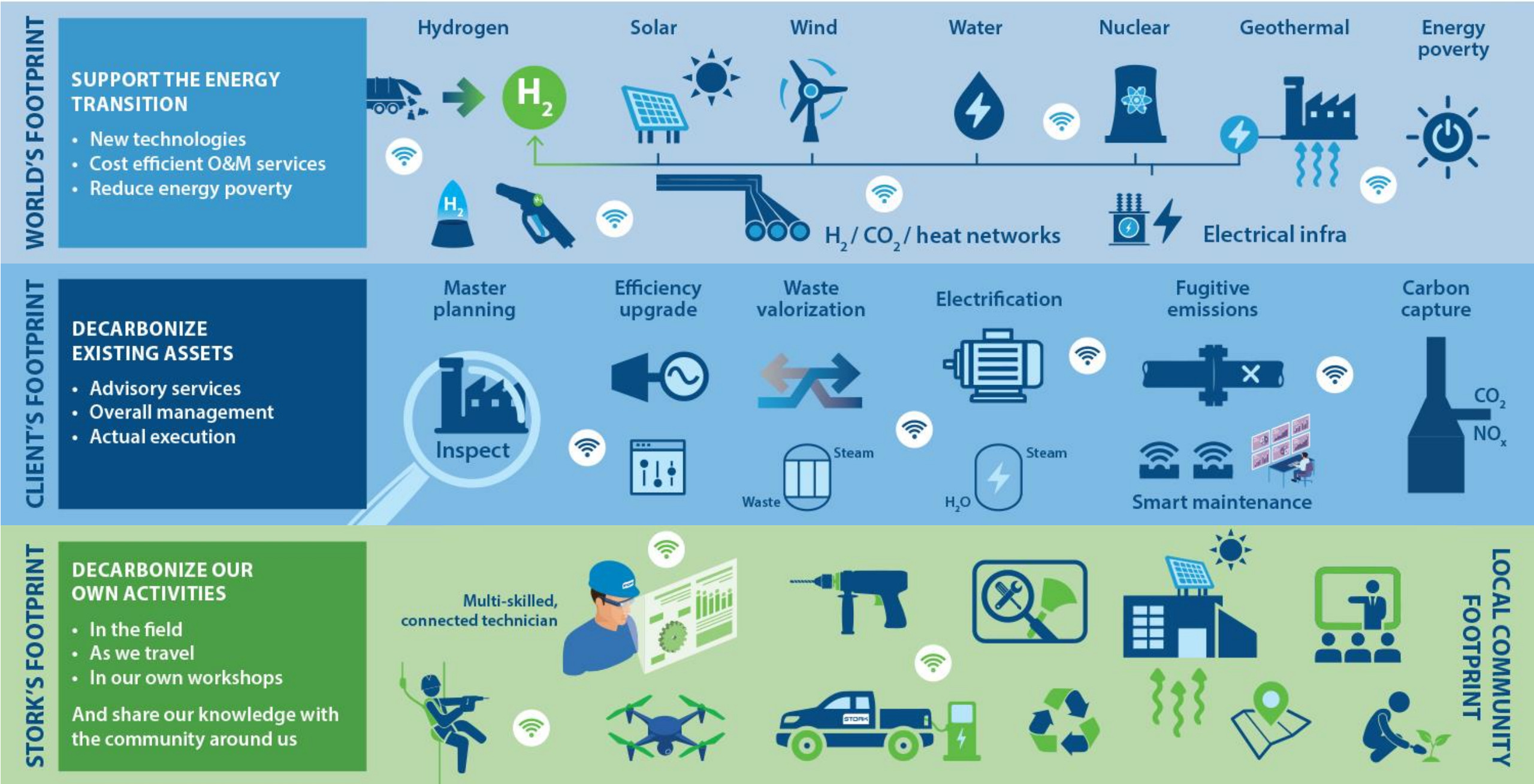
Maintenance analytics

Connected equipment

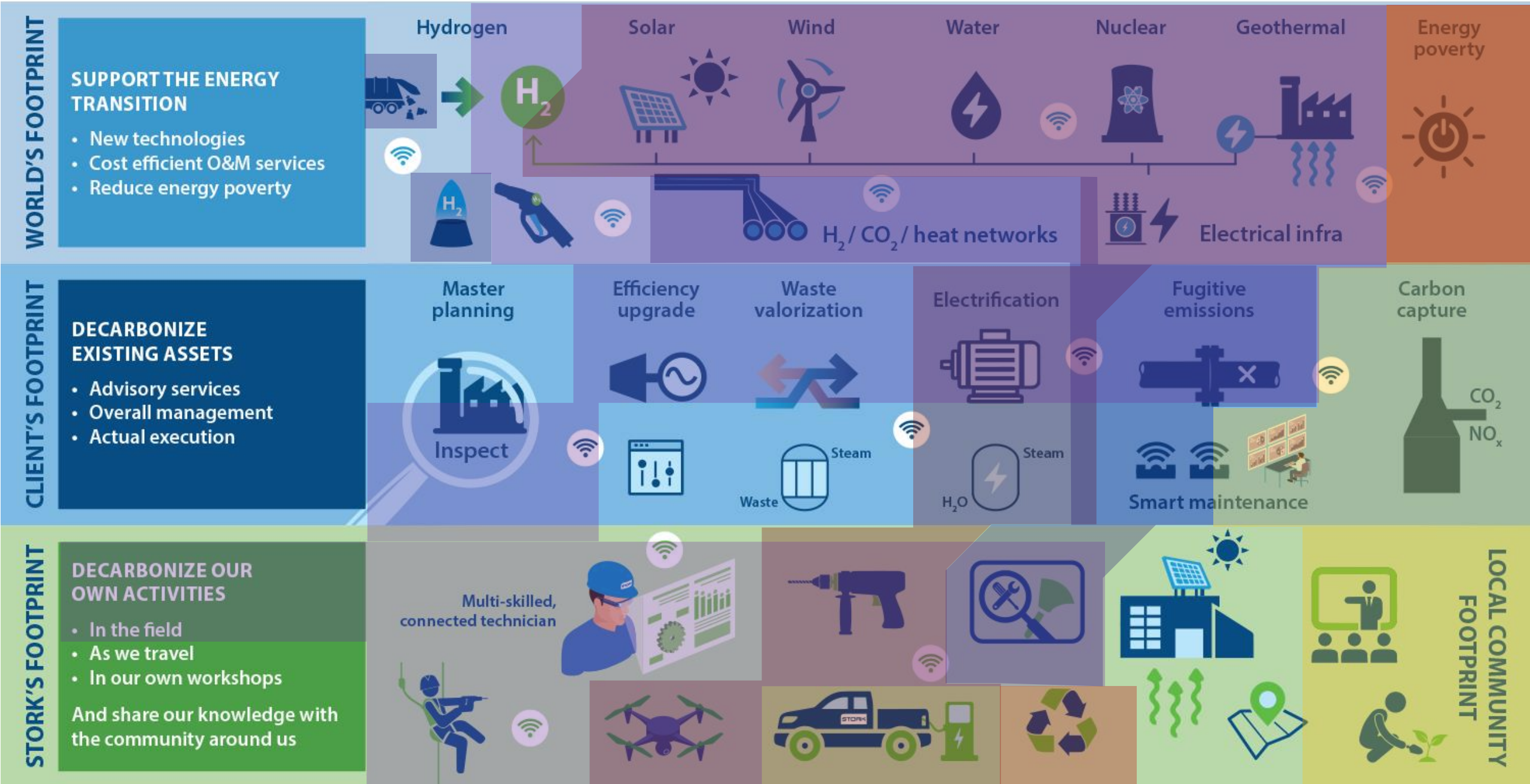
Field technology solutions

- Clean Energy
- Power
- Food & Pharma
- Manufacturing
- Upstream
- Refining & Chemicals
- Metals & Mining
- Infra & Water

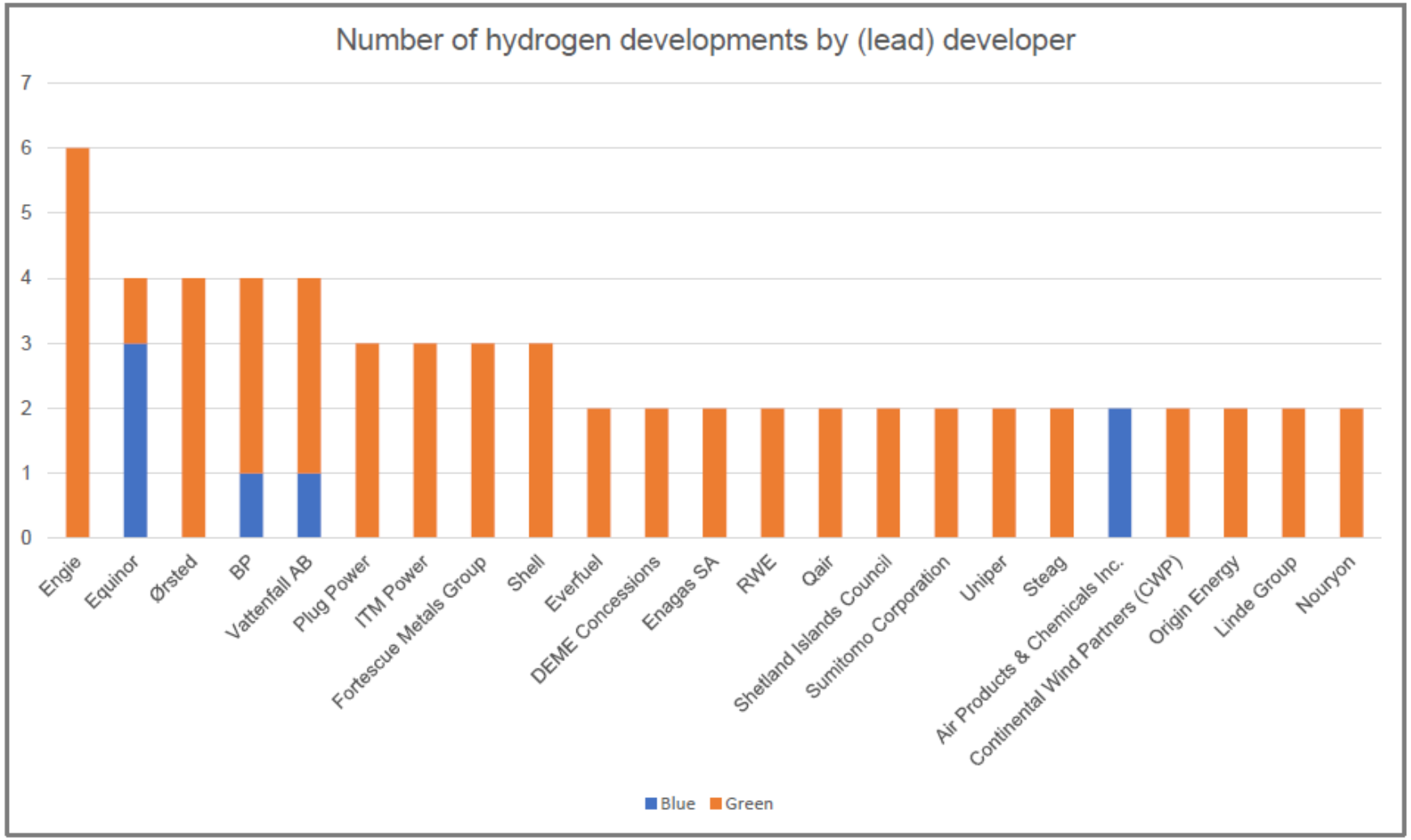
STORK DECARBONIZATION VALUE PROPOSITION – HOW WE PROECT THE ENVIRONMENT

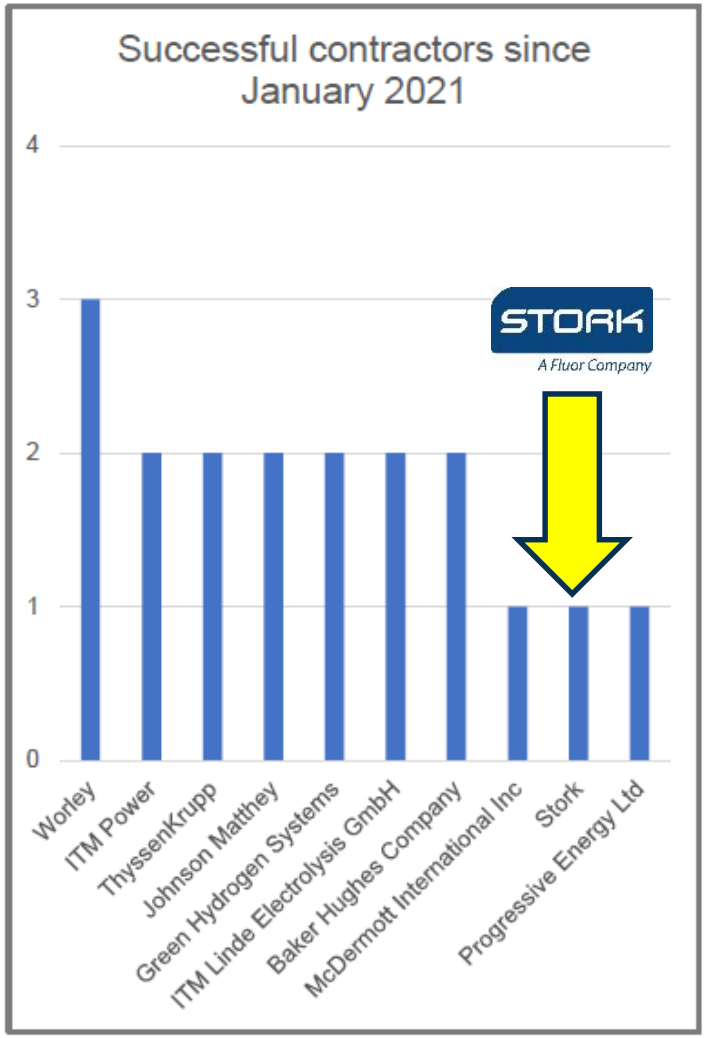


Site work related | Local impact theme | Involves fugitive emissions | Electrical theme | Circularity theme



Who are the players?





Hoogeveen (Drenthe)

City Hoogeveen 6 PJ
Gas 3.1 PJ (43%)
55.252 inhabitants (2017 data)
Nr 61 of the Netherlands.
127,77 km²

Coalition of Hydrogen ambassadors Kick-off

12 September 2017

WWW.LOODSKOTTER.NL

STORK A Fluor Company

EnTranCe ENERGY TRANSITION CENTRE

GREEN HYDROGEN,THE ENGINE FOR FUTURE-PROOF LIVING.

Our vision for the future?

At least 1 million Dutch homes fitted with a hydrogen central heating system.

