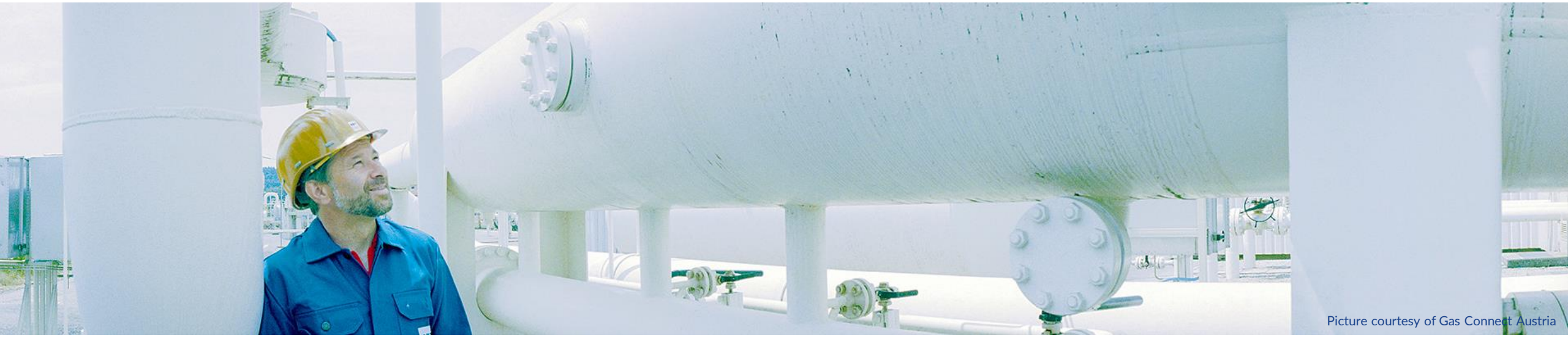


Picture courtesy of Gas Connect Austria

Prime movers' group on Gas Quality and H_2 handling

#9 meeting, 31 May 2021 (14:00 – 16:30 CET)

Online

Disclaimer

The information included in this presentation is subject to changes. The proposals are presented for informative purposes only since the work is still in progress.

The organisation is not liable for any consequence resulting from the reliance and/or the use of any information hereby provided.

Agenda

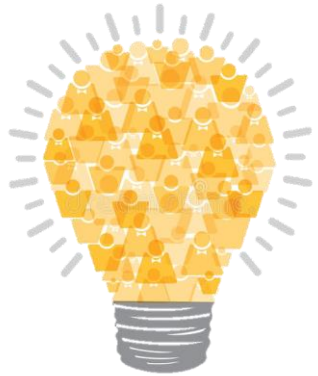
Agenda

Topic	Time
Welcome and agreement on agenda	14:00 – 14:05
Debrief on SG2 progress & PMG feedback	14:05 – 15:00
Debrief on SG1 progress & PMG feedback	15:00 – 15:40
The role of hydrogen in heating buildings by Matthias Janssen, Frontier Economics	15:40 – 16:10
A.O.B. & next steps	16:10 – 16:15

Debrief on SG2 progress & PMG feedback

Reminder: sub-group 2 scope & goal

- Provide conclusions that could be inputs to future Commission proposals on gas market design
- Facilitate **knowledge sharing and exchange** about the commonly faced **challenges related to gas quality and H2 handling**, as well as best practices and lessons learned on how to overcome them
- Identification and **assessment of the possibilities** for implementing gas quality & H2 management tools at different interfaces and check the **feasibility of interlinking** them for decarbonised systems
- Seek to sketch out a cost-efficient **'step-by-step' approach** to connect each individual sector or area within a future 'decarbonized' gas system. Assess what can be done and by when (short/medium and long-term)



Reminder: scenarios proposal & assumptions

Today

- Natural gas systems
- Point-to-point H2 connections
- Increasing biomethane injection
- H2 injection into the grid in pilot projects
- H2 mainly produced for dedicated onsite consumption
- Information on current limiting values is collected by Marcogaz, GERG, other associations work

Some gas quality fluctuations

1 scenario

Short-term/Mid-term (2025-2040)

- Developments of EU H2 backbone
- H2NG produced decentralized and injected to the grid
- Current installed base of applications limits the use of H2NG

Some end-use consuming H2NG

4 scenarios

Long term (2040-2050)

- Full deployment of H2 backbone at TSO and DSO level
- H2NG in some regions and/or as 'buffer' for H2 surplus
- Increased demand of H2 at all levels

Full sector coupling

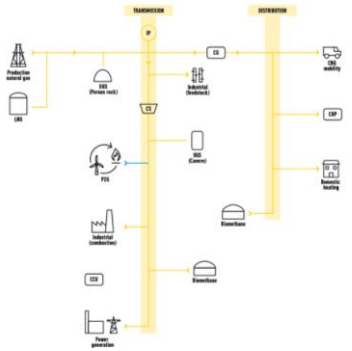
1 scenario

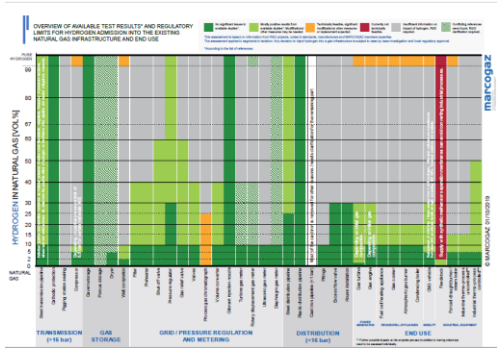
How to transition?

How to transition?

Reminder: scenarios proposal

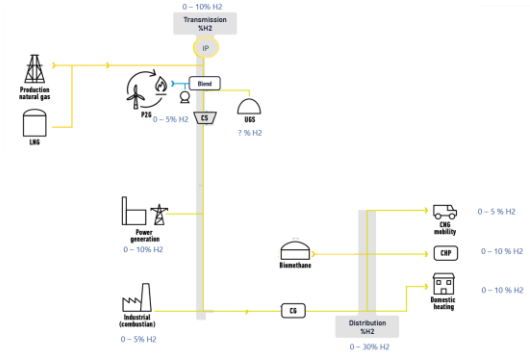
Today



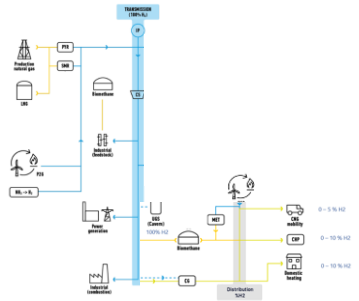


Short-term/Mid-term*

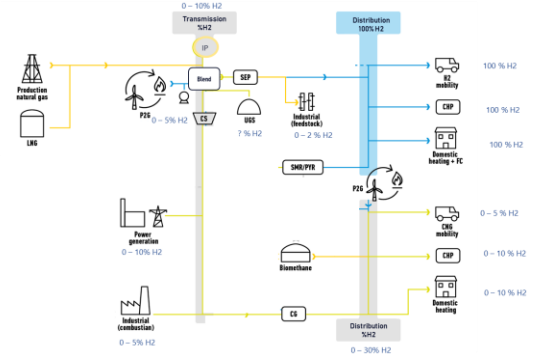
Delivering H2NG at TSO and DSO levels



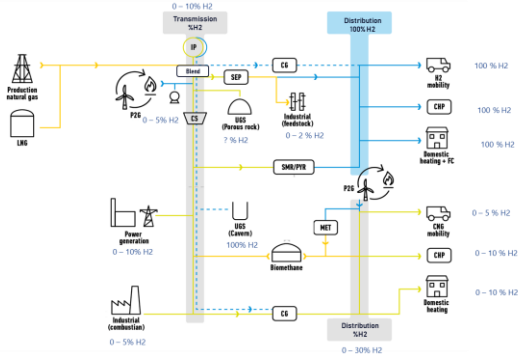
Delivering NG and H2 at TSO level and H2NG at DSO level



Delivering H2NG at TSO and DSO level, plus H2 at DSO level

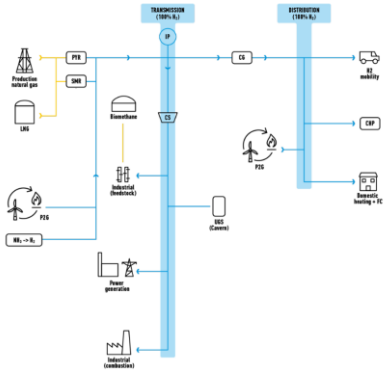


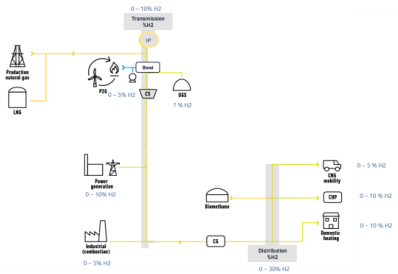
Delivering H2NG at TSO and DSO level, and H2 at DSO and TSO level



**They could be combined depending on region's requirements*

Long-term*





Note: In some regions, the injection on H2 could be switched to H2 backbones. The NG demand is expected to decrease

