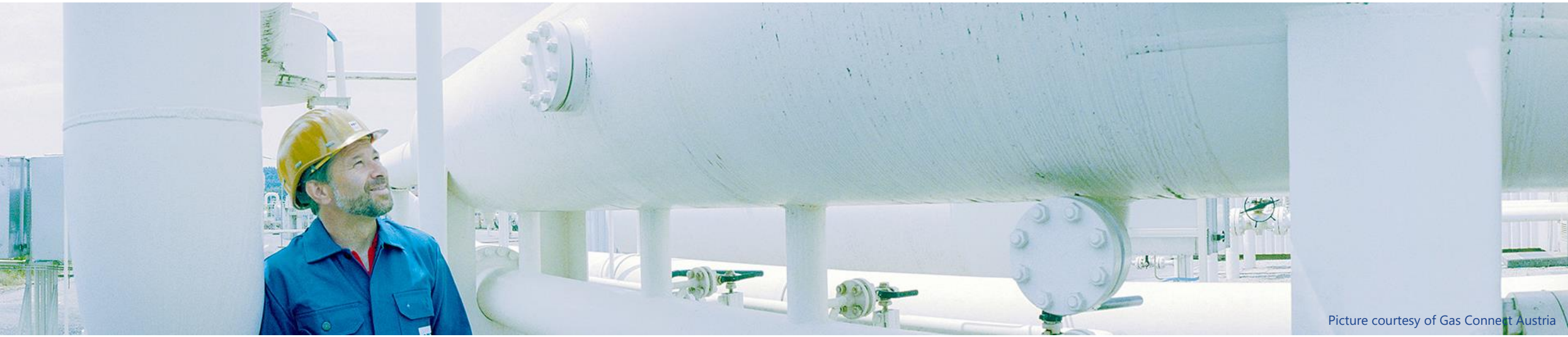
24 June 2021

Final



Picture courtesy of Gas Connect Austria

Advisory Panel for Future Gas Grids

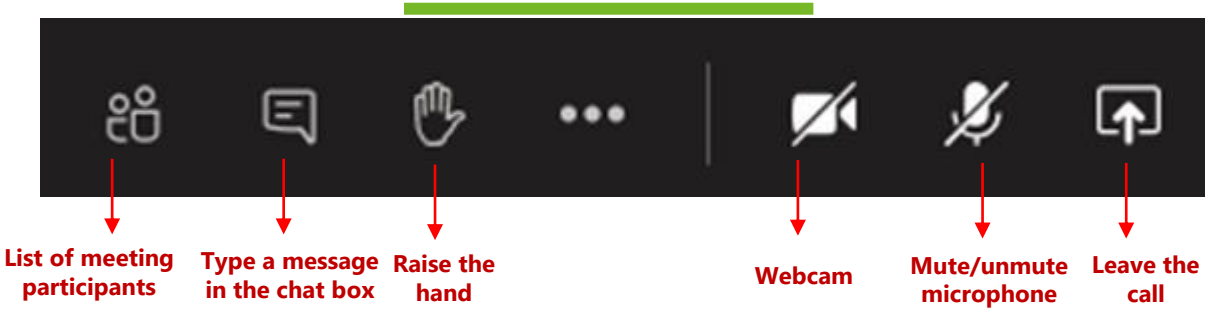
3rd meeting on 24 June 2021

Jan Ingwersen, ENTSOG General Director

Online

Introduction by Jan Ingwersen

Housekeeping



General:

- Please **mute your microphone** when not speaking
- Please **use the webcam** function only when you present
- Do **not connect via multiple devices**
- If you dialled in via phone, please **press *6 to mute/unmute**

Posing questions/interventions:

- Use **chat box** for **questions**
- '**Raise the hand**' if you want to intervene

Broad Stakeholder Representation

Aim of the Advisory Panel

Connecting the dots between:

- market players and stakeholders,
- initiatives and activities,
- work streams (technical, markets, infrastructure, regulation).

Focusing on HOW to transition gas grids.

Key take-aways from 2nd meeting of Advisory Panel

TEN-E revision:

- Some highlighted the need to include H2 ready infrastructure (including repurposing & retrofitting) and LNG terminals & storage facilities
- Some stakeholders stressed the importance of interconnections with 3rd countries
- Agreement on full energy system view beyond gas & electricity
- Welcomed the enhanced provisions on Energy System Integration, inclusion of categories such as H2, and smart gas grids

On Hydrogen and Gas Decarbonisation package:

- Agreement that Industrial competitiveness is important and the need for gradual regulation – offering sufficient certainty and flexibility to investors
- Differing views on cross-subsidisation between gas & H2 tariffs
- Differing views on regulatory framework: Include H2 into Gas regulatory framework vs separate H2 framework

On REDII revision:

- Differing views: One GOs framework for H2 vs distinct one for H2
- Some agreement on virtual trading of GOs which should not lead to 'green washing'
- Differing views of location of Electrolysers – either on site with a dedicated H2 supply grid as best option to supply industry vs security of supply and market liquidity needs
- Differing views on certification: EU-wide certification system vs international GOs system

Agenda

Description	Time
1. Introduction and welcome by Jan Ingwersen	13:00 – 13:10
2. European Clean Hydrogen Alliance project collection 2.1. DG GROW perspective on Clean Hydrogen Alliance project collection (Henning EHRENSTEIN, DG GROW) 2.2. Portuguese perspective (João GALAMBA, Deputy Minister and State Secretary of Energy, Portugal) 2.3. Port of Antwerp perspective (Didier Van OSSELAER)	13:10 – 13:45
3. Focus on End-users: use-cases of renewable and decarbonized gases 3.1. EU Turbines/EUGINE perspective on H2-ready gas turbines (Ralf WEZEL) (5min) 3.2. EHI perspective on H2 in heating (Federica SABATTI) (5min) 3.3. CEFIC perspective on H2 in chemical industry (Willem HUISMAN) (5min) 3.4. Discussion with all Members	13:45 – 15:15
4. Smart gas grids & digitalisation 3.1. Project presentation by SmartSim (Stefan RICKELT) (5 min) 3.2. Project presentation by EVIDA - DSO (Nikolaj Bjerg JENSEN) (5min) 3.3. Update from Prime Mover Group on Gas Quality & H2 Handling (Hendrik POLLEX) (5min) 3.4. Discussion with all Members	15:15 – 16:45
5. Summary and next steps	16:45 – 17:00
6. Closure of the meeting	17:00

2. European Clean Hydrogen Alliance project collection

DG GROW perspective

Mr Henning Ehrenstein

Deputy Head of Unit for Energy Intensive Industries & Raw Materials, DG GROW

Portuguese perspective

Mr João Galamba

Deputy Minister and Secretary of State for Energy, Portugal

Port of Antwerp perspective

Mr Didier Van Osselaer

Program Manager Sustainable Energy, Port of Antwerp

Q&A

3. Focus on End-users: use-cases of renewable & decarbonised gases

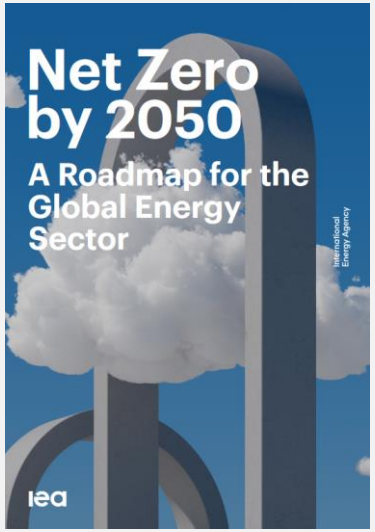
European Engine Power Plants Association