Tabel 1 Woningvoorraad naar energielabel, 2015

	Sociale huurwoning	Particuliere huurwoning	Koopwoning	Totaal
BENG	8.800	47.200	52.600	108.600
A	208.300	129.400	632.600	970.300
B	393.500	92.400	451.900	937.800
C	763.900	184.900	1.310.400	2.259.200
D	532.400	147.900	677.800	1.358.100
E	254.600	101.700	451.900	808.200
F	115.700	83.200	406.700	605.600
G	46.300	157.100	406.700	610.100
Totaal	**2.323.500**	**943.800**	**4.390.600**	**7.657.900**

Bron: WoON 2015 / EIB

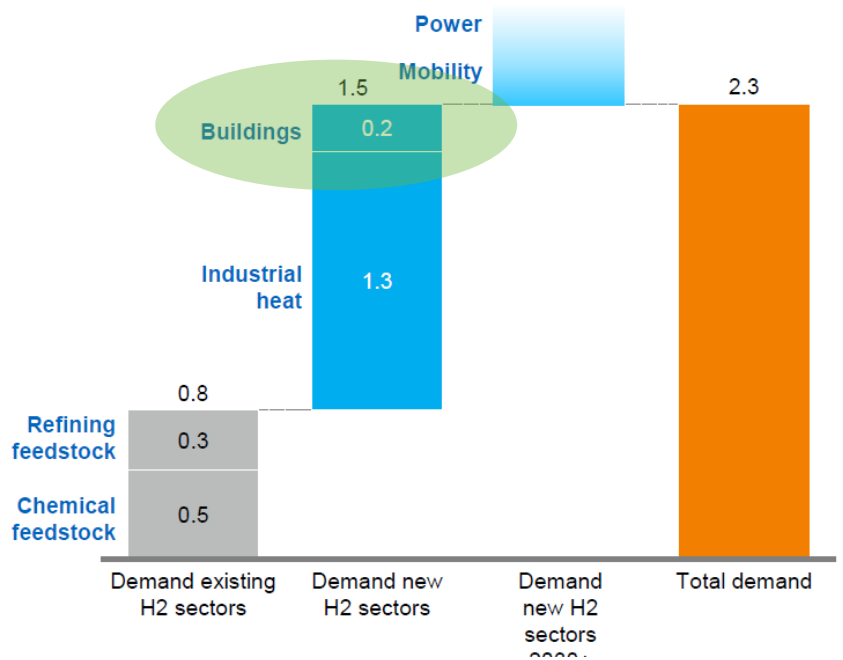
Heat Pumps

Combination Hydrogen Boiler and Hybrid Heat pump and some basic isolation will be the most attractive option.

Dutch Demand H2

The maximum H2 market in the Netherlands to 2030 is ~2.3 mtpa H2 with the majority of demand coming from new H2 applications

Estimated zero-carbon H2 market demand in the Netherlands in 2030, mtpa H2



Market sizing methodology

Chemical feedstock[1]	**100%** of grey H2 replaced with zero-carbon H2
Refining feedstock[2]	**100%** of grey H2 replaced with zero-carbon H2
Industrial heat[3]	Replacement of high-temperature heat by H2 for: **100%** In chemicals; **75%** in refining[4]; **20%** in steel[5]
Buildings	**100% H2** in 500,000 buildings[6]; **0.5% blend of H2** in natural gas for other buildings[7]
Mobility[8]	**600** trucks; **0** ships; Potential upside in both segments post-2030
Power[9]	**Up to 15%** of electricity production converted to H2 post-2030

Tabel 11 - Aantal HR-ketels op waterstof in 2020, 2030 en 2050

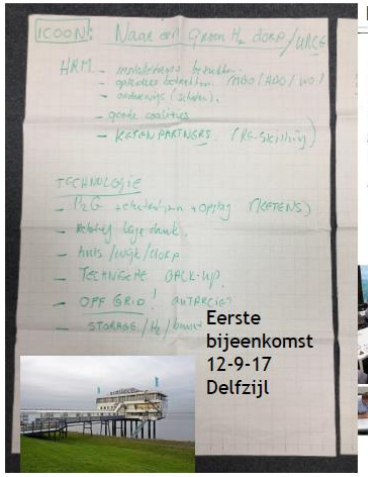
	2020	2030	2050
Aantal HR-ketels waterstof (WEQ) - laag	0	0	0
Aantal HR-ketels waterstof (WEQ) - hoog	0	280.000	5.600.000

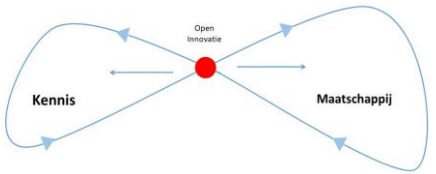
CW Delft and McKinsey

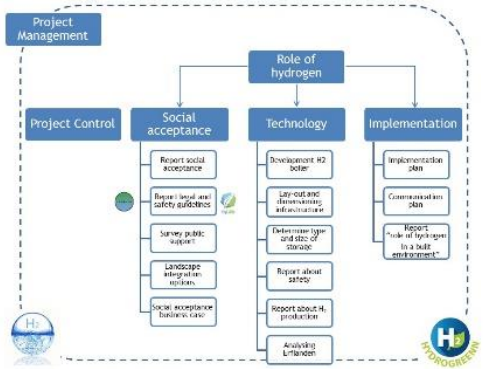
WICKED PROBLEMS

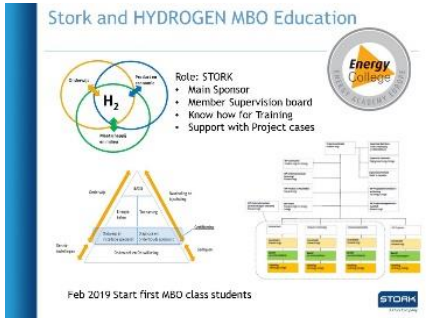
Based upon Rittel and Webber (1973)

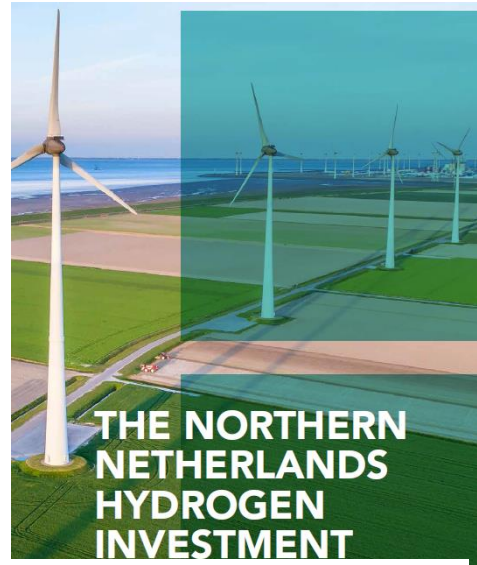
From slogan to concrete in 4 years

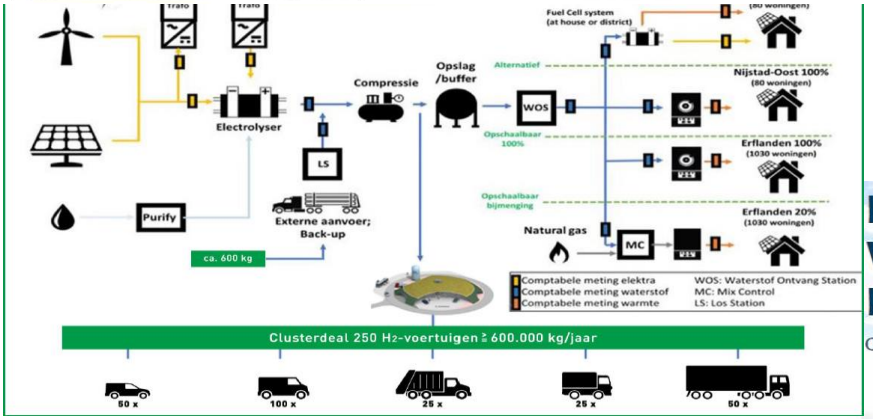




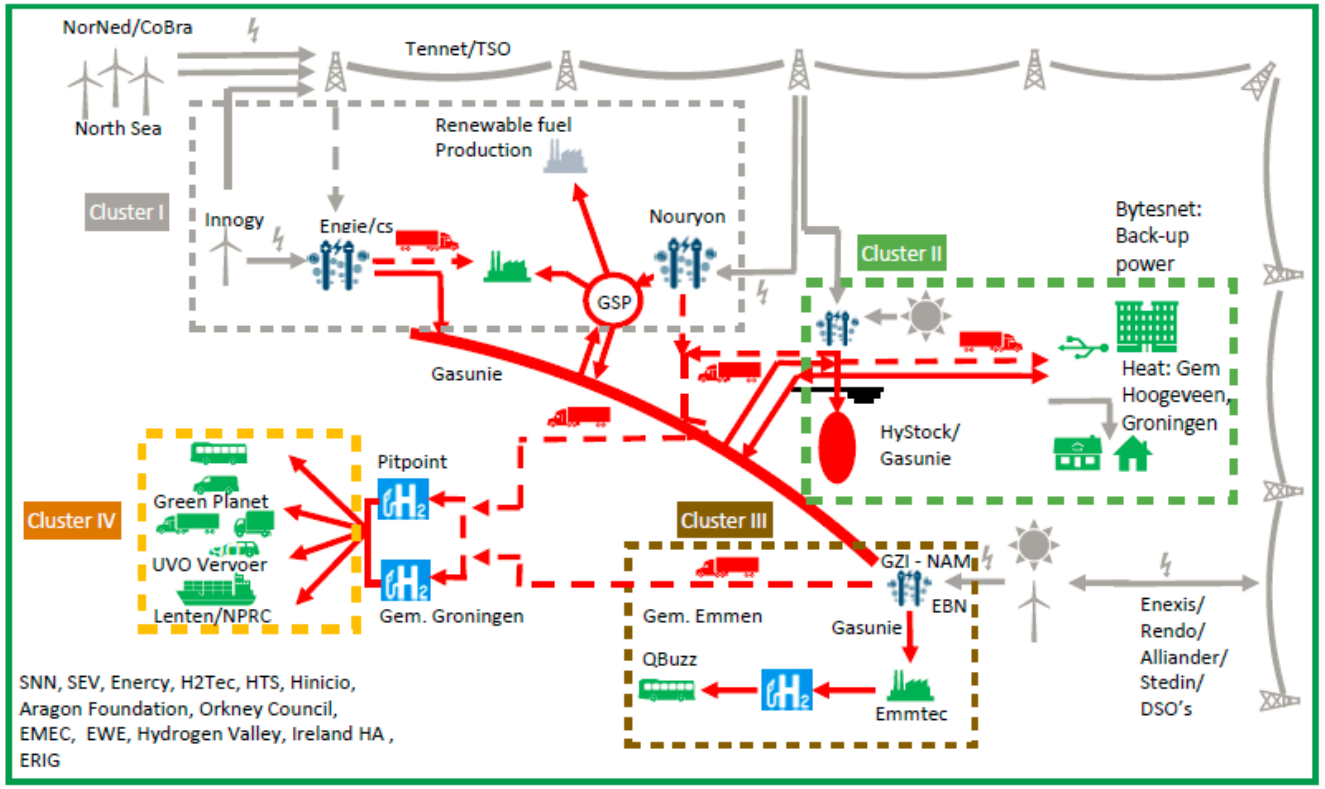








Part of the EU HEAVENN project



provincie groningen

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Europese miljoenen voor ontwikkeling waterstoftechnologie in Noord-Nederland

30 augustus 2019

Noord-Nederland is door Europa aanwezen als de regio waar de komende jaren de groene waterstoftechnologie zich verder moet ontwikkelen. Vanuit Brussel gaat er € 20 miljoen subsidie naar het project Hydrogen Valley, gericht op de ontwikkeling van een volledig functionerende groene waterstofketen. Het project kost in totaal € 90 miljoen, duurt zes jaar en gaat begin 2020 van start.

Internationale steun

De subsidieaanvraag is ingediend door HEAVENN, een samenwerkingsverband van 31 publieke en private partijen uit zes Europese landen. De leidende partijen bij de aanvraag waren het Samenwerkingsverband Noord-Nederland (SNN) en de New Energy Coalition. Bij het traject werden de partijen internationaal ondersteund, onder meer vanuit de Verenigde Staten en Japan. Het HEAVENN-project is bijzonder, omdat het de hele waterstofketen omvat en verbindt binnen één geografische regio.

Hydrogen Energy Applications for Valley Environments in Northern Netherlands

The Movie:

https://vimeo.com/368013901

HOW CAN WE MAKE DUTCH HOMES MORE SUSTAINABLE WITHOUT BURDENING THE COMMUNITY WITH SKY-HIGH COSTS?

In Hoogeveen, 22 representative parties are working on an innovative and constructive option for an alternative energy supply. We have joined hands on behalf of the government, higher education and the business world to form the Hydrogen District Hoogeveen consortium.

JOINING FORCES FOR A

HYDROGREENN
"the Green Hydrogen Economy in the Northern Netherlands"
22 consortium partners in case "hydrogen Hoogeveen"

RESPONSIBLE FUTURE

Phase 1: **Nijstad Oost**
100 homes

Phase 2: **Erflanden**
427 homes

Phase 3: **Ten Arlo Plant**
H_2 production with locally generated solar energy


Nijstad Oost
Erflanden
H_2 plant
WATER STOF WIJK

ABOUT NIJSTAD-OOST

- Located just outside of Hoogeveen
- Formerly an industrial area for sand extraction
- Landscape development with a combination of innovative living and recreation
- The convenient location lends itself to creating an organized, controlled environment
- The area is fitted with gas pipes and the necessary equipment

DEMONSTRATION PROJECT DELIVERABLES

1. An innovative hydrogen central heating system without CO_2 emissions thanks to a retrofit solution.
2. The technical development of a hydrogen central heating system with a plan for a hydrogen gas meter.
3. Legal and organizational support through the development of guidelines in the field of legislation, safety, standards and certification.
4. Well-founded advice for development and increased social support.
5. An economic spin-off for business through scalability to more than a million homes in the Netherlands alone.
6. A substantiated social cost / benefit analysis.