First deliverable

First deliverable: Initiatives & projects template

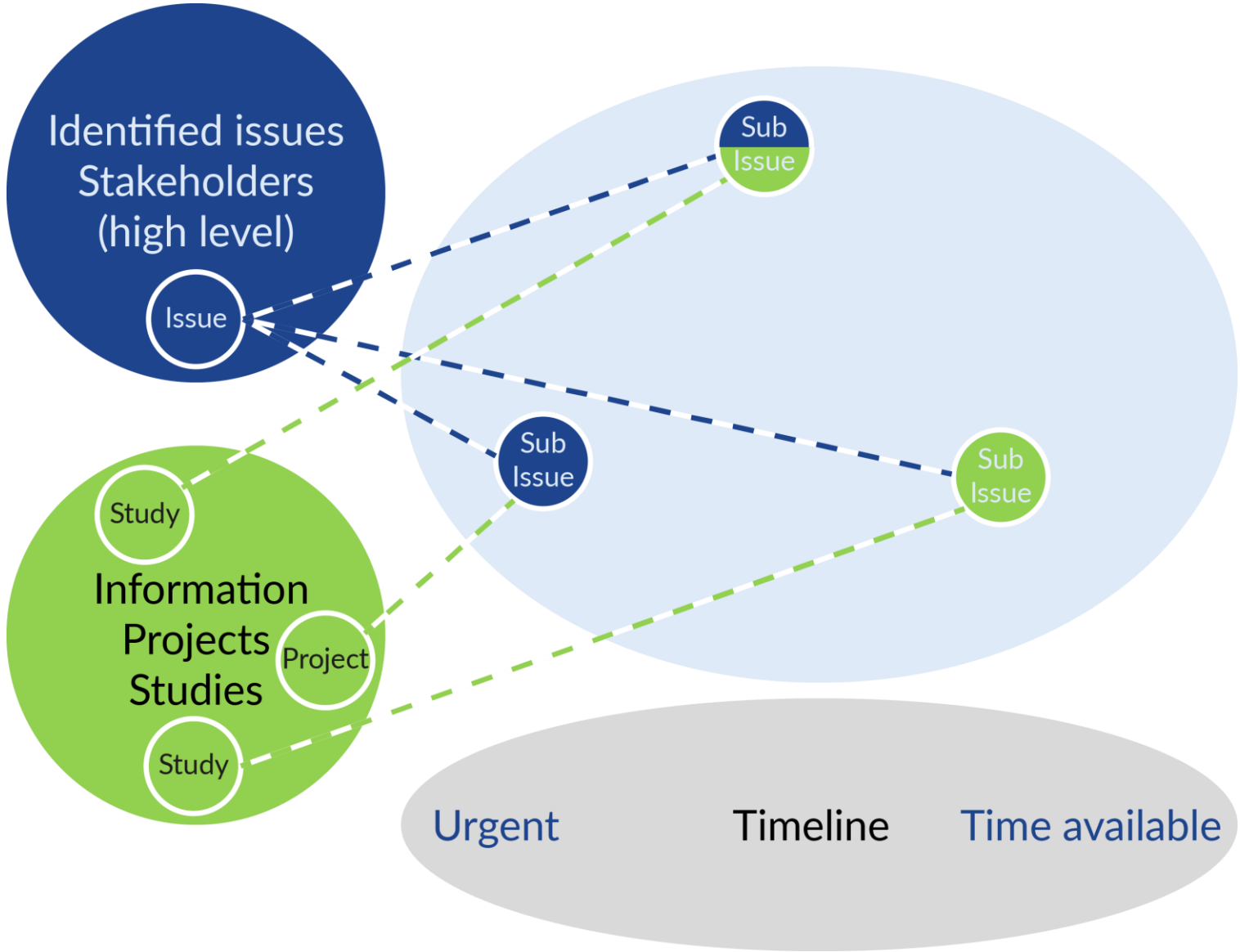
- Answers received from 10 associations (many companies involved)

More than 170 project

How does this work fit into SG2 deliverable?

PMG first deliverable (Dec 2020)

SG2 first deliverable (April 2021)



Most of the project included in the database are supported by private stakeholders and are focused on very specifics and technical issues

>170 *projects*

43% **H2**

Stakeholder Involvement	%	Perspective
Private	**72%**	**95% - Technical**
Public	**7%**	**87% - Technical**
Public & private	**11%**	**92% - Technical**
NA	9%	
Association work	**1%**	**Technical & Economic**

39% **Blend**

Stakeholder Involvement	%	Perspective
Private	**55%**	
Public & private	**19%**	**100% - Technical**
Public	**12%**	**80% - Technical**
NA	10%	
Association work	**4%**	**Technical**

18% **NA**

Stakeholder Involvement	%
Private	**45%**
Public	**10%**
Public & private	**13%**
NA	**29%**

No public information available for these projects (i.e., website, public report, etc)

Main Goals

Analysis of gas interchangeability, changes in combustion behaviour, infrastructure compatibility, hydrogen tests in households, gas qualities, equipment and gas quality test, etc…

Guidelines about billing when non conventional gases (biomethane, H2) are injected into natural gas grid

“Red” topics – Beyond scope/Already tackled somewhere else

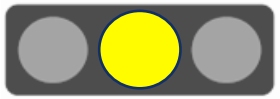
Which project/association is tackling each topic?

1. Overview of the different stages of H2 implementation on national level
   - Policy databases are available (e.g., IEA one), or studies (e.g., FCH 2 JU one)

2. R&D requirements (supporting scoping for European grant funded projects)
   - GERG roadmap, among others

3. Standardisation requirements
   - HIGGs project, PNR CEN/GERG, CEN/TC 234 TR, Hy4heat among other projects

“Yellow” topics – Input is missing



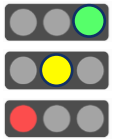
Inputs are not available, although they are welcome and, if provided, they would be included in SG2 work

- Hydrogen quality requirements for all appliances/end-users (supporting CEN TC 234)
  - CEN TC 234 work to start soon, EASEE-gas CBP to be published soon, Hydrogen Europe also working on it. Inputs from stakeholders are welcome in order to include them, in SG2 (e.g., H2 purity requirements by industry)

- Knowledge gap: technical feasibility of larger-scale hydrogen storage
  - Lack of expertise on the topic. Any input is more than welcome

- Economical perspective (mainly GQ management and H2 readiness costs)
  - Key aspect. Insufficient inputs. We need your support ☺

- Aspects related to biomethane
  - Although inputs are welcome, it was not considered to be an urgent topic to be tackled



Necessary inputs are availale. Expected to be tackled in SG2

Inputs missing. Not possible without them

Beyond scope/Already tackled somewhere else

Answers confirm high interest in the technical topics

20 Answers

TECHNICAL PERSPECTIVE (9 Answers)

overview of ongoing projects for all parts of the chain and ability for gap analysis	
Interaction btw space heat and process heat: impossible to separate the two >connected on same grid	
Overview of the different stages of implementation (H2) on national level	
Technical perspective is the strongest line, policy and economy can be only based on it	
Pedagogic overview of state of the art knowledge	
Hydrogen quality requirements for all appliances/end-users (supporting CEN TC 234)	
Linking technical solutions to a specific date (what is possible by...)	
R&D requirements (supporting scoping for European grant funded projects)	
knowledge gap: technical feasibility of larger-scale hydrogen storage	
Standardisation requirements	

ECONOMICAL PERSPECTIVE (7 Answers)

Cost of gas quality management	
Cost estimates for H2 readiness: transmission, distribution infrastructure and end-use appliances	
which is the maximum H2 blending threshold that keeps blending still convenient toward 100% H2?	
Energy system perspective: multiple benefits of H2NG, energy system cost savings, GHG reduction	
Cost allocation of quality handling?	
Cost estimates of H2-readiness of appliances for end-users and feasibility	
Is hydrogen deblending economically feasible?	

POLICY PERSPECTIVE (3 Answers)

alignment of ideas for a roadmap or at least the mutual understanding of the different ideas/concern	
Assessment of regulatory barriers & recommendations for the implementation of the roadmap	
Input into green gas package	

OTHERS (1 Answers)

Any aspects related to biomethane which are not covered through H2NG scope?	

In brief: Key points to include

Deliverable type

- Include all aspects (**technical, economic, policy**) **under different timelines** (today, short/mid, long term)
- Indicate **current barriers, future developments** (regulatory & technical), and **recommendations/action plan**
- Do not go into details of scenarios, just sufficient information to point out trends

Technical

- Identify **technical feasibility**
- Link **solutions to date** (what is possible by when)
- State of the art knowledge (do **not go into details**)

Economic

- **Cost of H2 readiness** of different parts of gas value chain (infra, end-users)
- Hydrogen **deblending costs** & feasibility
- **Gas quality management costs**

Policy

- Overall goal is to **give inputs to EC work on "Hydrogen and decarbonised gas market package"**
- Assess regulatory **barriers & include recommendations**
- **Mutual understanding** of ideas, concerns and challenges along the gas value chain

Sketching the roadmap

What is expected from SG2 participants? (1/2)

WG 1

WG 2

Acceptable H2 range that can be handled by each appliance/application

New developments for gas appliance/applications to handle future gas quality

How could the network operate this way

Understanding of how to make use of 'smart' gas grids

Based on expressions of interest and feedback submitted in January 2021 and identified topics to be tackled within SG2

What is expected from SG2 participants? (2/2)

WG 2

Blending, de-blending & injection facilities

How to accommodate H2 injection requests within a limited available blending capacity in the grid