EUTurbines

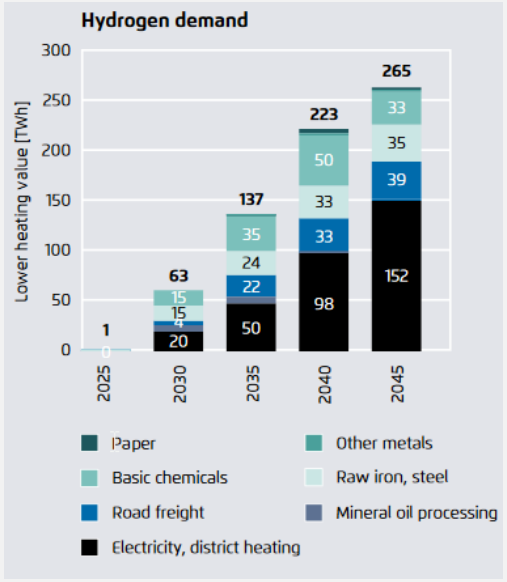
H2 & Gas Power Plants

ENTSOG Advisory Panel for Future Gas Grids – 24 June 2021

Gas Power Plants as H2 consumers



After 2030, low-carbon hydrogen use expands rapidly in all sectors in the NZE. **In the electricity sector, hydrogen and hydrogen-based fuels provide an important low-carbon source of electricity system flexibility, mainly through retrofitting existing gas-fired capacity to co-fire with hydrogen**, together with some retrofitting of coal-fired power plants to co-fire with ammonia. **Although these fuels provide only around 2% of overall electricity generation in 2050, this translates into very large volumes of hydrogen and makes the electricity sector an important driver of hydrogen demand.** (page 76)



The consequence of the electrification efforts:

H2-fuelled power & CHP plants will become main H2 consumers

EU approach to focus on “hard-to-decarbonise” industry sectors is misleading

Hydrogen-ready Gas Power Plants

EUTurbines definition
NEW H2-ready Gas Power Plants

Level A 100% H2	Level B up to 25% H2[2]	Level C up to 10% H2[2]
• A1: **no** substantial modifications	• B1: **no** substantial modifications	• C1: **no** substantial modifications
• A2: **minor** upgrading required	• B2: **minor** upgrading required	• C2: **minor** upgrading required
• A3: upgrading possible	• B3: upgrading possible	• C3: upgrading possible

Retrofitting existing plants

- No off-the-shelve product – need for case-by-case analysis
- EUTurbines & EUGINE to provide checklists
- Not just a turbine / engine question
- Very important: avoiding further space requirements for additional gas mixing unit

H2-readiness of new plants will not be a challenge – but needs a common understanding

Upgrading existing plants needs individual analysis. Up to 20-30% H2 blending requires in most cases small modifications

H2-ready – but will there be H2 available?

Market challenges

H2 power plants may not be attractive for investors (expensive H2, limited operating hours)…
… nor to H2 suppliers (no steady demand)
… but provide essential benefits to the energy system

Access challenges

- Planning of H2-backbone and H2-valleys ignores power plant locations → retrofit?
- Trend to decentral plants connected to the distribution grid – will distribution grids remain?
- Optimised location planning according to electricity grid needs or access to H2 grid? Integrated planning is key!

"H2-ready" needs to be accompanied by a plan to have access to H2

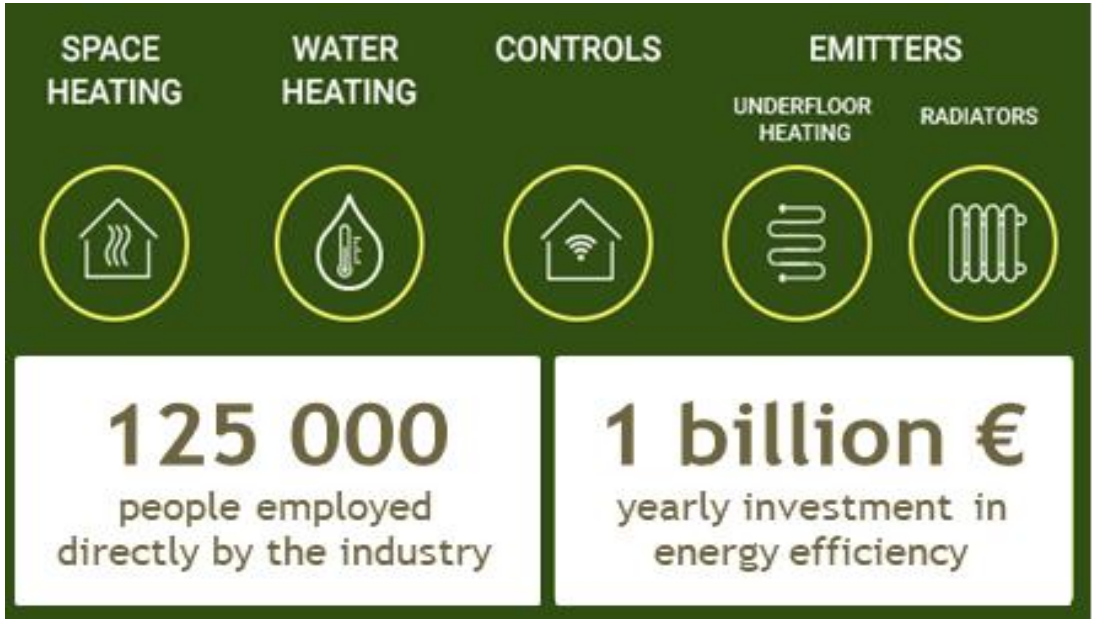
Ignoring H2 supply for gas power plants in the planning now will cause problems for the electricity system as of 2030!