ORGANIZATION WORK PACKAGES

Project Management

Role of Hydrogen

Project Control

Social acceptance

- Legal, Safety and standards (NEN)
- Public acceptance
- Landscape integration
- Social acceptance business case /MKBA

Technology

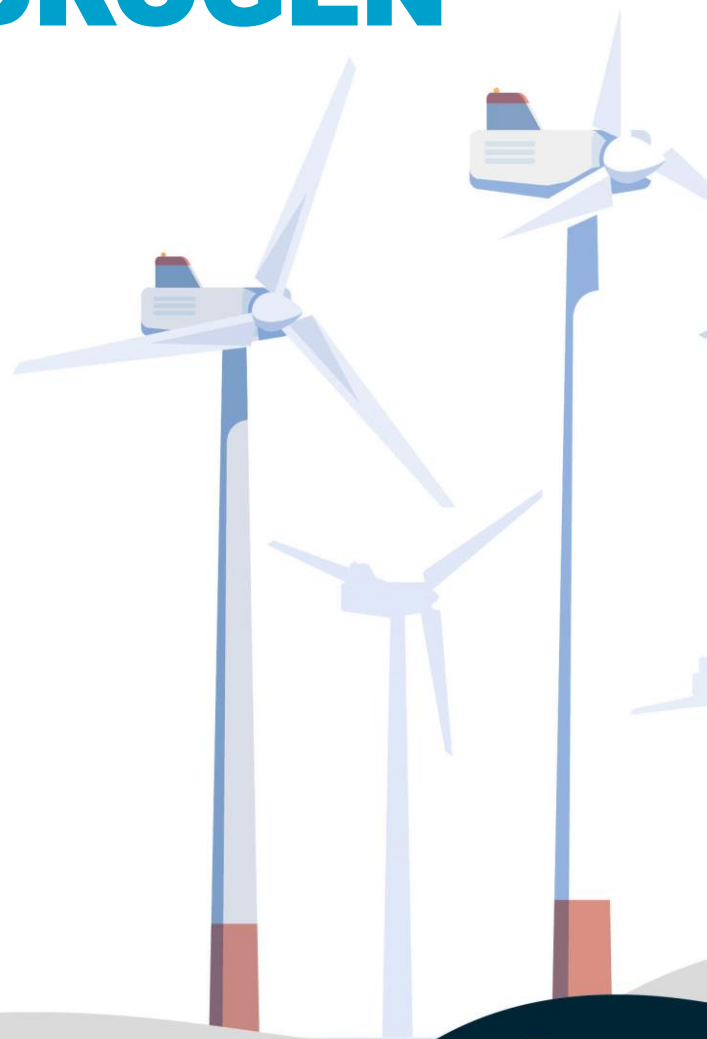
- H2 CV-burner, House
- Fuel-cell house
- Infrastructure
- Measurements
- Storage and Compression
- External transport
- Conversion / Production H2
- Power plant
- Plotplan
- System test installation
- Utilities
- Fall-back scenario
- Central process control
- SIL safety devices and controller

Implementation

- Communication and public acceptance
- Report “Role of Hydrogen”
- Project CAPEX – OPEX/ financing
- project implementation
- Market Model

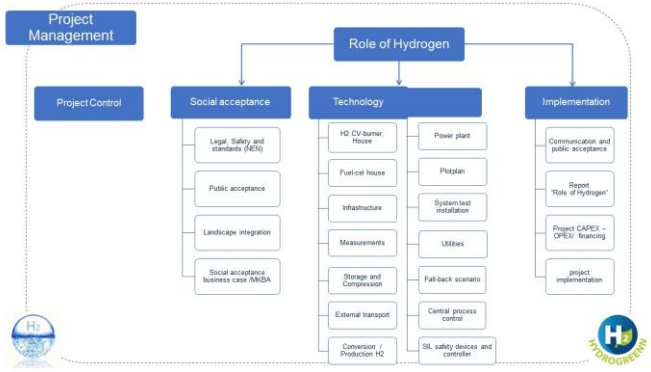
INITIATIVES RELATED TO HYDROGEN ENERGY DEVELOPMENT

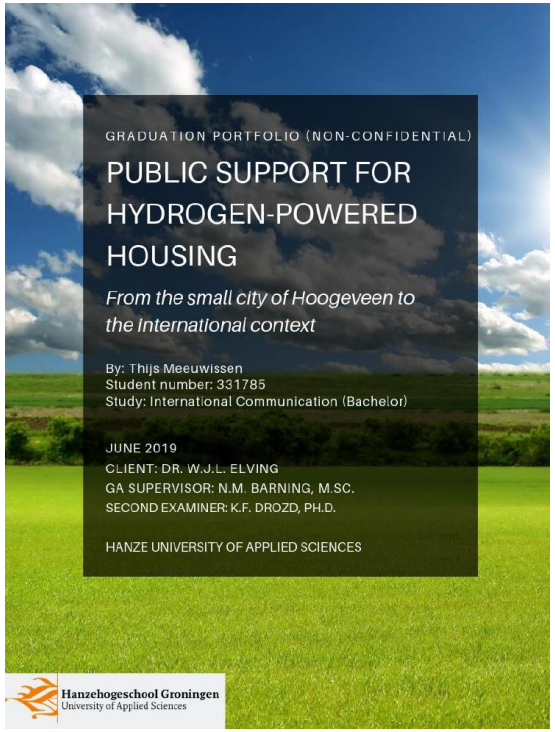
- A Green Planet hydrogen refueling station in the Hoogeveen municipality, near the village of Pesse.
- Functional from the end of 2019.
- Conversion by NAM of a former natural gas processing plant in Emmen into a sustainable energy hub.
- Opening of the green hydrogen installation HyStock in Veendam by Gasunie. Functional since June 26th. 2019



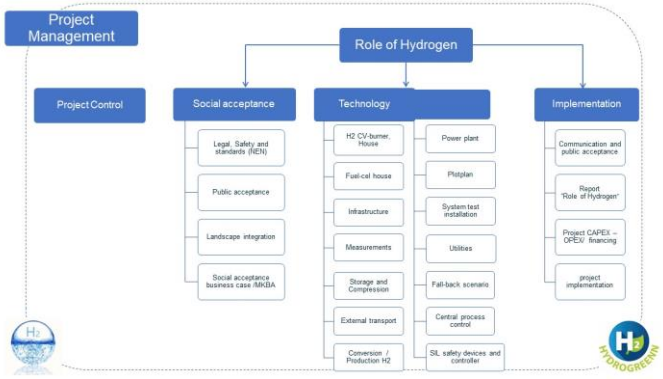
SOCIAL ACCEPTANCE CHALLENGE

- Legal
- Public acceptance
- Landscape integration
- Social Acceptance Business case





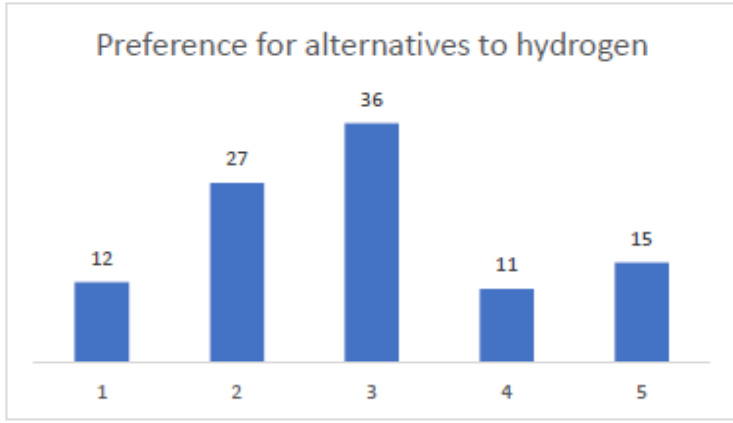
SA LEGAL AND NEN CHALLENGE



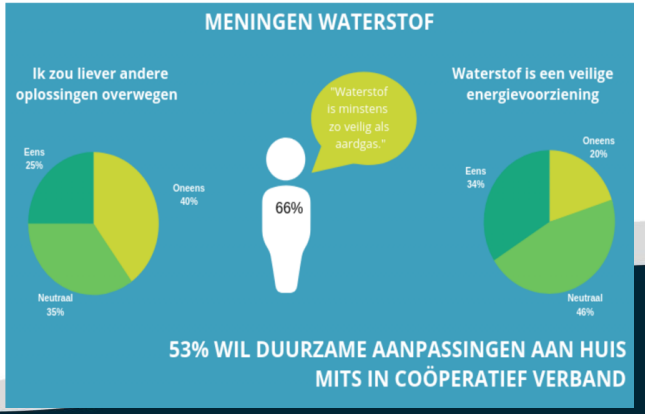
- Legal frame work for Hydrogen is missing or how to fit Hydrogen in current regulation
- Items
  - Ownership – of conversion installation and infrastructure?
  - Who is allowed to sell Hydrogen to the public (market model)?
  - How to fit safety regulation into current standards. (storage in public neighborhood)
  - Can we force people to change to Hydrogen?
  - Should we use the Gas or Heat law as an umbrella for this project?
  - What is the back-up facility?

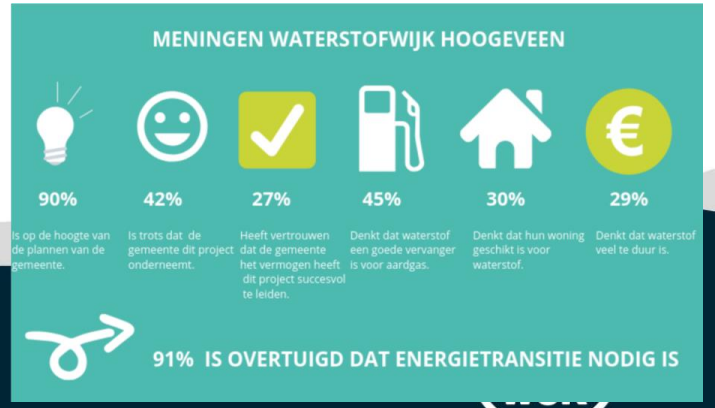
SA PUBLIC ACCEPTANCE CHALLENGE (at Start)

- Gains
  - Affordable
  - Sustainable
  - Status in community
  - Contribution
- Pains
  - Cost for household
  - Concern about safety (20%)
  - Technical feasibility



With 1 being "highly disagree" and 5 being "highly agree" clearly a majority of people is in the **neutral part** where the average person voted 2.9 on preferring alternative sustainable measures than hydrogen. This indicates that much is still to do in the field of informing and convincing the people of the neighborhood; they know a project is happening, but they do not know the exact content or the benefits which it would bring.





HOW GREEN SHOULD GREEN BE?

- H_2 Production versus H_2 application
- Solar – Wind – external grid with green power certificates
- Cost is an important driver for households, but 100% green is more expensive than 90% green (CO_2 reduction)
- Green Hydrogen versus Blue Hydrogen.
- **Hoogeveen project will be green but Leeds 21 project will be blue.**

In New National VESTA MAIS Model Blue and Green Hydrogen will be part of modelling.

COST: HOW TO CLOSE THE FINANCIAL GAP?

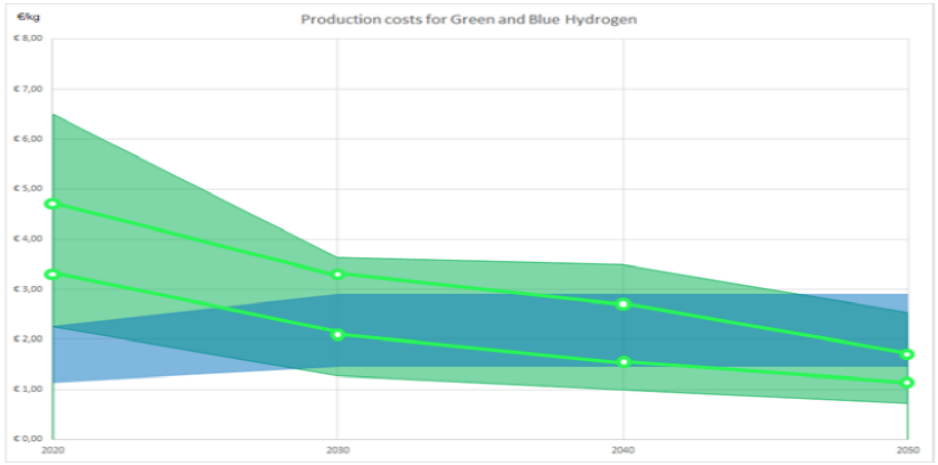
- CAPEX
- OPEX

Hydrogen versus Natural gas versus all electric.

Why now?

- We will use a National Dutch program – “Aardgas vrije Wijken” around 4,4 Million Euro to execute this program.
- HEAVENN EU Funding

Hydrogen Price forecast in Euro/kg, From 9 sources



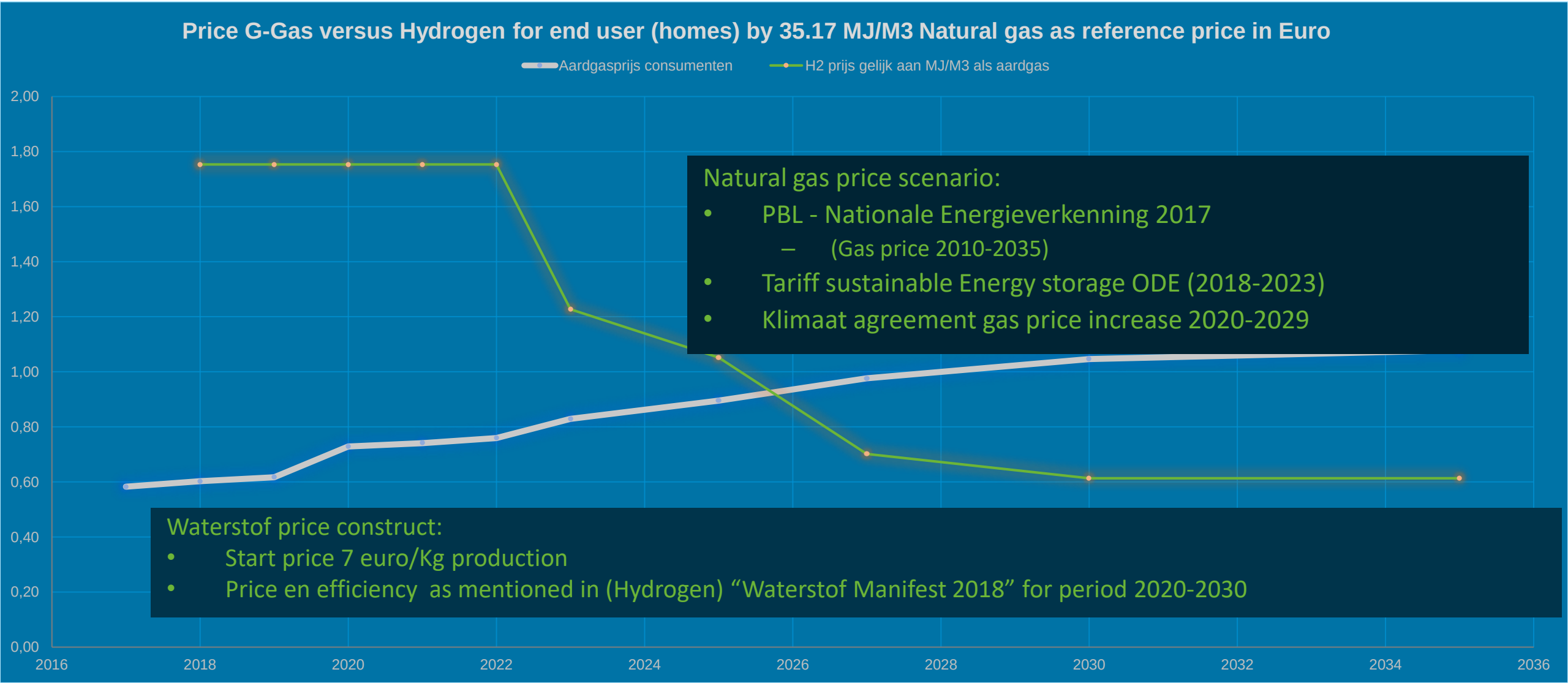
Bronnen:
Bloomberg NEF - Hydrogen's Plunging Price Boosts Role as Climate Solution
TKI Nieuw Gas - Roadmap Hydrogen
IEA - The Future of Hydrogen
METI Japan - Basic Hydrogen Strategy
CE Delft - Waterstofroutes Nederland
DNV-GL - Hydrogen in the electricity value chain
"TNO samen met DNV GL - Waterstof uit elektrolyse voor maatschappelijk verantwoord netbeheer - Businessmodel en businesscase"
Nature Energy - Economics of converting renewable power to hydrogen
IRENA - Hydrogen: A renewable energy perspective

