Hydrogen pipelines and transport infrastructures: international experience

Parallel session A

Wind Meets Gas 2022

Hosted by: Julio Garcia-Navarro

06-10-2022

Program

Presentations (13:30 - 15:00 hrs)		
Summary results HyDelta 1	NEC/HyDelta	Julio Garcia
Hydrogen Standardisation – Research Actions	GERG	Alexandra Kostereva
P2G and Hydrogen in the European and Regional Context	ERIG	Hans Rasmusson
Hydrogen & Distribution Networks	GRDF	Thomas Muller
H2-Flag ship projects Austria – From research to implementation	ÖVGW	Sascha Grimm
Discussion (15:00 - 15:30 hrs)		

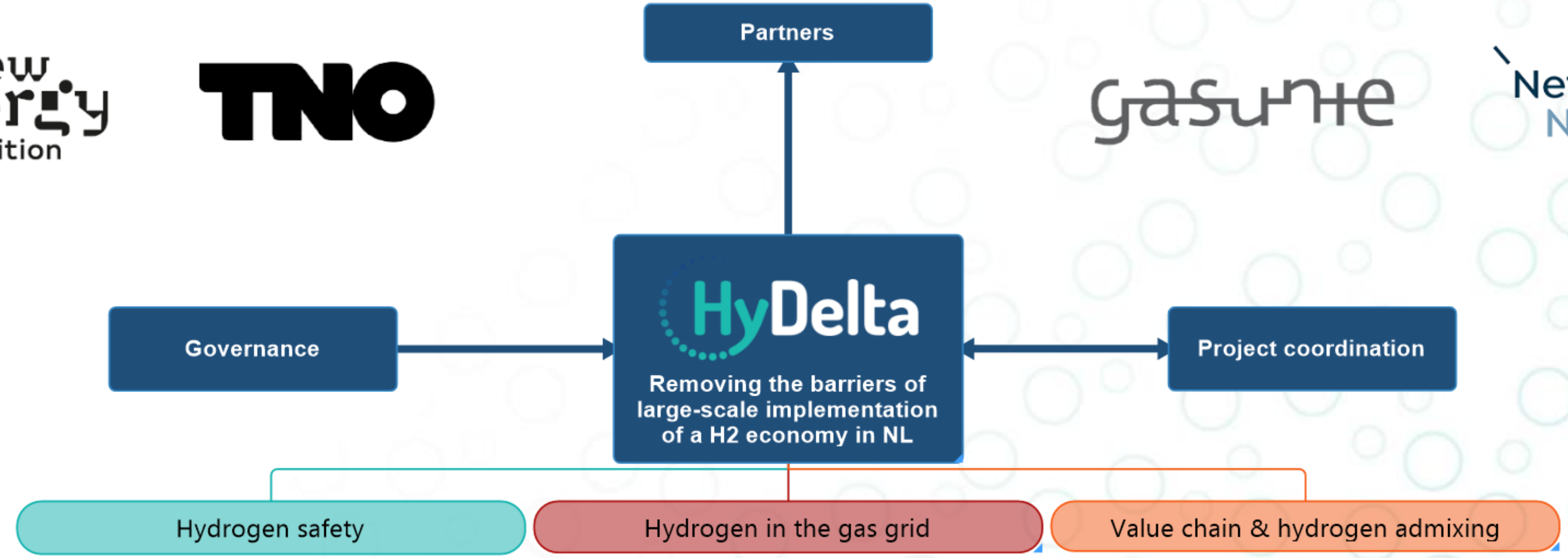
Summary results HyDelta 1

Julio Garcia-Navarro

Project coordinator

06-10-2022

HyDelta 1 – key data of the project

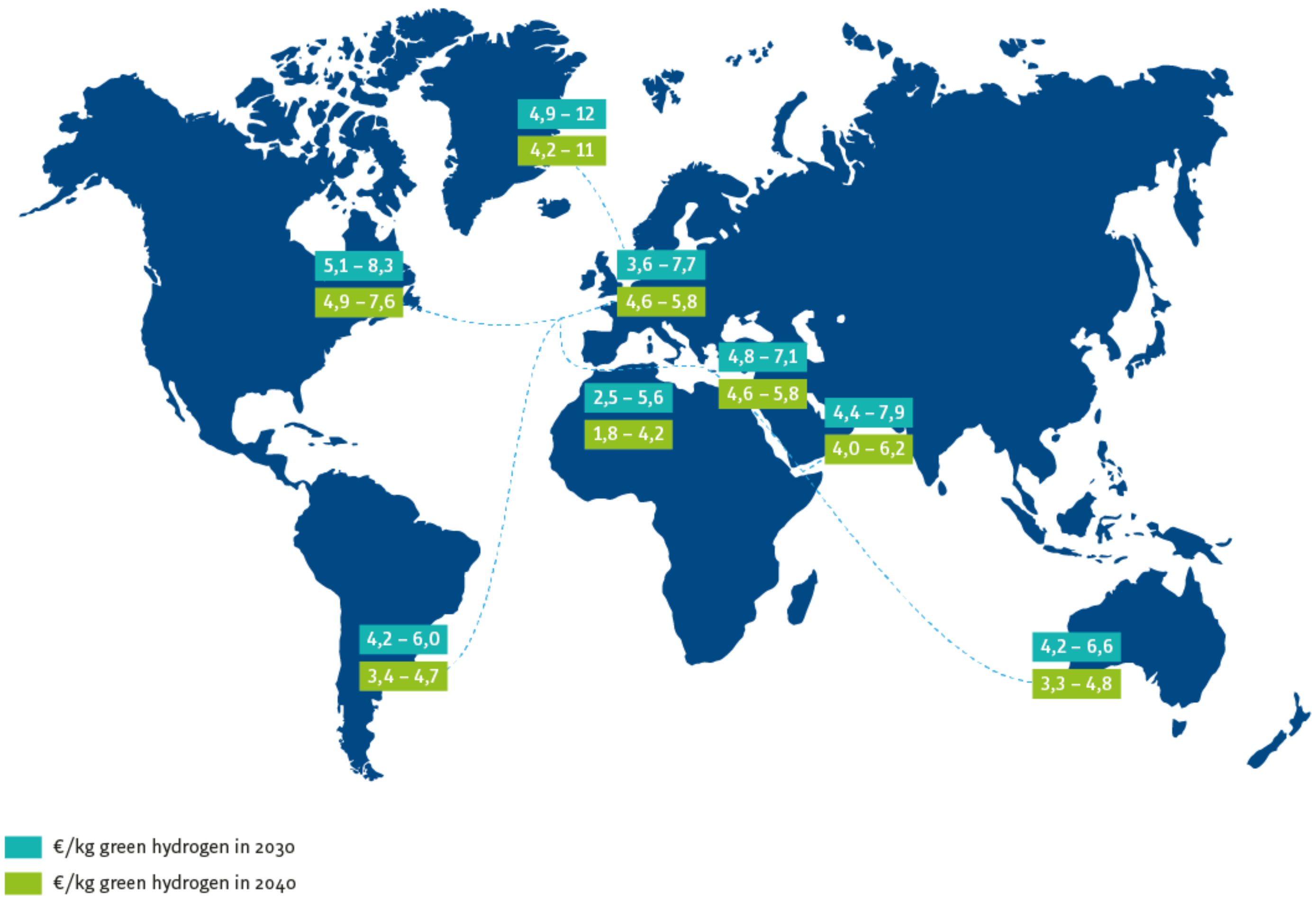


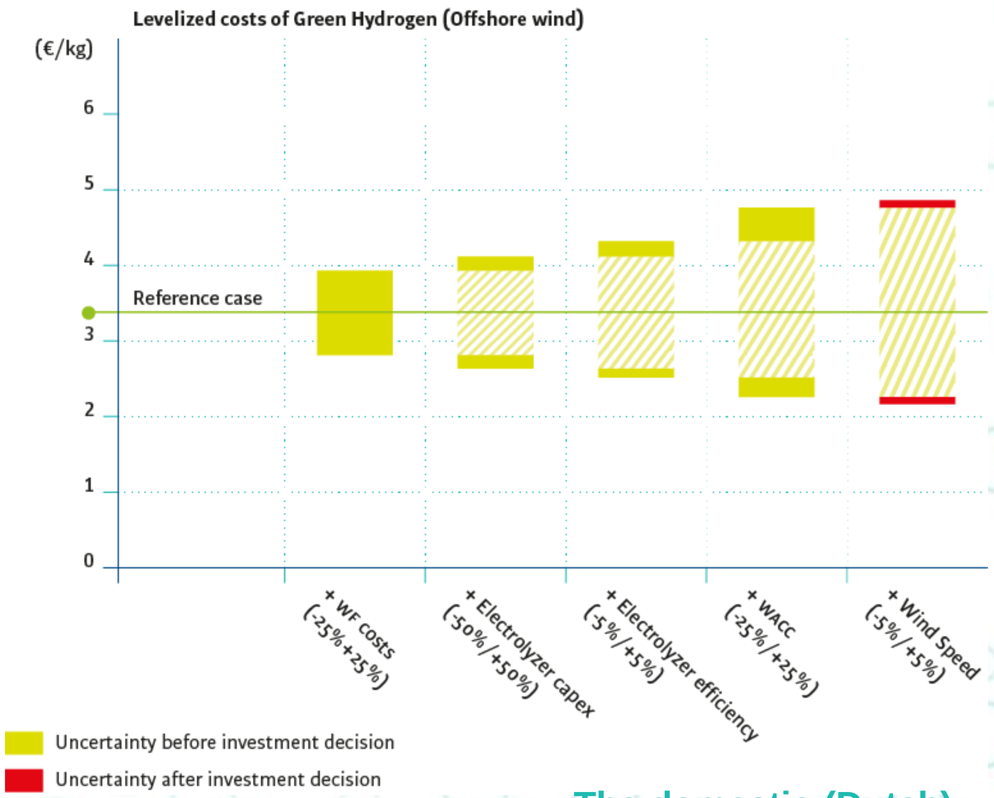
The HyDelta consortium: a public-private cooperation between research institutions and the Dutch transmission and distribution system operators, with the goal to research the economic and safety aspects of hydrogen transport via the existing natural gas infrastructure.

The HyDelta 1 project in numbers	
Duration	17 months
Budget	€2.3M
Number of deliverables (all publicly available*)	37 (*downloaded ~7000 times as per September 2022)
Coordinator	New Energy Coalition

Dit project werd medegefinancierd door TKI Nieuw Gas | Topssector Energie uit de PPS-toeslag onder referentie nummer TKI2020-HyDelta

Hydrogen production costs

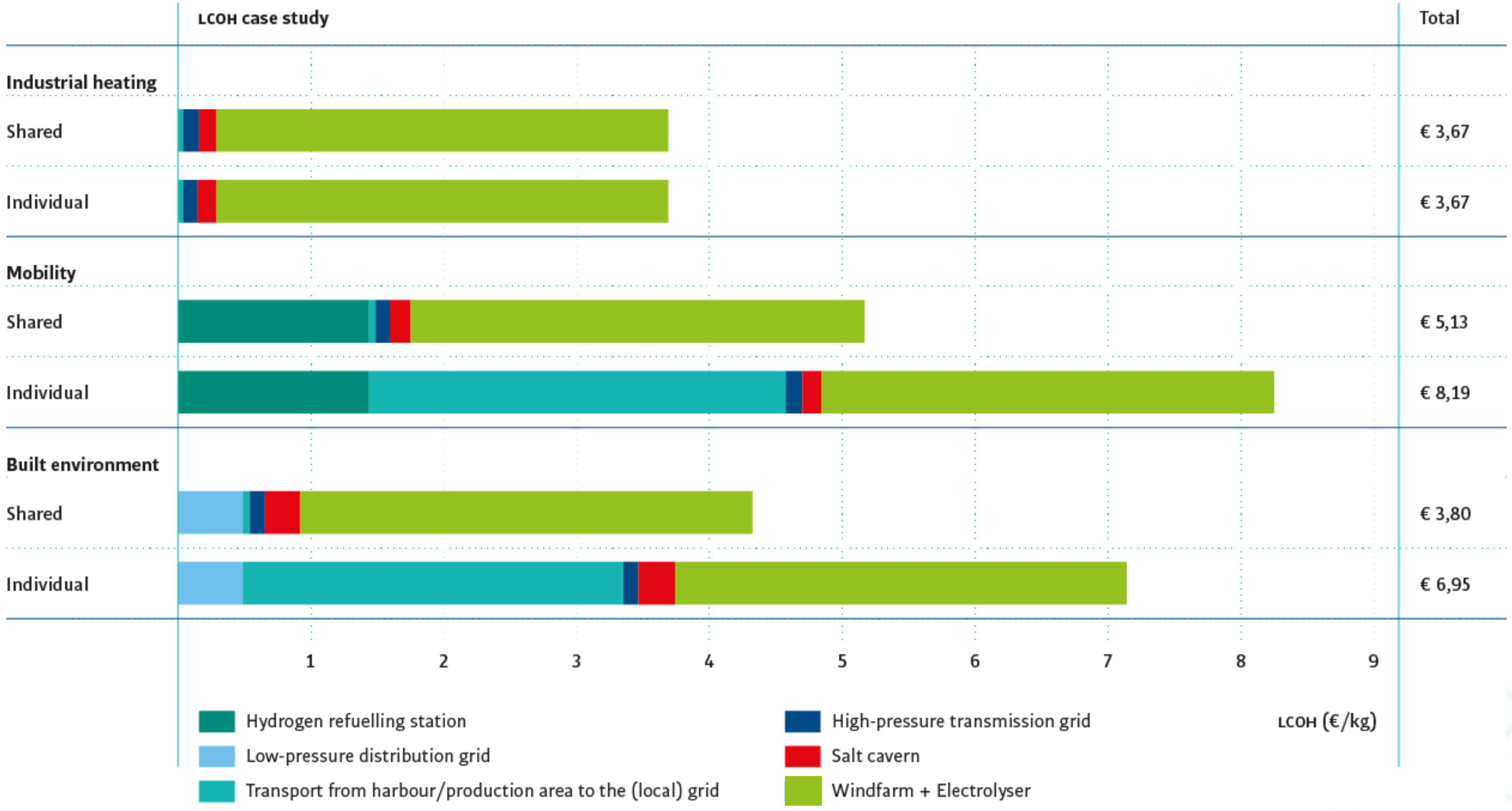


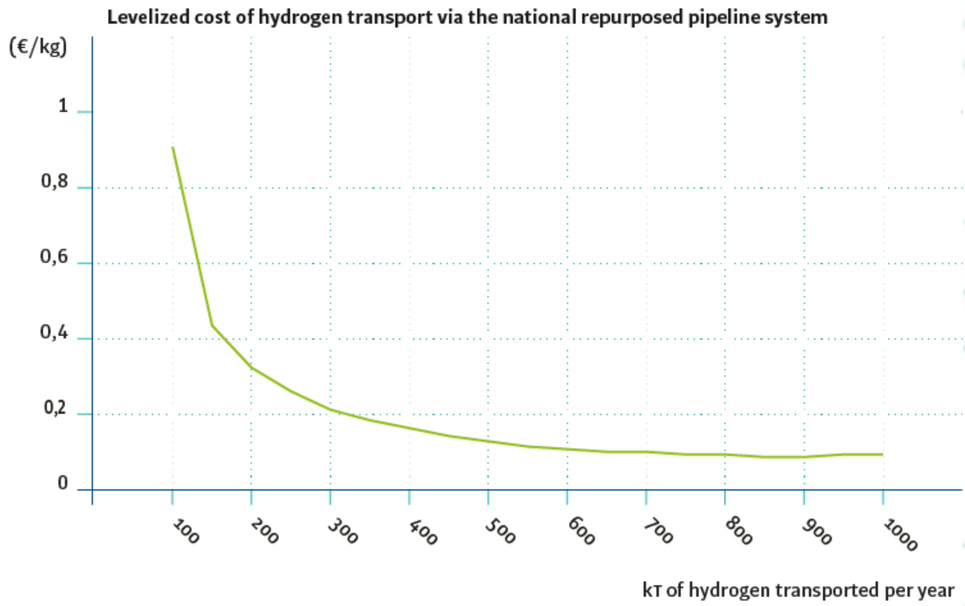


Green hydrogen can **compete** with **gray** hydrogen possibly as early as **2030**

The domestic (Dutch) production of clean hydrogen is remarkably competitive with respect to (future) imports of green hydrogen