A perspective from end users: heating

Federica Sabbati, Secretary General,
European Heating Industry - EHI

ehi
association of the
European Heating Industry

EHI brings together manufacturers of heating systems in Europe



ehi association of the European Heating Industry

A perspective from end-use: why we need RES gases to decarbonise buildings

EU energy consumption

> **40%** in buildings

> **85%** spent for heating

& hot water

EU buildings

40% built before 1960

1,5% new built/ year

1% renovation/ year

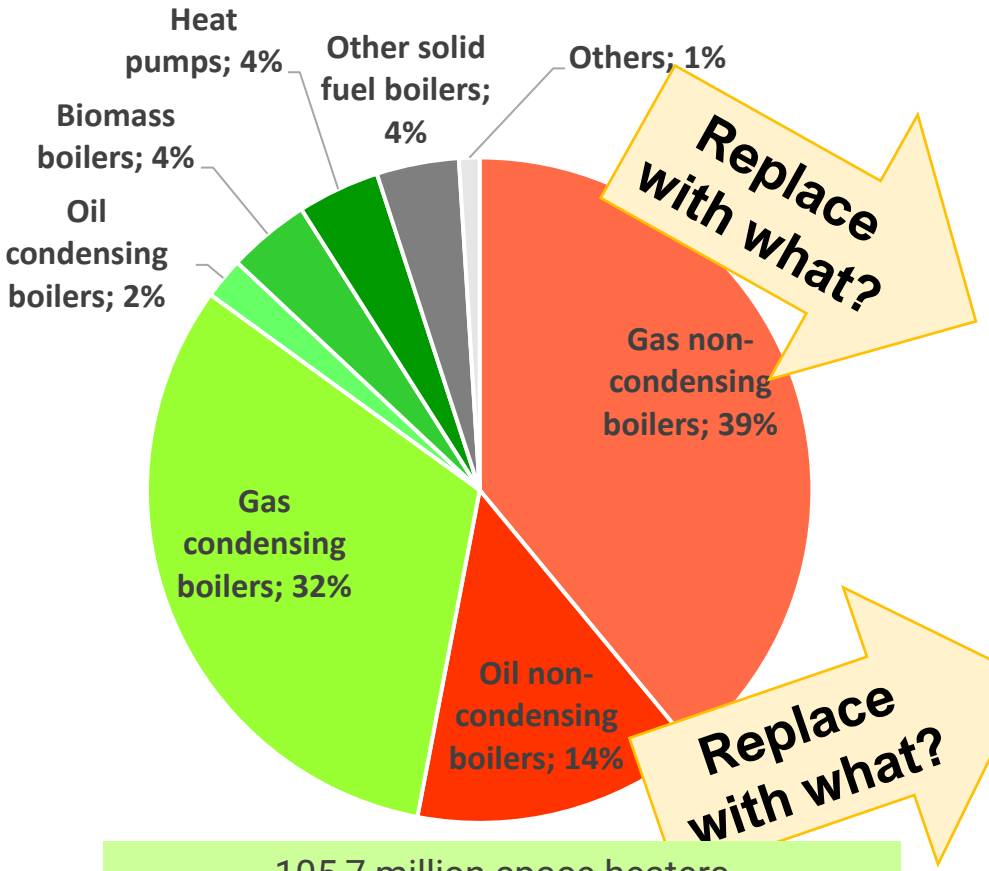
Long term scenario of the EU Commission for decarbonisation of buildings in 2050:

34% direct electrification

What about the rest of buildings?

Heating transformation is multitechnology - ‘fit for 55’ technologies available

EU installed stock of heaters in 2019, EHI data



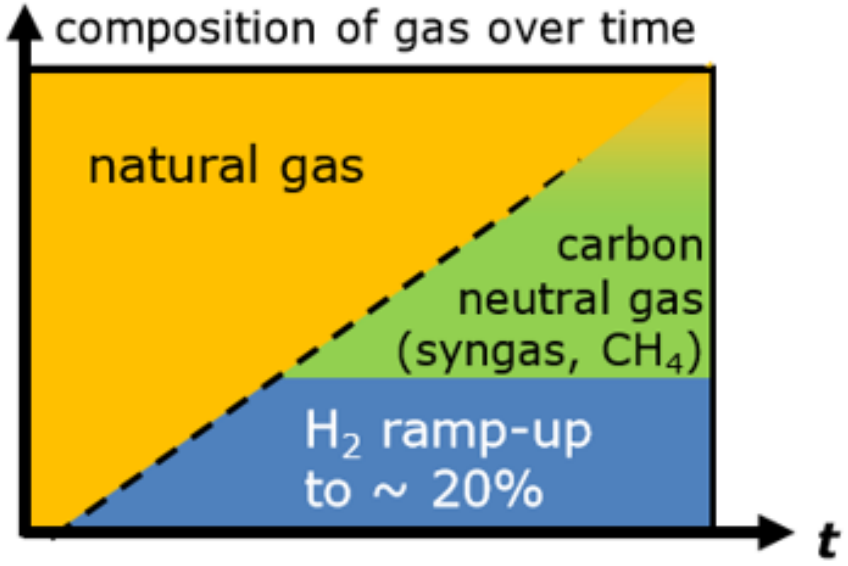
105,7 million space heaters
58% old & inefficient, > 61 million appliances

Different building, different technology; quick payback.

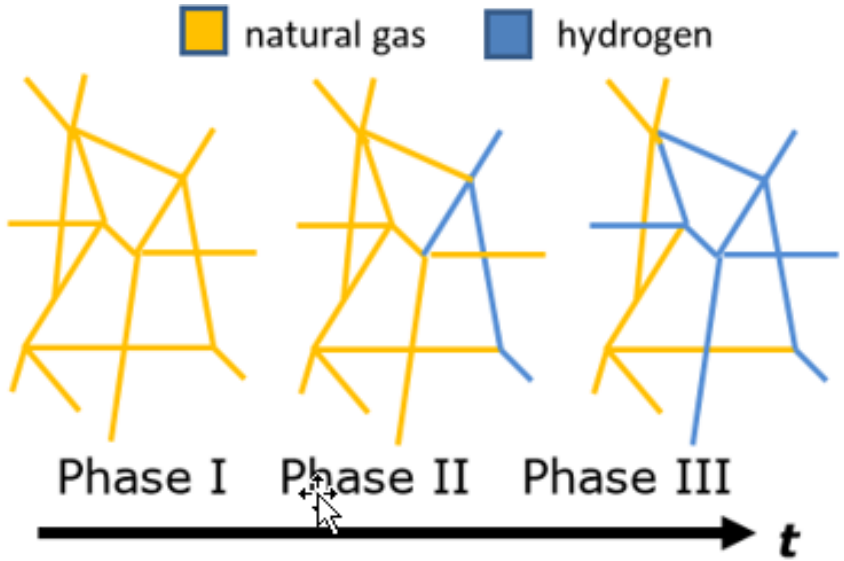
ehi association of the European Heating Industry

Existing gas infrastructure: an asset for buildings decarbonisation?