Bron: P*roductiekosten groene waterstof; Bron Van As-Jacobsson & Hellinga 2020 (CE_Delft; Jongsma, Chris; Van der Veen, Reinier; Vendrik, Joeri 2020, 16)*

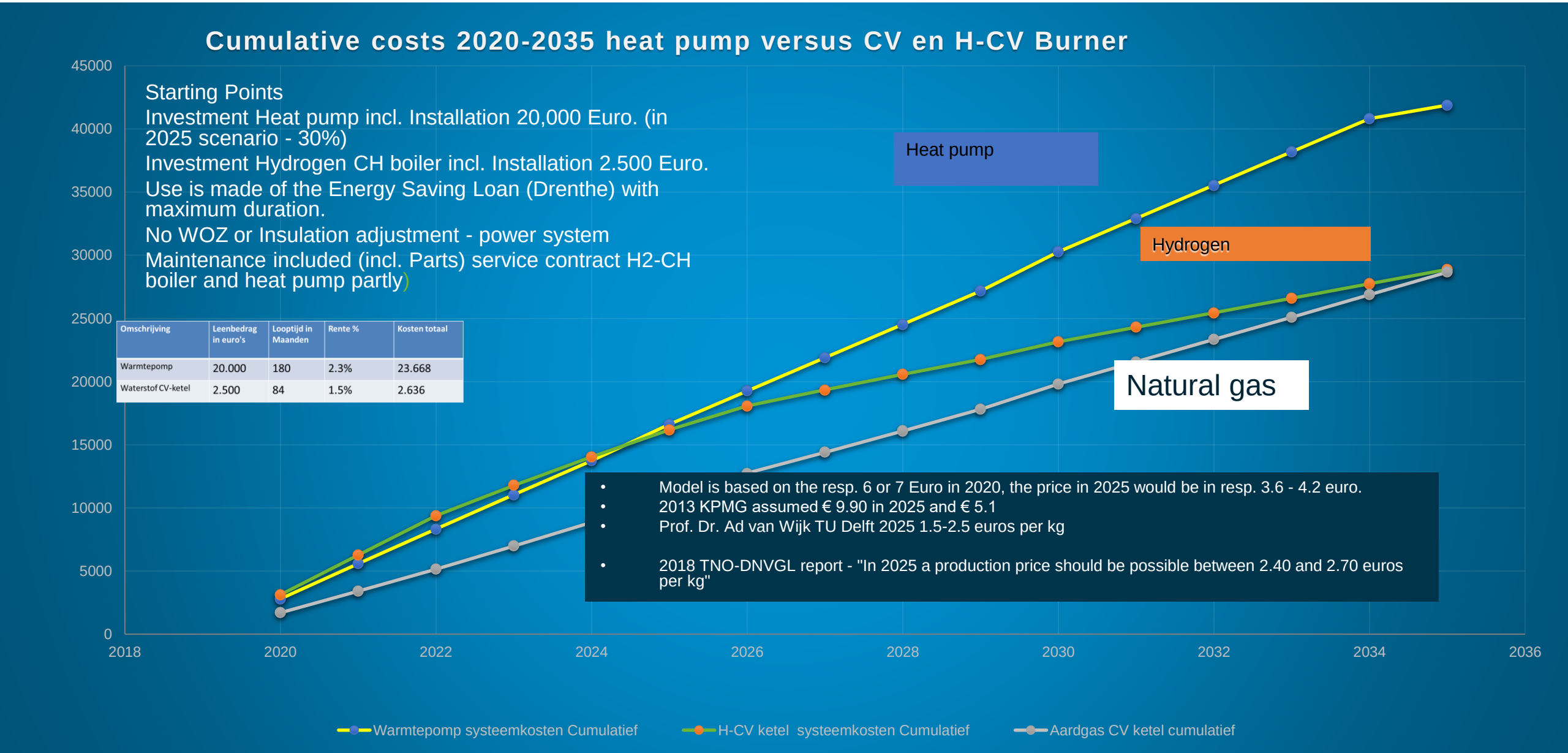
	2030 Min	2030 Gem	2030 Max	2050 Min	2050 Gem	2050 Max
Min/Max	€ 1,27		€ 4,75	€ 0,73		€ 2,55
Gemiddelde		€ 2,72			€ 1,43	
Gemiddelde Min/Max	€ 2,17		€ 3,4	€ 1,04		€ 1,66

Kostprijzen groene waterstof 2030-2050 ontwikkeling (CE Delft 2020 tabel 20) (Hoogervorst, N; 2020, 29 tabel 20)

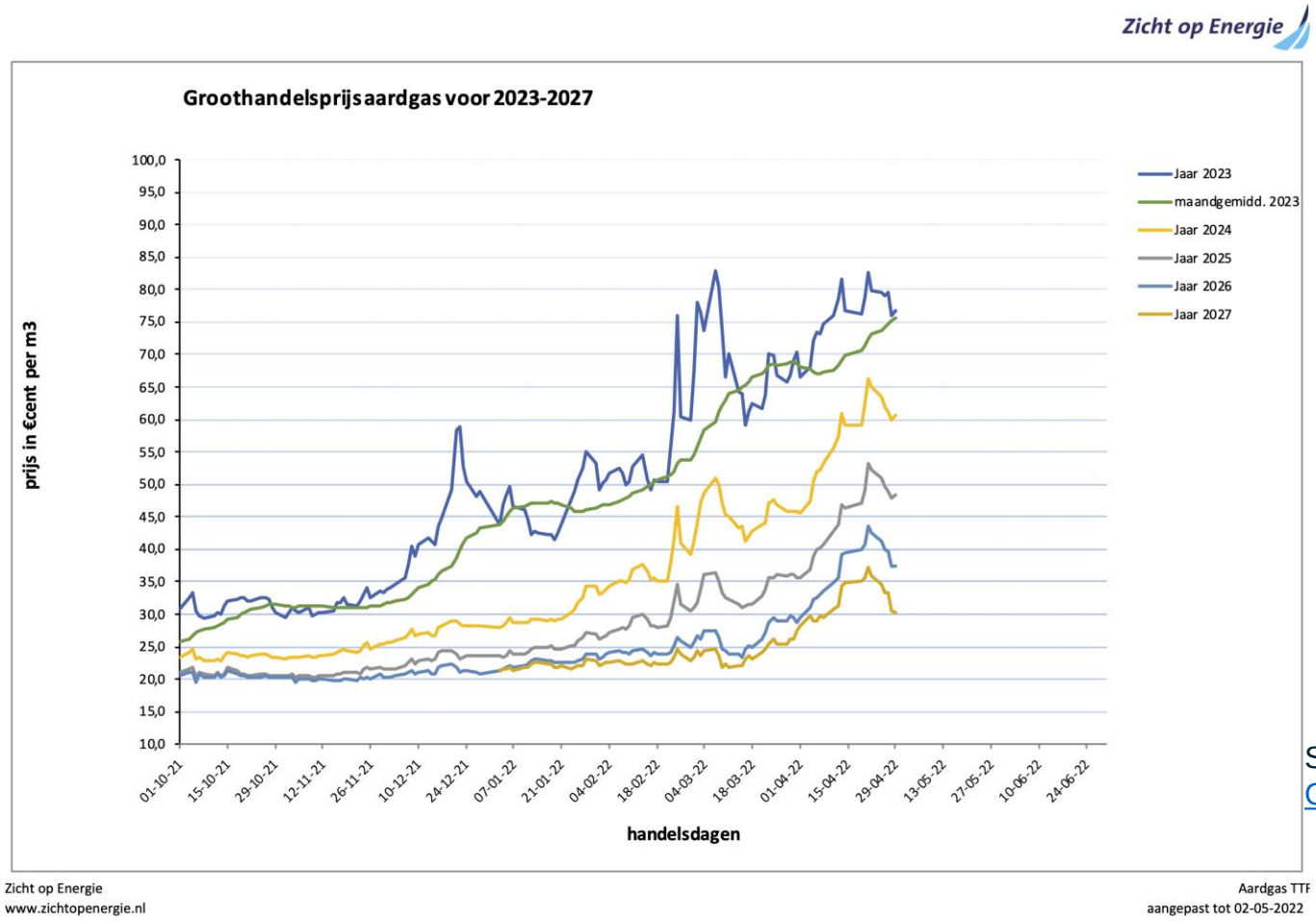
HYDROGEN PRICE 2020: 8 EURO/KG EXCL. TAX
PRICE DEVELOPMENT



H2 PRIJS 7 EURO/KG 2020



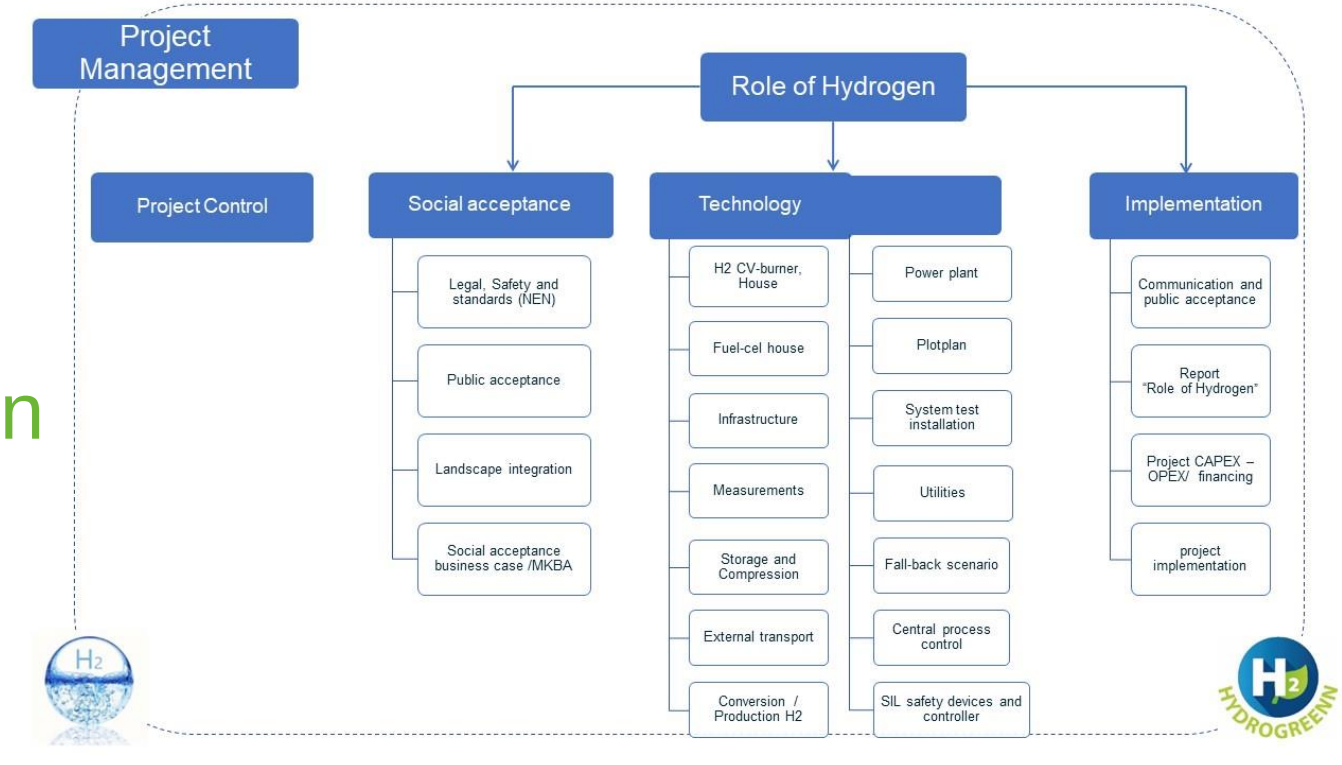
Wholesale price of natural gas 2023-2027