Hydrogen value chains

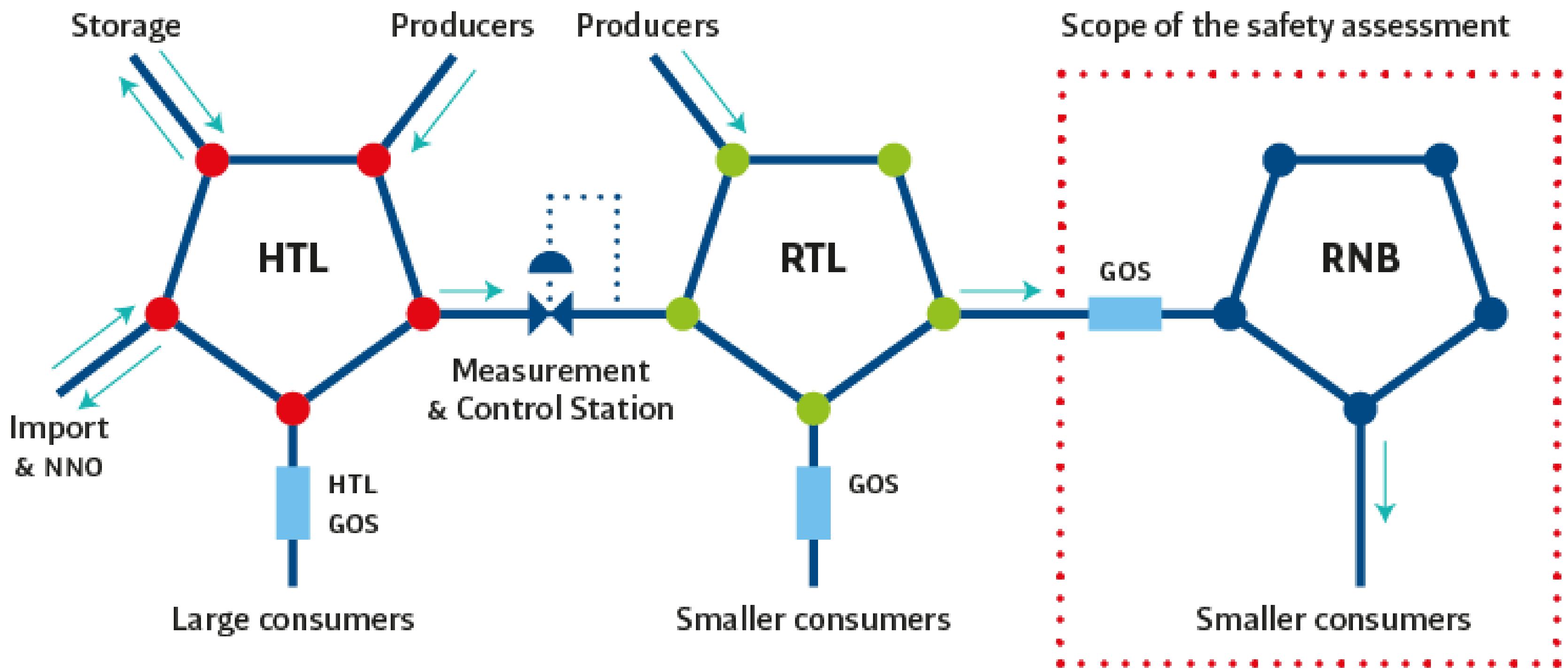




The costs of value chains can be significantly reduced when the use of the existing transport capacity can be shared by several users

Conclusion
When it comes to the cost of hydrogen, we have to think in terms of the entire value chain

Safe transport of hydrogen in the distribution grid



The two most **critical measures** to reduce safety risks regarding (potential) hydrogen leakages in the **distribution** network and the built environment are:

- **Odorization of hydrogen**
- **Optimal ventilation in closed spaces**

Most of the tested **components** of the natural gas network (pressure regulators, gas stations, gas valves and pipes and indoor installations) showed the **same leak tightness** for **hydrogen** as for **natural gas**

Conclusion
Besides a few adjustments, the (Dutch) gas distribution network is largely suitable for the introduction of hydrogen

Safe transport of hydrogen in the distribution grid

HyDelta

Onderwerp	Norm	Status/ Action	Content-wise	CEN/NL committee	Comments
Pressure testing in pipelines	EN 12327	Expand all clauses for hydrogen	The parameters for the test procedures must be adjusted	CEN: TC234 NL: 349008	Work safely. Definition in NEN 7244-7, still to be adjusted.
Gas fiscal flow metering	EN 12405	Developing cheap gas sensors. Increase the number of measuring points?	with variable gas composition, measure H2 concentration individually	CEN: TC 237 NL: 310066	Measuring devices can use H2 as a carrier gas, so they do not detect H2
Varying gas composition; determine the gas composition with high frequency	nieuw	Geographical aspects and time-dependent differences in H2 natural gas mixtures (H2IGO 2.3.1.4)	H2 sensors capable of measuring in a natural gas matrix are commercially available	CEN: n.v.t. NL: NBNL / H2IGO platform session 2021.	No start on this topic yet. Meter suppliers and Meter Responsible Parties have a preference for constant H2 content.
Safety and ATEX classification	ATEX guidelines	Hydrogen is described in ATEX regulations	Gas group IIC applies for > 75% H2 in natural gas	ATEX	This is critical for EVCDs, provided they are fitted in the metering cabinets.
Safety leak-tightness requirements and verification	Dutch national guidelines (VWI)	define acceptable values	There is no standard for what we consider acceptable leakage.	CEN: NL: NBNL	

The table above contains the **standards** that were identified as the standards with the **highest priority** towards **introducing hydrogen** in the **distribution** grid and the built environment

To cover all relevant safety aspects of hydrogen transport, various new standards must be introduced, or existing natural gas standards must be expanded to include hydrogen

How to introduce hydrogen to the gas grid

HyDelta

Proposed schemes

Proposed scheme	1: Industrial	2: Fuels	3: Generic gas mix
Market sectors	Chemical industry	Mobility	Public gas delivery
Obligated parties	Industries currently using hydrogen	Fuel suppliers	Gas suppliers
Base of the quota	% of H2 used	% of fuels (GJ) sold	% of gas delivered
Type of pilot	Virtual pilot	Pilot by adapting existing regulations	Pilot in specific region

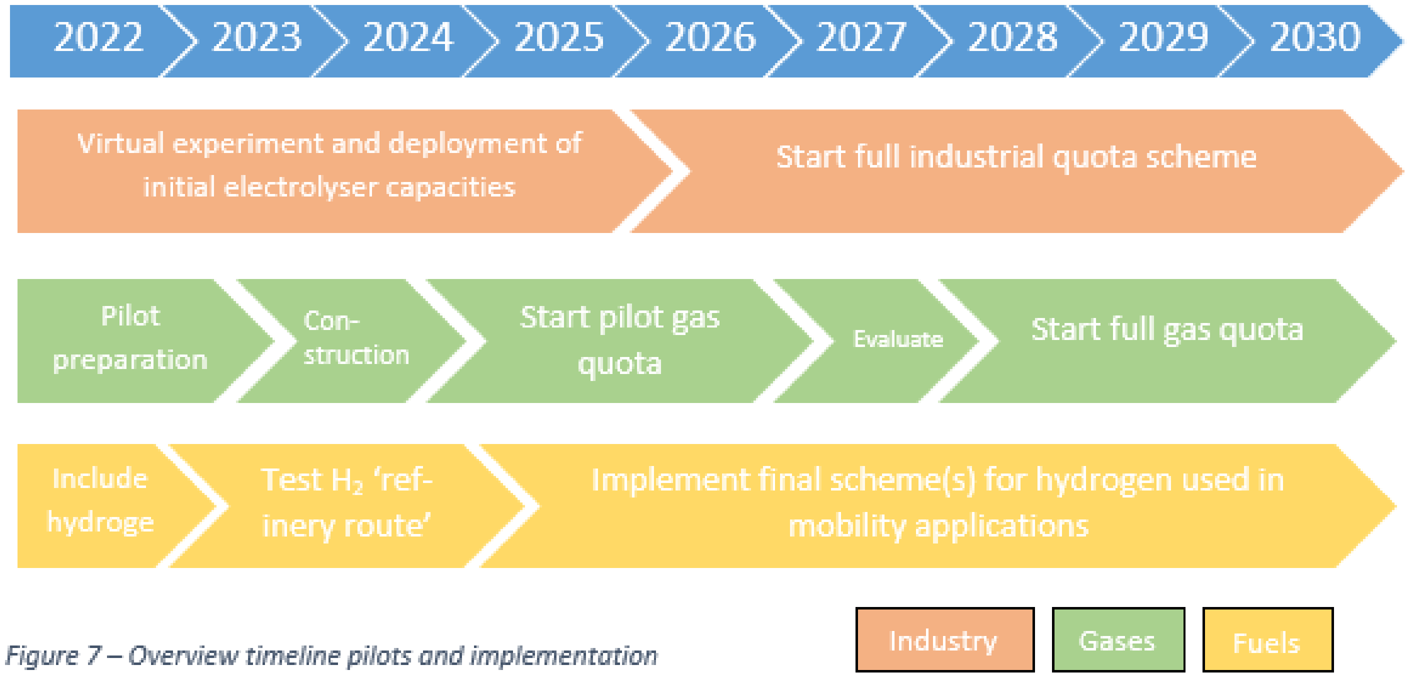


Figure 7 – Overview timeline pilots and implementation

It makes sense to quickly carry out a set of pilots on industrial and other applications of hydrogen in preparation for the mandatory purchase and/or mixing of hydrogen in the gas transport system. Careful consideration must be given to what this requires for both physical and administrative blending

Conclusion
The demand for hydrogen can be accelerated by mandatory purchase and blending; preliminary pilots are functional and necessary in the short term

HyDelta 1 summary report

HyDelta

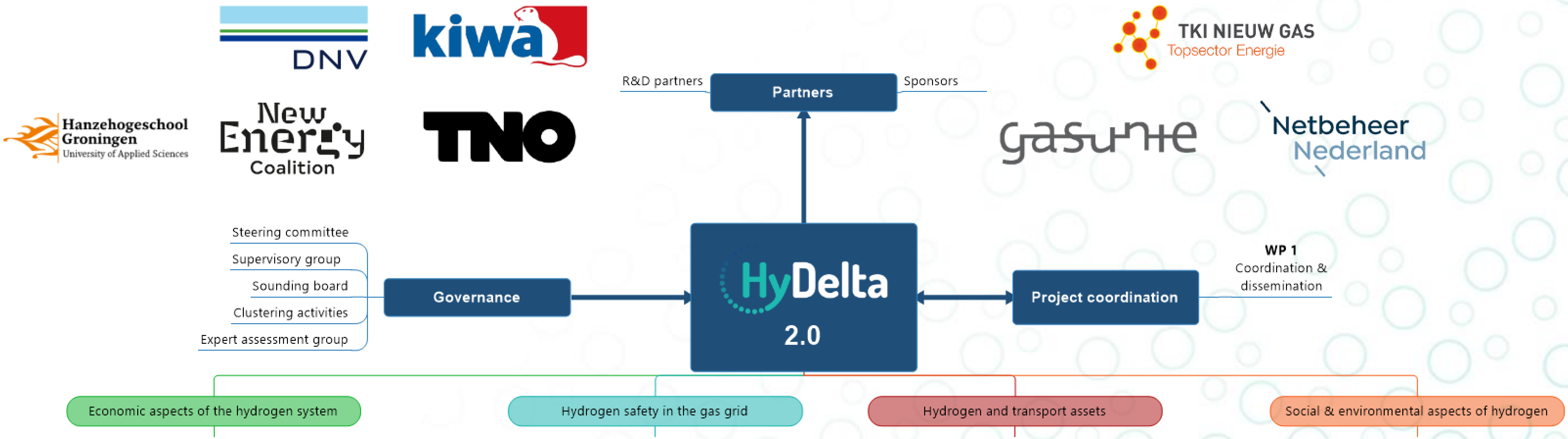
The most important findings of the HyDelta 1 project as well as their implications for the hydrogen economy have been summarized in the

HyDelta 1 summary report

Available online as of today

hydelta.nl/research-programme

HyDelta 2 – the next step in the HyDelta programme



HyDelta 2: particular focus on topics such as:

- Social acceptance of hydrogen transport
- The use of hydrogen to decongest the electricity grid in the Netherlands
- Safety procedures in the high- and low-pressure networks (ignition, containment of leaks, etc.)

The HyDelta 2 project in numbers	
Duration	12 months
Budget	€2.4M
Number of deliverables (all publicly available)	36 (expected)
Coordinator	New Energy Coalition

Dit project is medegefinancierd door TKI Nieuw Gas | Topssector Energie uit de PPS-toeslag onder referentie nummer TKI2022-HyDelta

HyDelta

HyDelta 1 & 2

Thank you for your attention!

Julio Garcia-Navarro

Project coordinator

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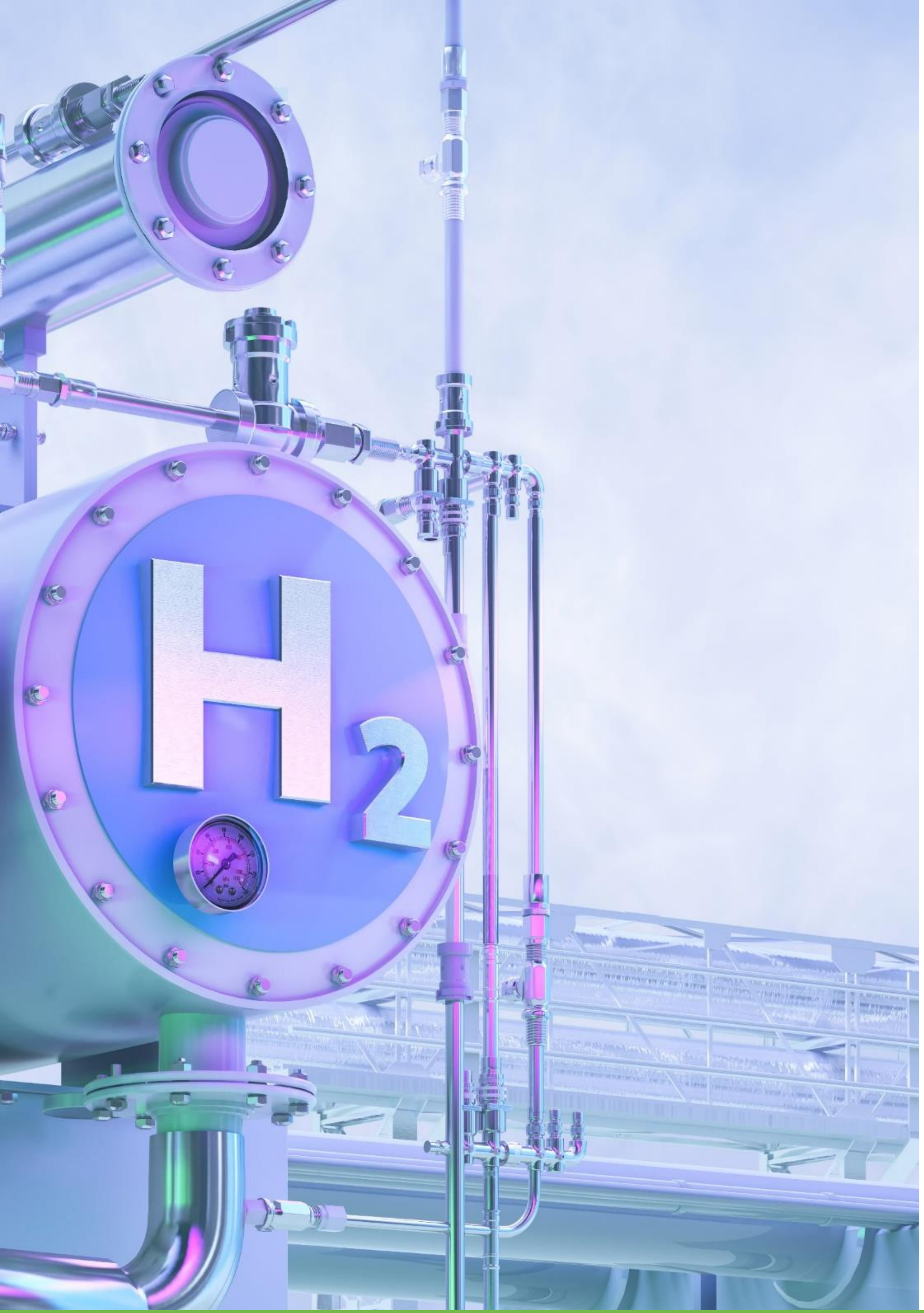
Visit us on
hydelta.nl
to access all our research results