Blending



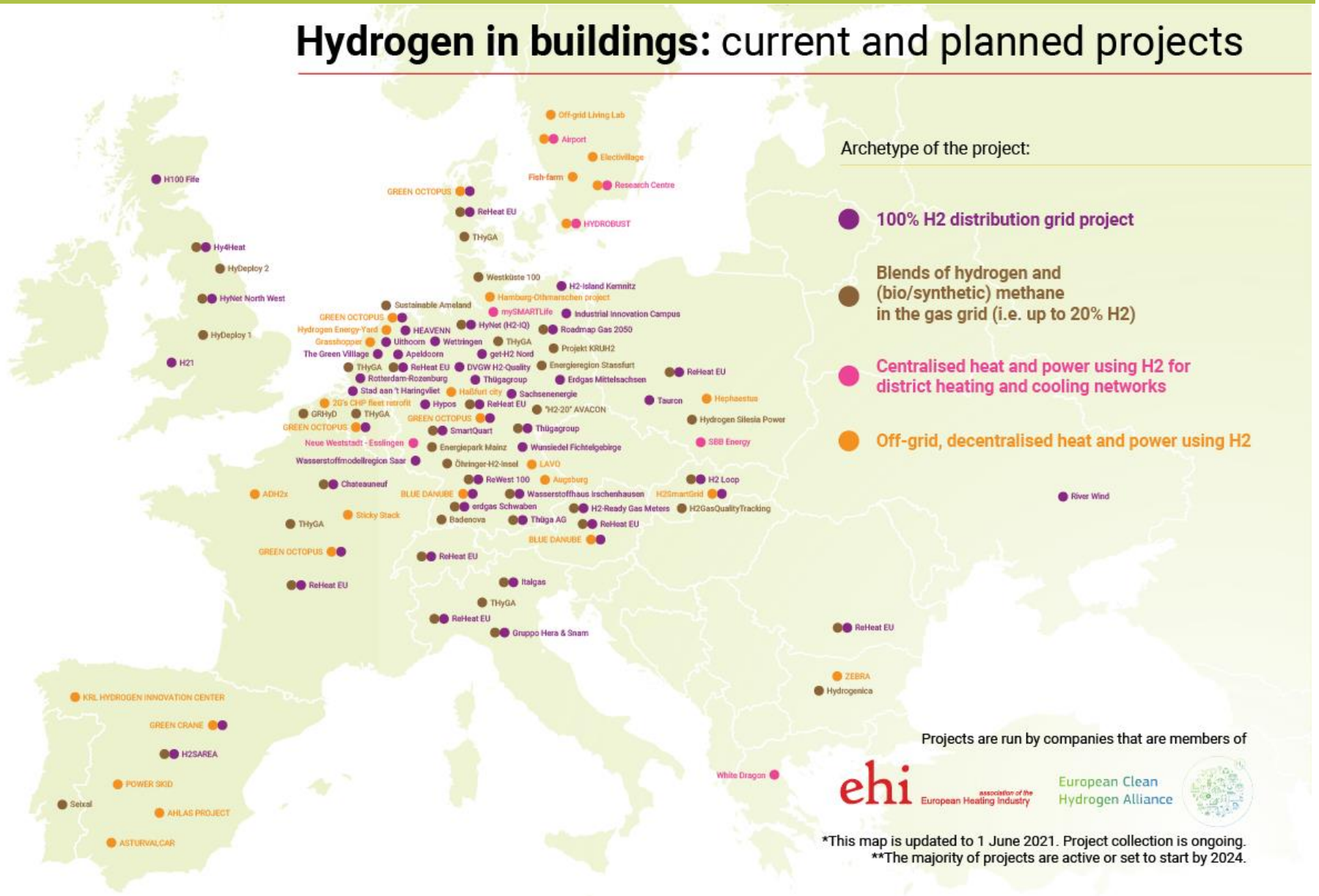
100% H2 grids



- Most of heating systems today are gas based (~ 70% of stock)
- Large storage capacity in the gas grid, sized to cope with seasonal heating demand and security of supply.
- Use grid as an asset to transport and distribute decarbonised and renewable gases?

Hydrogen for building projects today

83 projects across Europe… and counting!



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Perspective and cost estimate for residential consumers

Today	2025-2029	Costs

• **All gas end use products** installed in stock (>1995) can work with bio methane and bio-LPG and up to 10% H2 blend without any extra cost
 	
• **Many modern condensing boilers** can work with **up to 20% H2 blend** with new certification **without** any **extra cost** (intermediate step towards decarbonisation)
	• **Ecodesign:** all domestic gas condensing boilers and thermally-driven heat pumps placed on the market:
	  • from 2025: capable to process up to 20% H2
	  • from 2029 ready for retrofit: from natural gas to 100% H2.
	
	• **Energy label**: show that appliances can work well with green gases.
		100% H2-ready technology: **minor cost effect to the end user; no regret solution** toward CO2-neutrality:
		
		• domestic H2-ready boiler **~+17%,** compared to condensing natural gas boiler; conversion kit to 100% H2 **~13%** of H2-ready boiler price
		
		• H2-ready thermally-driven heat pump: total cost increase for consumer **~5-6%** *

* EHI paper: “EHI position on green gases for heating”

ehi association of the European Heating Industry

ehi

association of the
European Heating Industry

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Cefic perspective on H_2 in the chemical industry

Willem Huisman

24 June 2021, ENTSOG

3rd meeting of Advisory Panel for Future Gas Grids

The European Chemical Industry Council, AISBL – Rue Belliard, 40 - 1040 Brussels – Belgium
Transparency Register n°64879142323-90

Potential of hydrogen in industrial projects

Why it is important to strive for 'climate-neutral':

- Reduction of large amounts of greenhouse gas emissions (several 100 million tonnes/a).
- Preservation of industrial sites and employment while transitioning to climate-neutral manufacturing.
- Preservation of the making industry in Europe, thereby ensuring a certain level of independence.
- Maintain technological leadership in Europe (vital for a resource-restricted region).

Hydrogen and the chemical industry:

- The chemical industry produces hydrogen, for own consumption – about 4 Mt/year
- Hydrogen is used first and foremost as feedstock
- Current hydrogen production via unabated steam methane reforming: clearly unsustainable in a climate-neutral society.

ECH2A – Industry archetypes

Relevance for the chemical industry

Number	Archetype	Comments
1	Hydrogen for industrial heat	H_2 replacing fossil fuel for high-heat applications that cannot be electrified ('hard-to-abate').
2	Hydrogen for multi-industrial hubs	Large-scale H_2O electrolyser on a site/hub feeding wide range of applications.
3	Hydrogen as feedstock for the chemical industry (with carbon from various sources)	Conversion of clean H_2 and CO_2 or CO into chemical building blocks (e.g. methanol, olefins, synthetic naphtha).
4	Hydrogen for steel manufacturing (DRI and Hot Metal)	Use of H_2 for Direct Reduction of Iron Ore (DRI) and alternative iron-making processes, replacing coal/coke/fossil fuel.
5	Hydrogen for e-fuels production (e-kerosene, other e-fuels)	Separate archetype (from #3) due to application-specific pain points on the end-user side.
6	Hydrogen as feedstock for refining	Replacement of grey hydrogen.
7	Hydrogen as feedstock for ammonia	Replacement of grey hydrogen.

Main challenges for clean hydrogen use in industry

- Lack of clear terminology, as well as a comprehensive certification and verification framework for clean hydrogen.
- Growing demand for low-carbon products but resistance to pay the necessary premium to cover the additional cost.
- Current cost of renewable and low-carbon hydrogen is too high.
- Current availability of renewable and low-carbon hydrogen is low.
- Current availability of affordable and abundant renewable electricity is low.
- Current availability of hydrogen-related infrastructure is low.
- Technological risk during process scale-up to commercial size.
- Lack of prioritisation from the EC on the sectors/functions that hydrogen should be primarily destined for from now to 2030.

Closing remarks: Hydrogen, renewable and low carbon gases, and the chemical industry

- The chemical industry is the main industrial consumer of natural gas and the main producer and consumer of hydrogen
- Hydrogen is expected to play a key role in supporting the chemical industry in the transition towards carbon neutrality
- The chemical industry can use hydrogen and renewable and low carbon gases both as feedstock and as energy carriers
- Our priority is to preserve gas quality.
  Failing to do so would have negative impacts on our equipment and our feedstock.
- Hydrogen, on the one hand, and renewable and low carbon gases, on the other hand, should be delivered in dedicated pipelines.

Thank you.