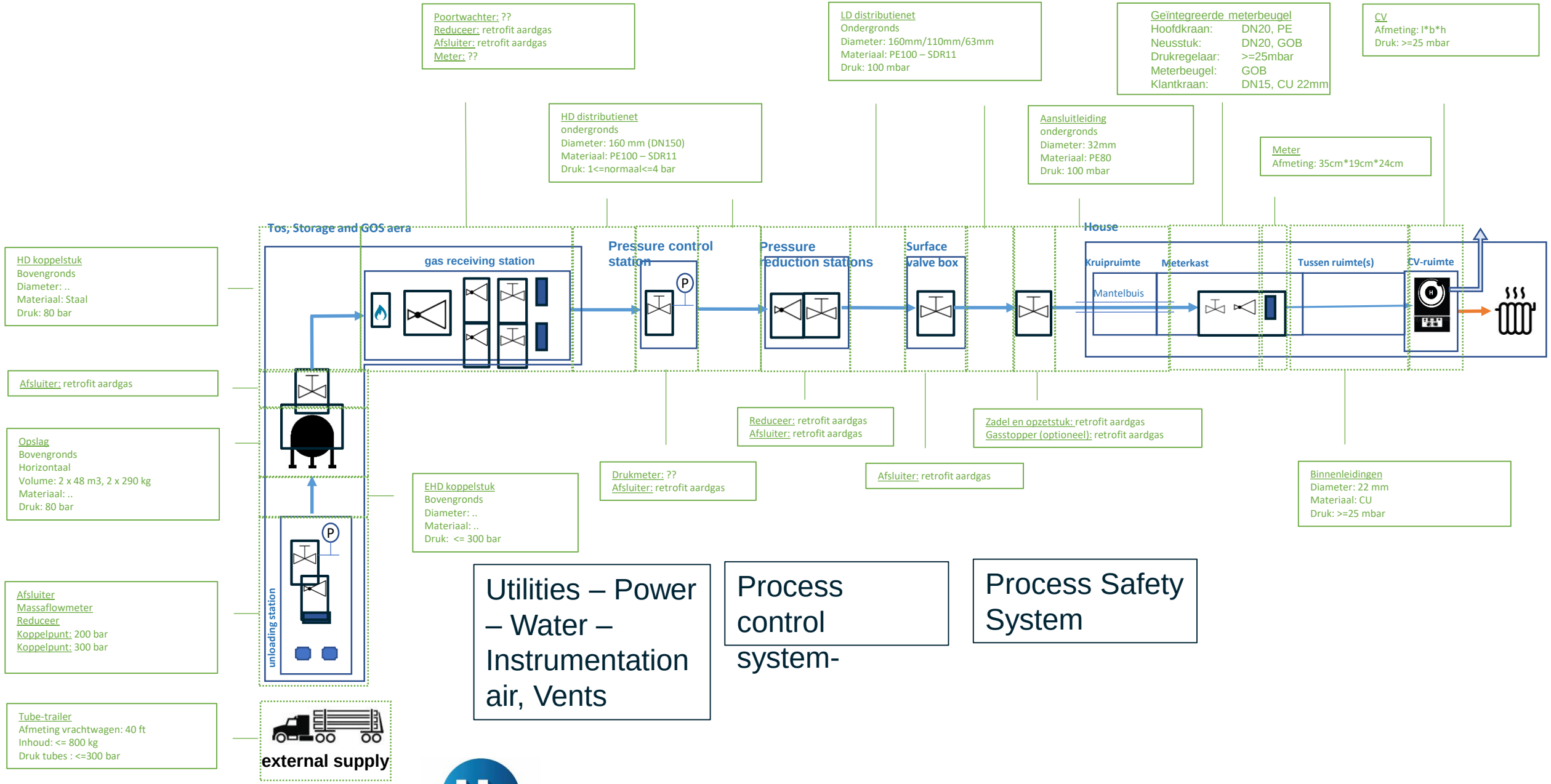


Source 2-5-2022:
[Ontwikkelingen aardgasprijzen | Zicht op Energie]

TECHNOLOGY CHALLENGE

- Gas quality
- Measurement
- Conversion
- Storage and Compression
- Infrastructure
- H2 Heater – House
- System test installation

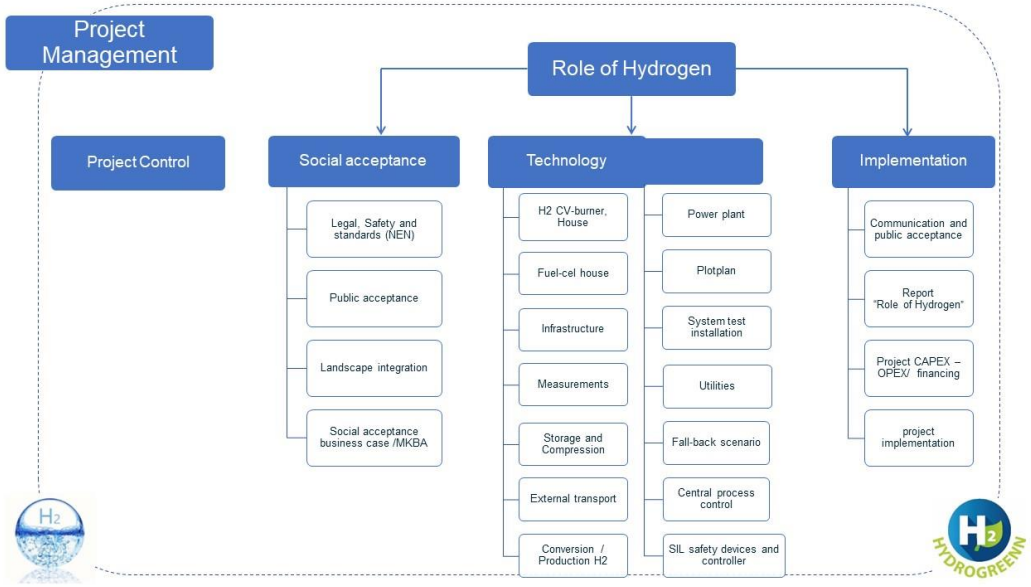




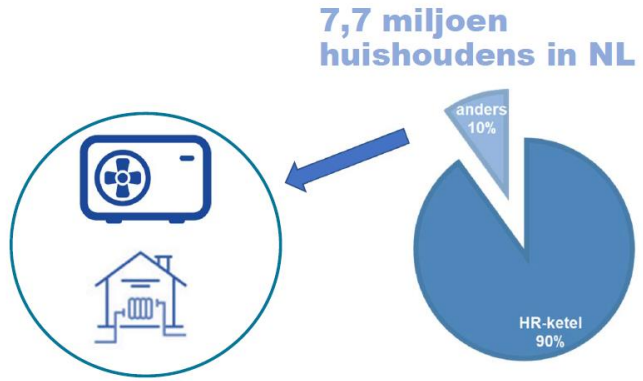
VO Phase 1:“primairy design” | in operations | components

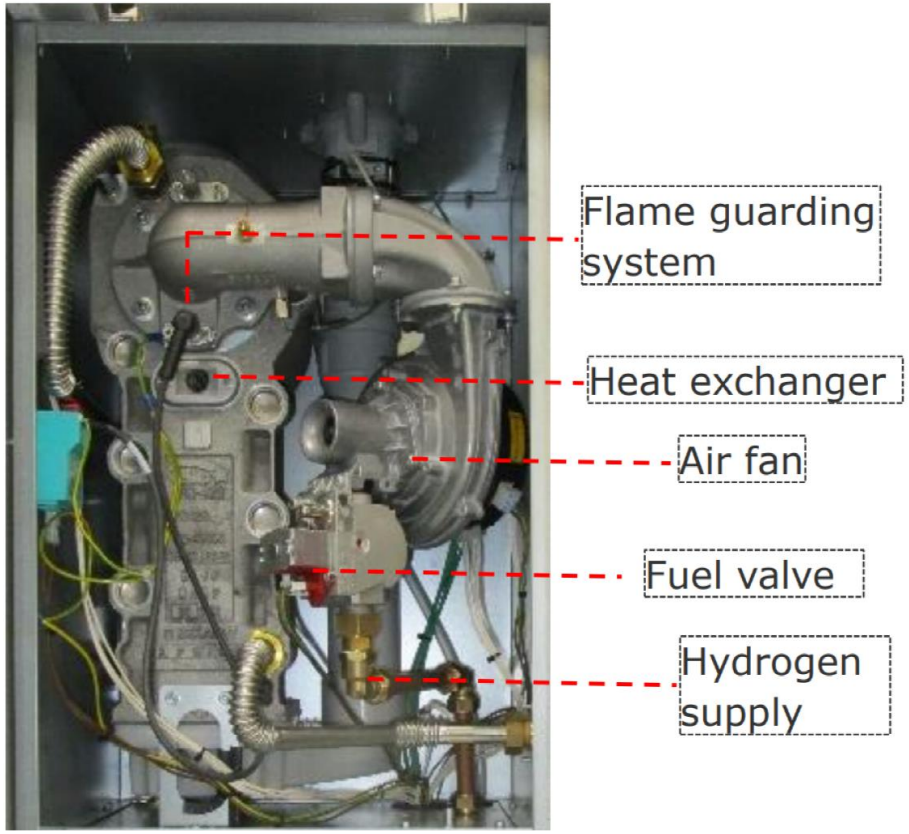
TECHNICAL CHALLENGE QUALITY OF GAS

- Gas quality
  - Do we need an odorant or should we use a sensor?
    - Most of gas leaks are outside the house, most leaks with excavation work
  - What kind of odorant do we use?
    - Same as natural gas? (THT)
    - Other Smell?
    - Harmless for fuel cells?



Hydrogen Boiler





message H2-boiler - retrofit solution

CO2 - none

CO - none

NOx - much lower (reported reductions > 50%)

CAPEX - slightly higher

OPEX

maintenance - similar

TECHNICAL CHALLENGE MEASUREMENT

- Gas Measurement
  - We will lose some Hydrogen quality / calorific value on the route:
  - Who should pay for that?
  - Do we need a QA H2 measurement after the handover?
    1. Tube trailer to tank
    2. Electrolyzes to tank
    3. From high pressure storage – compressor when we handover to the 4 bar net?

TECHNICAL CHALLENGE MEASUREMENT

- Measurement
  - What has to be the frequency of scanning?
  - Should we measure flow of energy or heat transfer?
  - Can we use the G4 measurement
  - Does it fit into the “Meterkast” meter cupboard in the houses?

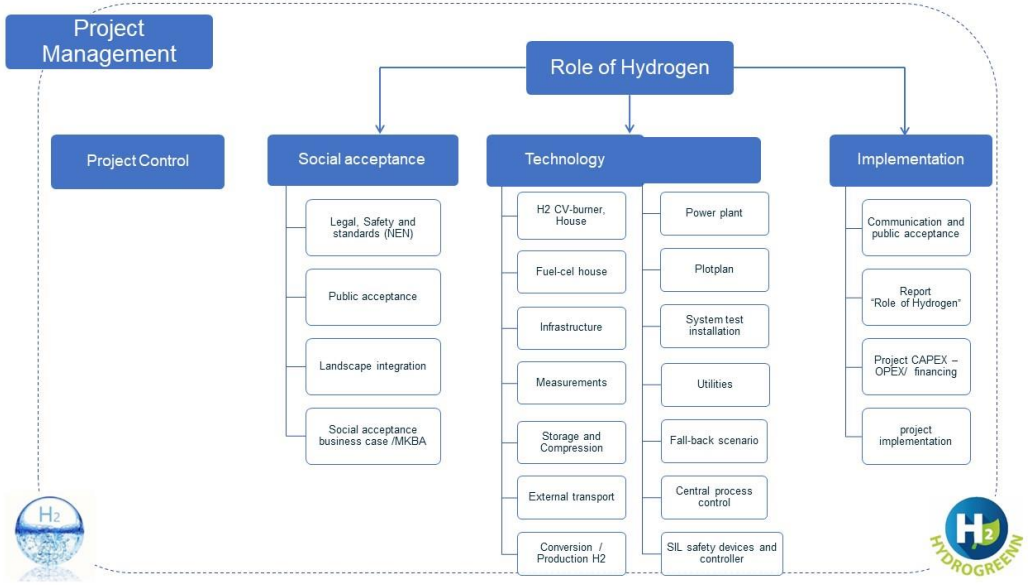
  - YES we can use the existing G4 measurement in the houses

TECHNICAL CHALLENGE STORAGE /COMPRESSION

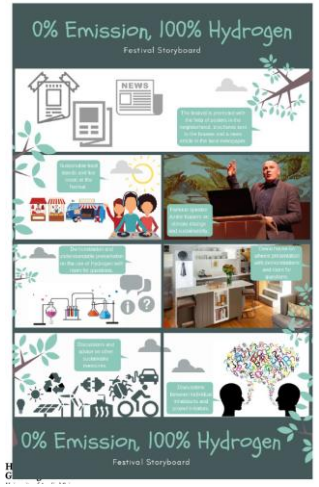
- H2 Storage and compression
  - What kind of pressure do we need to lowest cost of storage?
    - Low pressure – we need a large tank
      - Landscape interaction
    - High pressure we will need additional compressor:
      - Also higher cost
      - Energy efficiency will go down.

TECHNICAL CHALLENGE HOUSES

- H2 Heater – House
  - Do we need a odorant or should we use a sensor?
  - Thermal acoustic sound problem with higher flows?
  - What is the internal house gas infrastructure quality?
  - Cooking will converse to electric.



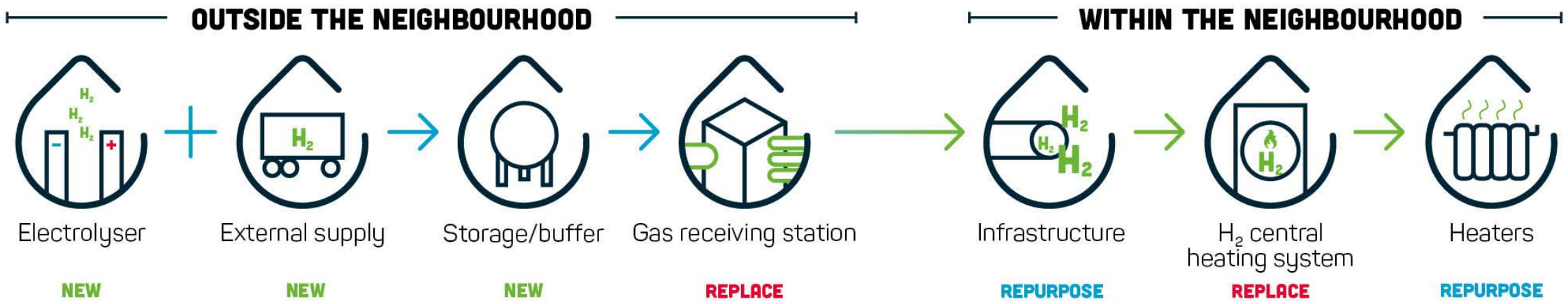
IMPLEMENTATION CHALLENGE



- Communication and public acceptance
  - Public website https://www.hoogeveen.nl/waterstof
- Project report
  - Public Report Waterstofwijk Hoogeveen
  - Public Report **Indicative Social cost benefit analysis Hydrogen heating MKBA Hydrogen City Hoogeveen the Netherlands**
  - Public Report Waterstofwijk Hoogeveen Safety
- Project CAPEX / OPEX/ Financing
- Project implementation
- Market model (for H2 Gas supply)