Or follow us on social media at
linkedIn.com/company/hydelta
to find out about our latest developments



Hydrogen Standardisation – Research Actions

6TH OF OCTOBER 2022

ALEXANDRA KOSTEREVA

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GERG THE EUROPEAN GAS RESEARCH GROUP

The European Gas Research Group

GERG THE EUROPEAN GAS RESEARCH GROUP

Our members

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- Collaborative R&D group for gas with strong industry focus
- Over 30 members - gas companies, research centres and universities
- Young Researchers Event – Awards supporting the best students
- Links to Brussels Institutions and External Organisations

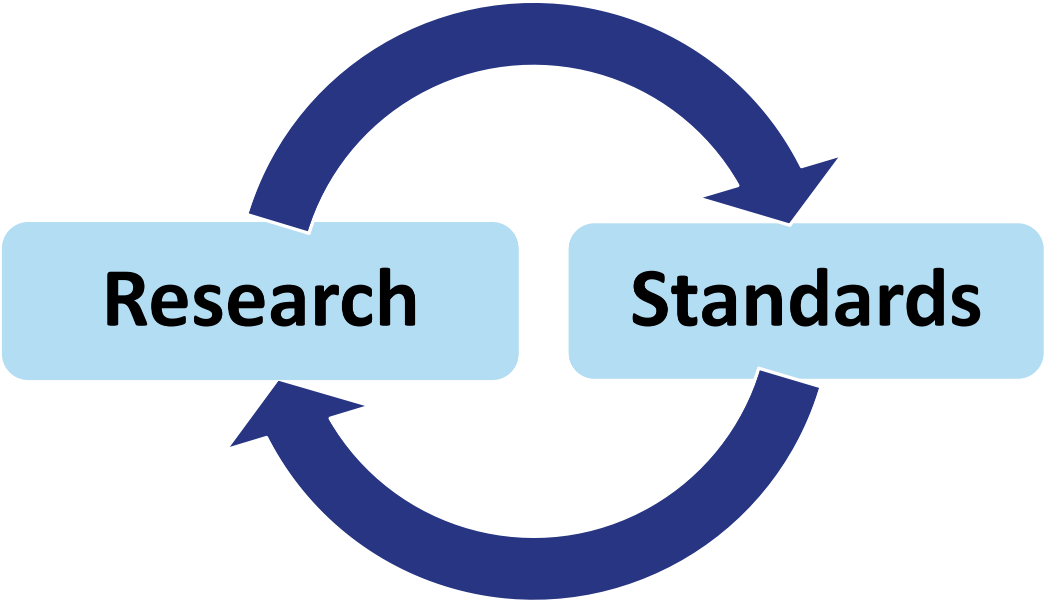
knowledge 4 innovation K4I Forum of the European Parliament • FCH • cen • entsog • gie Gas Infrastructure Europe • PRCI Pipeline Research Council International • gti • EPRI • LCRI • Decarbonised Gas Alliance • FUTURE FUELS CRC • eurogas • gas naturally • IGEM • IGU • marcogaz

EC-funded Projects

DEO • CONRAD • DIGBUILD • VOGUE • MICROMAP • PRESENSE • LABNET • GIGA • COMBO • NATURALHY • ORFEUS • INTEG-RISK • GASQUAL• LNG DENSITOMETER • ELEGANCY • THYGA • Biomethane Barriers • H2PNR

PNR?

- PNR: Pre-normative research
- Standards help to **bridge the gap between research and market** and increase the probabilities of market up-take
- Incorporating latest knowledge into new standards provides the foundation for **further developments**, **new research** and ultimately **new knowledge**



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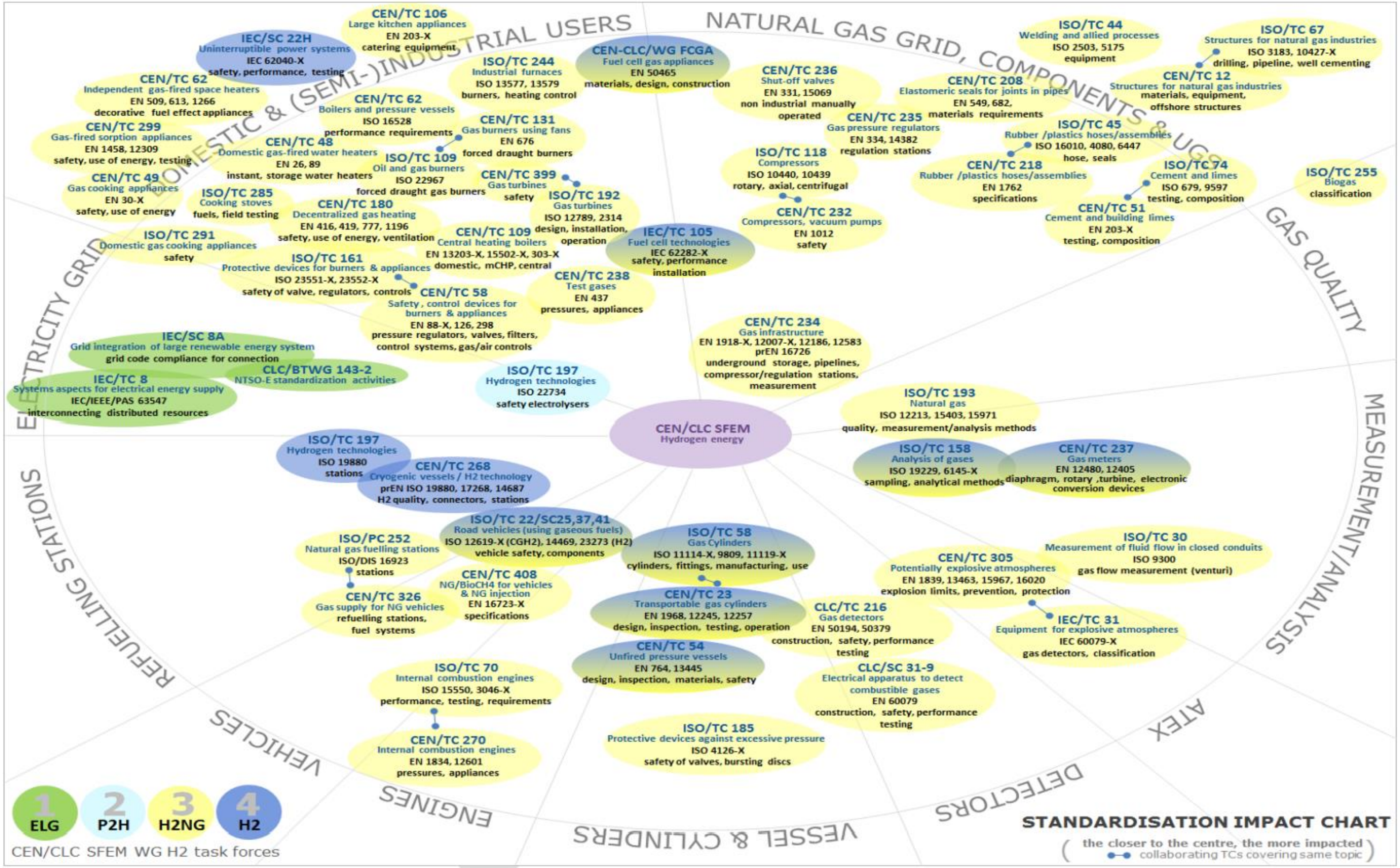
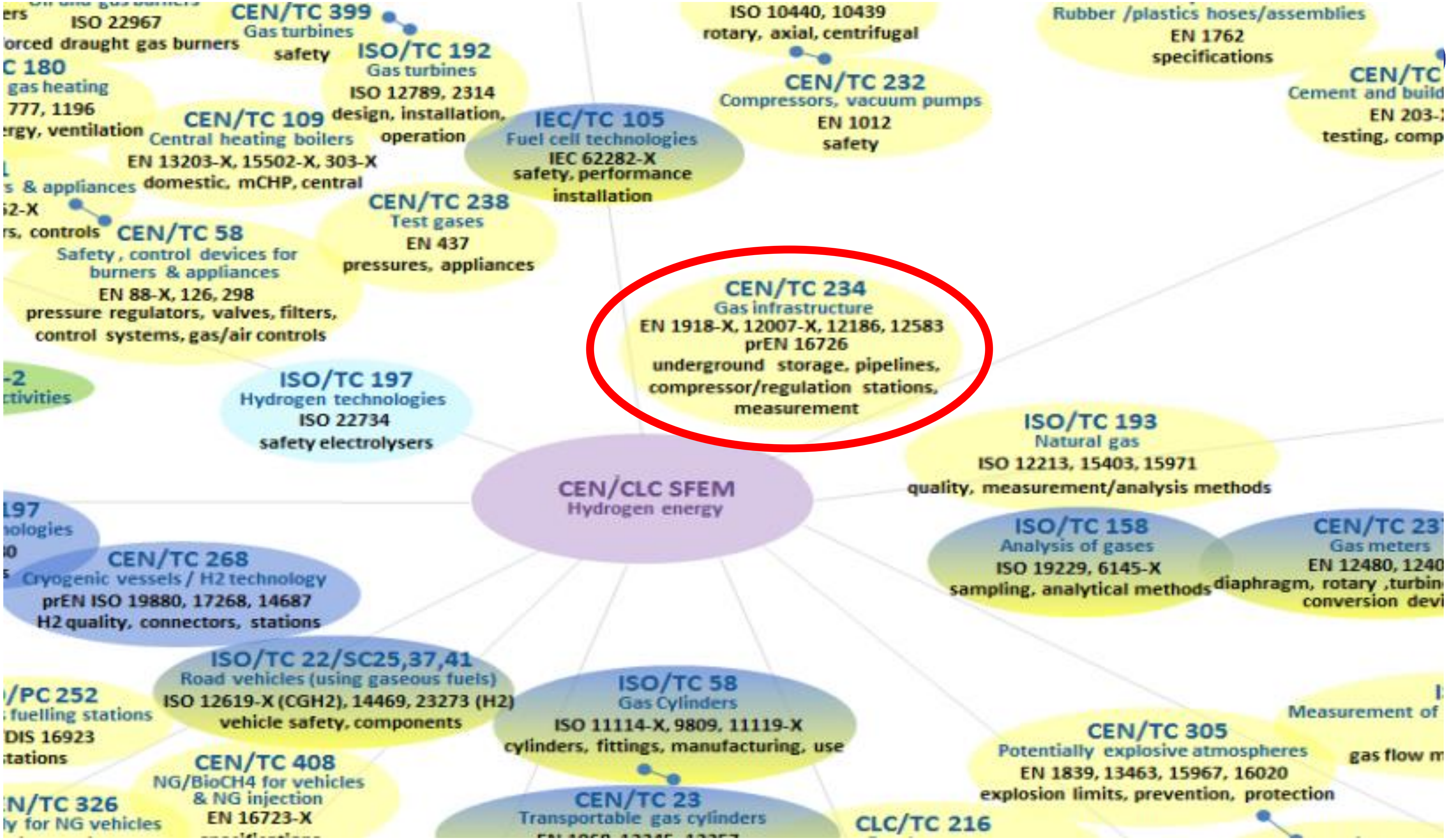


Figure 2 Mapping of international and European standardization activities in the area of hydrogen and H2NG.

SFEM WG H2 Final report



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CEN H2 PNR: Objectives and Priorities

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- To perform **detailed knowledge surveys** on the priorities
- To develop a **detailed understanding of the state of the art** relating to hydrogen injection in the gas networks based on international information sources
- To understand **gaps in knowledge** and develop proposed plans for mitigation
- To develop **recommendations** which include planned PNR activities to lower or remove barriers and enable update of standards or development of new ones
- To understand the **benefits of these actions versus business as usual** and to establish **costs of future PNR to remove barriers** wherever possible

	Priority / topic area	Lead
1	Safety	DNV
2	Gas Quality	GRT Gaz
3	Underground storage	DBI
4	Power Generation and Engines	DNV
5	Industry	Engie
6	Steel Pipes	GRT Gaz
7	Network Equipment	DBI
8	End use commercial and domestic	DGC
9	*Gas Quality Requirements for industrial users**	*GRT Gaz*
	Project administration on behalf of CEN	DIN
	Coordination, interfaces and transverse subject management	GERG

** A state of the art survey*

Project team

Delivery team	In kind support
DBI Gastechnologisches Institut, DNV, DGC Danish Gas Technology Centre, engie, enagas, GRTgaz, Imperial College London, kiwa, RISE Research Institutes of Sweden, TNO innovation for life	fluxys, gasunie, GAZ system, GRTgaz, nationalgrid, snam, storengy, TERĒGA LE GAZ, ACCÉLÉRATEUR D'AVENIR
CEN 234 Supervisory Board – over 100 experts from CEN TCs, Sector Fora, associations etc	
982 days	**Over 150 days**

Methodology

- First phase for each topic: **bibliographic/knowledge study and gap analysis to understand the state of the art** – well over 1000 data sources collected

- Each main WP leader collated information on transversal elements between topics (deliverable);

- Second phase was **detailed assessment of knowledge and gaps and finally reporting on these gaps and defined actions to mitigate**

Klaas van Alphen (Future Fuels CRC)	Plastic pipes for hydrogen and blends	Project Report	**3.1-03 Future proofing plastic pipes**	2022	Australia	Deakin University, University of Wollongong, APA, Jemena, Worley Parsons, OSD, AusNet	Develop a standardised suite of tests to identify polymer/elastomeric compatibility with hydrogen and its blends and generate an understanding of the capacity for current pipeline materials (plastics and elastomeric) to transport future fuels
Robert Judd (GERG)	Storage	External publication	**Current status of chemical energy storage technologies**	2020	Europe	Joint Research Center (JRC)	The aim of this report is to give an overview of the contribution of EU funding, specifically through Horizon 2020 (H2020), to the research, development and deployment of chemical energy storage technologies (CEST). In the context of this report, CEST is defined as energy storage through the conversion of electricity to hydrogen or other chemicals and synthetic fuels. On the basis of an analysis of the H2020 project portfolio and funding distribution, the report maps research activities on CEST at the European level. In addition, projects funded at national and international level, occurring within the same timeframe, have been considered.
Maxime Bertin (GRTGaz)	General	External publication	**Options of natural gas pipeline reassignement for hydrogen : Cost assessment for a Germany case study**	2020		S. Cerniauskas et al.	
Maxime Bertin (GRTGaz)	Integrity	Internal Report	**Impact sur la ténacité d'un mélange 99,5%N2 + 0,5%H2 et calculs API**	2020	France, Europe	GRTgaz	Experimental study of the effect of hydrogen on toughness of an API X70 steel and defact assessment ussing API579 "fitness for Service
Maxime Bertin (GRTGaz)	Integrity	Internal report	**Impact de l'ajout d'hydrogène sur les cirètre du Guide d'Analyse des Défauts**	2020	France, Europe	GRTgaz	Study of the effect of hydrogen of GRTgaz defect assessment criteria
Amelie Louvat (GRTGaz) Graham Hill (GHD)	General	External publication	**H2@Scale: Opportunities for Hydrogen as an Energy Intermediate**	2020	USA	NREL	Document summarizes objectives of H2@Scale project and desired outcomes for future of hydrogen in energy systems.
Robert Judd (GERG)	Summary of projects	Internal Report	**National Grid Hydrogen Innovation Programmes**	2020	UK, Europe	Antony Green	A complete list of Completed, ongoing and Future Natioanl Grid Hydrogen Projects
Robert Judd (GERG)	Summary of projects	Internal Report	**Strategic Hydrogen projects of GERG Members Overview**	2020	Europe	GERG	To understand the current panorama of member activities in order to construct a Roadmap for hydrogen introduction
Gary Choquette (PRCI)	Boiler End-Use	External publication	**The Development of Natural Gas/Hydrogen Boiler System**	2020	Netherlands, Europe	DNV	A sustainable route to reduce the CO2 emission of industrial heating processes is the addition of hydrogen to natural gas and on the long term to replace natural gas completely by hydrogen. In this study a burner system that allows the safe and reliable combustion of natural gas, natural gas/hydrogen mixtures and hydrogen is developed and tested.
Klaas van Alphen (Future			**FFCRC 3.1-01 | Review of future fuels**			University of Wollongong,	Literature review - Review fracture control methodologies and testing methods for future fuels pipelines, review past and present projects along with existing