Transversal

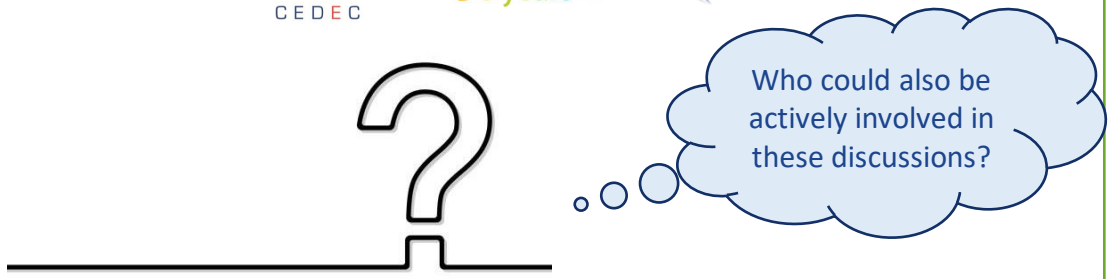
GEODE

GD4S Gas Distributors For Sustainability

CEDEC

eurogas 30 years

entsog



marcogaz

GERG THE EUROPEAN GAS RESEARCH GROUP

gie

eurelectric

FARECOGAZ

EURAMET

CEER Council of European Energy Regulators

cen

CENELEC

EASEE-gas Streamlining the gas business

EFET European Federation of Energy Traders

European Commission Joint Research Centre

Energy Community

Based on expressions of interest and feedback submitted in January 2021 and identified topics to be tackled within SG2

WG 1 (downstream sector)

Structure

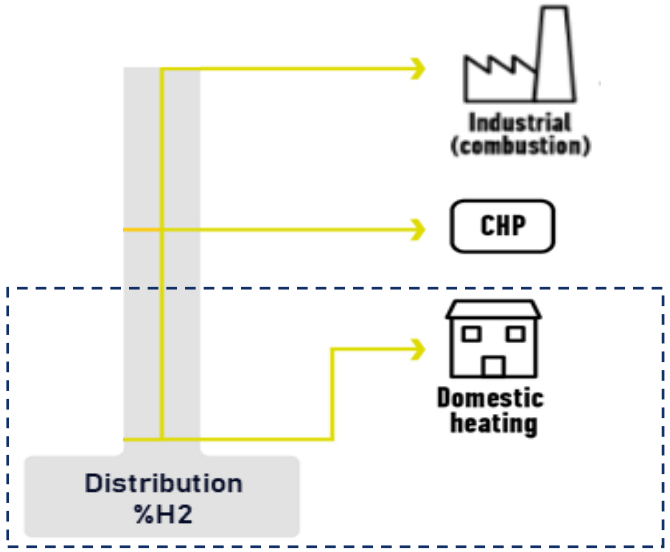
1. **Today**
   - For each industry/sector (e.g., turbines, engines, chemical, heating appliances, etc.) and for new and 'older' appliances/applications
     - Current acceptable x – y % H2 range
     - Challenges due to GQ/H2
     - Available solutions
2. **Short/mid term (2025 – 2040)**
   - For each industry/sector and for new and 'older' appliances/applications
     - Expected acceptable x – y % H2 range to be handled and why e.g., what is the H2NG threshold to switch to H2?
     - Challenges expected depending on scenario (H2NG, H2, etc)
     - Solutions (technical, regulatory, new appliance/ applications developments) + expected costs + which solutions by when
     - Information needed from TSO/DSO side?
3. **Long term (2040 – 2050)**
   - For each industry/sector and for new and 'older' appliances/applications
     - Expected acceptable x – y % H2 range to be handled and why (e.g., what is the H2NG threshold to switch to H2?)
     - Challenges expected depending on scenario (H2NG, H2, etc)
     - Solutions (technical, regulatory, new appliance/ applications developments) + expected costs + which solutions by when
     - Information needed from TSO/DSO side?

WG 2 (midstream sector)

Structure

1. **Today**
2. **Short/mid term (2025 – 2040)**
   - Challenges due to GQ/H2:
     - Blending, de-blending & injection facilities
     - How to accommodate H2 injection requests within a limited available blending capacity in the grid
     - How to deliver the GQ needed by different end-users
   - Potential solutions: How could the network operate under different scenarios, what would be needed by when, how much would it cost, e.g., Cooperation with other parties (e.g., information provision); Deployment of 'smart' gas grids; Storages; More active role at GQ management at upstream, etc
3. **Long term (2040 – 2050)**
   - Challenges due to GQ/H2:
     - Blending, de-blending & injection facilities
     - How to accommodate H2 injection requests within a limited available blending capacity in the grid
     - How to deliver the GQ needed by different end-users
   - Potential solutions: How could the network operate under different scenarios, what would be needed, how much would it cost

Example 1: Domestic heating



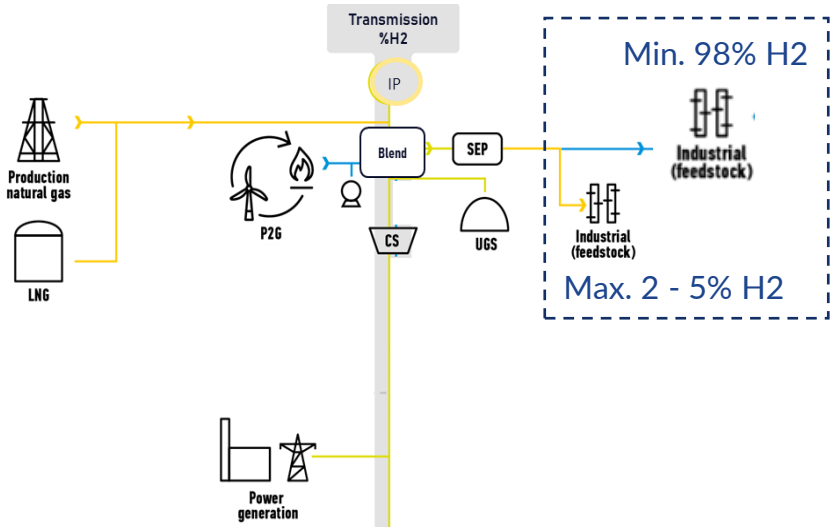
Estimated cost range needed for:

- GQ management & information provision tools for DSOs
- ✓ Modification appliance vs replacement

Example of answer: from 100.000 – 250.000 €/unit, from 700.000 – 1.000.000€; 100.000€ +/- 40%; +15% extra cost vs current

Installed stock	Gas end use products installed in field (>1995) can work with bio methane and bio-LPG and up to 10% H2 blend without any extra cost.
20% hydrogen appliances	Many modern domestic (≤70 kW) gas condensing boilers can work with up to 20 vol-% H2 blend with new certification without any extra cost.
100% hydrogen-ready appliances	Increased purchase price of the hydrogen ready boiler compared to a natural gas boiler is on average about 17%; about 3.3% for thermally-driven heat pumps. The price of hydrogen conversion kit from natural gas to 100% hydrogen as a percentage of the hydrogen ready boiler purchase price is about 13%; about 2.5% for thermally driven heat pumps. This is based on aggregated figures from EHI members in the position paper attached. These prices can drop in the future, also depending on quantities built.
EHI recommendations	In 2025: to introduce a mandatory ecodesign requirement for domestic (≤70 kW) gas condensing boilers and thermally driven heat pumps to be '20% hydrogen appliances'.
	In 2029: mandatory ecodesign requirement for domestic (≤70 kW) gas condensing boilers and thermally driven heat pumps are '100% hydrogen-ready appliances'. It means that all domestic boilers and thermally driven HPs put on the market to work with natural gas should be designed and approved to be installed and to operate on with it and, following a conversion and re-commissioning process, to then operate safely and efficiently using 100% hydrogen.
Replacement rate	The average replacement rate across Europe is about 4%/ year, which means that the time before replacement is around 25 years.