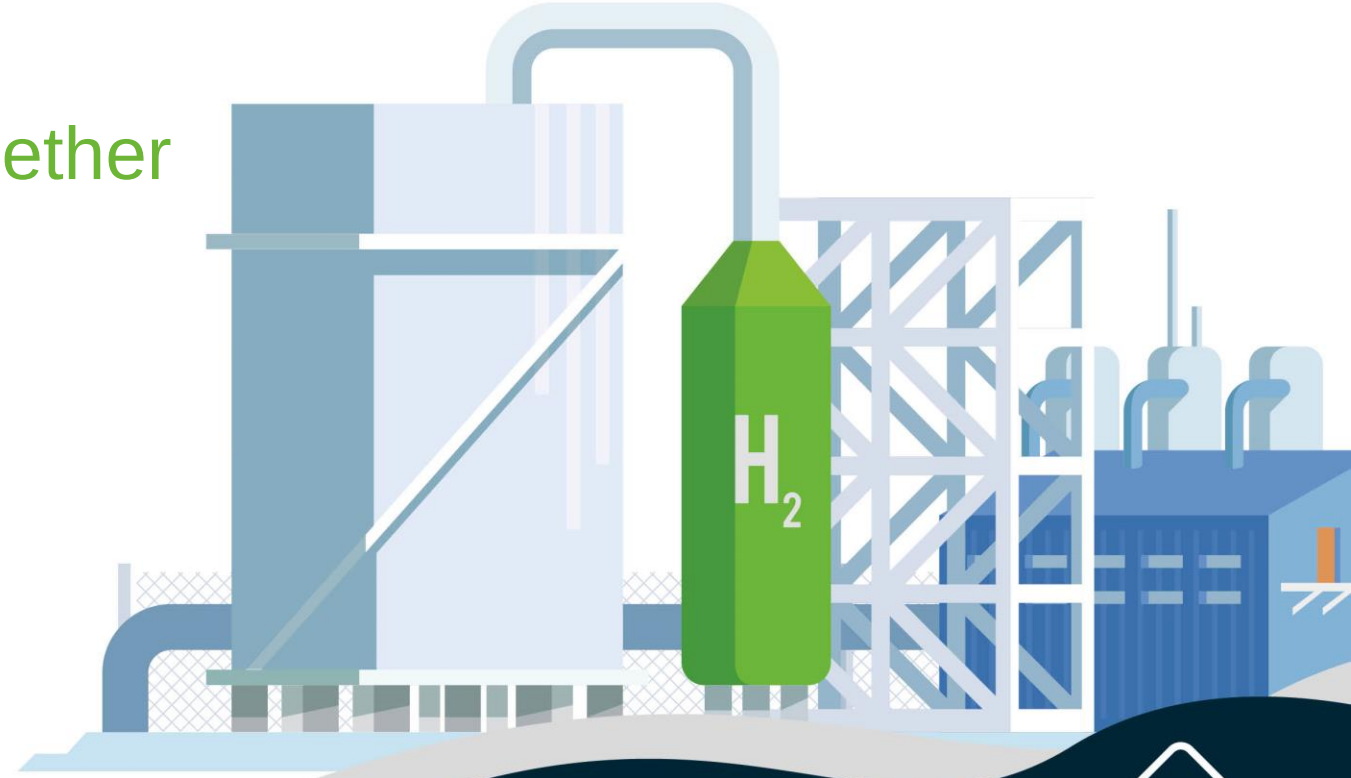
FROM PLANNING TO PRACTICE

Installation, Infrastructure and Storage at the demonstration project in the new housing district Nijstad-Oost



WHAT WE ASK OF OUR NATIONAL POLITICIANS

1. An open mind
2. The possibility of working together
3. Financial support
4. Room to innovate



Green Deal H2-wijken

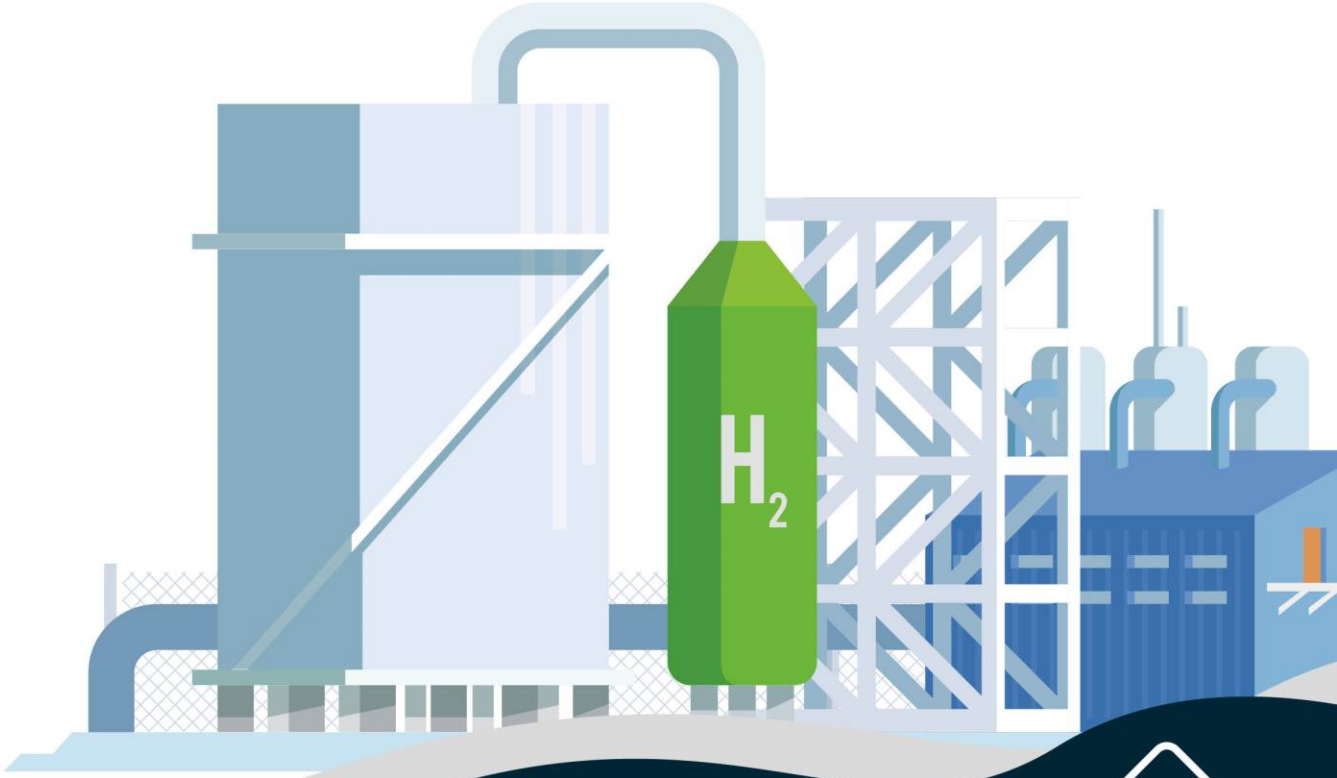
C-234
Green Deal H2-Wijken
Naar praktische toepassing van waterstof als warmtevoorziening in woonwijken

Partijen:

1. De Minister van Economische Zaken en Klimaat, Bas van 't Wout, hierna te noemen: EZK;
2. De Staatssecretaris van Infrastructuur en Waterstaat, Stientje van Veldhoven, hierna te noemen: IenW;
3. De Minister van Binnenlandse Zaken en Koninkrijksrelaties, Kajsa. H. Ollongren, hierna te noemen: BZK;

CHALLENGES

CREATING A HYDROGEN FUTURE



H_2 in Build Environment

YOUR SUBTITLE HERE

2021 First 100% H2 Project at Hoogeveen

2023 First 100% H_2 Project
Existing houses at Hoogeveen

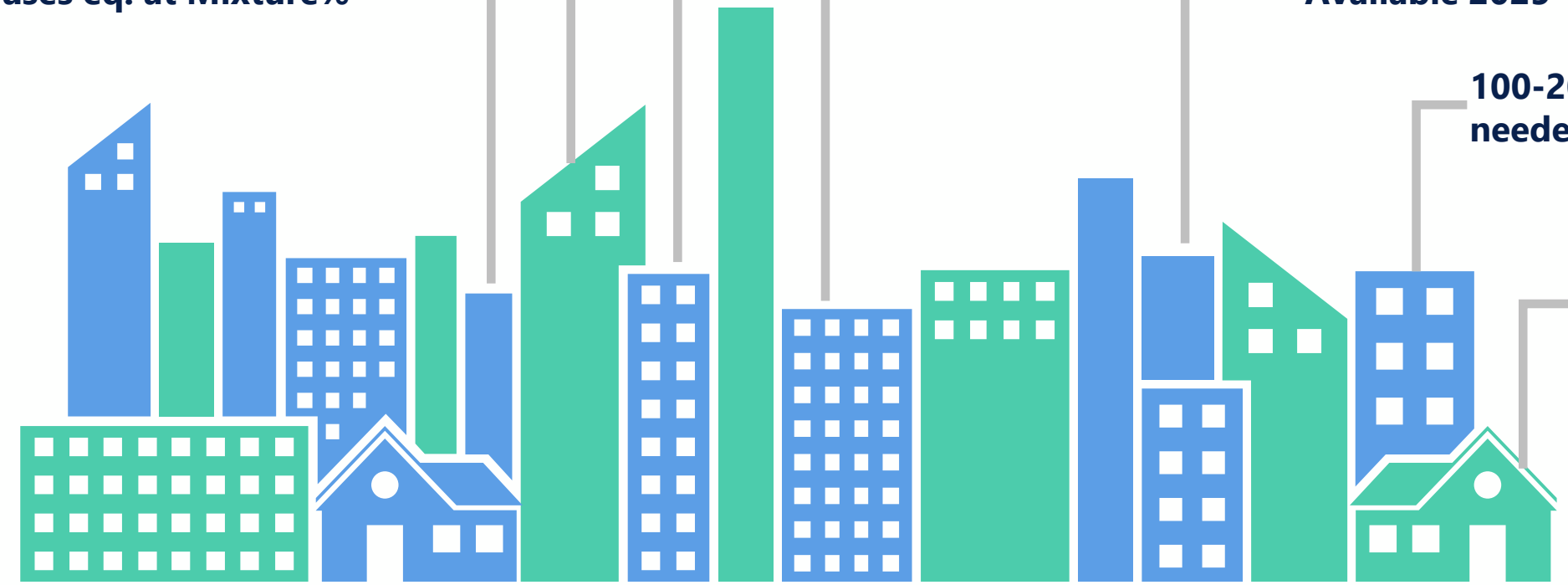
250.000 Houses at 100%
250.000 Houses eq. at Mixture%

2024- 100K H_2 Burners on Dutch market possible

Main H_2 TSO Gas grid
Available 2025

100-200 K TON H_2
needed

Best result
when
combined
with hybrid
heat pump



H_2 in Build Environment-outlook 2050

YOUR SUBTITLE HERE

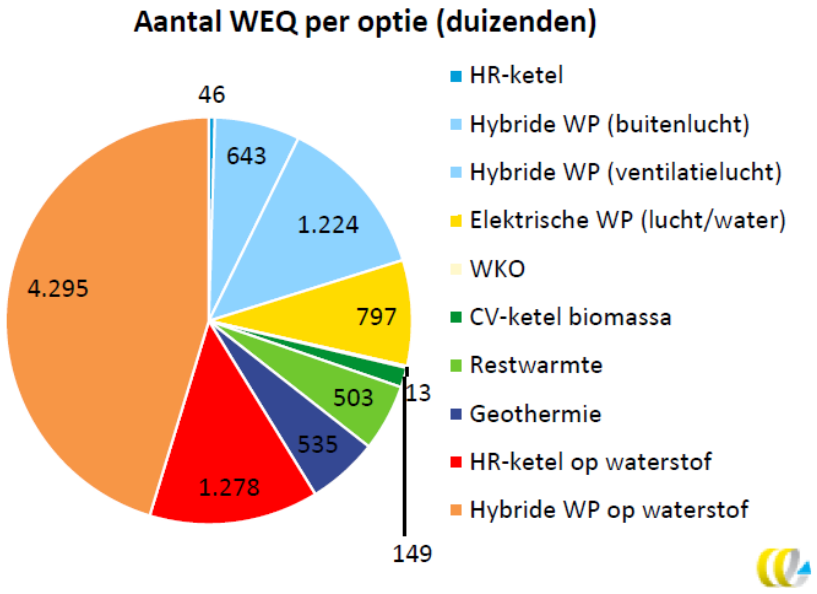
Hydrogreen H_2 Project consortium, Market > 1 million Houses

CE Delft 1,2-1,7 H_2 houses – "Net van de Toekomst"

Stedin 38% of there > 2 million houses

2019 Berenschot 2 million H_2 houses is possible

""Net voor toekomst update 2020" scenario C" 20% of all houses om Hydrogen a (D) 60%



Noot: Definitie WEQ - woningequivalent: woning of 150 m^2 utiliteitsbouw

H_2 in Build Environment

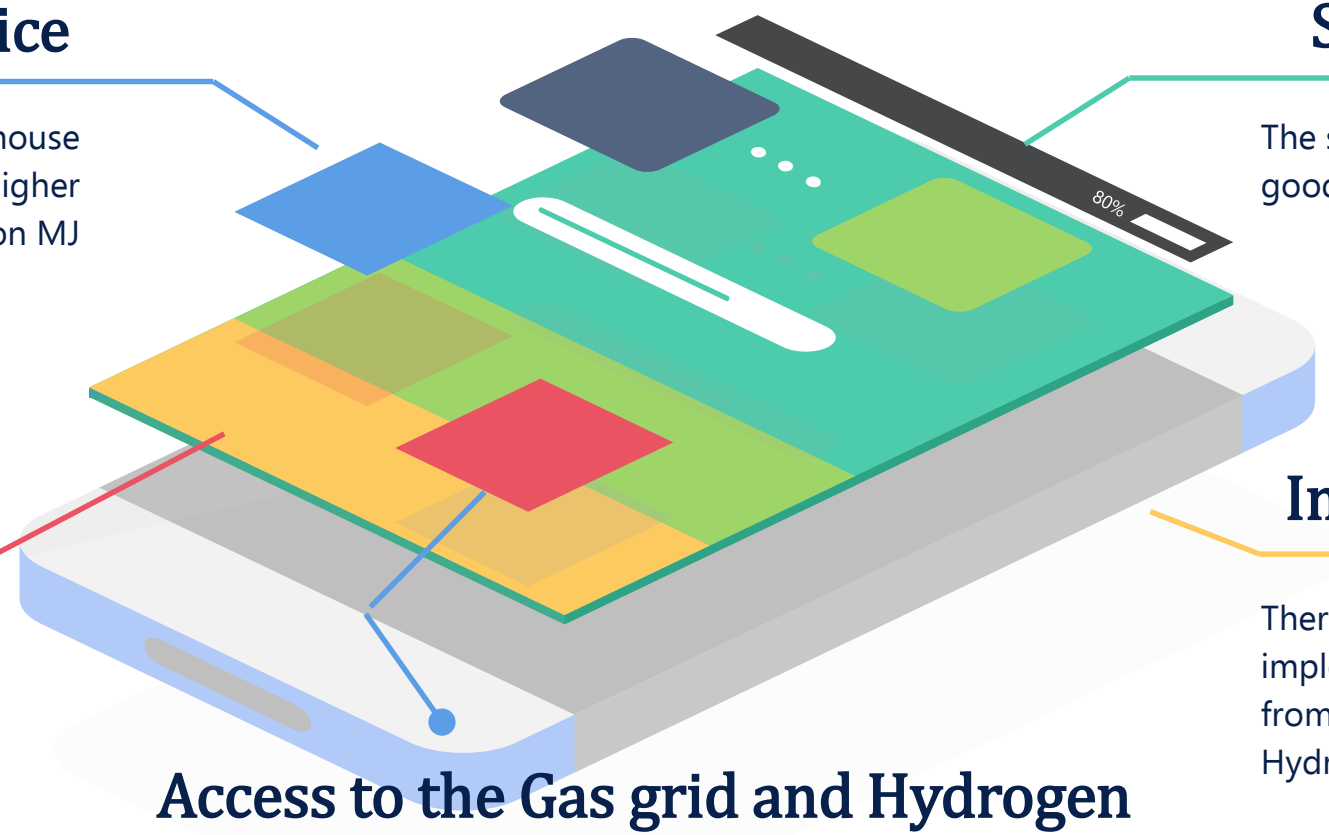
Restrictions

H2 Energy Price

The Hydrogen cost for house owner should not being Higher as National Gas price on MJ

Safety

The safety standard should be as good as Natural Gas.