Identification Initial review by:
Subtopic
Nature of knowledge
Document Publication title
Publication year
Geographic area (Country)
Authors
Objectives
Results
%H2 studied
%H2 acceptable
Availability of data
Sharing modalities
Source
Relevance of study

CEN H_2 PNR: next steps

- Alignment with **European-level standardisation** initiatives
- Continued ongoing use of the collected canvas to develop and deliver on priorities with CEN TCs
- **Specific action within CEN SF JTF** : Task Force Industrial Needs Hydrogen Quality
- Input into **Research Roadmap exercises**:
  - Launch of research and PNR projects **in GERG and with Partners**
  - Launch of projects in collaboration with **other associations**
  - Launch of projects in the **Horizon** framework (Clean Hydrogen Partnership, etc)
- Continued dissemination of information (e.g. European Commission) and beyond

Task Force Industrial Needs Hydrogen Quality

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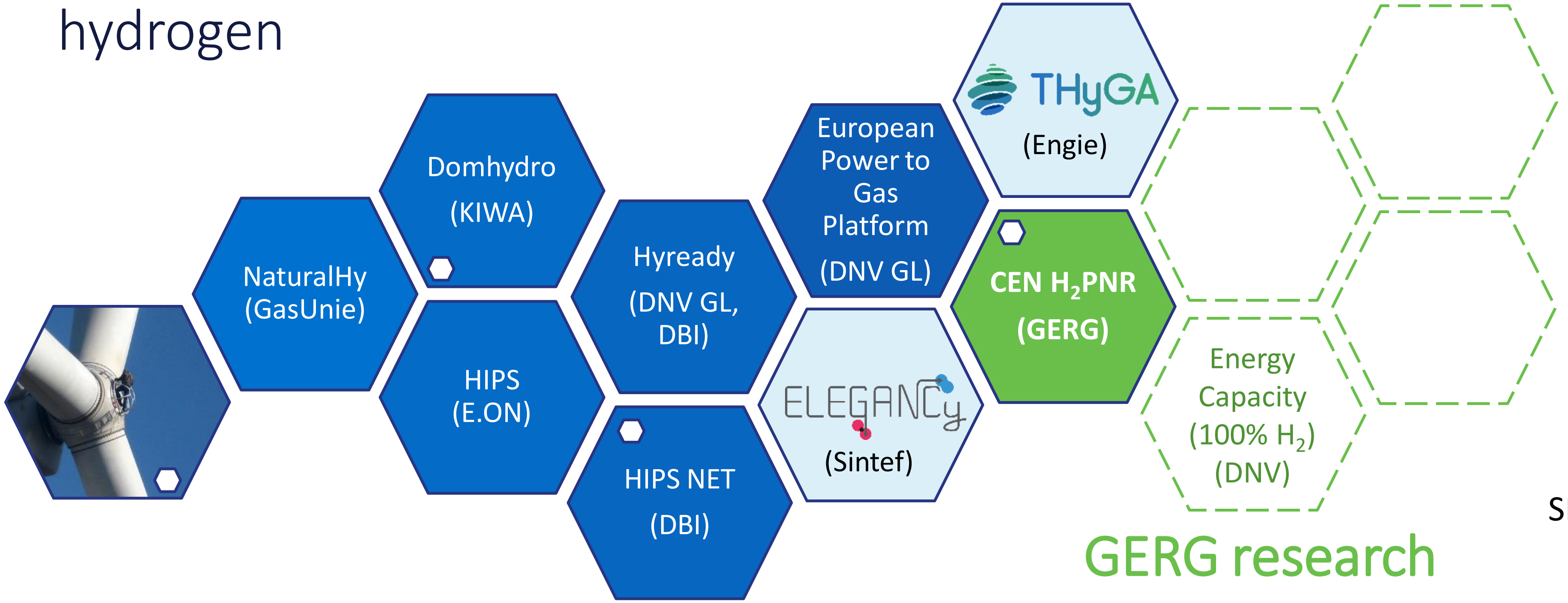
CEN CENELEC

- New Task Force created during the CEN H2 PNR project
- For gas quality of H_2 making use of the current NG infrastructure, a maximum of 98% can be guaranteed.
- **Objectives of the TF**:
  - Determine the needs of the industrial end-users
  - Assess impacts of the H2 quality (technical, financial)
  - Define needed PNR / Standards.

CEN H2 PNR in GERG Hydrogen activities:

Network adaptation and hydrogen



GERG research roadmap

SFEM Working Group Hydrogen

Fundamental Research

Gap analysis + PNR

Standards

GERG Hydrogen Research Roadmap

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Gas Quality	Asset Materials	End-Uses	Maintenance and Safety	Underground Storage	New Technologies
Meters, analysers and sensors	Pipeline integrity	Industrial end-use	Odorisation	Salt caverns, Aquifers and Depleted O&G Fields	H_2 injection & blending
Quality of H_2NG blends & dedicated H_2 grids	Impact of H_2 on other components & new materials	Domestic and commercial appliances	Safety: leak, flammability & explosivity		Ammonia & other H_2 carriers
Gas properties and billing	Impact of H_2 on compressors	Combus-tion of H_2NG blends	Maintenance & monitoring		Separation of H_2 & natural gas from the blend

>100 Hydrogen Experts

16 Categories

6 Timelines

115 Research Topics

A holistic approach within GERG

- Current exercise: **Mapping of the research gaps**
- Objective: **visualise progress** and **incentivise action** on the most critical topics that are not being addressed

Existing work	**Funding opportunities** (e.g., Horizon Europe, Euramet, etc.)
• GERG Members' projects • Other ongoing industry projects	• Clean Hydrogen Partnership • Euramet • Partner associations: PRCI, EPRG… • Etc

- Collaborative, living document => networking tool for experts

Linkage to the THyGA project:
Testing Hydrogen admixture for Gas Applications

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THyGA

Project Objectives

SCREEN THE PORTFOLIO OF APPLIANCES

Screen and segment the portfolio of appliance technologies in the **domestic and commercial sectors** and assess the impact of hydrogen admixtures.

TEST APPLIANCES

Test **up to 100 various residential and commercial gas appliances** (boilers, water heaters, cooking appliances, catering equipment, local space heaters, radiant heaters…). **Up to 60 vol.% of hydrogen admixed.**

MAKE RECOMMENDATIONS

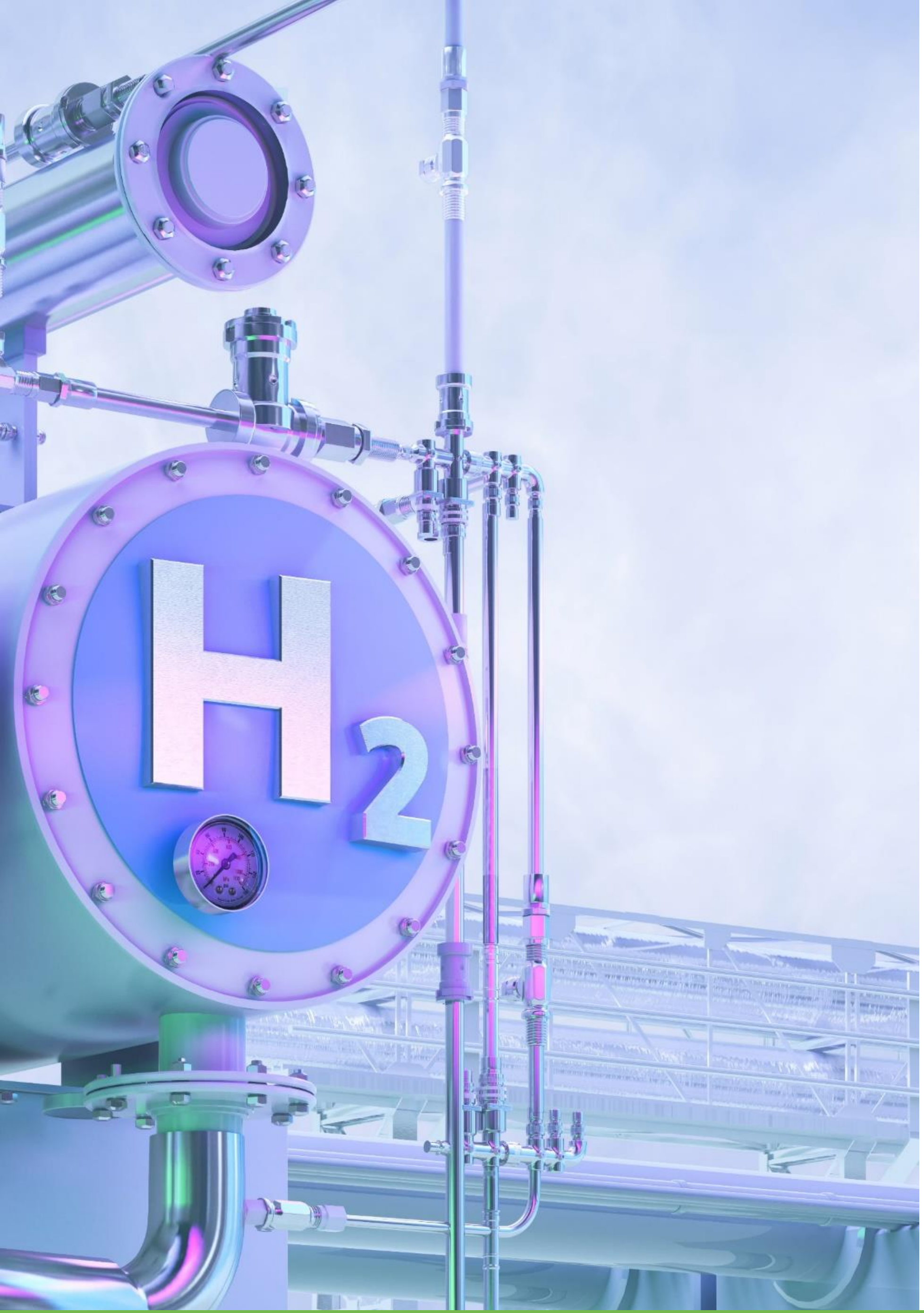
Make recommendations for **manufacturers, decision makers and end-users** along the gas value chain for appliance design, manufacture and certification.

DEVELOP A CERTIFICATION PROTOCOL

Work on **certification protocol for different levels of H2 in natural gas**, exchanges and recommandations to Technical Committees

Standardisation activities:

- Overview of the **current standardisation/ certification framework** and description of the identified issues
- Overview of relevant existing testing/ certification experience – joint workshop organized with the CEN PNR project



Wrap-up

- The CEN H_2 PNR project was a **flagship initiative**, successfully delivered through the engagement of the large project team.
- The extensive literature study confirmed that gaps remain in all sectors related to the introduction of hydrogen to the gas networks – technical or regulatory.
- **Collaborative R&D** and knowledge sharing are key to ensure the efficient development of H_2 technologies.

https://www.gerg.eu/anniversary-conference/

European Research Institute for Gas and Energy Innovation

P2G and Hydrogen in the European and Regional Context

Sep 6th 2022 at Wind meets Gas, Groningen

Hans Rasmusson
Secretary General

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The ERIG working principle for research about *"the optimal exchange between electrons and molecules"*

- Country Members bring in national research and industry connections to the ERIG Community
- The ERIG Community elaborate on topics of common interest, form consortia and generates EU funded projects
- The projects generate knowledge, facts and innovation
- The output serves the public and the EU

ERIG Theses for the European Energy Future

Three overarching guiding principles

1. **Quality** - Suggestions for actions must be based on accountable research and realistic projections of possible developments

2. **Completeness** -Time, existing infrastructure, and overall systemic effects must be primary considerations

3. **Feasibility** - Disruption must be minimised for social acceptance and feasibility

Three theses for a successful energy transition

1. **Gas in the center**

   - Gas is the key factor in achieving an integrated energy system of electrons and molecules

2. **Multi-gas not Mono-gas**

   - All types of energy gas should be considered and deployed on the market based on their GHG reduction potential

3. **Gas is an R&D priority**

   - R&D efforts for gas solutions must be intensified

Overview of the ongoing projects with ERIG involvement

1. **HIGGS** - Hydrogen in Gas Grids
2. **LivingH2** – Living Laboratory Demonstration of Complete Pure Hydrogen Fuel Cell Cogeneration System
3. **MefHySto** - Metrology for Advanced Hydrogen Storage Solutions
4. **HEAVENN** - Hydrogen Energy Applications for Valley Environments in Northern Netherlands
5. **SuperP2G** - Synergies Utilising renewable Power Regionally by means of Power to Gas
6. **Hy2Market** - Interconecting regions in Europe developing H2 Business cases
7. **ReHaul** - Renewable Long Haul Road Transport Study Considering Green House Gas Emissions, Technology Improvements and European Infrastructures

Follow us on LinkedIn and Twitter

"The HIGGS project will help decarbonize the European gas grid by clearing the pathway for the admixture of hydrogen."

HIGGS Hydrogen in Gas Grids
www.higgsproject.eu

"Hydrogen will play a major role in energy storage systems – our project will secure correct metrology of hydrogen and hydrogen blends"

MefHySto Metrology for Advanced Hydrogen Storage Solutions
www.mefhysto.eu

"P2G is a key technology to bridge the major energy grids and consumers - our project will help stakeholders find and evaluate the beneficial regions"

SUPER P2G
www.superp2g.eu

Hydrogen in Europa – Status Quo

EU Hydrogen Strategy

- **Untill 2024**
  - Installation of 6 GW H_2-Elektrolysers
  - Production of ~ 40 MWh renewable H_2
- **From 2025 to 2030**
  - Installation of 40 GW H_2-Elektrolysers
  - Production of ~ 400 MWh renewable H_2
- **From 2030 onwards**
  - Large scale deployment of H_2 in all hard to abate sectors

REPowerEU

REPowerEU is the approach of the European Comissions to end end dependancy from import of Russian fossil fuels.

__Focus__

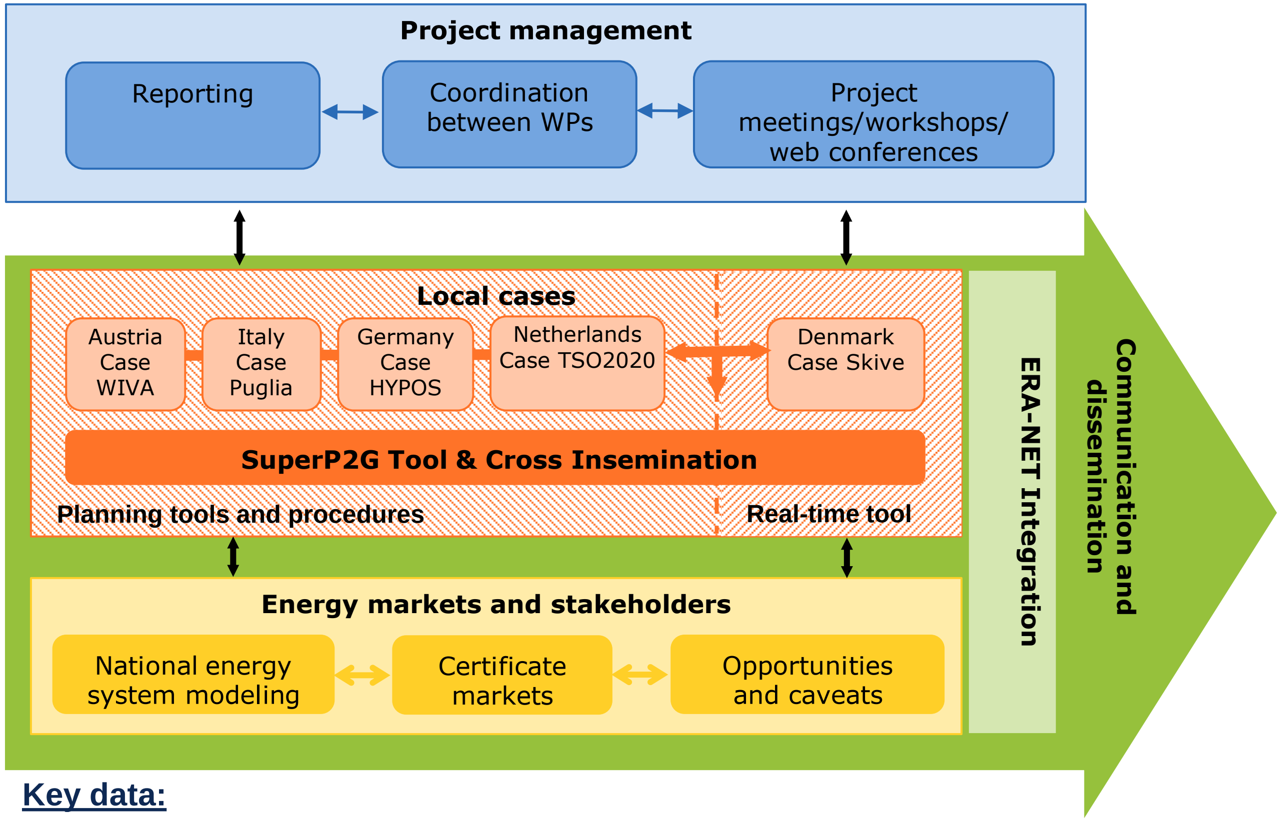
a) **Saving energy**
b) **Production of clean energy**
c) **Divercification of the energy supply**

1. Hydrogen Acceleration by installing **17,5 GW electrolysers until 2025**
2. Supply the industry with **10 Million tons of European** produced renewable hydrogen + **10 Million tons import** to Europe
3. Increase the ambition from 40% renewable energy in **2030 to 45%**
4. Increase the production of **Biomethane to save 17 billion m3 of Natural Gas import**

SuperP2G - Synergies Utilising renewable Power REgionally by means of Power-To-Gas

The Project at a glance

- SuperP2G interconnects leading P2G initiatives in five countries, ensuring joint learning.
- Each national project focuses on different challenges, where researchers team up with local need-owners to co-create solutions.
- SuperP2G focuses on improving existing evaluation tools including open access, as well as develop a new open tool.
- This is supplemented with analysis of regulation and markets, as well as stakeholder involvement.