Contact:
Nicola Rega
Energy Director
nre@cefic.be

About Cefic

Cefic, the European Chemical Industry Council, founded in 1972, is the voice of large, medium and small chemical companies across Europe, which provide 1.1 million jobs and account for 15% of world chemicals production. Cefic members form one of the most active networks of the business community, complemented by partnerships with industry associations representing various sectors in the value chain. A full list of our members is available on the Cefic website.
Cefic is an active member of the International Council of Chemical Associations (ICCA), which represents
chemical manufacturers and producers all over the world and seeks to strengthen existing cooperation with global organisations such as UNEP and the OECD to improve chemicals management worldwide

The European Chemical Industry Council, AISBL – Rue Belliard, 40 - 1040 Brussels – Belgium
Transparency Register n°64879142323-90

Discussion

Questions for debate

1. What is the cost aspect of using H2 in end-use applications? Who will pay for the investment needed?

3. What does the industry need from TSO/DSOs in short and long-term perspective?

2. What is the key obstacle/barrier in using renewable & low-carbon gases in end-use & what is needed to mitigate?

4. Smart gas grids & digitalisation

Gas quality tracking

a digital solution for today's & future gas grids

Dr. Stefan Rickelt, SmartSim GmbH

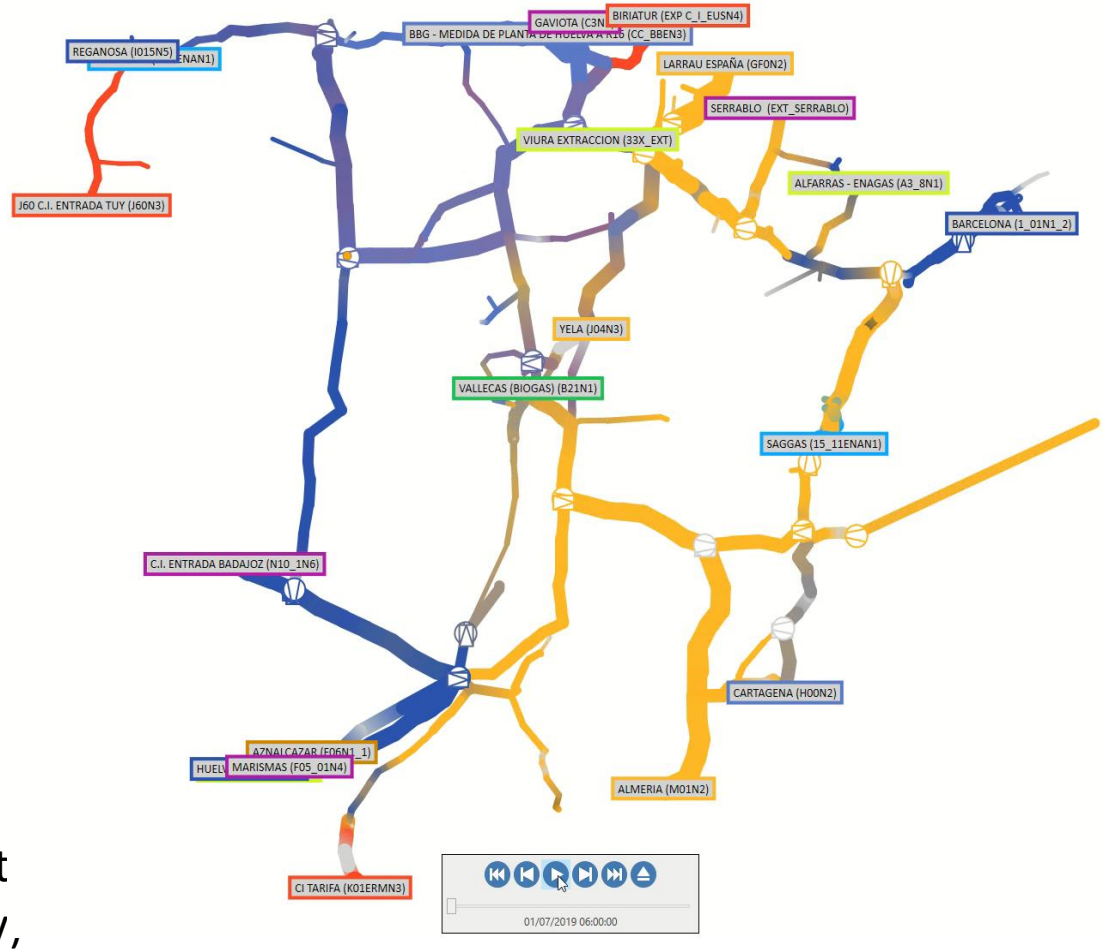
3rd meeting of ENTSOG Advisory Panel for Future Gas Grids

24.06.2021

SmartSim

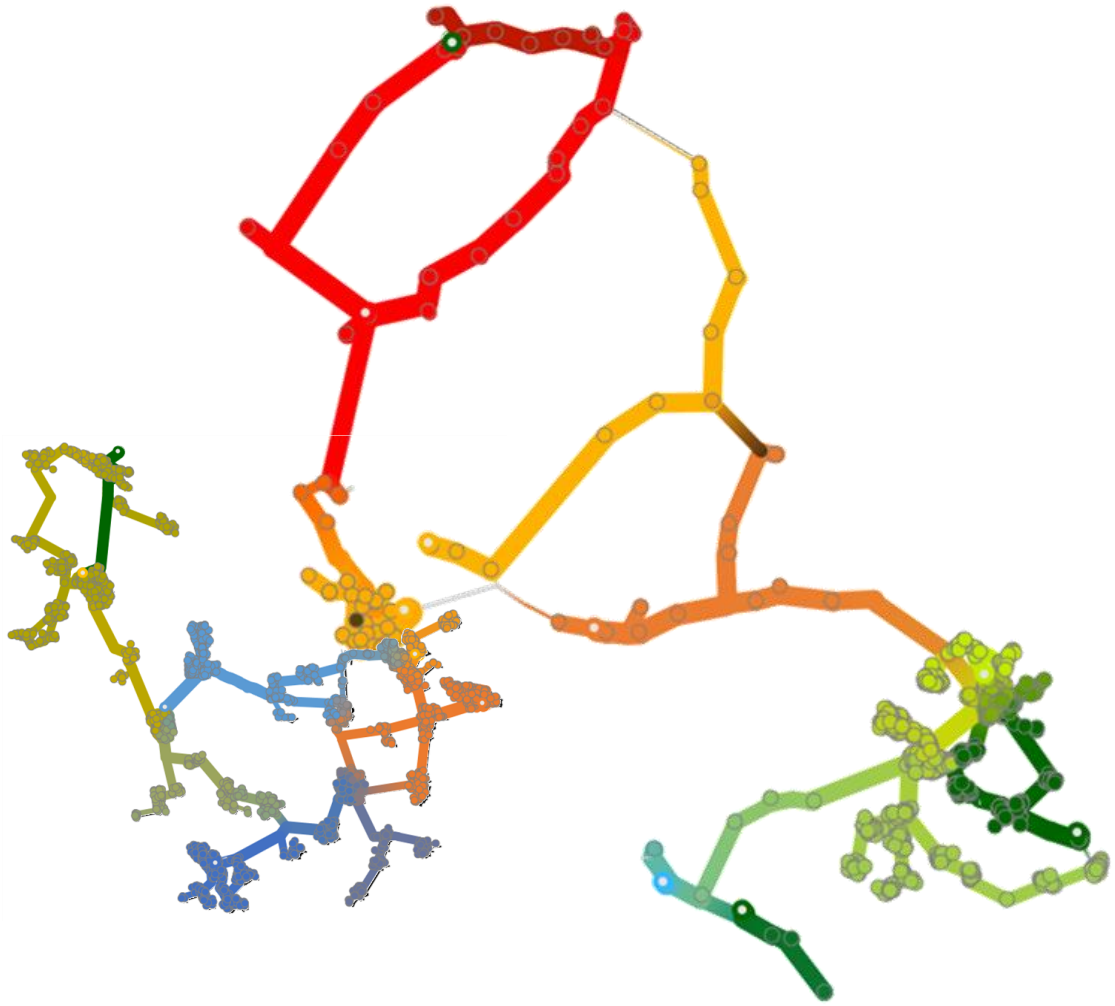
Gas quality tracking – past

- Used for **transmission grids** for **20 years**
- Applies **measured data** as input data volumes, pressures, gas quality…
- **Dynamic simulation** typically in hourly resolution
- Gives a clear picture about the **gas distribution of a past period**
- Systems are used for billing
- Undergo an **approval process** which includes **validation with measurements**
- Example: gas quality tracking at transmission grid of Enagás
- in contrast, capacity planning simulations only provide a st steady-state simulation for a scenario (coldest/hottest day,