Example 2: Feedstock industry at TSO level



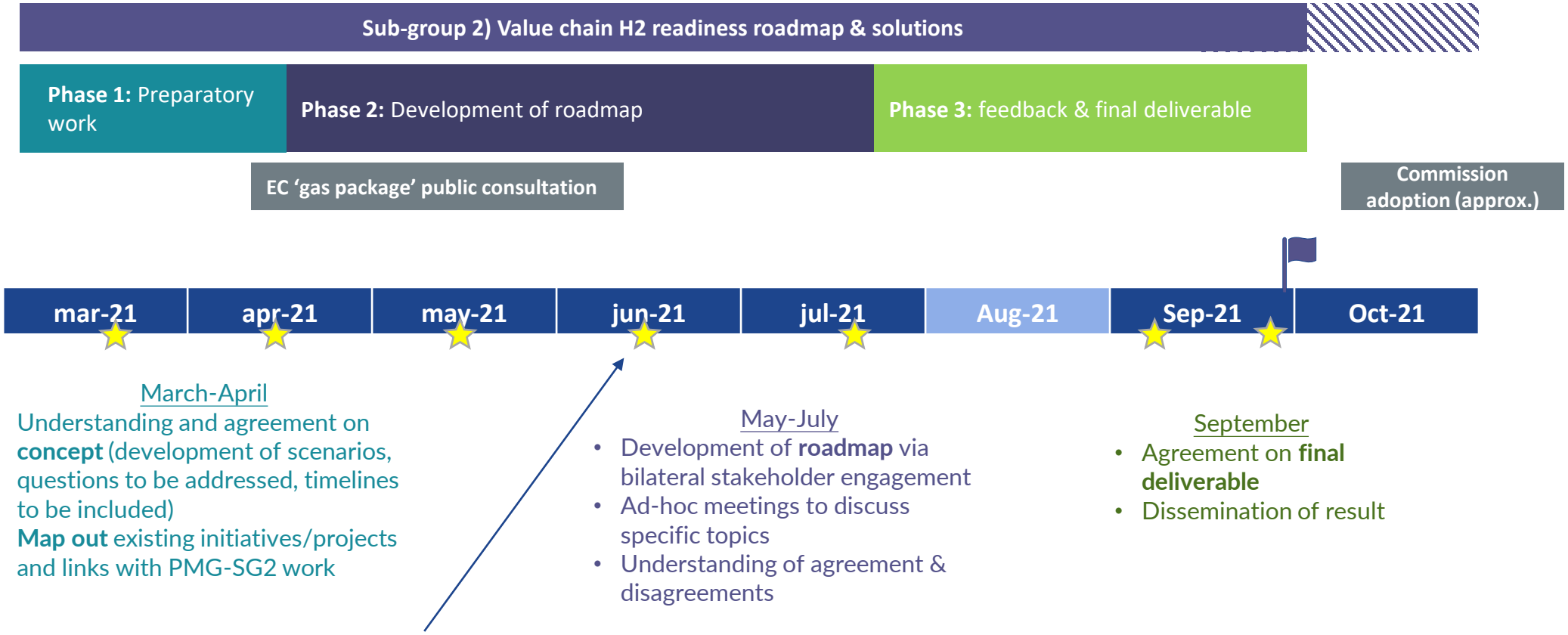
Estimated cost range needed for:

- GQ management tools at TSO side
- Modification application vs replacement for industry
- Deblending facilities

Example of answer: from 100.000 – 250.000 €/unit, from 700.000 – 1.000.000€; 100.000€ +/- 40%; +15% extra cost vs current

Installed application	Up to 2-5% H2 in NG (based on Marcogaz infographic)
Modification of application	Costs for higher H2NG?
Replacement	Costs for full replacement? When is a replacement necessary?
Information provision	Which information is expected from the TSO?
Industry Recommendations	Modification vs replacement? Deblending facilities?

Proposed plan



March-April

- Understanding and agreement on **concept** (development of scenarios, questions to be addressed, timelines to be included)
- **Map out** existing initiatives/projects and links with PMG-SG2 work

May-July

- Development of **roadmap** via bilateral stakeholder engagement
- Ad-hoc meetings to discuss specific topics
- Understanding of agreement & disagreements

September

- Agreement on **final deliverable**
- Dissemination of result

EC consultation closes on 18 June.

Key inputs from this process need to be provided by then (especially on GQ management costs) → SG2 to deliver a few examples based on available information

Thank you for your attention

Co-chairs of SG2

Gas Distributors GD4S For Sustainability

Ruggero Bimbatti

EASEE-gas Streamlining the gas business

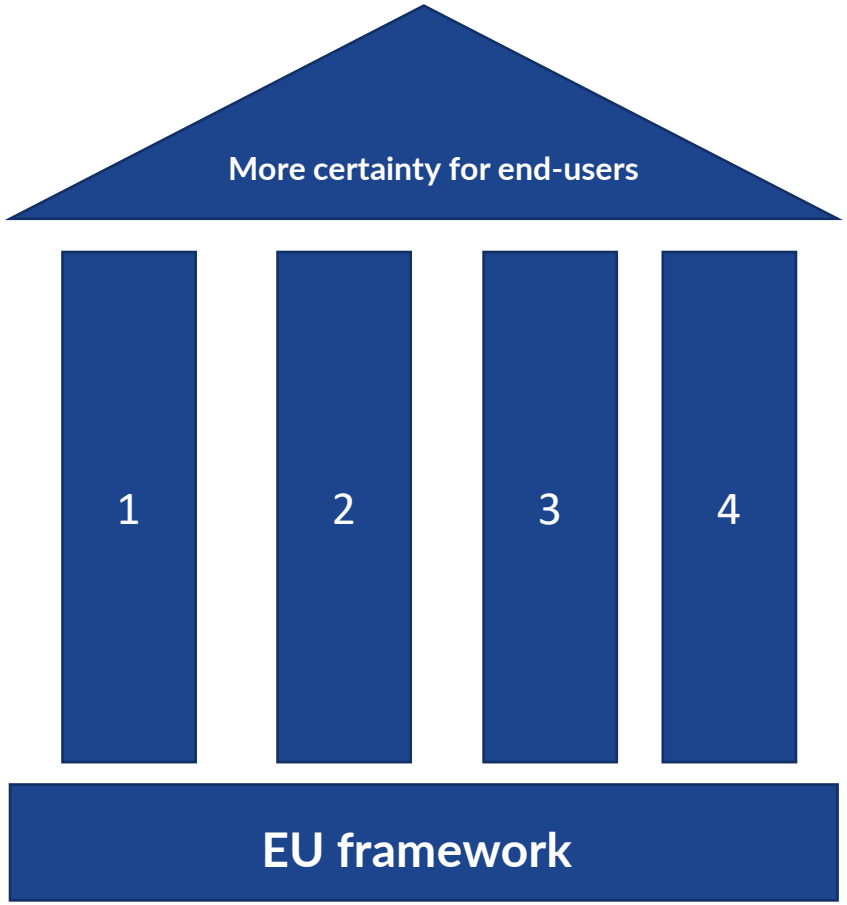
Peter van Wesenbeeck

Debrief on SG1 and PMG feedback

The implementation of the WI classification system proposal at exit points…

- Gives more **certainty to the end-users** [about the WI they would receive], especially with regards to the increased diversification of gases including renewable and decarbonised gases in the future
- Needs a strengthened **communication and information provision** between the different stakeholders (producers, suppliers, network operators and end-users)
- Needs the definition of **transparent and reliable methodology & a regulatory framework** at EU level
- Needs a **neutral party** to ensure the correct implementation of the process

Which are the “pillars” of the process?



1. Strengthen the **communication, information provision and cooperation** between all relevant parties (producers, suppliers, network operators and end-users).

2. Extension of the **transparency on WI information** provision to end-users (as part of gas quality information provision).

3. Definition of a **neutral party** to ensure the correct implementation of the process.

4. Development of a process to **investigate and implement the necessary mitigation measures for WI** aspects in cooperation with all relevant parties (producers, network operators, end-users).

There are other elements worth mentioning… but without these pillars there is no foundation for the rest of the process!

How could SG1 process be included into EU legislation?

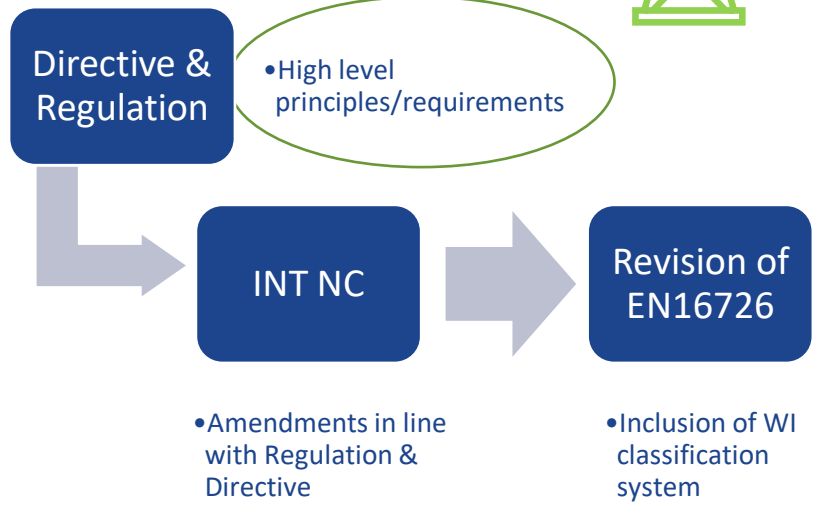
What we have today

1. Information provision on GQ based on Art 17 INT NC. Only applicable for TSOs towards DSOs or customers
2. Transparency on WI and GCV information provision at Ips (art 16 INT NC)
3. NRAs involved when GQ may hinder cross-border flows (art 15 INT NC)
4. Customers have the right to contact network operator for potential assessment of mitigation measures

What we want tomorrow

1. **Strengthen** the communication, information provision and cooperation between all relevant parties (producers, suppliers, network operators and end-users).
2. **Extension** of the transparency on WI information provision to end-users (as part of gas quality information provision).
3. Definition of a **neutral party** to ensure the correct implementation of the process.
4. Development of a process to **investigate and implement the** necessary mitigation measures for WI aspects in cooperation with all relevant parties (producers, network operators, end-users).