Key data:

- Duration: 36 Months
- Start: 01.11.2019

Research partners:

- **Denmark:** DTU ME, DTU Elektro, GreenLab Skive
- **Austria:** JKU Linz
- **Germany:** DBI-GTI, DVGW-EBI
- **Italy:** CNR, Uni Bologna
- **Netherlands:** RUG-FEB
- **Europe:** ERIG

The national Cases – Each case has different focus

Netherlands Case – TSO2020
contribute to the realisation of societal objectives in the field of climate policy by **exploring the economic conditions** and **potentials of hydrogen** supply chains **Production, Transport, Storage, Distribution, Trade, Consumption** thereby giving in-depth insight to stakeholders on the **costs and benefits** of several options **to design such a system**

Germany Case – HYPOS
improve existing tools **“H2Index II”** and **“EcoMeth”** for **H2-Prize analysis** and **optimal location of P2G value chains** suitable for the regional development **considering future H2-Demand** and **process engineering and design of P2G-plants**, tailored to fit the **specific application and circumstance**

Denmark Case – GreenLab Skive
make it possible for **local multi-energy carrier-based business park** to manage **multiple value streams** in **real time** as well as **optimise the infrastructure set-up** in a feasible way

Austria Case – WIVA P&G
promote regional integration of renewable energy across energy vectors by providing a **methodology for assessing future demand** for **renewable H2** and **SNG** for the **industry**, including aspects of **cost development** based on existing tools of **“MOVE”, “Collect”, “Prestige”**

Italy Case – Apulia
allow for national regional smart energy systems and sectoral integration evaluation including P2G by providing a **national database for dynamic power production** info and **hydrogen demand** based on **public available data** added with **own results** of analysis and **laboratory tests**

One example of a possible Tool-Chain from SuperP2G – the Apulia Case Study

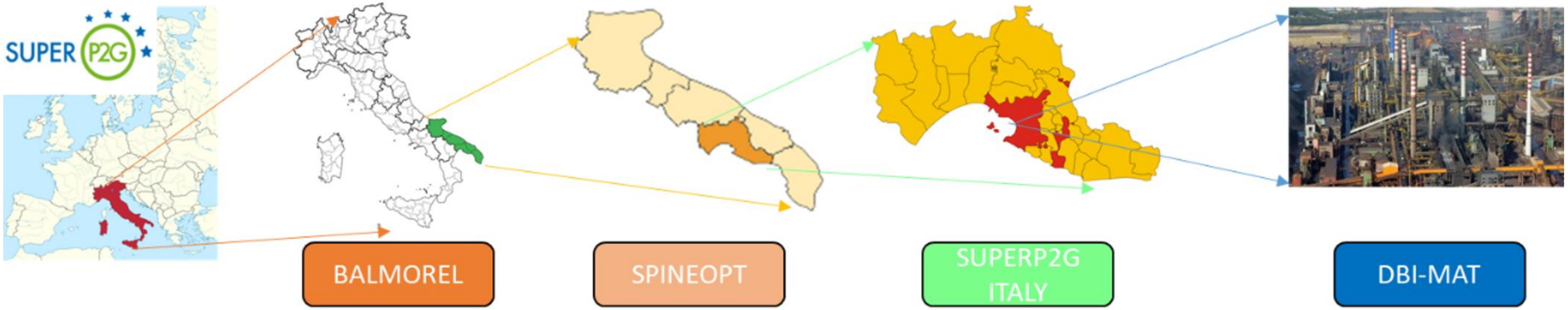
Basic Facts about the Apulia province

- **Electrical Renewable Energy:** 51,000 PV plants and 1,000 wind turbines installed in Apulia in 2021
  - Photo Voltaic: 2.55 GW with about 3,5 TWh/year
  - Wind: 2,45 GW with about 4,5 TWh/year

- **Biological Renewable Energy:** Up to 75,000 ton/year of agricultural residues are available in the region.

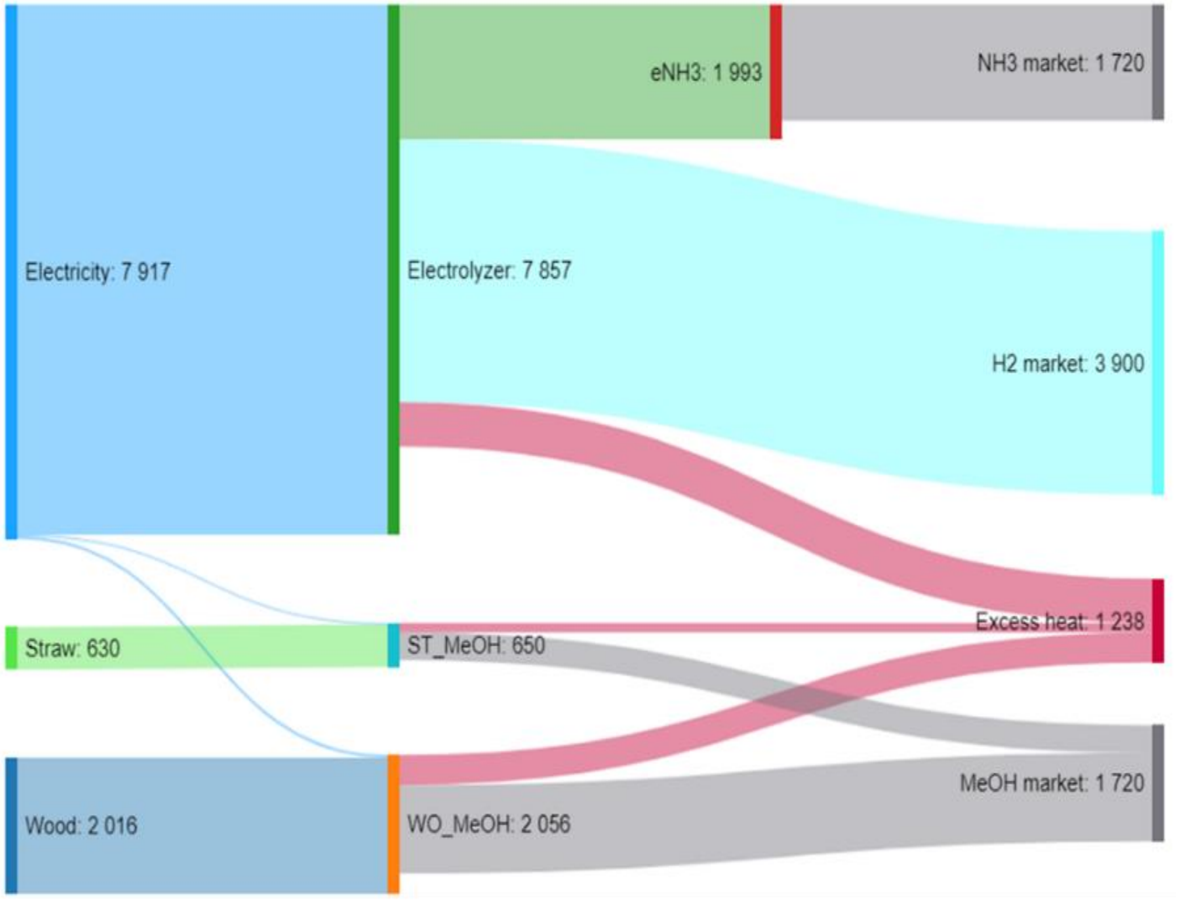
The objective of the case study

1. to **evaluate** the **resources** and the **P2X conversion technologies** to ensure the **best techno-economic performance of the system** for each region of Apulia
2. to identify the optimum **size and location** for the installation of **P2G plants** at local level
3. to investigate the **design** and **operation** of a **P2G plant** connected to the existing **steelmaking plant** in Taranto.

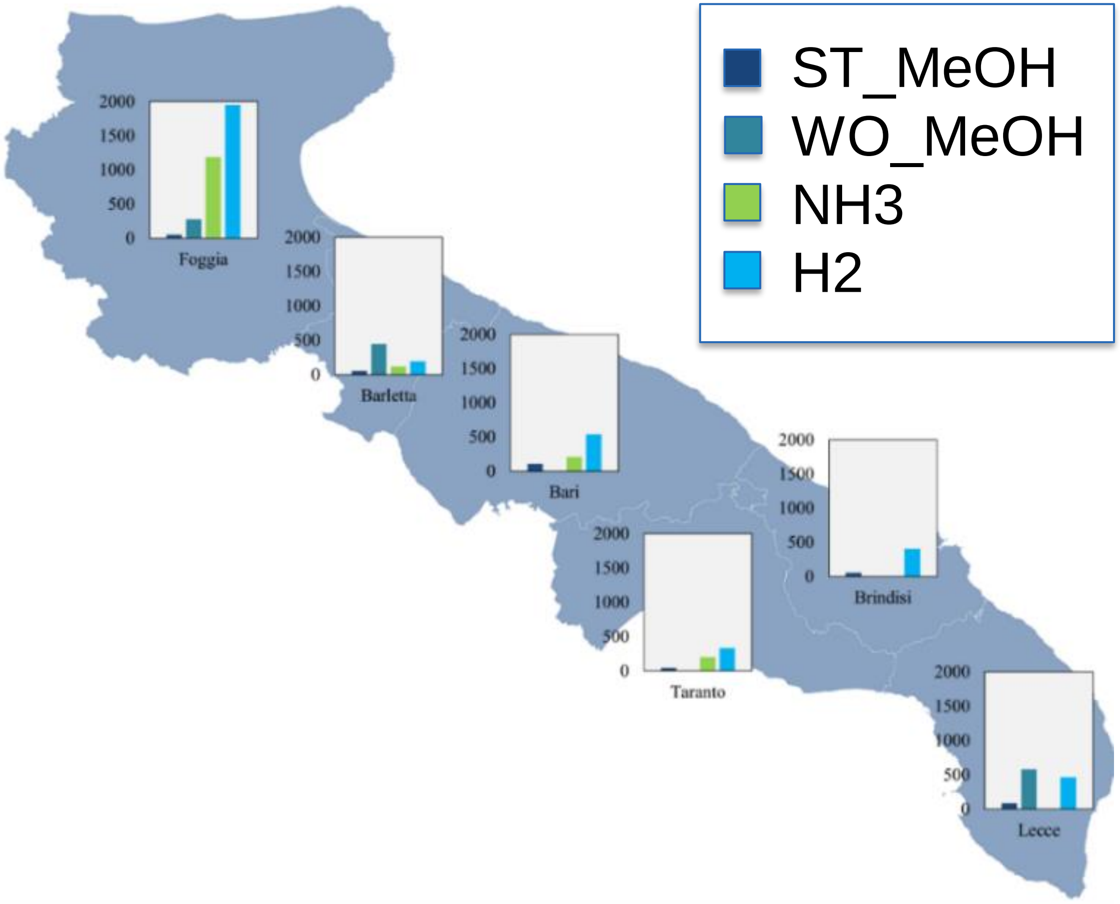


Renewable value chains and potentials in the Apulia regions using "BALMOREL" and "SPINEOPT"

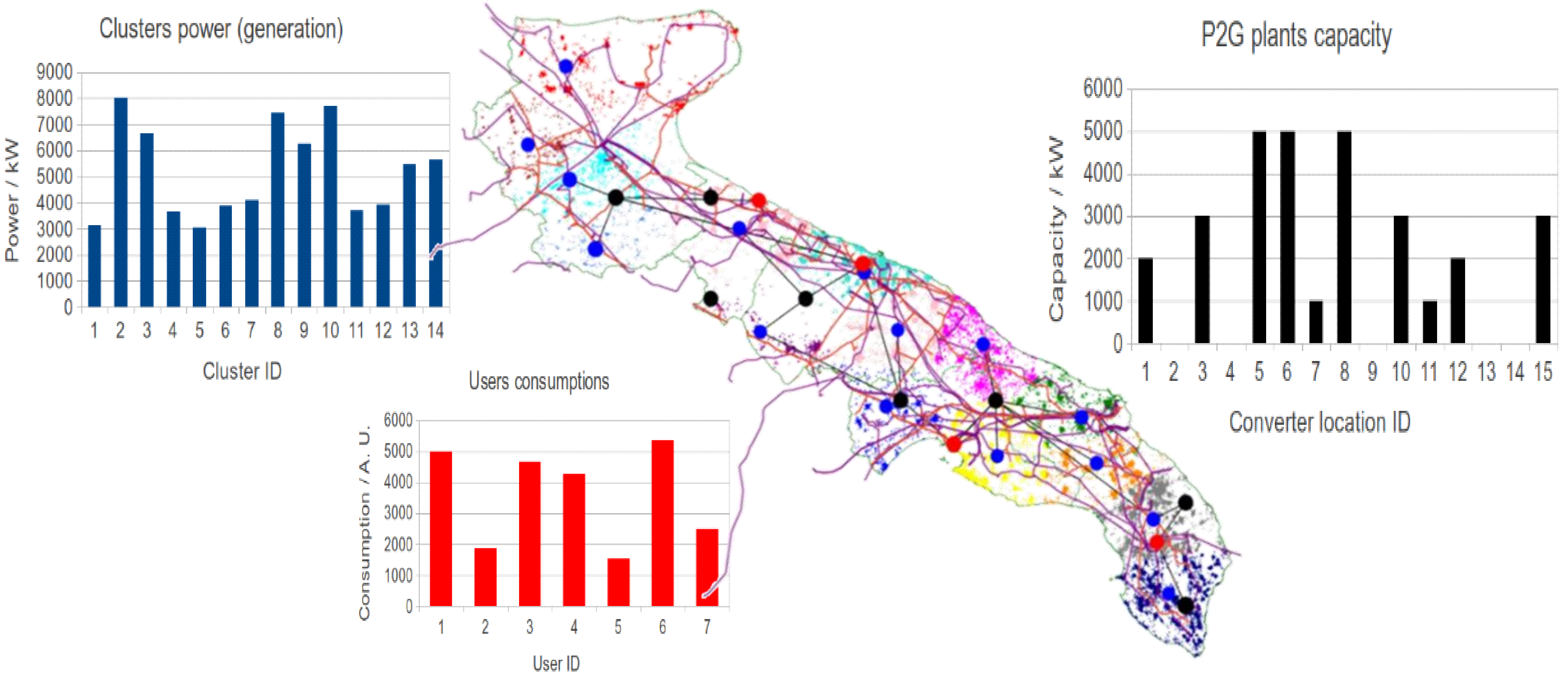
Resources, Conversion and End use (GWh/a)



Renewable Fuel Production in 2050 (GWh/a)