TSO/DSO – ACM Permit

Network operator need ACM permit to transport Hydrogen under regulated business

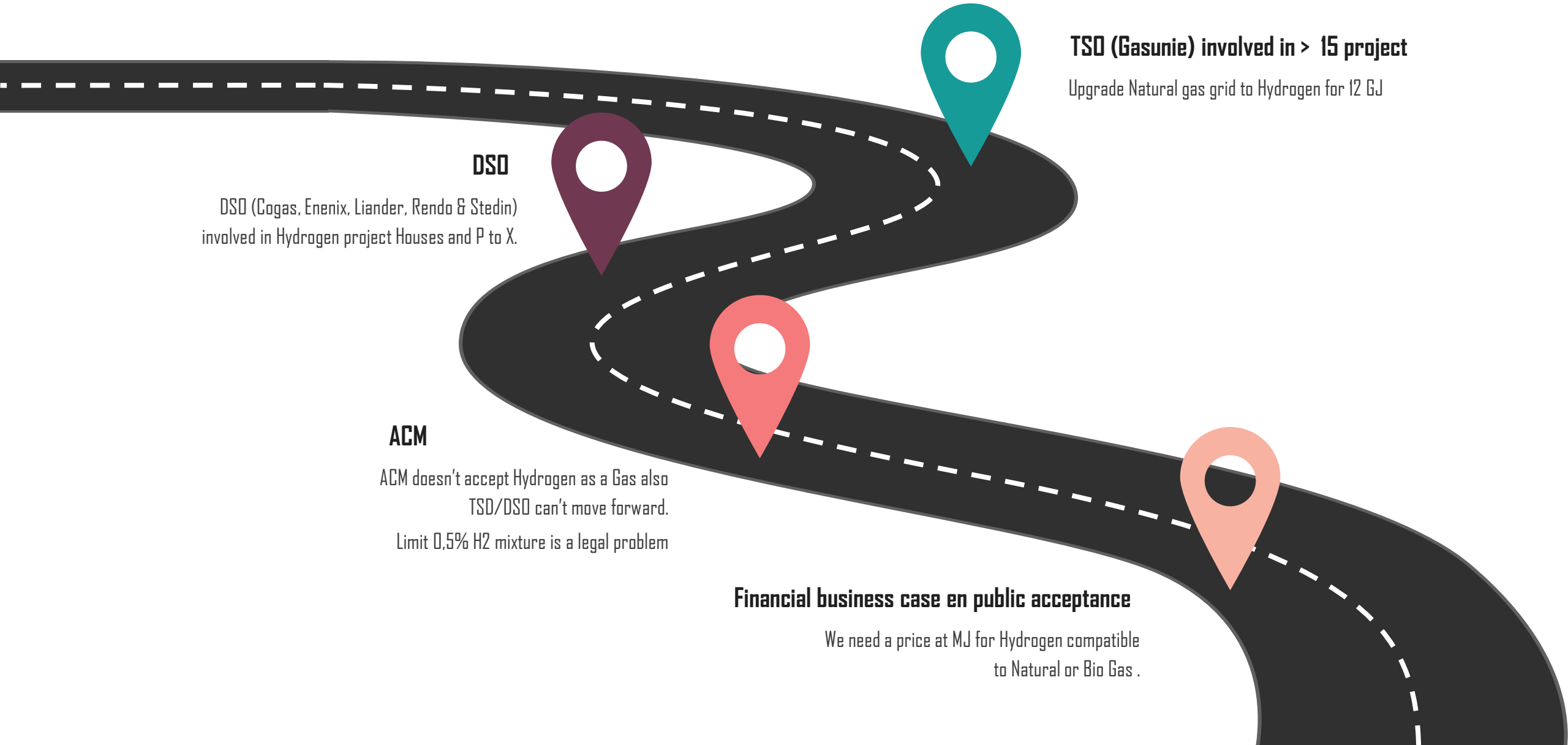
Implementation

There should be an implementation plan to convert from National gas network to a Hydrogen network.

Access to the Gas grid and Hydrogen

Start in area of Energy hubs

Hydrogen Network and projects



TSO (Gasunie) involved in > 15 project

Upgrade Natural gas grid to Hydrogen for 12 GJ

DSO

DSO (Cogas, Enenix, Liander, Rendo & Stedin) involved in Hydrogen project Houses and P to X.

ACM

ACM doesn't accept Hydrogen as a Gas also TSD/DSO can't move forward.

Limit 0,5% H2 mixture is a legal problem

Financial business case en public acceptance

We need a price at MJ for Hydrogen compatible to Natural or Bio Gas .

Samenwerken aan waterstof: nu stappen zetten voor 2025 en 2030

POLITIEK

- 1 MW elektrolyse in Nederland
- Waterstofleiding tussen Zeeland en de Deltaregio

- Beleidsvisie H2
- Exploitatiesubsidie opschalingsfase 500MW

- Uitrol Nationaal programma H2
- Implementatie RED II (EU richtlijn)
- Certificering H2
- Besluit extra wind op zee voor H2

Nieuwe tenders offshore wind voor H2

Uitrol opschalingsprogramma naar 3-4 GW

Nederland koploper waterstof!

50-75 GW in 2050
Voldoende CO2-vrij regelbaar vermogen

60 MW elektrolyse | 200 MW | 500 MW | 1500 MW | 4000 MW

Opschalingstraject Waterstofcoalitie en Klimaatakkoord

Nu | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2027 | 2030 | 2040 | 2050

BEDRIJFSLEVEN

- Opstarten nieuwe waardeketens voor circulaire chemie en transport
- Eerste waterstofinfrastructuur binnen industrieclusters

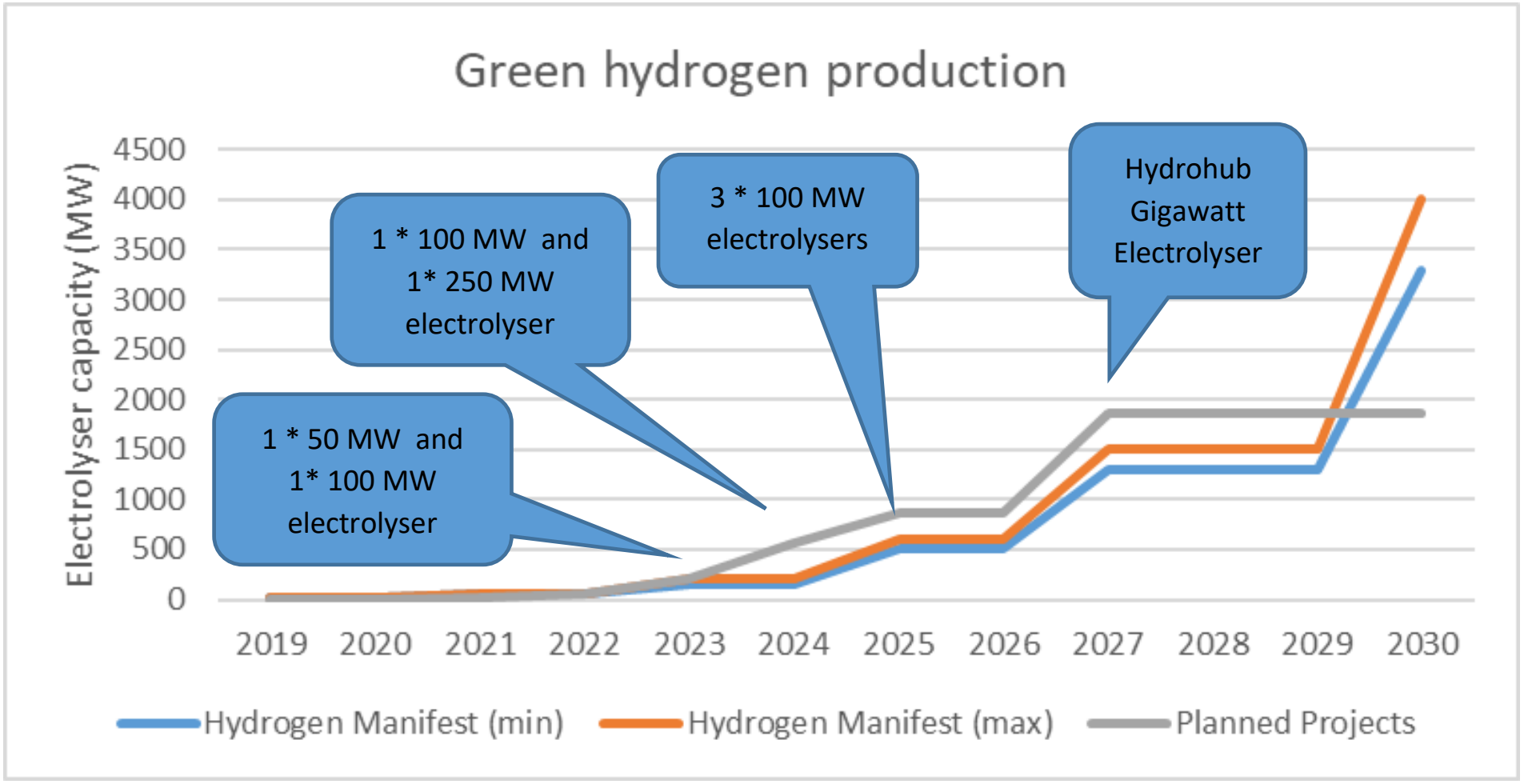
Eerste investeringsbesluiten elektrolyzers

H2-opslag in zoutcavernes

Eerste Backbone-verbinding

Landelijk H2-backbone transportnet

DE WATERSTOF COALITIE


Green hydrogen production
Electrolyser capacity (MW)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
1 * 50 MW and 1* 100 MW electrolyser
1 * 100 MW and 1* 250 MW electrolyser
3 * 100 MW electrolysers
Hydrohub Gigawatt Electrolyser
Hydrogen Manifest (min)
Hydrogen Manifest (max)
Planned Projects

For more information, please contact:

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The Netherlands

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W: www.stork.com
LI https://www.linkedin.com/in/willemhazenberg

NEXT STEPS

Implementation in the neighbouring Vinex district of Erflanden is the next step. As of 2022, the goal is to equip 1,100 homes with green hydrogen as a sustainable source of energy.

Activiteiten na ondertekening intentieverklaring

Bewoners:
- Bewonersavond Erflanden
- Bewonerssessies voorbereiding uitvoering

Uitvraag rollen:
- Marktoriëntatie waterstofleveranciers
- Marktconsultatie waterstof CV-ketel

Projectmanagement:
- Keten overzicht
- Planning
- Business Case
- Risicodossier

RTV Drenthe

Ruim 4 miljoen euro subsidie voor waterstofwijk Erflanden ...

De gemeente Hoogeveen krijgt ruim 4 miljoen euro subsidie voor de ... "In Nederland is er een aantal projecten waarbij wijken overgezet ...

26 okt. 2020

RTV Drenthe

6,5 ton van provincie Drenthe voor waterstofwijk Hoogeveen

6,5 ton van provincie Drenthe voor waterstofwijk Hoogeveen ... van een deel van de al bestaande woningen in de naastgelegen wijk Erflanden.

17 nov. 2020

C-234
Green Deal H2-Wijken
Naar praktische toepassing van waterstof als warmtevoorziening in woonwijken

Partijen:

1. De Minister van Economische Zaken en Klimaat, Bas van 't Wout, hierna te noemen: EZK;
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3. De Minister van Binnenlandse Zaken en Koninkrijksrelaties, Kajsa. H. Ollongren, hierna te noemen: BZK;

Uitbreiding ketenpartners:
- Energie van Ons

Voorlopig ontwerp:
- Distributienet
- Losstation en GOS
- Installatie nieuwbouw woning
- Inrichting voorkeurslocatie

Omgeving - en vergunningen:
- QRA – voorkeurslocatie
- Botsproef met veiligheidsregio en RUD
- Gesprek eigenaren – voorkeurslocatie

Next project phase

	Oriëntatie	Ontwikkel	Voorbereiding	Realisatie
Wie	Hydrogreenn (22 partijen)	Gemeente Hoogeveen, NAM, Gasunie, Energystock, New Energy Coalition, RENDO	Gemeente Hoogeveen, NAM, Gasunie, New Energie Coalition, Energie van Ons, RENDO	
Hoe	Samenwerkingsovereenkomst	Intentieovereenkomst	Samenwerkingsovereenkomst	
Wat	Voorloopstudie "Waterstofwijk, Plan voor waterstof in Hoogeveen; 2020“	Omgevings- en vergunningsmanagement Business case en investeringsbereidheid Juridische kader Rol en keteninvulling Voorlopig ontwerp	Final Investment Decision zomer 2022. Business case per partij Definitief ontwerp Onderlinge overeenkomsten Vergunningen Draagvlak bewoners	

juli 2021

TIJDLIJN SHORT-TERM

2019 | 2020 | 2021 | 2022

1-11-2021 start Ketel duurtest (100 dagen)