The time is **NOW**



A.O.B. & next steps

Overview of next steps

Prime movers' group (plenary meeting)

- Next meeting on **30th June from 10:00 to 13:00**

Sub-group 1) WI framework

- Meetings scheduled: **2nd June, 14th June, 23rd June**

Sub-group 2) Value chain H2 readiness roadmap & solutions

- Next meeting on **15th June**
- Ad-hoc meetings to be scheduled
- First deliverable to be ready by end-June (focus on GQ & H2 handling options & costs)

The role of hydrogen in heating buildings by Matthias Janssen, Frontier Economics

https://www.frontier-economics.com/uk/en/news-and-articles/news/news-article-i8293-hydrogen-in-the-heat-market/

The role of hydrogen in heating buildings

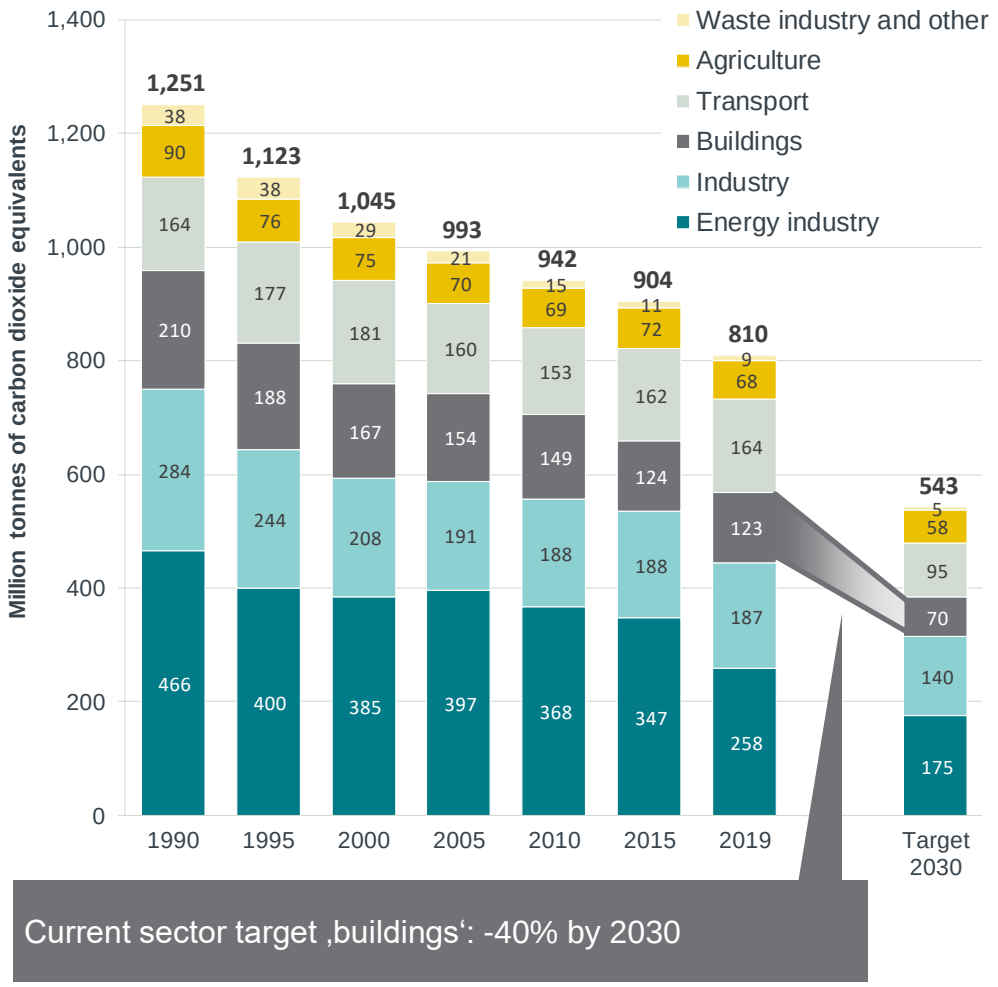
Presentation to the Prime Movers' Group on GQ and H2

31 May 2021

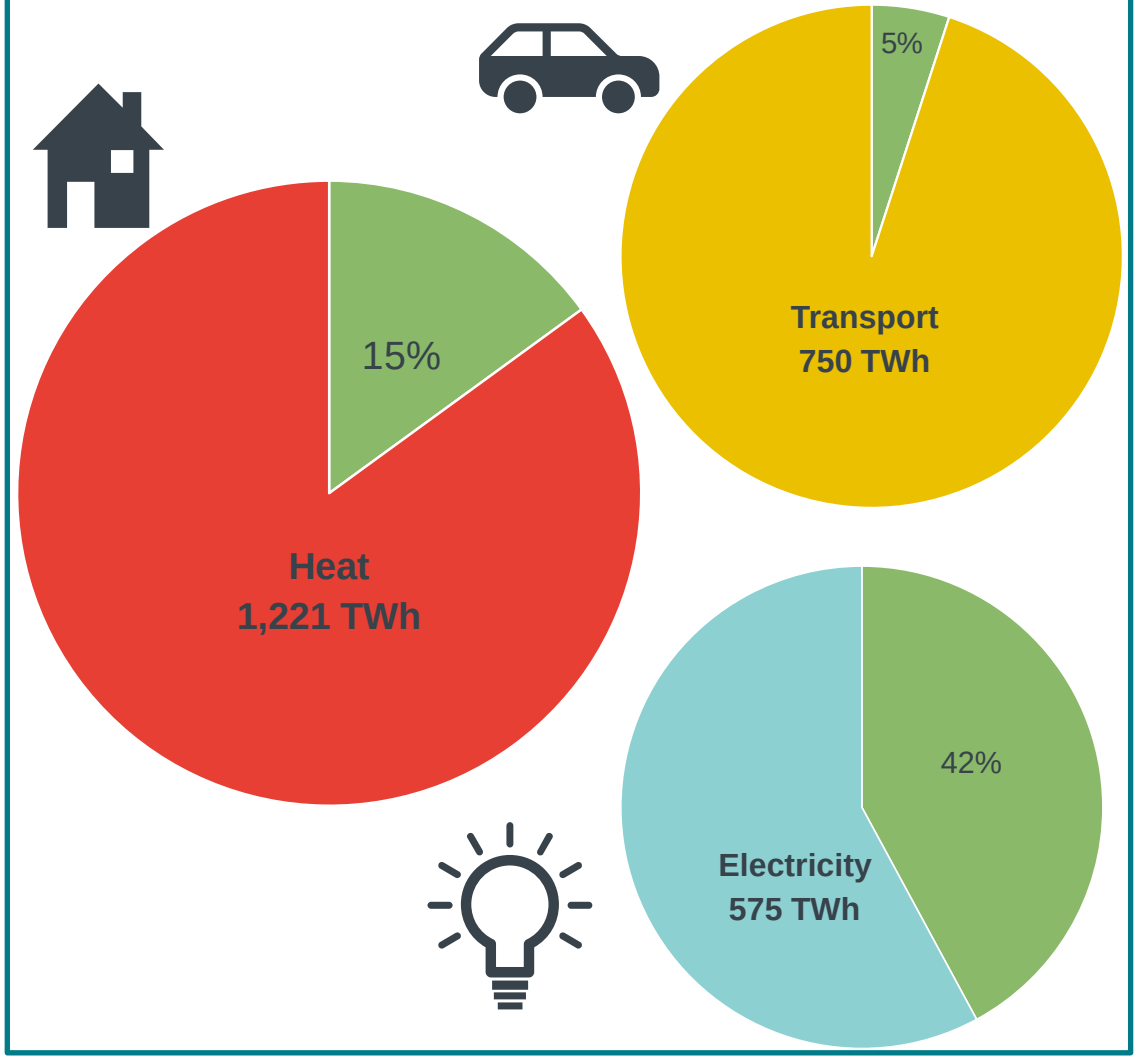
The heating sector is one of the **major fields of action** on the road to a defossilised society.

Carbon emissions in the heating sector are to be reduced by at least 40% in 10 years by 2030, roughly as much as in last 30 years