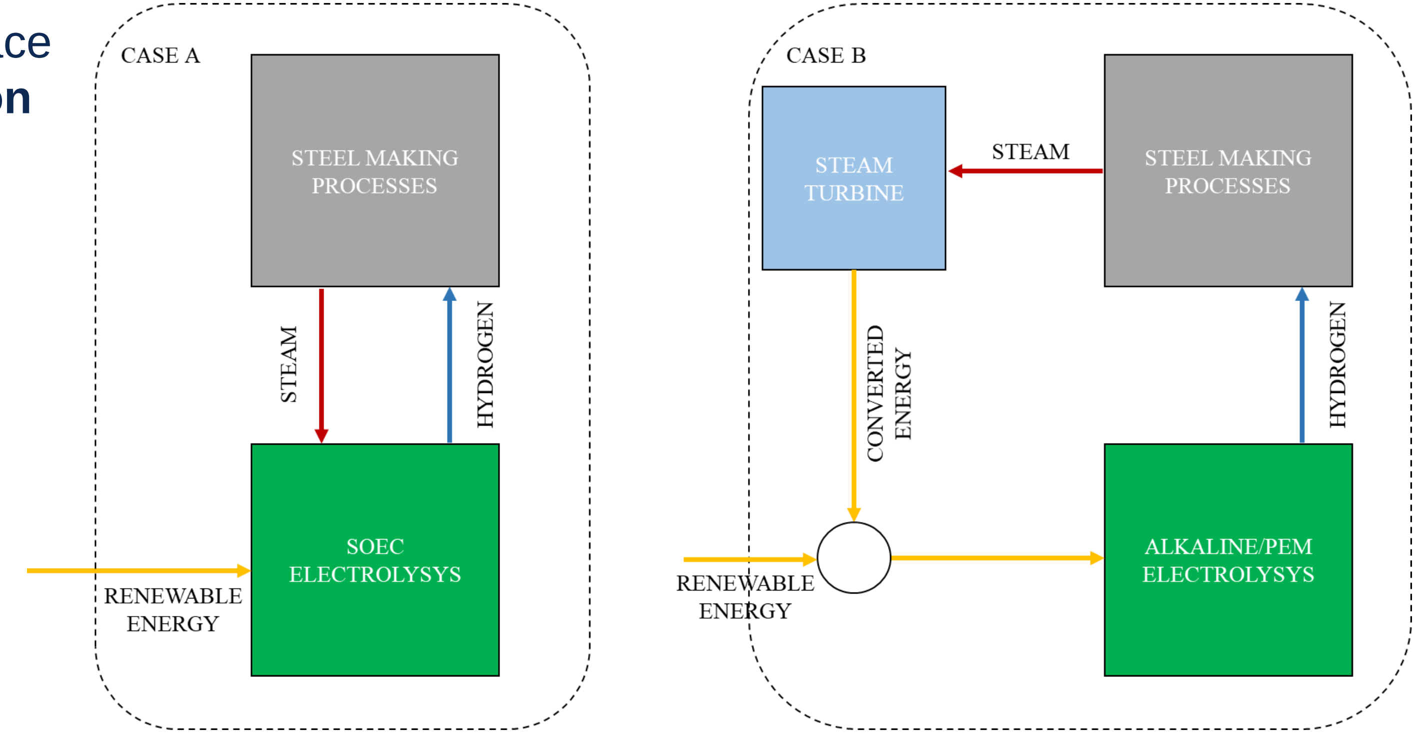


Identifying the optimal location and size for P2G Plants in the Apulia province with "SUPERP2G-ITALY"



Optimisation of a P2G and industrial site combination in Taranto with „DBI-MAT“

- **Waste heat available** in a Basic Oxygen Furnace (BOF) steelmaking process, i.e., **0.034 MWh/ton of steel**
- **Case A:** Utilise steam **directly** for the **SOEC** electrolyser
- **Case B:** Utilise steam **indirectly** via a steam turbine to produce (additional) electricity for:
  1. **Alkaline** Electrolyser or
  2. **PEM** Electrolyser



Closing Slide

ERIG

Summary and Conclusions

1. Non-discriminating, transparent, internationally recognized **crediting** of **greenhouse gas emission avoidance** along the entire production chain of all **renewable and climate friendly gases**

2. A hydrogen **top-down approach** needs to be complemented with the **bottom-up** perspective – and should include the **valorization of existing Natural Gas infrastructure**

3. **The SuperP2G project offers a tool-box to help**
   - **Identify** hydrogen value chains and potentials
   - **Optimize** location and sizing of P2G plants
   - **Fine tune** and adapt P2G-plants to local energy concepts

Outlook

- **SuperP2G includes many more tools, models and results – a closing workshop is foreseen for March 2023**
- If you want to join, seeks more information or want to get in contact with us:
- SuperP2G: Dettmering@erig.eu

www.superp2g.eu
erig@erig.eu

- **We are at Wind meets Gas with a stand and in the online match making**

European Research Institute
for Gas and Energy Innovation

P2G and Hydrogen in the European and Regional Context

Sep 6th 2022 at Wind meets Gas, Groningen

Hans Rasmusson
Secretary General

rasmusson@erig.eu
+32 2786-3000

Hydrogen & Distribution Networks

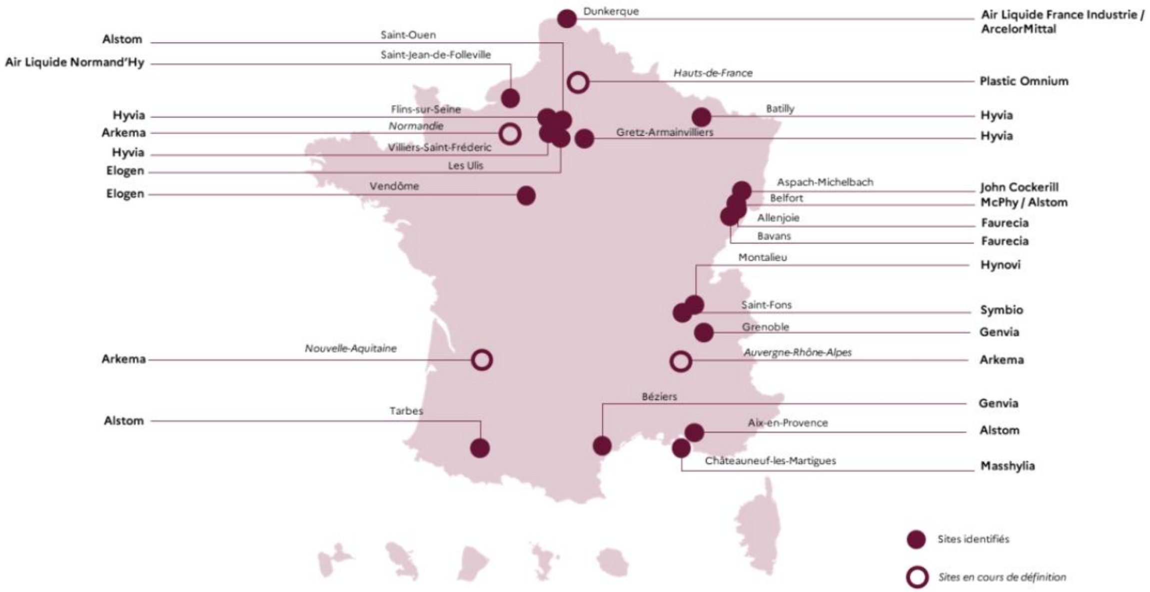
Wind meets gas

October 6. 2022

GRDF
GAZ RÉSEAU DISTRIBUTION FRANCE

French Hydrogen Strategy - Status

- H_2 Strategy published in sept. 2020 & integrated in the post covid relaunch plan
- 7 B€ until 2030 with 2 B€ in 2021-2023 period+ 2 B€ for giga-factories
- Ambition to be a leader in low carbon hydrogen production : 6.5 GW electrolysis power by 2030
- Hydrogen seen as an opportunity to increase France energy independency, accelerate decarbonisation, and create jobs
- Priorities set on the replacement of grey hydrogen in industry and the development of heavy mobility (Trucks, boats, train and planes)
- 10 projects selected in the IPCEI program, with 2,1 B€ of public subsidy (Giga factories, tanks, Fuel cells, trains and utility vehicles, materials)

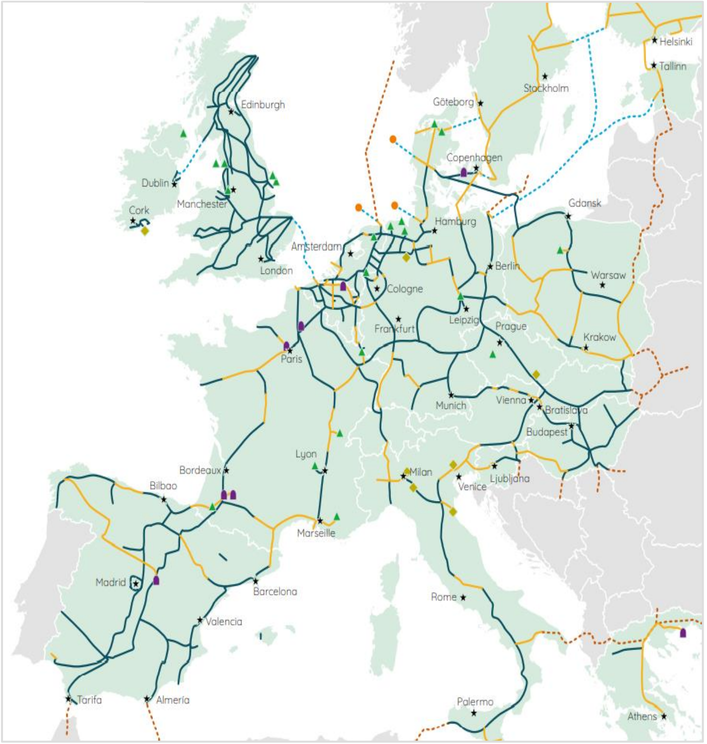


French pre-notified IPCEI projects

The controversial question of H2 infrastructure : how will we move H2 from point A to point B ?

- The subject of H2 supply infrastructure is scarcely described in the European and National Hydrogen Strategies, and is still an open question
- Always the chicken and egg dilemma
- Another debate around it : national independency vs. access to large amount of cheap renewable hydrogen
- What’s really at stake is the level of ambition that we have for hydrogen, and its contribution to a flexible, resilient, decarbonised energy system
- Gas infrastructure do require time and consistency

European backbone - 2040



Vision of the hydrogen bakbone by the european gas TSO

The potential role of the Distribution Networks

- As expressed through the Ready4H2 initiative, we DSO believe that distribution networks can help achieve the **full potential of hydrogen** and accelerate its penetration, by safely and efficiently **linking hydrogen production sites to more widespread uses.**

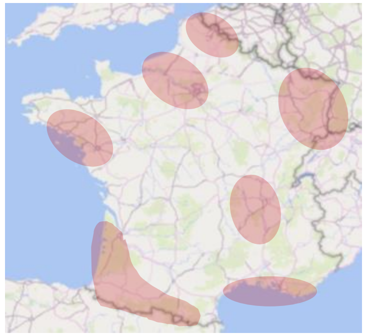
- **Various advantages of the distribution networks** are:
  - Safe, efficient and cost effective way to bring gas to customers
  - Strong compatibility of the existing infrastructure with e-methane, blends and pure hydrogen
  - Interconnection with transport and storage
  - Connection of millions of end customers
  - Operation by skilled professionals, already in place

GRDF

A possible scenario of hydrogen distribution networks deployment

2030	2040	2050
Local développement linked to demonstration projects : conversion of industrial clients, heavy mobility, even buildings **in favourable areas**	Development in the favorable zones and next to the backbone first sections	Extension of the distribution network **around the Backbone and in the favourable areas**

Forseen Hydrogen clusters in France



- Municipalities in the vicinity of the backbone
- Industrial consumers of feedstock hydrogen and convertible processes
- H2 Backbone drawing in 2040

GRDF ambition

To value the distribution networks and our DSO know how in order to offer a reliable, safe and efficient Hydrogen low carbon supply solution, on the last km towards the final customers

The first demonstration projects will allow to get the expertise, competences and operational experience to prepare a more massive development of hydrogen distribution after 2030

GRDF hydrogen program

As a major gas DSO with a public service mission, our role is to **prepare the transition to a fully decarbonised gas system by 2050**, which will include various green gases, **among which hydrogen**

3 main work area to prepare the distribution of hydrogen

Prepare a suitable regulatory context at the National and European levels

Technical Roadmap

- Emerging projects
- Network
- End uses

Experimentation & training platform

Prepare the implmentation of local hydrogen projects (2025 – 2030)

Technical feasibility of hydrogen supply through the distribution network

Over the past few years, GRDF has carried out research projects and a field trial (GRHYD) regarding the compatibility of the network and end used with H2 and blends

⇨ **A compatibility of up to 20% H2 was confirmed.**

⇨ **However, it is also possible to switch to operation with 100 % H_2 with some small upgrades.**

R&D now focuses on removing barriers towards a safe integration of pure hydrogen into the existing distribution

R&D Roadmap with 8 priorities

1. Material compatibility
2. Components (meters, valves, …)
3. Plastic pipes
4. Metal pipes
5. Safety
6. Leakage
7. Gas quality & Odorization
8. Network monitoring

READY

In France, 98% of pipelines are « material ready » for conversion to pure hydrogen

GRDF

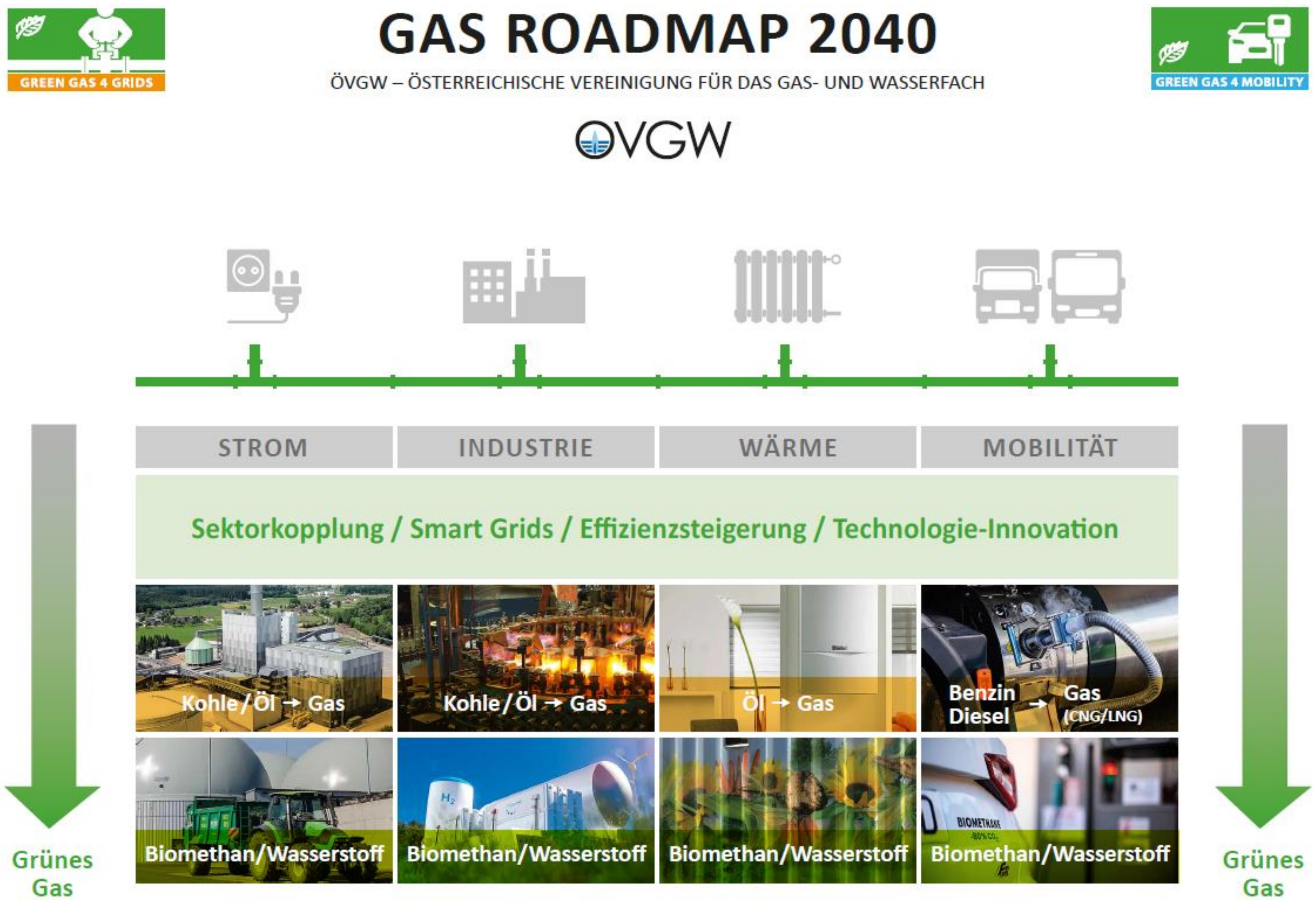
Thank you !