31-12 Bestemmingsplan gereed

28-2-2020 Bestemmingsplan vrijgeven

3-08-12 Onherroepelijk worden bestemmingsplan bestuurlijk

4-08-20 Schop in de Grond infra

1-2-2021 Bouw GOS en opslag

31-5-2021 Huizen gereed

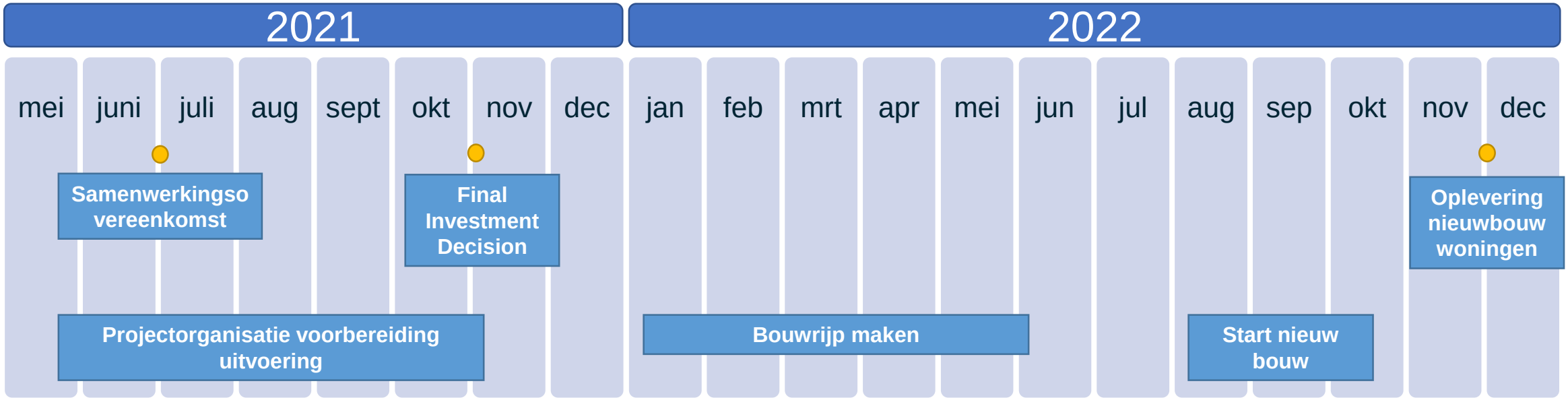
1-6-2021 Start H2 Levering

1-8-2022 Electrolyse lervering

1-11-2022 Electrolyse in bedrijf

LONG-TERM TIMELINE

Planning Nijstad-oost

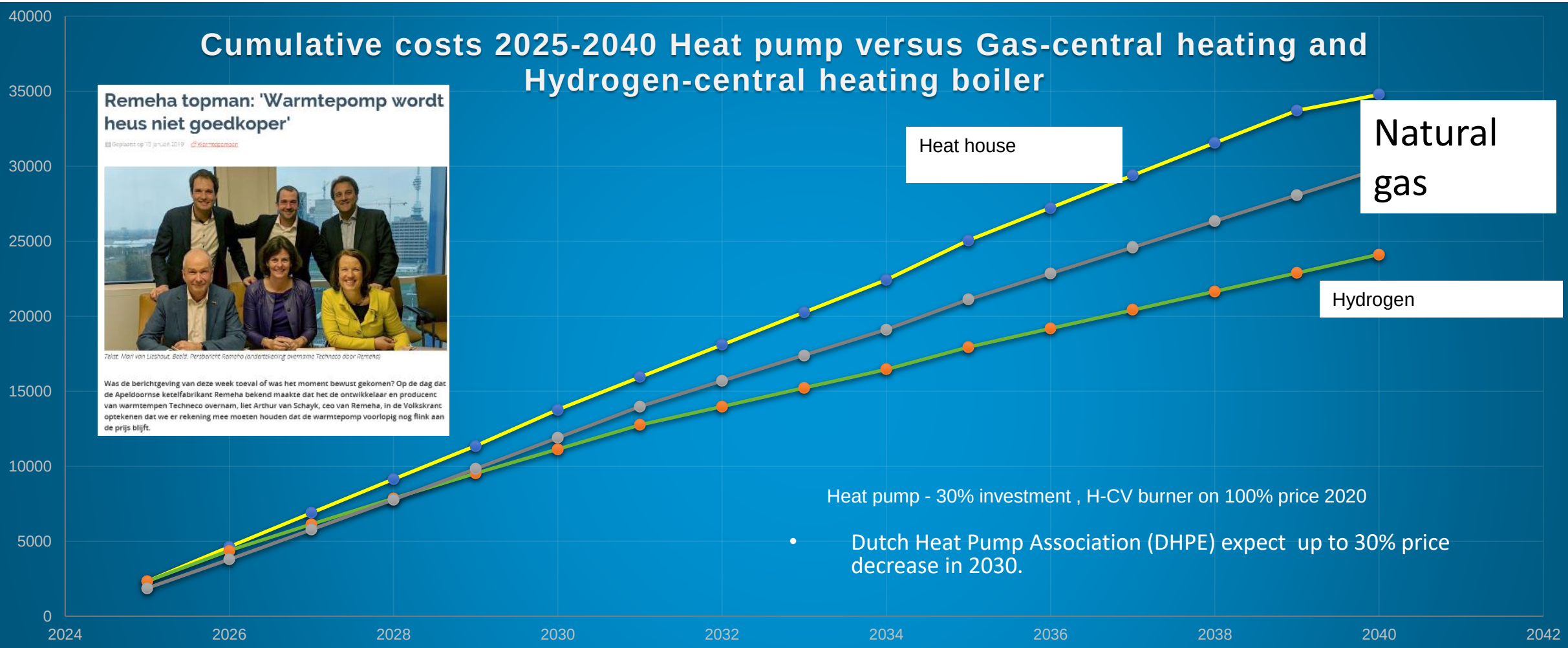


INNOVATIVE PLANS?
WE'RE READY.
ARE YOU?

WATER STOF WIJK

BACK-UP SLIDE

START 2025 – WARMTEPOMP -30% INVESTERING



Heat pump - 30% investment , H-CV burner on 100% price 2020

- Dutch Heat Pump Association (DHPE) expect up to 30% price decrease in 2030.

HOUSE AMOUNT AND ENERGY LABEL

Tabel 1 Woningvoorraad naar energielabel, 2015

	Sociale huurwoning	Particuliere huurwoning	Koopwoning	Totaal
BENG	8.800	47.200	52.600	108.600
A	208.300	129.400	632.600	970.300
B	393.500	92.400	451.900	937.800
C	763.900	184.900	1.310.400	2.259.200
D	532.400	147.900	677.800	1.358.100
E	254.600	101.700	451.900	808.200
F	115.700	83.200	406.700	605.600
G	46.300	157.100	406.700	610.100
Totaal	**2.323.500**	**943.800**	**4.390.600**	**7.657.900**

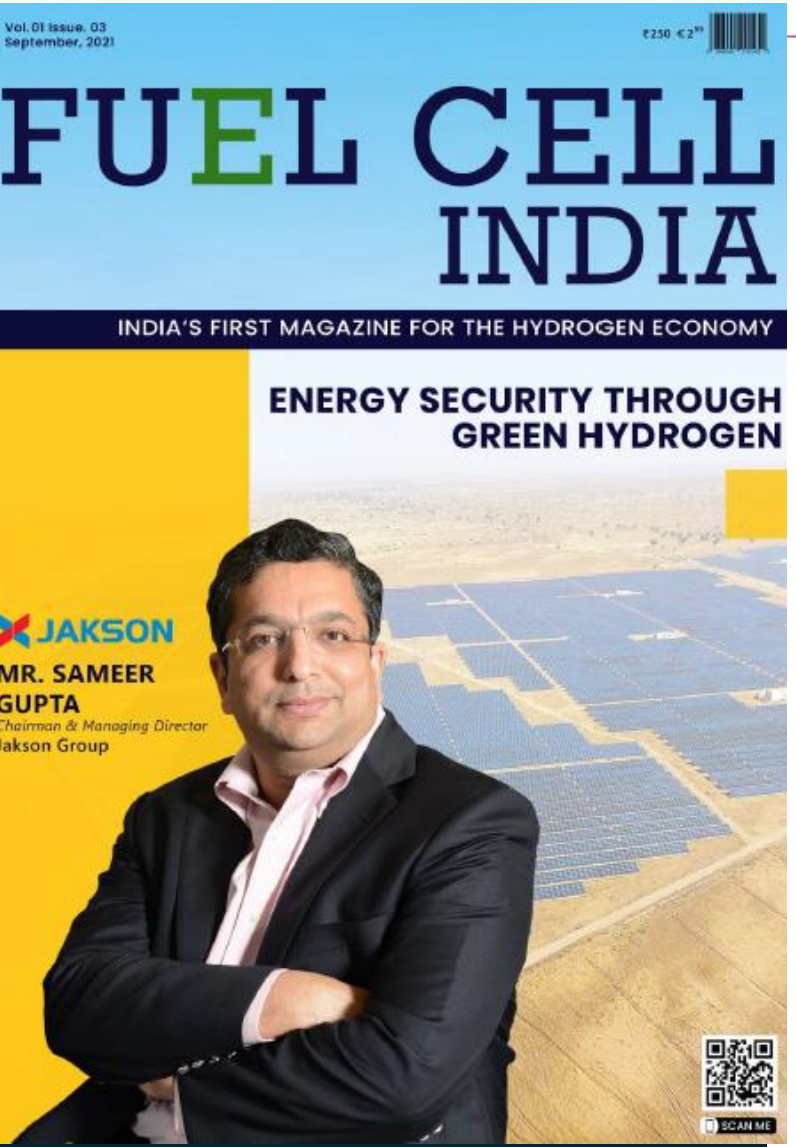
Bron: WoON 2015 / EIB

Heat Pumps

Combination Hydrogen Boiler and Hybrid Heat pump and some basic isolation will be the most attractive option.

Hoogeveen – Nieuws in India

Link 9/21



ARTICLE

100 new homes running entirely on hydrogen in the municipality of Hoogeveen, Netherlands

INCREASED concern over carbon emissions has caused many governments to push for reduced CO_2 emissions in their countries across many sectors, including commercial and residential buildings. Rather than heating buildings using traditional methods such as natural gas, some municipalities are looking to convert boilers from natural gas to hydrogen, to eliminate carbon emissions.

The municipality of Hoogeveen in Netherlands intends to build around 100 homes in the new district of Nijstad-Oost; these homes will run entirely on hydrogen. Construction work is due to start in 2022. The municipality sees this development as a way of contributing towards the energy transition in the Netherlands; by building gas-free homes.

The aim of the HYDROGREENN - municipality of Hoogeveen project was to deliver a (techno-economic) blueprint and associated technology concept for the heat supply of the 100 houses in the new district of Nijstad-Oost on 100% hydrogen (H_2), based on operating with a hydrogen central heating boiler. The key challenge of the project is focused on creating new residential areas without having the need for natural gas as the key energy carrier to supply heating and to make urban areas more sustainable. This blueprint and technology must be capable of being applied to existing residential districts throughout the Netherlands. As well as reducing the use of natural gas, this will also create a market opportunity for the parties concerned. The blueprint will not only cover technological aspects, it will also incorporate the social business case, hydrogen sources and support from residents. This approach will be compared to other hydrogen-based solutions (fuel cells, local heat networks etc.), in order to gain insight into advantages and disadvantages.

Nijstad-Oost is not a standalone project; it is a demonstration project serving as a catalyst for the application of hydrogen in the built environment. The reason why we are not starting with existing buildings straight away is so that we can create, from a greenfield site, a clearly-defined and controlled environment that is comparable to existing buildings (as regards infrastructure and equipment). The controlled environment will serve as a launching pad for applying the technology to existing homes in the nearest district.

This constitutes the first step in a multiannual program, with its own concrete objectives. Effects in the newly built homes will be followed closely but the project is also a prelude to scaling up the technology for application to the nearest existing district Erflanden. An issue that is even greater than new homes in the Netherlands: how do we make the existing heat supply more sustainable? That's why work will also focus on hydrogen boiler solutions for existing homes using experience gained from this project. Blending tests will then be introduced gradually for these existing homes until they are also eventually running entirely on hydrogen.

The hydrogen project is a unique collaboration between 22 organizations encompassing the whole chain, consisting of government authorities, knowledge institutions and companies. They are investing a total of 15.000 man -hours in the project.

Willem Hazenberg
Project Manager, Stork
Hydrogen City Project - "HYDROGREENN"

The final report containing the research results of Waterstofwijk Hoogeveen (Hydrogen plan in the Dutch town of Hoogeveen). The most important conclusion of the two-year study is that existing residential areas can also switch from natural gas to -sustainable – hydrogen for their heating. The specially developed hydrogen boiler makes use of the existing natural gas infrastructure. Heating the 'built environment' with hydrogen is therefore not limited to new build site construction. The report was presented today during a webinar to the consortium members of the project. The basis for the implementation of the plan is the Nijstad-Oost demonstration project in Hoogeveen with 100 new homes. The municipality of Hoogeveen, together with the consortium parties involved, will now take the steps to realize the plans: the construction of the hydrogen network and the connection of 100 new homes in Nijstad-Oost. This will be followed by the conversion of 427 homes in the existing Erflanden district. Hydrogen for existing buildings The study shows that heating with hydrogen in the built environment can be safely used as a substitute for natural gas.

The Northern Netherlands created a six-year plan HEAVENN (Hydrogen Energy Applications in Valley Environments for Northern Netherlands) and the Northern Netherlands is the first region to receive a subsidy for their so-called Hydrogen Valley. The North Netherlands' subsidy application for a Hydrogen Valley has been approved by the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) of the European Commission. It concerns a subsidy of 20 million euros with a public-private co-financing of 70 million euros. This brings the total project size to around 90 million euros. This subsidy is intended for the development of a fully functioning green hydrogen chain in the Northern Netherlands.

Over the past several years, the Northern Netherlands has accelerated its hydrogen project pipeline together with its ambitions of becoming the leading European hydrogen ecosystem. The Northern Netherlands has received recognition from the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) Hydrogen Valley grant as the leading European Hydrogen Valley developing a full-fledged green hydrogen value chain, and is highlighted as a target region for the European Just Transition Fund. Furthermore, global businesses (e.g., Engie, Equinor, RWE, Shell, and Vattenfall) have increasingly committed to the Northern Netherlands as their hydrogen ecosystem of choice, and regional governments have increased their commitments to realize the Northern Netherlands hydrogen ecosystem. Close collaboration with surrounding countries will add to the region's development.

This increased momentum has brought about the next phase in the realization of the Dutch hydrogen opportunity, moving from pilots and demos to maturing and scaling up the Northern Netherlands hydrogen ecosystem. To highlight the ambitious nature of the Northern Netherlands, one goal of the region is to have offshore hydrogen production by 2030. Whereas the project pipeline in the 2019 Investment Agenda was worth EUR 2.8 billion in total, all investments in this 2020 Investment Plan amount to over EUR 9 billion.

The author may be contacted through his twitter account: @WillemHazenberg

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Practor Hydrogen for Industry Drenthe College.
Chairman “HYDROGREENN” (HYDROGen Green Regional Energy Economy Network Northern Netherlands)
Project manager & consortium lead Hydrogen city project Hoogeveen
Advisory Board member TKI Energy Human Agenda LC
Advisory Board member NEN Normalization platform Hydrogen
Advisory Board member (Supervision corporations) MBO Hydrogen education
Advisory member Waterstof Booster EnTranCe.
Member expert team Future NAM renewable energy

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