Gas quality tracking – present

- **Important advances** of simulation techniques during **last years**
- **Integration of renewable gases** set the demand to track different gases
- With **SmartSim**, we succeeded in applying gas quality tracking in distribution grids in the last 10 years
- **More and more DSOs apply gas quality tracking** in grids where exit points have no hourly volume metering
- Now first implementations to **downstream distribution grids** and **city grids**
- Requirements defined in **ISO 15112** (“Energy Determination”)



Gas quality tracking – future

- Gas quality tracking to become feasible for gas **grids with high complexity**

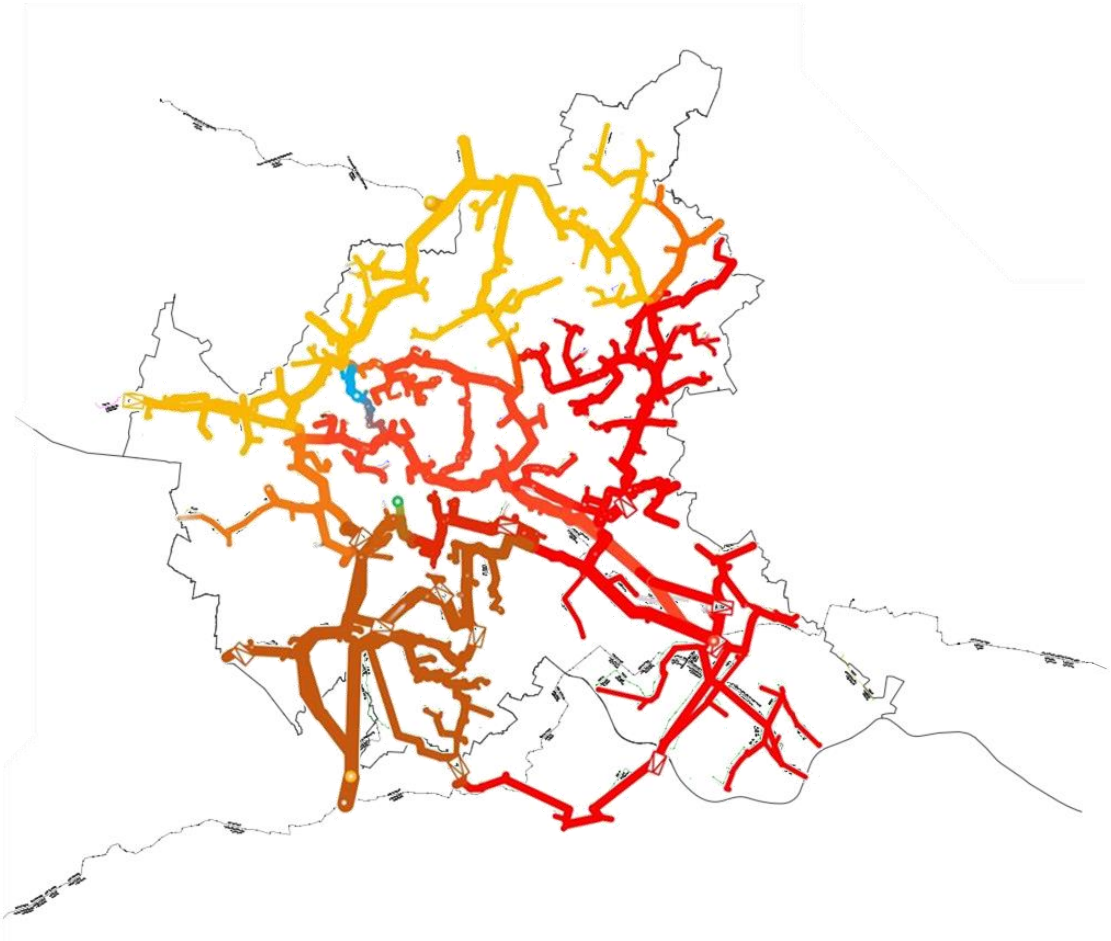
City grids

- Often have **large capacities** to receive renewable gases
- Have a **key role in integration of renewable & decarbonized gases** and reduce carbon footprint

Wobbe Index classification

- CEN SFGas GQS gives proposal of WI requirements
- Possible with gas quality tracking systems available today

Forecasting of gas quality variations (CV/Wobbe) and **hydrogen**



Thank you for your attention!

Dr. Stefan Rickelt

stefan.rickelt@smartsim.energy

+49 178 854 4585

SmartSim

ENTSOG Advisory Panel for Future Gas Grids

24th of June 2021

Nikolaj Bjerg Jensen - Evida

Evida – The Danish DSO

- Fusion of three former DSO's
- Around 400.000 Danish gas consumer
- Operates more than 18.000 km of distribution grid

