

Hydrogen transport through PE100 pipes

H2 research and developments for PE100+ Association



Kiwa Technology B.V.

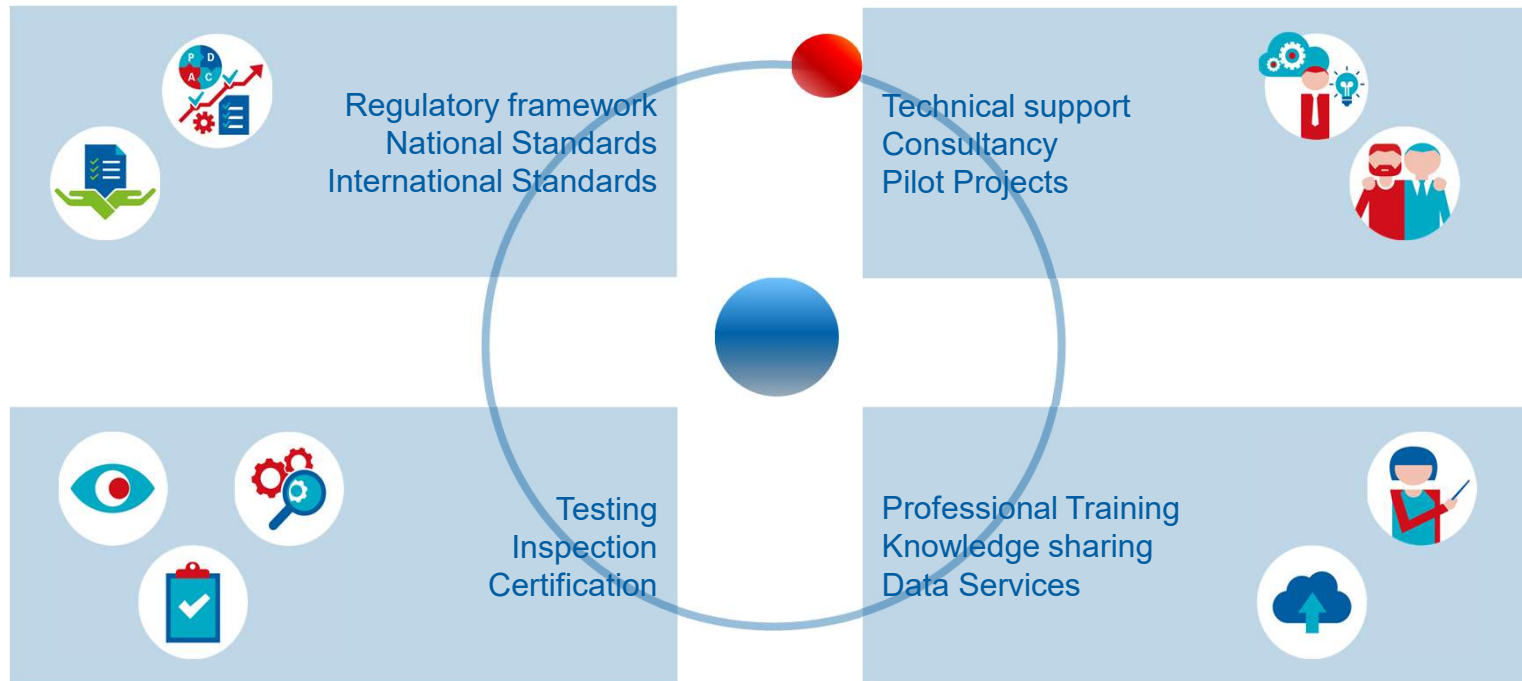
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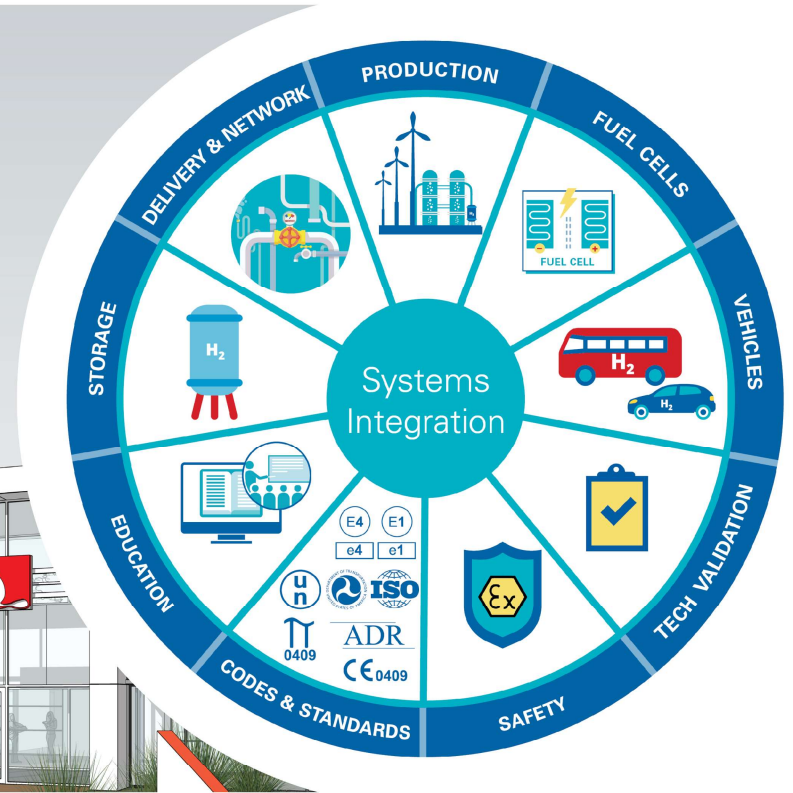