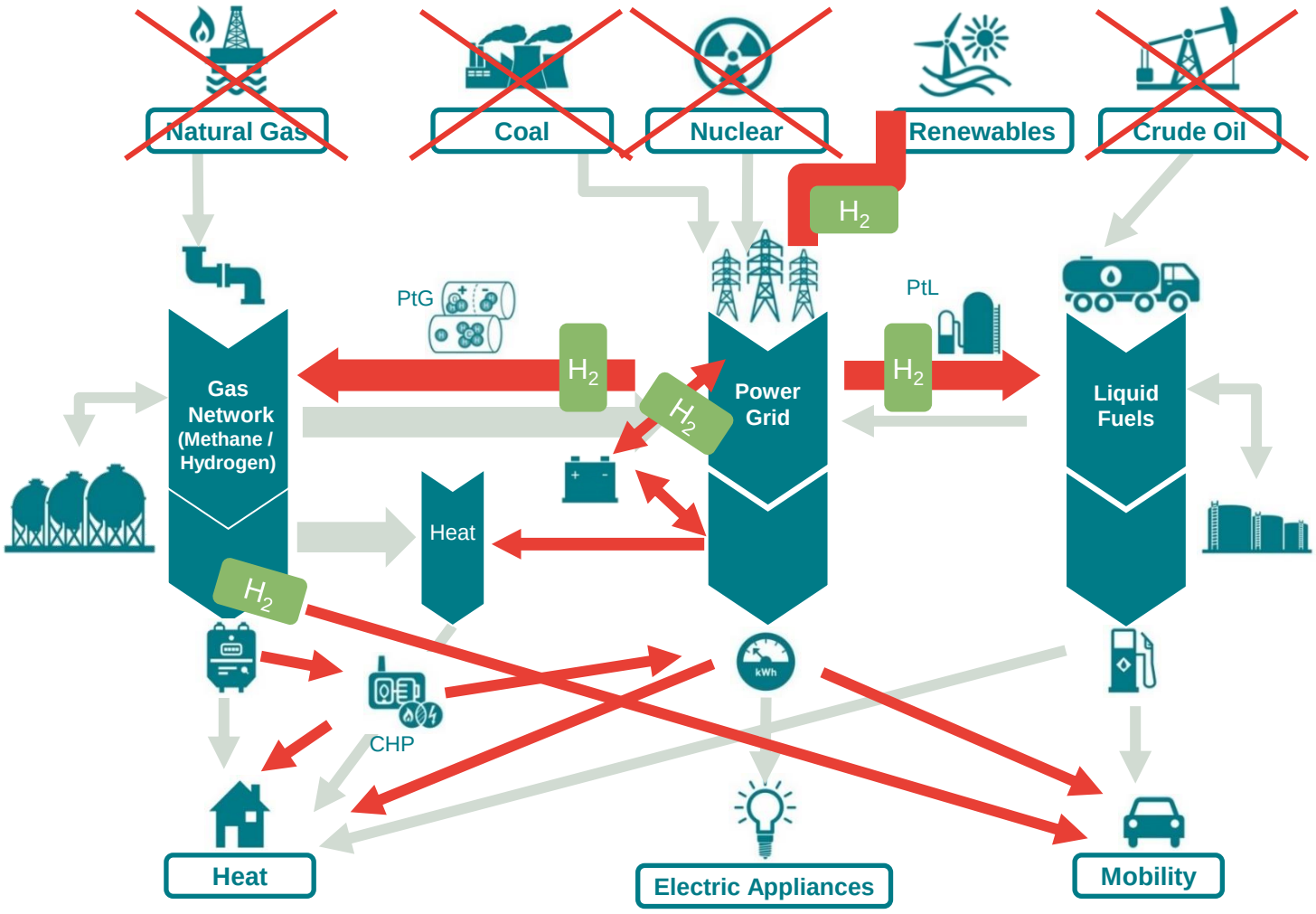
Space heating is fourth largest source of emissions…



…with heating applications accounting for half of final energy demand in Germany (2019)



Hydrogen is the crucial secondary energy carrier for the transition of the energy system to 100% renewable energy sources



EU - A hydrogen strategy for a climate-neutral Europe


EUROPÄISCHE KOMMISSION

Brüssel, den 8.7.2020
COM(2020) 301 final

MITTEILUNG DER KOMMISSION AN DAS EUROPÄISCHE PARLAMENT, DEN RAT, DEN EUROPÄISCHEN WIRTSCHAFTS- UND SOZIALAUSSCHUSS UND DEN AUSSCHUSS DER REGIONEN

Eine Wasserstoffstrategie für ein klimaneutrales Europa

DE – The National Hydrogen Strategy

Hydrogen can make a key contribution to the **specific challenges** in the heating sector.

Heterogenous building stock requires a broad mix of technologies; there is no one-size-fits-all heating system

Diverse heating sector – Appropriate heating technology depends on numerous individual characteristics (level of renovation, grid connection, local climate, usual behaviour, preferences, neighbourhood…)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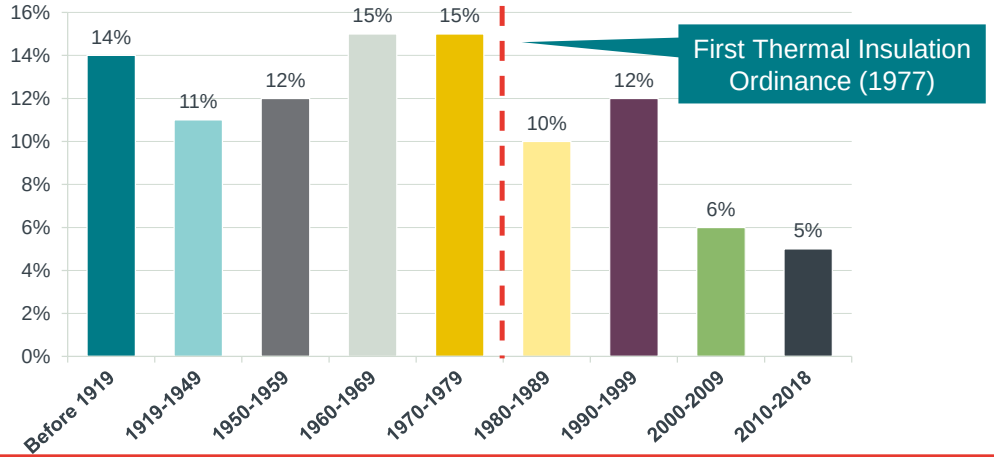
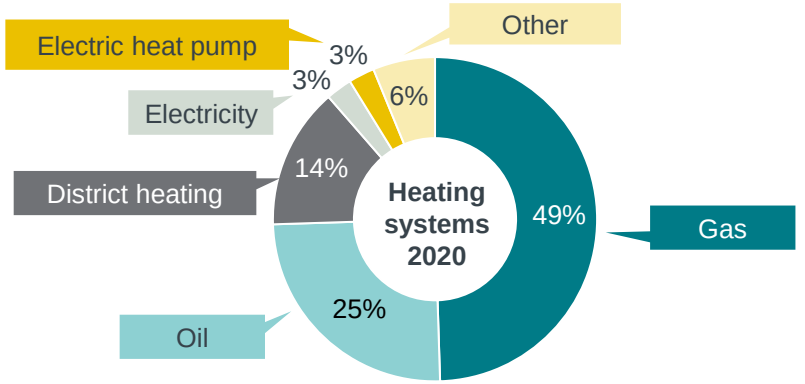
Year of construction

Share of housing units with heating by year of construction



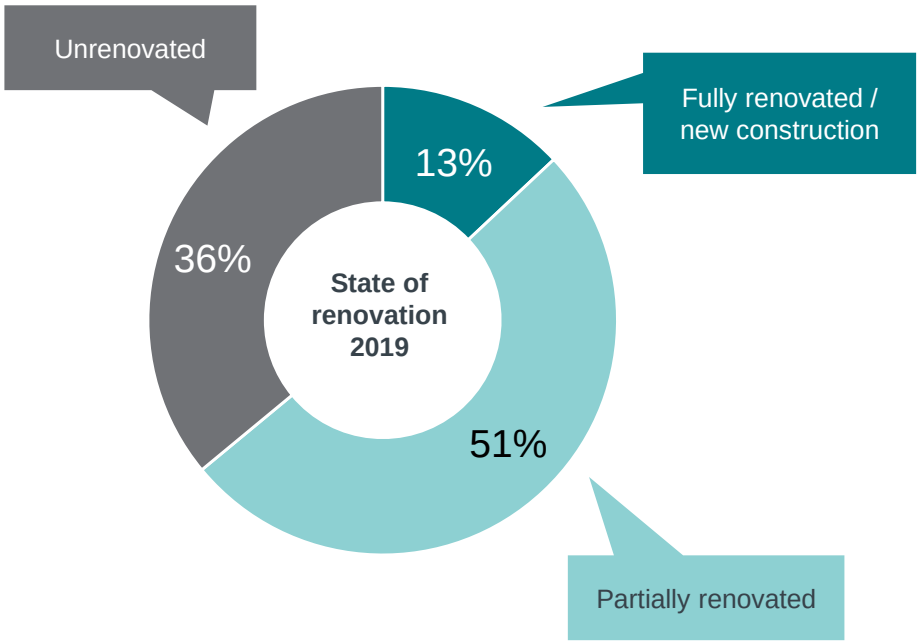
Heating systems



Hydrogen can also help to overcome practical hurdles to the pace of renovation

Across the EU, deep renovations are carried out only in 0.2% of the building stock per year […]. At this pace, cutting carbon emissions from the building sector to net-zero would require centuries..
European Commission (2020)*

In Germany, only 13% of buildings are new or deeply renovated…



… and supply and demand side constraints hamper acceleration

Supply effect

- **Very high renovation business capacity utilisation** today (~ 90%)
- Plus, **shortage of skilled workers** (1/3 of all craftsmen are over 50)