evida

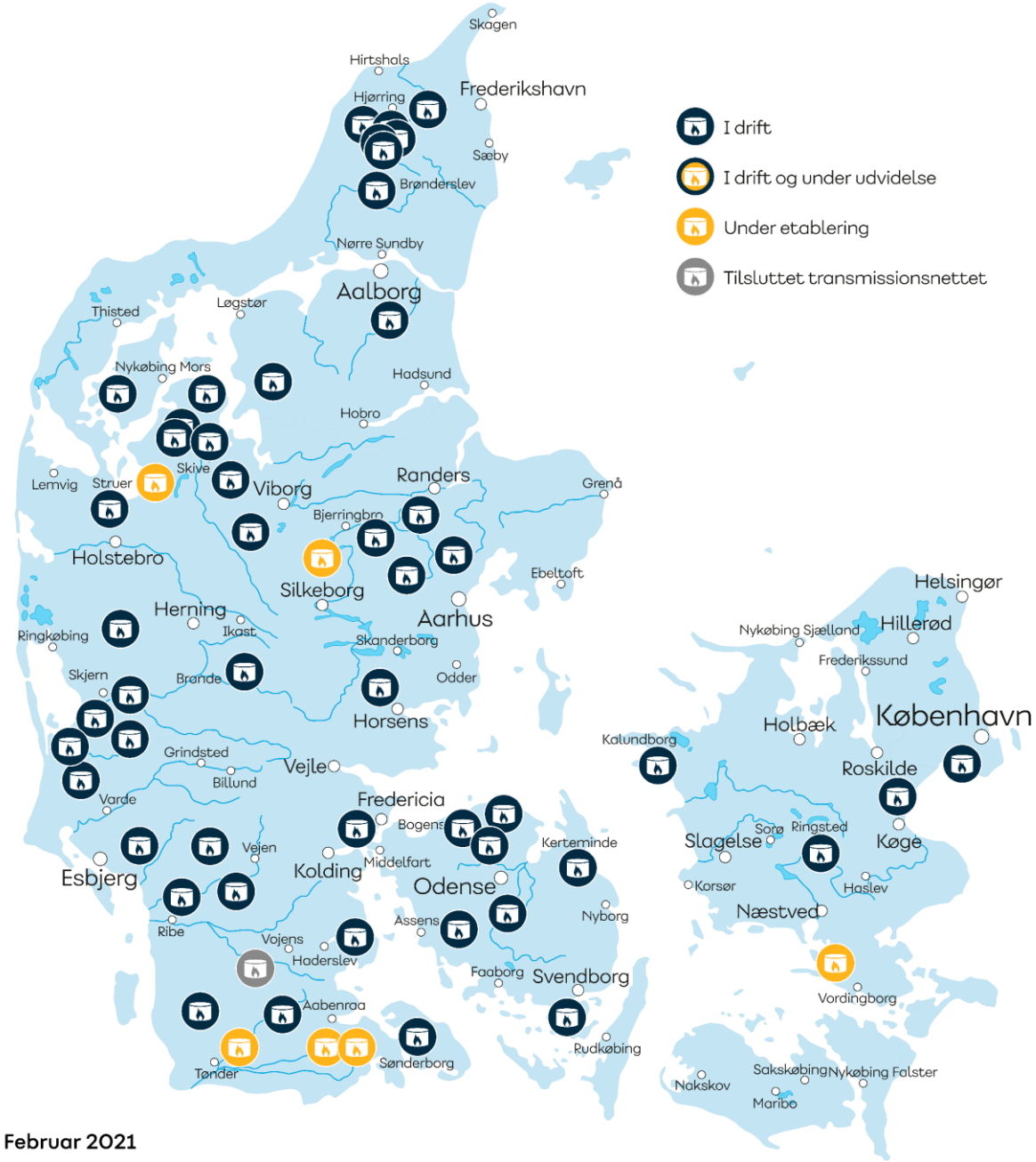
Bimethane production

Decentral production

Located in rural areas without high consumption

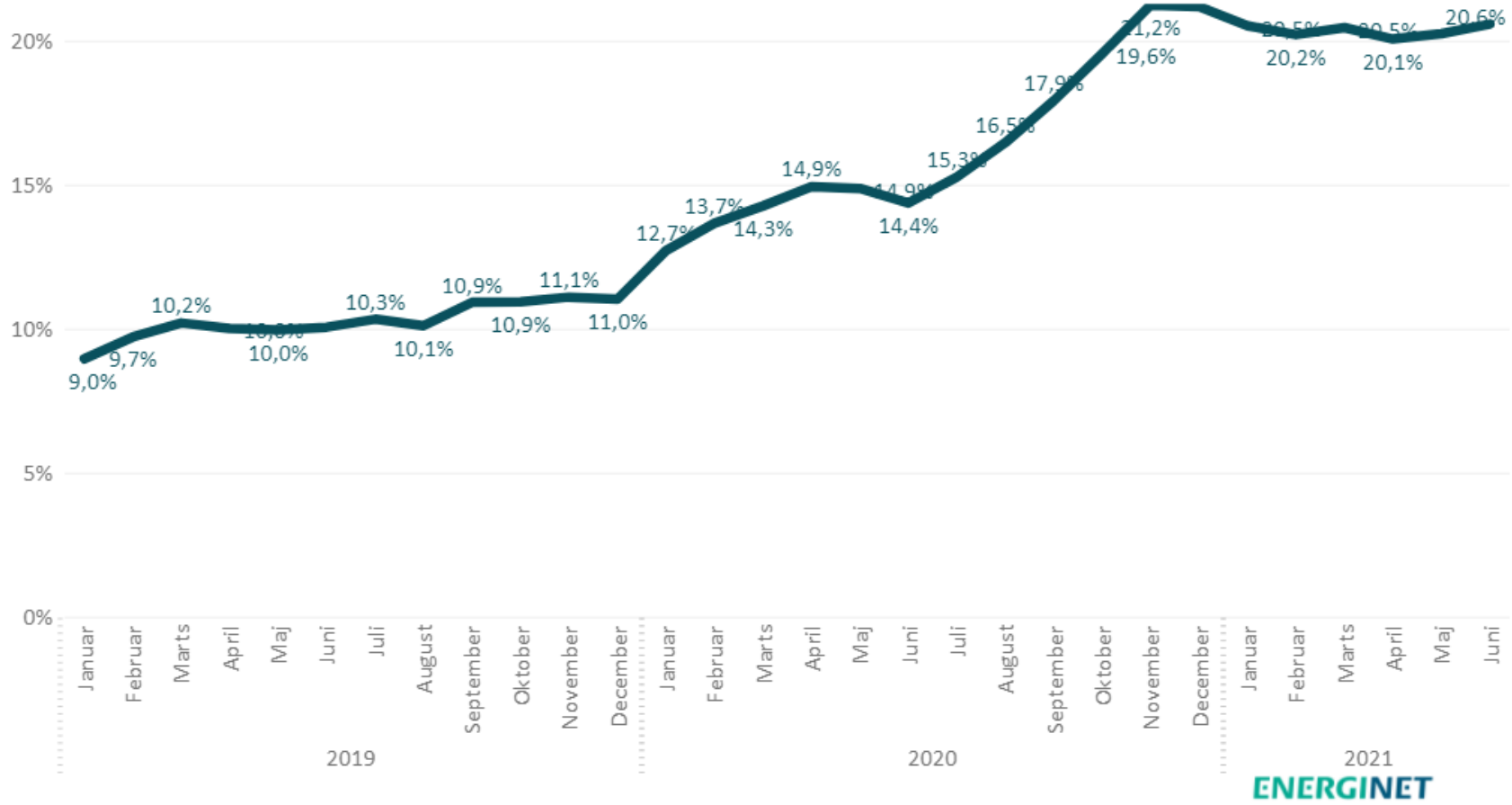
Leads to excess biomethane in certain periods of the year

Leads to a complex CVs due to a combination of biomethane and natural gas – this was the main reason to implement quality tracking