Agenda

- High level summary on the report **Future-proof gas distribution networks** and what happend thereafter
- Various hydrogen pilots including the HyDelta research program
- Insights and thoughts on hydrogen from a European perspective
 - EC, CHA, Hydrogen Europe
 - GERG, Marcogaz and various standardizations committees

How does Kiwa support the hydrogen sector





Research | Consultancy | Development | Support | International Network | Feasibility | Testing | Inspection | Certification | Training

Future-proof gas distribution networks

- *In order to achieve the objectives of the Paris climate agreement, the Netherlands wants to **reduce carbon dioxide emissions in the built environment to 0% by 2050**. Fossil energy sources give way to sustainable energy.*
- In the Netherlands most households are connected to the NG network (92% in 2019).
- Decarbonization has far-reaching consequences, including for network operators.
- Is there is still a future for the existing gas network?
 - This question is topical for the regional network operators because choices must now be made for maintaining the gas network for the long term.

- General question; What would be involved in switching from natural gas to the sustainable gases (biomethane and hydrogen).
 - Baseline includes ensuring safe, reliable and affordable transport.

- The following research questions were then answered:
 - to what extent is the current gas distribution network resistant to sustainable gases?
 - what adjustments are needed to make the existing gas networks suitable?
 - what costs are involved in the changeover?



Compatibility of the distribution materials

■ Plastic and metals with different degradation mechanisms

- For plastics a chemical reaction or changing physical properties by swelling or absorption.
- Factors like; pressure, time, temperature, gas composition.

■ Literature study, pilots, experience from industry

- Danish PE network for H₂, pilot period 10 years
- H₂/NG blending pilot in Ameland (NL)

I Main materials present in the gas distribution network

Gas distribution				
	Connection lines	Main lines	Components outside (e.g. coupling, valve, filter, pressure regulator)	Components (eg coupling meter, dome pressure regt)
PE (PE50, PE80 en PE100)	X	X	X	X
Hard PVC	X	X	X	
Impact resistant PVC	X	X	X	
NBR			X	X
SBR			X	X
POM			X	X
Asbestos cement		X		

Conclusions with regard to materials



■ The overall finding from the inventory is that the current gas distribution network will not be significantly affected by hydrogen. For all known materials, with steel, PE and PVC as the most important, no noticeable degradation is to be expected and observed both on the basis of the literature consulted and on the basis of the laboratory tests and practical tests carried out.

→Also see Hermkens et al - PE pipes enable the transport of Hydrogen_PPXIX_2018

■ The existing gas distribution networks are suitable for transporting biomethane or 100% hydrogen. Modern materials such as impact-resistant PVC, PE and cathodically protected steel are also suitable for the use of these sustainable gases.

Outcome of the project

■ Conclusions

- Existing network is fit for purpose and currently applied construction and design techniques suffice
- Attention to safety aspects, gas meter and appliances
- Costs operator/customer are limited compared to alternatives

■ Recommendations

- Maintain local gas network if there are no alternatives
- Network expansion/replacement with currently used materials
- Collect more practical experience and fill in knowledge gaps

- Report led to the introduction of GASTEC QA approval requirement (AR) 214 "Suitability for hydrogen gas".