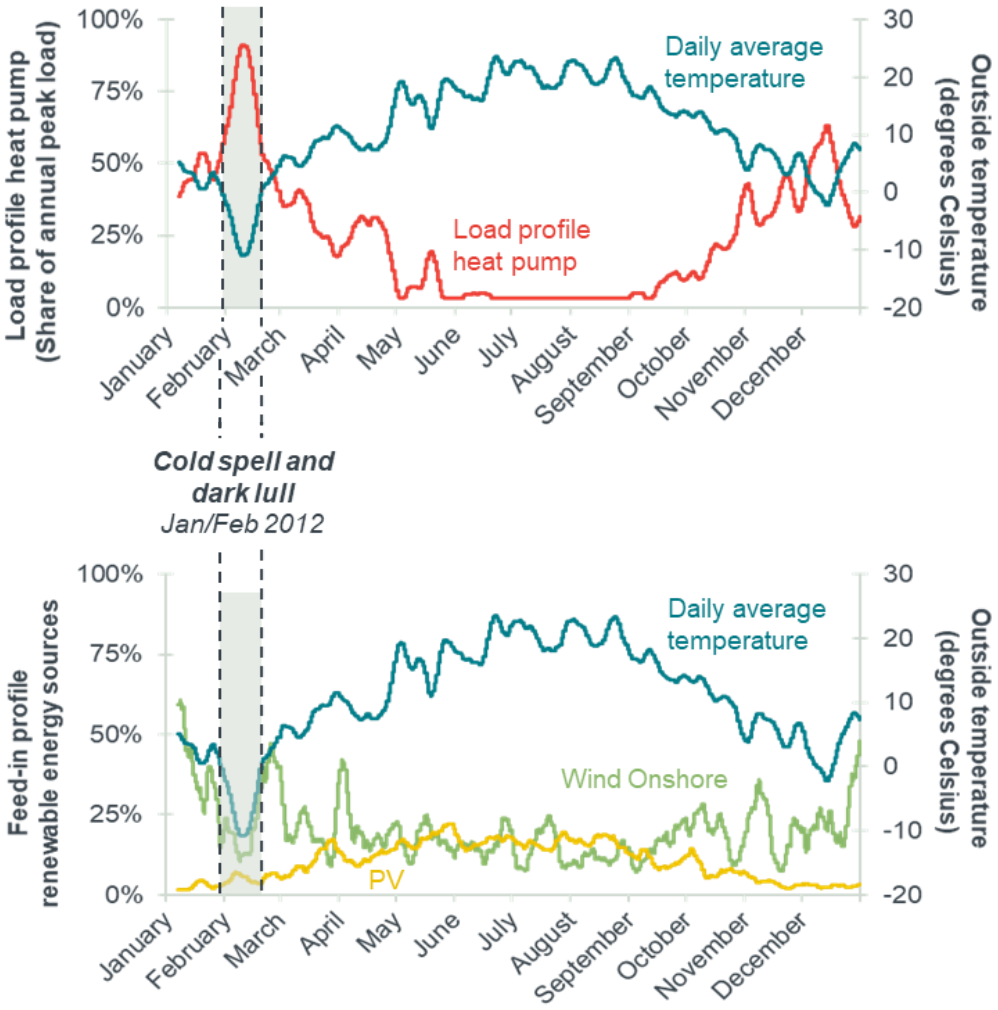
Demand effect

- **Age structure of owners** (almost 40% are over 65)
- **Low salience,** high complexity
- **Owner-user dilemma**

* Europen commission, A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives.

System view: An electrification of the heating market requires provisions for „kalte Dunkelflauten“

Example 2012



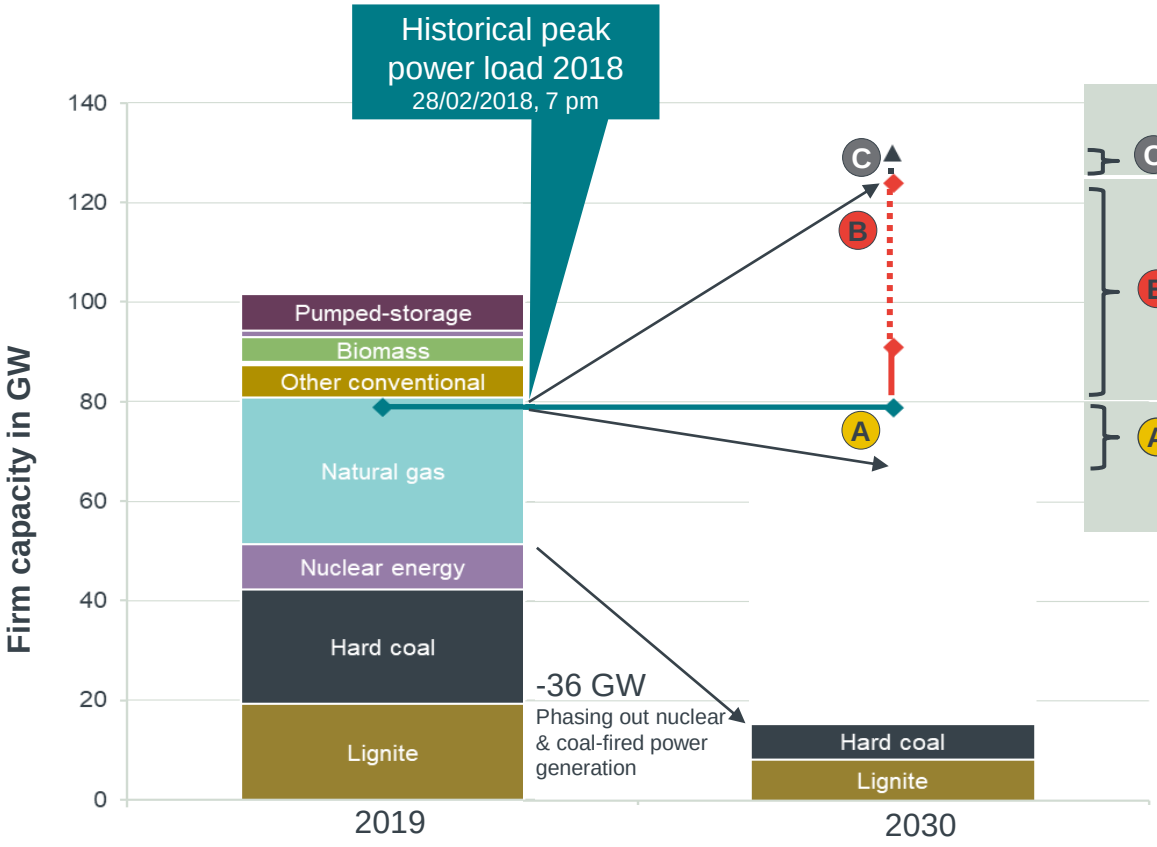
Electrifying heat demand increases system peak substantially (despite high energy efficiency of electric eat pumps)

Example 2030: 5 million additional electric heat pumps lead to increase in power peak load of **12 to 45 GW** (compared to 80 GW today)

Electrifying heat demand AND replacing fossil power production by wind and solar power raises question how to secure heat supply in winter peaks

Source: Frontier Economics (2021) based on various sources (KommEnergie, SWM Infrastruktur, netztransparenz.de and Bundesnetzagentur).
Note: Dark lulls refer to dark and windless periods (low generation from wind and PV).

An electrified heating market thus places considerable requirements on additional secured electricity generation capacity...



C **Increased** peak power load **due to e-mobility e.g. > 5 GW**

B **Demand effect of heat pumps 12 – 45 GW**

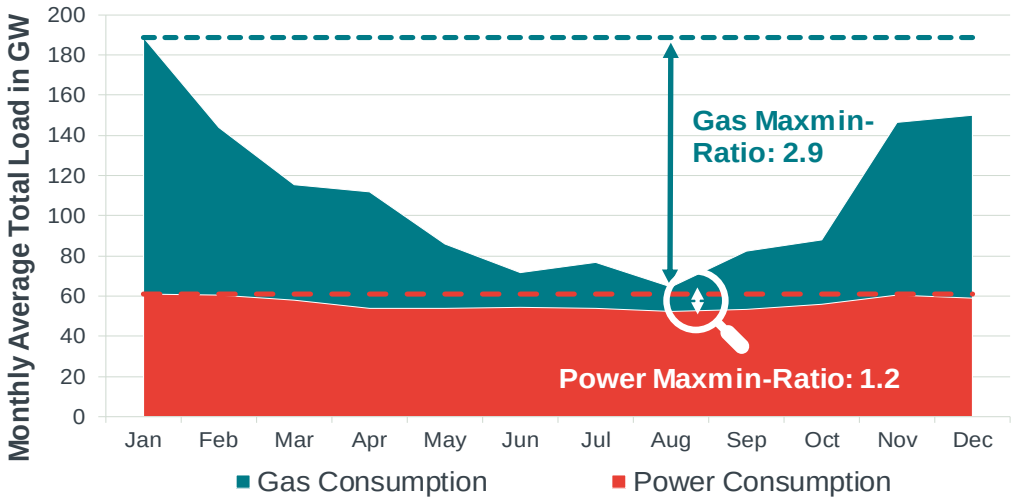
A **Supply effect from shutdown of coal and nuclear power: 13 GW**

"Gap 2030":
~ 30 - 63 GW
A + B + C

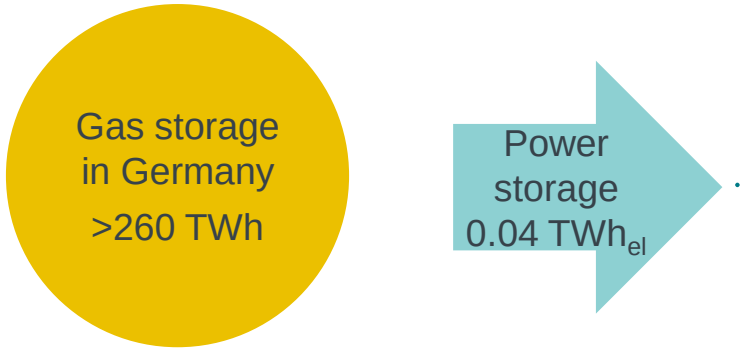
... at the same time as existing capacity is reduced by nuclear & coal phase-out

In contast, the gas system is used to provide secure energy for heating and could be adjusted to supply heat with hydrogen

While the power system has not yet been confronted with strongly seasonally fluctuating demand from heating, the gas system is dealing with this ever since...