H2-Flag ship projects Austria – From research to implementation

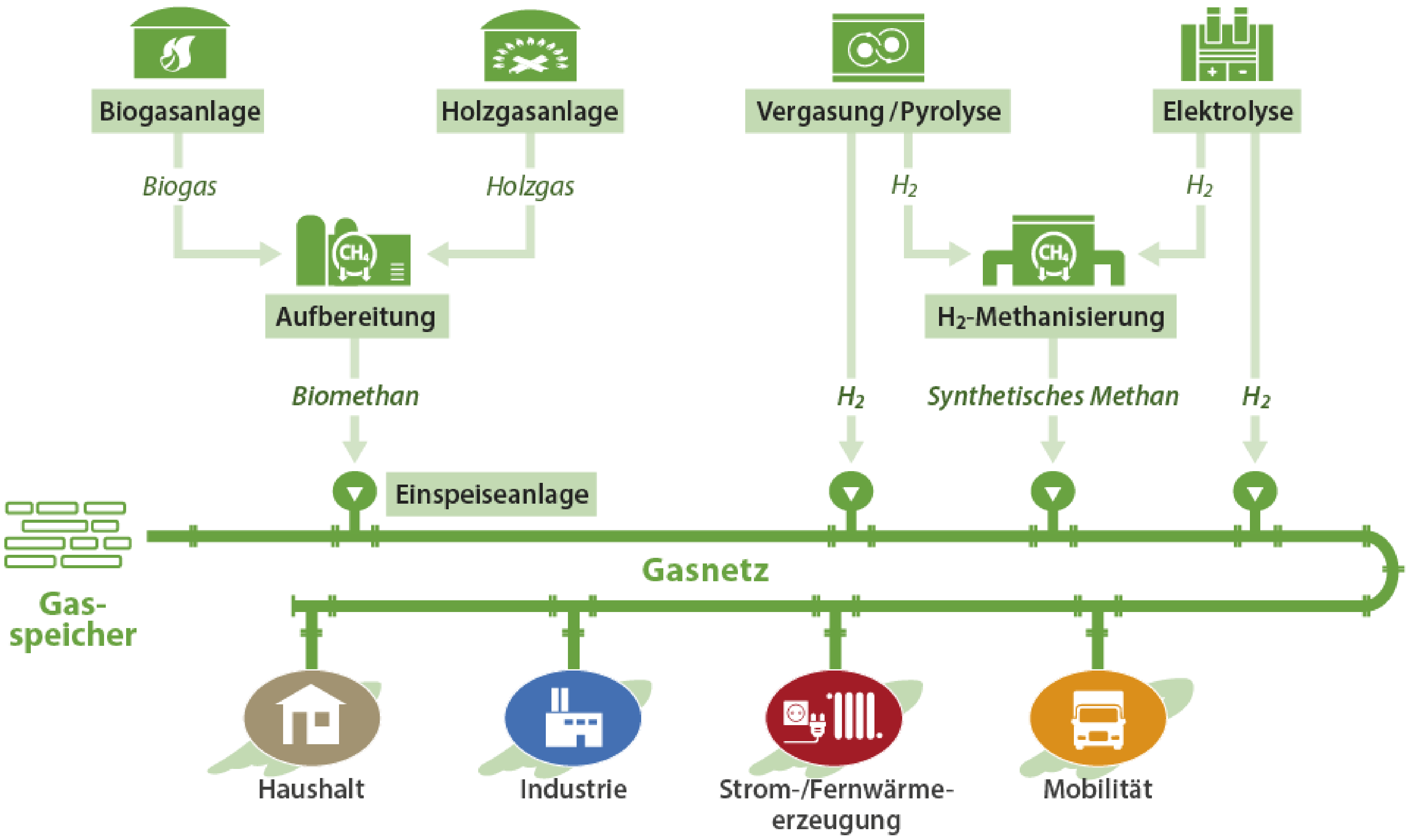
Dipl. Ing. Sascha Grimm

06.10.2022

ÖVGW - Forschung



ÖVGW - Forschung

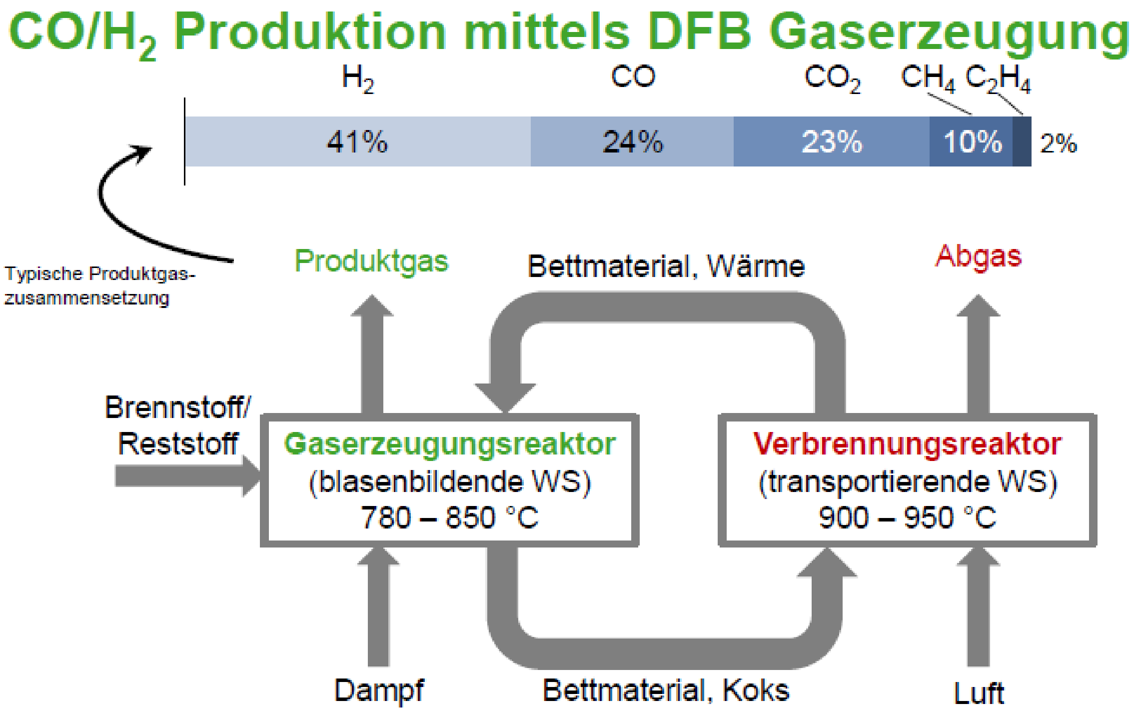


https://www.ovgw.at/gas/ueber-gas/interaktive-gasgrafik/

ÖVGW Project: **BIG Green Gas**

GREEN GAS 4 GRIDS GREEN GAS 4 MOBILITY

- Gasification of biomass Waste2Value (e.g. sewage sludge, Bark)



ÖVGW Projekt: **HyGrid - Pilot Study**

GREEN GAS 4 GRIDS GREEN GAS 4 MOBILITY

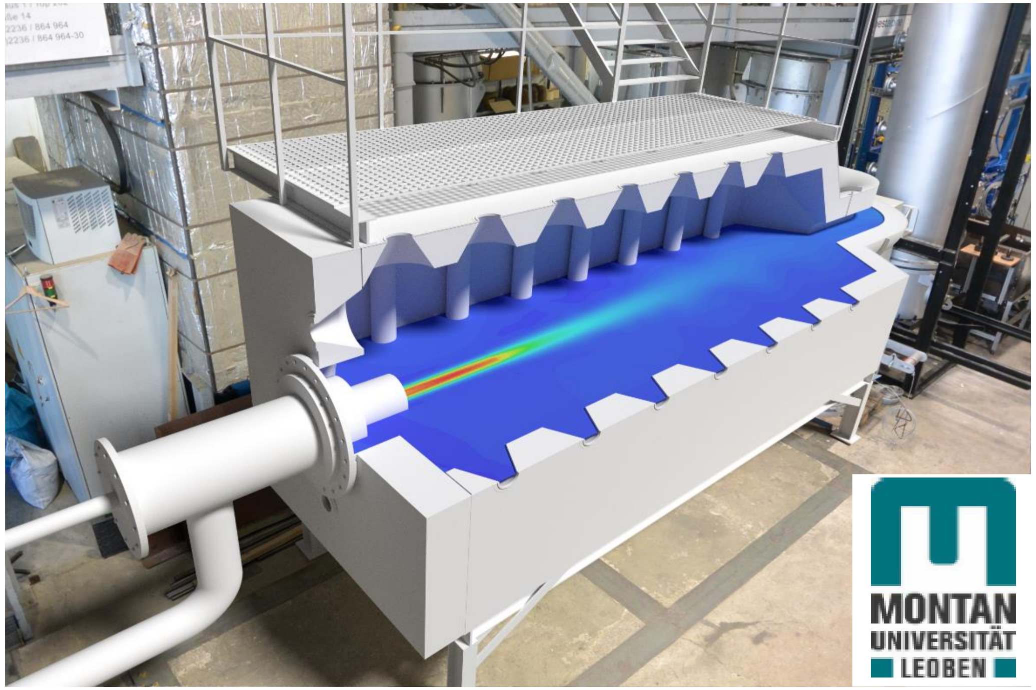
HyCentA HYDROGEN CENTER AUSTRIA

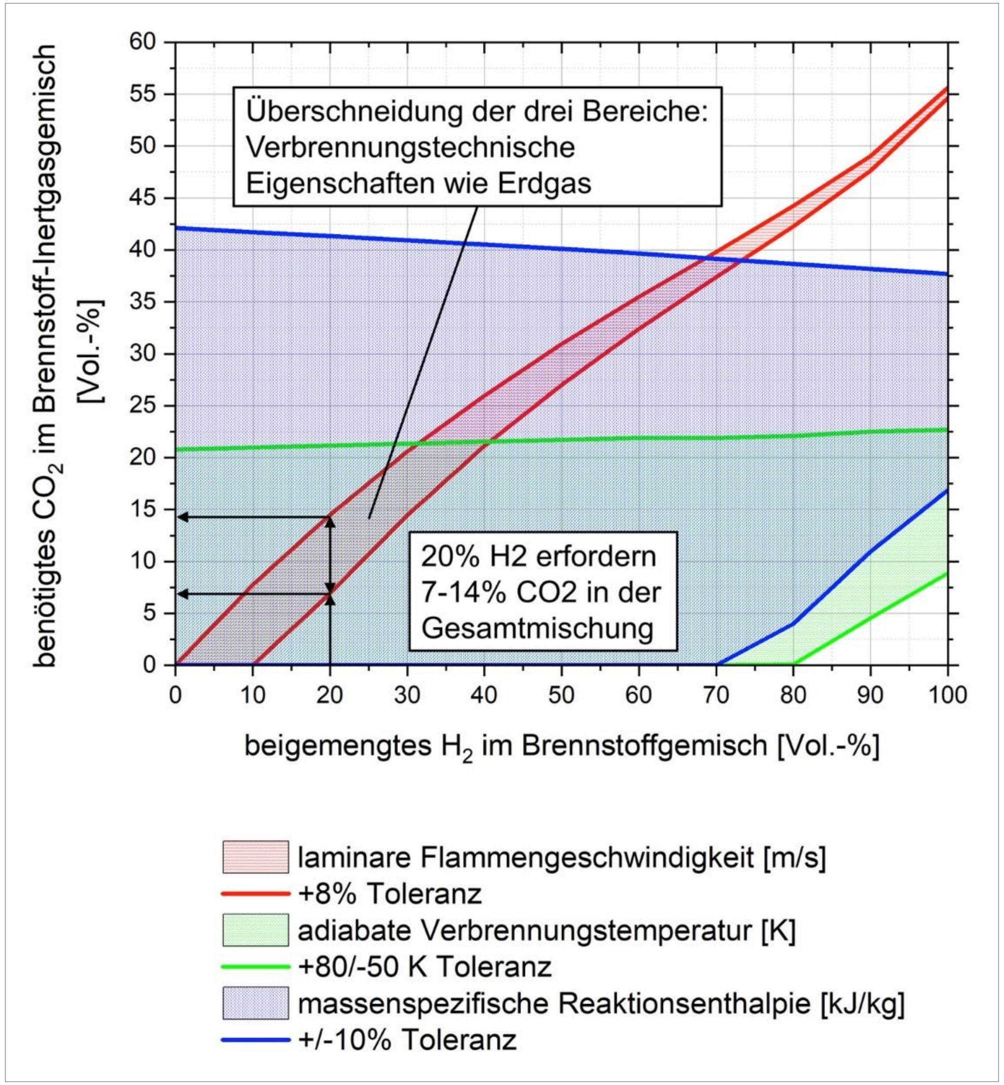
- Hydrogen quality in repurposed pipelines
- Grade A (98 % H_2)
- Grade D (99,97 % H_2)

ÖVGW Projekt: **Schwankender H_2-Anteil für Industrie**

GREEN GAS 4 GRIDS GREEN GAS 4 MOBILITY

- **Ajustment of the oxygen supply**
  - Measure H2: thermal conductivity detector
- **Inert gas Admixture (N, Ar, CO_2, Abgas)**

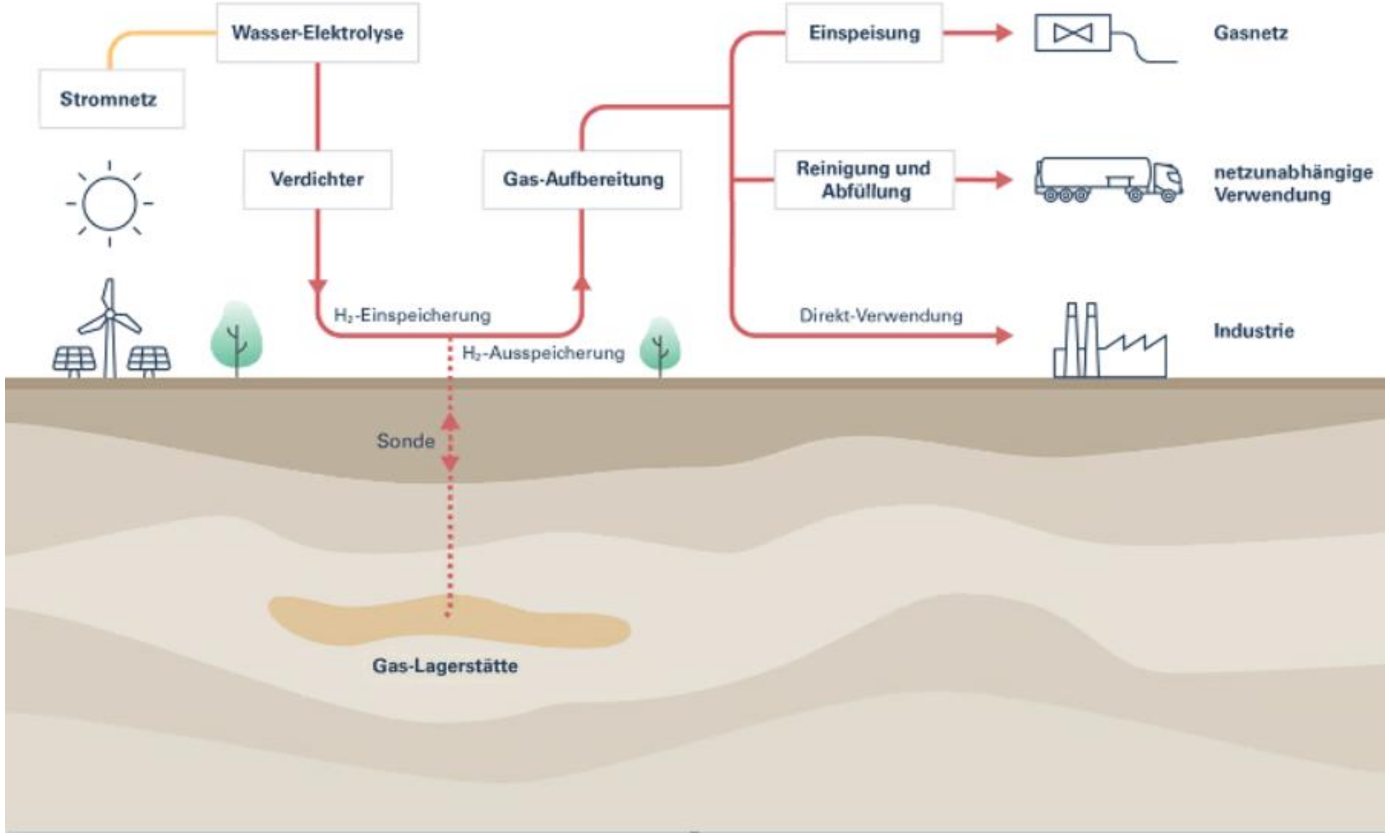




„Underground Sun Storage 2030"– RAG Austria AG

UNDERGROUND SUN.STORAGE

- 2 MW Electrolyzer
- 1,6 Mio Nm³ working gas volume
- 400 – 600 Nm³/h
- 56 -76 bar
- https://www.underground-sun-storage.at