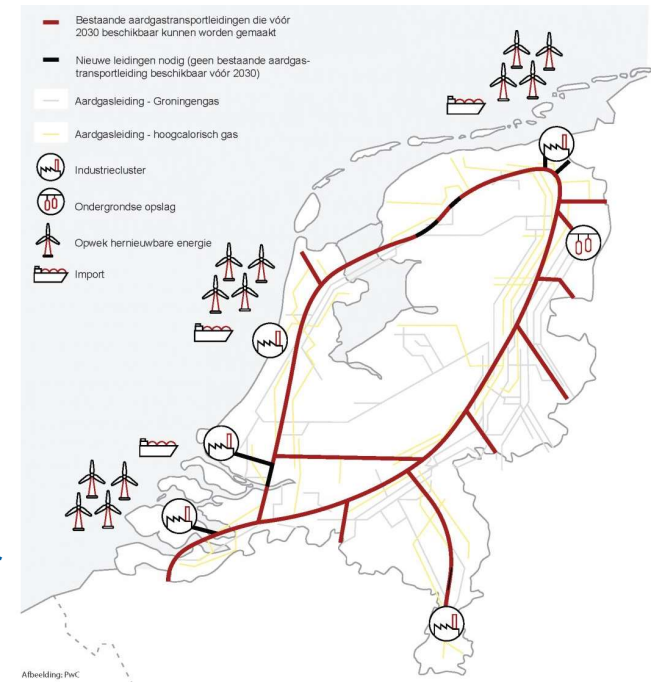


What happened since..

Hydrogen gained a lot of attention

Two 'game changers'

- Hydrogen backbone will be realised in 2030 in the Netherlands by Gasunie (HyWay27 project).
The first in its kind.
- Dutch gas distribution companies announced together with the government that hydrogen could be an additional option for supplying heat to the build environment in 2030.
Now is the time to investigate in research.



Dutch H2 distribution pilot projects

- Focus in this stage is safe working/safety
- All 11 pilots are closely aligned and all knowledge is shared
- Pilots in various stages of the value chain

1 North Sea Wind Power Hub
Eiland in de Noordzee 2030 - 2050
Elektrolyse voor transport van waterstof naar land.



2 Entrance terrein Hanzehogeschool
Groningen 2019 - 2020
Test waterstofnet inclusief waterstof cv-ketels.



3 Waterstofwijk Wagenborgen
Wagenborgen 2020 - 2030
30-40 bestaande woningen verduurzamen middels hybride warmtepomp op waterstof.


7 Demo- en trainingswoning
Apeldoorn 2020 - 2026
Demo en trainingswoning voor waterstof op het terrein van KIWA.


8 Waterstofpilot H2 Lochem
Lochem 2022 - 2025
Waterstof als alternatief voor aardgas in monumentale Woningen.



9 Waterstofpilot The Green Village
Delft 2019 - 2025
Beheren van een 100% waterstofnet.




4 Waterstofpilot H2 Oosterwolde
Oosterwolde 2021 - 2026
Waterstof voor inpassen van grootschalige zonne-opwek.


5 Waterstofpilot Hoogeveen
Hoogeveen 2020 - ∞
H₂ toepassing in bestaande infrastructuur en gebouwde omgeving.



6 Tijdelijk ombouw Uithoorn
Uithoorn 2020
14 woningen ombouwen van aardgas naar waterstof.


10 Waterstofpilot P2G
Rotterdam Rozenburg 2013 - 2023
Gesloten waterstofsysteem in de gebouwde omgeving.


11 Waterstofombouw
Stad aan 't Haringvliet 2025 - ∞
Ombouw waterstof in de gebouwde omgeving.





- New houses
- Existing houses

HyDelta research program

Removing the barriers hindering the introduction of hydrogen in the existing infrastructure for transmission and distribution



Consortium from NBNL, Gasunie, TKI Nieuw Gas, TNO, NEC, Kiwa, and DNV GL

Topics

- Safety and hydrogen
- Gasstations
- Mains, services lines, connections, household installations
- Gas metering
- Odorization
- Existing valves in transmission systems
- Standardization
- Development of educational tracks
- Techno economic value chain analysis
- Admixing and mandatory blending

HyDelta research program (2)

■ WP3 Standardization a.o.:

- Insight in relevant standardization projects in the EU
- Gap analysis between standardization and current knowledge gas grid operators
- Safeguard interest of hydrogen distribution in NL

■ WP1C mains, connections, and house hold installations a.o.:

- Safe operations of hydrogen networks (f.i. purging NG network with H2 or flaring)
- How to conduct leak tightness tests on networks
- Influence of current network on hydrogen gas quality (dust, THT, permeation outside in)
- Risk on house hold installations (customers) when converting to 100% hydrogen

European perspective on hydrogen

- European Commission (summer 2020) – *‘To become climate-neutral by 2050, Europe needs to transform its energy system, which accounts for 75% of the EU's greenhouse gas emissions. The EU strategies for energy system integration and hydrogen, adopted today, will pave the way towards a more efficient and interconnected energy sector, driven by the twin goals of a cleaner planet and a stronger economy.’*
 - The pillar or transport & distribution is vital and funding is available through various ways.
- Hydrogen Europe, brings together diverse industry players, large companies and SMEs, who support the delivery of hydrogen and fuel cells technologies.
 - Are able to shape strategic objectives, priorities and governance for the EU's hydrogen plans. Hydrogen transport & distribution is a crucial pillar in the H2 supply chain.