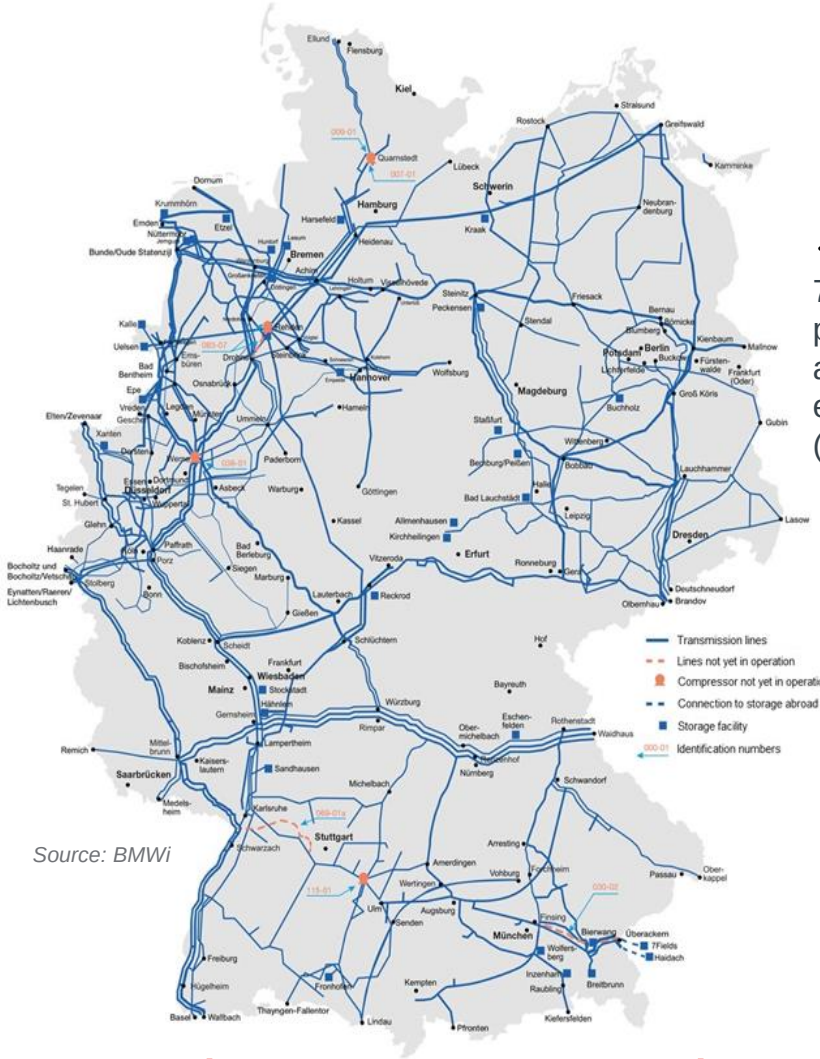


... and the gas infrastructure is dimensioned accordingly !



Source: Frontier Economics on the basis of Eurostat (figure above) as well as IEA Statistics and ENTSO-E (figure below).

The existing gas infrastructure can relieve the power grid and transport renewable energy to the consumer via hydrogen…



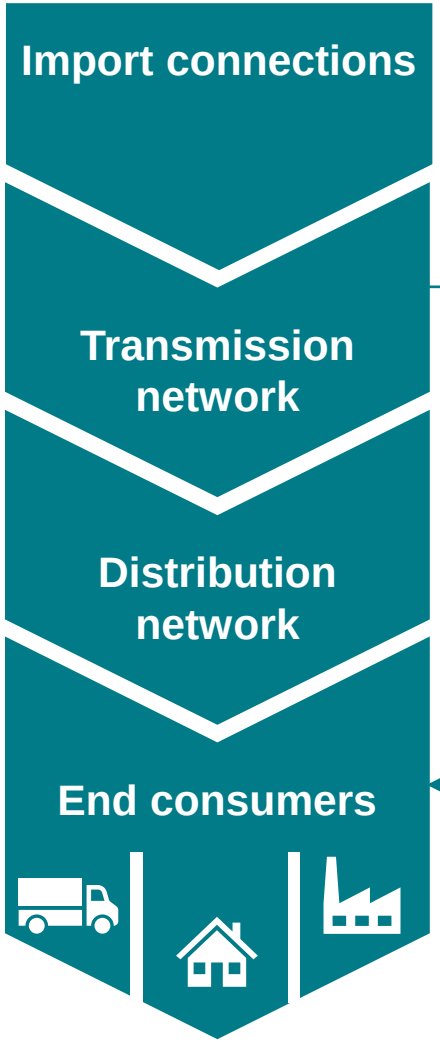
Source: BMWi

Large north-south capacity

75 GWh/h transport via pipelines possible, 4 times as much as on the electricity side (18 GW)

Good connection to households

Nearly 50% of all households have a gas connection



Many import connections

350 GWh/h import via pipelines possible, 13 times as much as on the electricity side (25 GW)

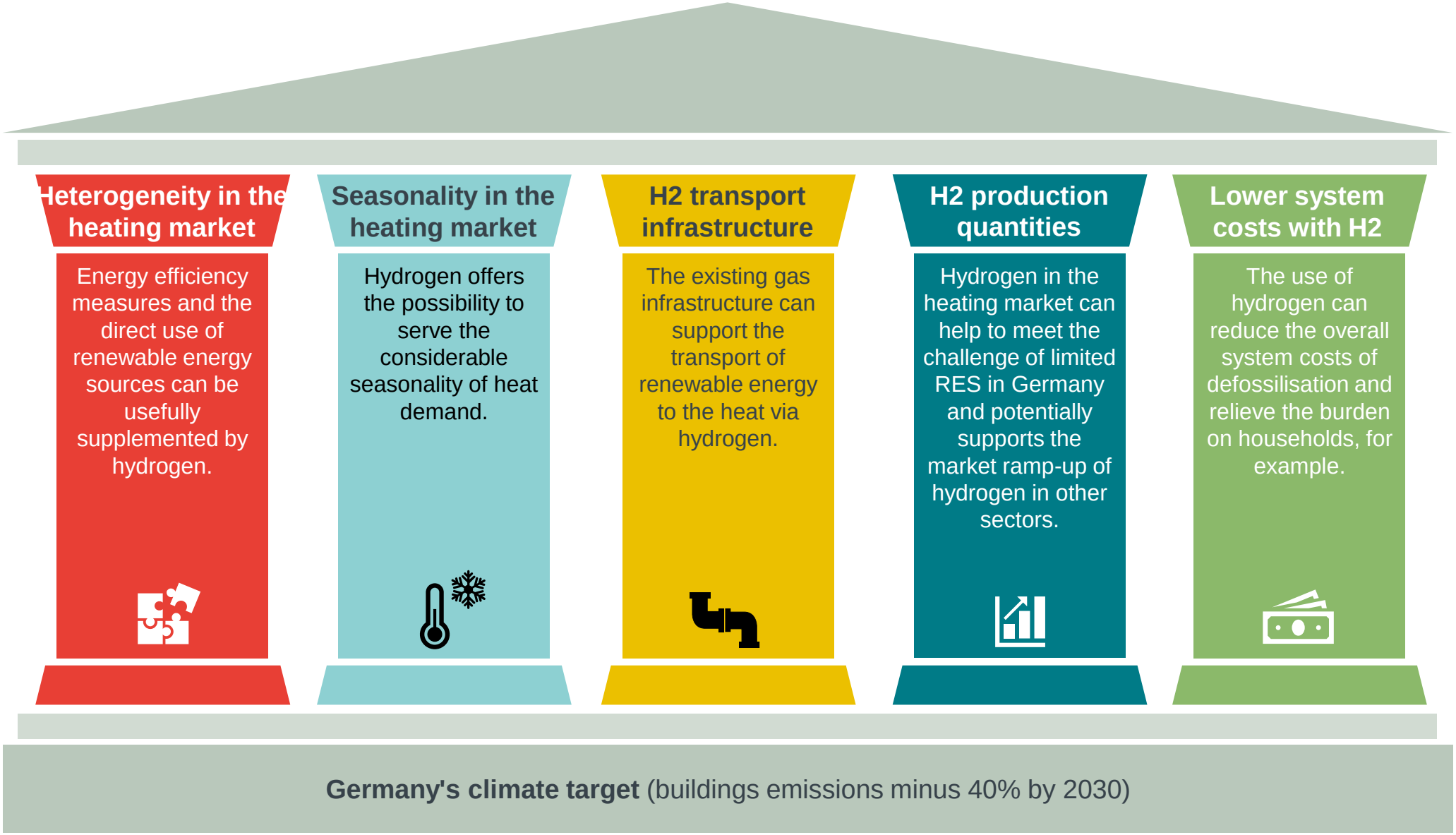
With the exception of around 500 large facilities, all industrial consumers (>99.9%) are supplied via the distribution network!

…however, a targeting of specific demand segments is only feasible to a limited extent

“

We need a **mix of technologies** for the transition of the heating sector and hydrogen can make a potentially important contribution.

Hydrogen can contribute to cutting down emissions in the heating sector and should be part of the technology mix!



What conclusions can be drawn for the regulatory framework?

The challenge of defossilisation of the heat sector can only be met by **using all options**; we cannot afford to exclude possibilities

Due to the heterogeneous requirements, **a mix of technologies** is required

Freedom of choice regarding technology has a special value

Preserving options is crucial in the face of existing uncertainty

Technology neutrality

as a central paradigm for regulatory frameworks

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Thank you for your attention

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