K1 MET · TU WIEN Technische Universität Wien Vienna University of Technology · Verbund · EVN · ENERGIE AG Oberösterreich Wir denken an morgen · axiom · VORZEIGEREGION ENERGIE · voestalpine ONE STEP AHEAD. · WIVA P&G Energy Model Region · BOKU Universität für Bodenkultur Wien · ENERGIE INSTITUT · HyCentA · rag AUSTRIA AG · powered by klima+ energie fonds

„Renewable Gasfield“ – Energie Steiermark AG

- Electrolyzer 1,0 MW_e
- PV plant 850 kWp
- Methanation plant 100 kW_e
- H2: 300 t/a
- Bio-SNG: 225 MWh/a

- Trailer filling station
- H_2 filling station
- H_2 for industry
- Bio-SNG injection into the gasgrid
- Commisioning Autumn 2022

HyCentA HYDROGEN CENTER AUSTRIA · ENERGIEAGENTUR Steiermark · VTiU Verfahrenstechnik · ENERGIE INSTITUT an der Johannes Kepler Universität Linz · WIVA P&G Energy Model Region · ENERGIE NETZE STEIERMARK Ein Unternehmen der ENERGIE STEIERMARK · Das Land Steiermark

„H_2 Future“ - Verbund AG - Voestalpine AG (https://www.h2future-project.eu/)

H2FUTURE
Green Hydrogen

- 6 MW PEM-Electrolyzer in the steel plant
- 26-month demonstration
- Grid services for balancing the power grid
- Continued operation after project end
- Roll-out scenarios for replacing coal and coke with green hydrogen
- https://www.wiva.at/project/renewable-gasfield/

voestalpine ONE STEP AHEAD.

SIEMENS energy

Verbund

APG

K1MET metallurgical competence center

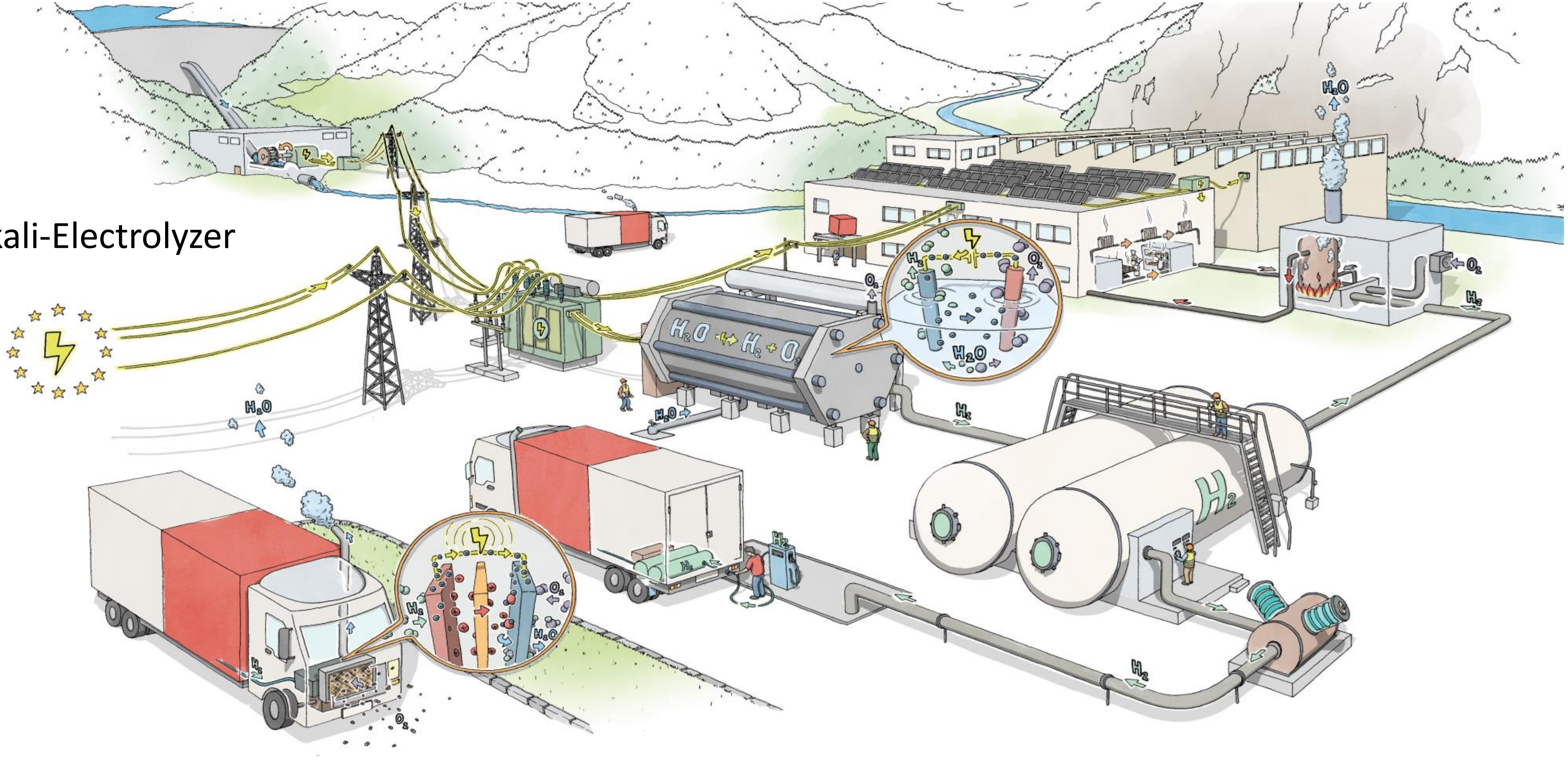
TNO innovation for life

Project facts & figures
Budget: 18 millon EUR
Funding: 12 million EUR
Duration: 4.5 years

FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

„Demo4Grid“ – MPREIS Warenvertriebs GmbH (https://www.demo4grid.eu/)

- 4 MW_e Alkali-Electrolyzer



Partners:

MPREIS, iht Industrie Haute Technologie, Inycom, Fundación para el desarrollo de las nuevas tecnologías del hidrógeno en Aragón, fen systems, DIADIKASIA S.A. Business Consultants, fen research

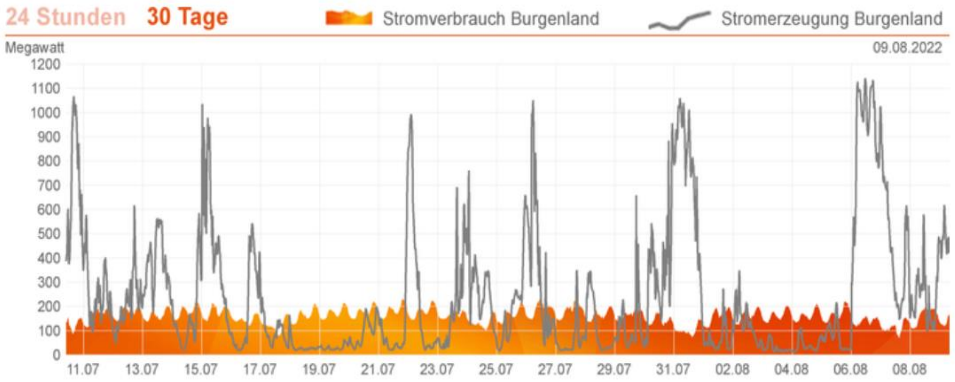
powered by klima+ energie fonds

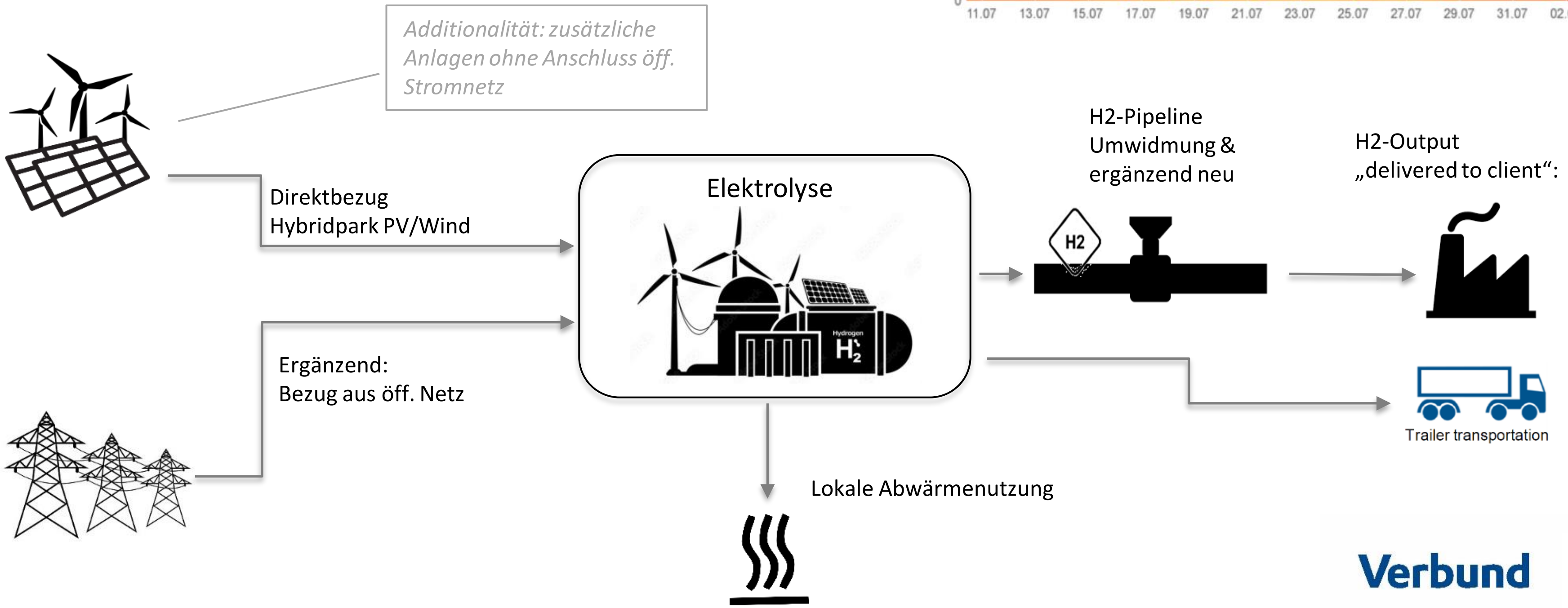
Funded by: FFG Forschung wirkt.

Funded by: FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

„Pannonia Green Hydrogen“- Verbund AG – Burgenland Energie AG

- 60 MWe Electrolyzer 2026
- Building up to 300 MWe Electrolyzer until 2030
- 40.000 t/a green hydrogen production





Verbund

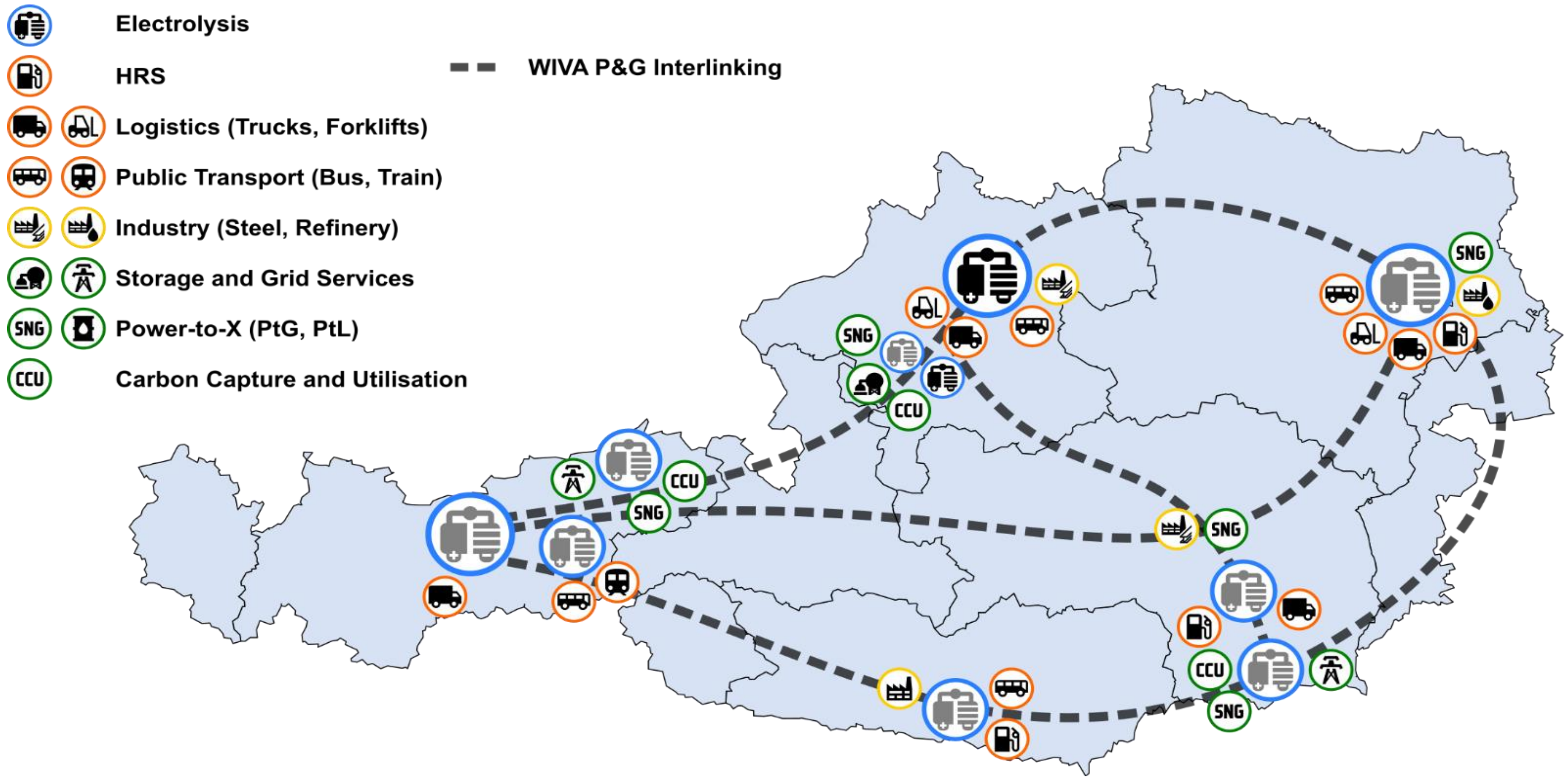
Burgenland Energie

„H2EU+Store“ – RAG Austria AG (https://www.h2euplusstore.com/)

WIVA P&G - Wasserstoffinitiative Vorzeigeregion

WIVA P&G Energy Model Region

- **H_2 – Project overview Austria: www.wiva.at/v2/projekte/**



Thank you for your attention!

Discussion (until 15:30 hrs)

Julio Garcia
NEC/HyDelta

Alexandra Kostereva
GERG

Hans Rasmusson
ERIG

Thomas Muller
GRDF

Sascha Grimm
ÖVGW