European perspective on hydrogen (2)

- Clean Hydrogen Alliance, aims to identify and build up a pipeline of viable investment projects along the H2 value chain
 - The alliance will play a crucial role in facilitating and implementing the actions of the new European hydrogen strategy and in particular its investment agenda.
An industry blueprint estimates investments of €430 billion until 2030.
 - Transmission & distribution have great interest and are seen as strategic priority measures that will be put in place in coming years to actually allow the H2 strategy to be implemented.
 - Amongst other pilot projects to gain experience/knowledge and research on the network aspects are seen as crucial for the future.

Marcogaz and GERG

■ Marcogaz (association of European gas transmission and distribution companies) has a H2 Task Force with working groups to ensure a common European consensus

■ Within GERG (European initiative for gas research) hydrogen is one of the pillars for research in the coming years.

Opportunities exist to blend hydrogen into the existing natural gas network, and also to repurpose the network for dedicated hydrogen use.

- f.i. European Commission funded project “Removing the technical barriers to use of hydrogen in natural gas networks and for (natural) gas end users”
- Direct connection with a new WG within CEN/TC234 to oversee the work
- Gap analyses which can be translated to pre-normative requirements

Wrap up

- A lot is happening on the field of hydrogen
- Focus of this presentation is on transport/distribution but there are developments throughout the hydrogen value chain.
- Do we foresee a role for PE100 pipes for distribution of hydrogen?



Stay in touch

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What makes Kiwa as a partner unique in the transition to H2



Network and collaboration with experienced international colleagues



Direct, 'Practical' experience in international, national and regional projects



A seat in various standards committees for H2



International expert and knowledge partner with vast experience in grids and gas grid systems operations



Direct access to relevant parties; suppliers, system operators, producers, ..



Unique mix of knowledge and expertise in the complete supply chain from production to end use



NBNL Hydrogen Roadmap

Overzicht van de stappen

	2020	2021	2022	2023
 Klant en product	<ul style="list-style-type: none"> Mogelijkheden samenstelling waterstof en toepasbaarheid (1 vraag Q2-21) Hoe waterstof herkend kan worden in verschillende samenstellingen (1 vraag Q4-21) 	<ul style="list-style-type: none"> Neveneffecten van het gebruik van waterstof samenstellingen op installaties van derden 		<ul style="list-style-type: none"> Hoe waterstof te verrekenen in verschillende samenstellingen Welke standaard specificaties van waterstof te gebruiken als norm Externe invloeden op waterstof (samenstelling) kwaliteit
 Infrastructuur	<ul style="list-style-type: none"> Technische risico's bij transport, distributie en toepassing van waterstof 	<ul style="list-style-type: none"> Beheersmaatregelen voor veilig transport, distributie en toepassing van waterstof (Het geschikt maken van) componenten en gereedschappen te gebruiken i.c.m. waterstof 		<ul style="list-style-type: none"> De kosten voor aanleg en beheer van transport en distributie van waterstof
 Omschakelen	<ul style="list-style-type: none"> Systeemkeuzes bij omschakelen en de impact ervan op de netbeheerders 	<ul style="list-style-type: none"> Vereiste externe randvoorwaarden voor start omschakeling Kansen en kosten van netbeheerders bij het omschakelen 	<ul style="list-style-type: none"> Vereiste voorbereidingen van netbeheerders om te kunnen helpen bij de omschakelkeuze 	<ul style="list-style-type: none"> Operationele aanpakken om een gebied efficiënt, veilig en klantvriendelijk om te zetten
 Markt-samenwerking	<ul style="list-style-type: none"> Een fasering in de tijd van de toepassing van waterstof in de verschillende marktsegmenten (GO, M, I) 	<ul style="list-style-type: none"> Hoe te blijven anticiperen op de ontwikkelingen in marktsegmenten/marktrollen Ontstane rollen bij de inzet van waterstof en in de ordening van de waterstofmarkt 	<ul style="list-style-type: none"> Hoe gaan de fysieke waterstof keten(s) eruit zien Wat te doen om de taken horende bij de (verwachte) netbeheerdersrollen te kunnen voldoen 	

Pilots in general

- Ports are investigating local H2 networks
 - Also looking at CCS
 - Pipelines to depleted gas field in the North Sea
 - Off shore Production of H2
 - RTP systems for H2 and CO2
- Industrial areas the same
- Local H2 networks with local supply