Biomethane production in Denmark

Share of biomethane in the grid compared to the danish gas consumption



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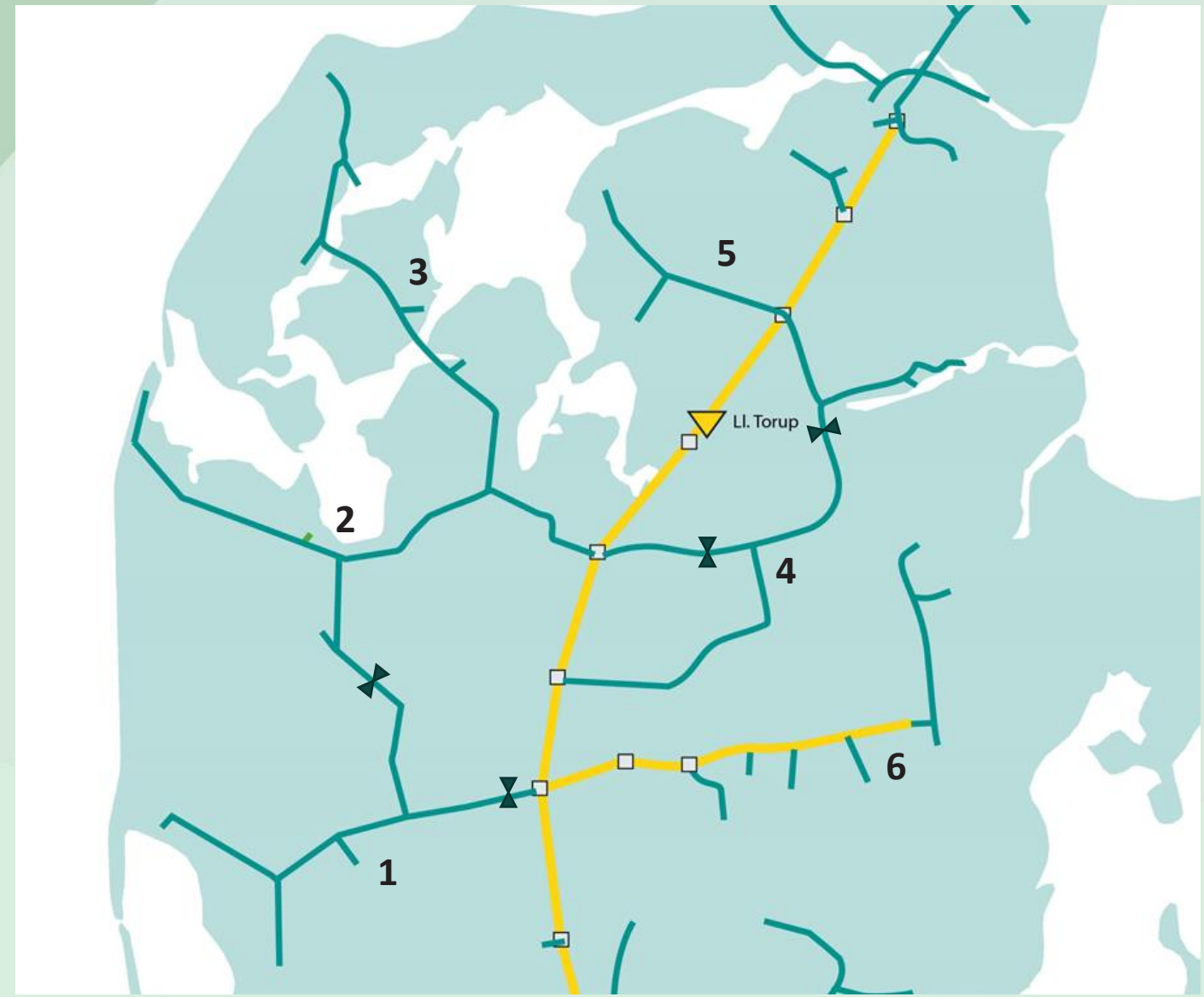
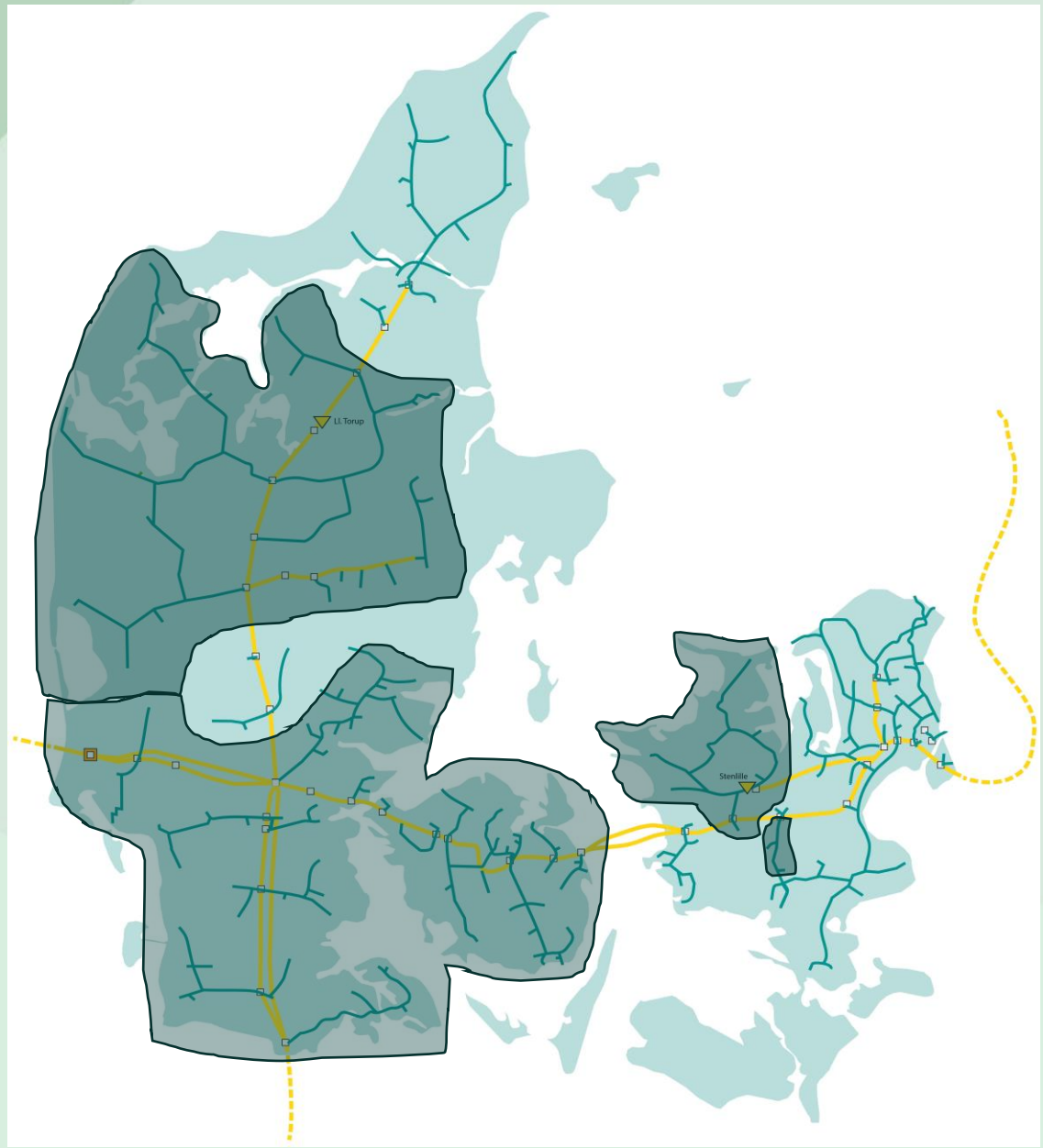


Challenges related to biomethane

- Changing CV complicates the billing
- Decentralized production → Exces/surpluss biomethane



Implementation of gas quality tracking

- Based on measured inputs for entry- and exitpoints. This is for example:
  - Pressure
  - Gas composition
  - Calorific value
  - Flow and consumption

- The software simulates the gas flow– which means the CV, gas composition, pressure etc. is available for the gas grid.

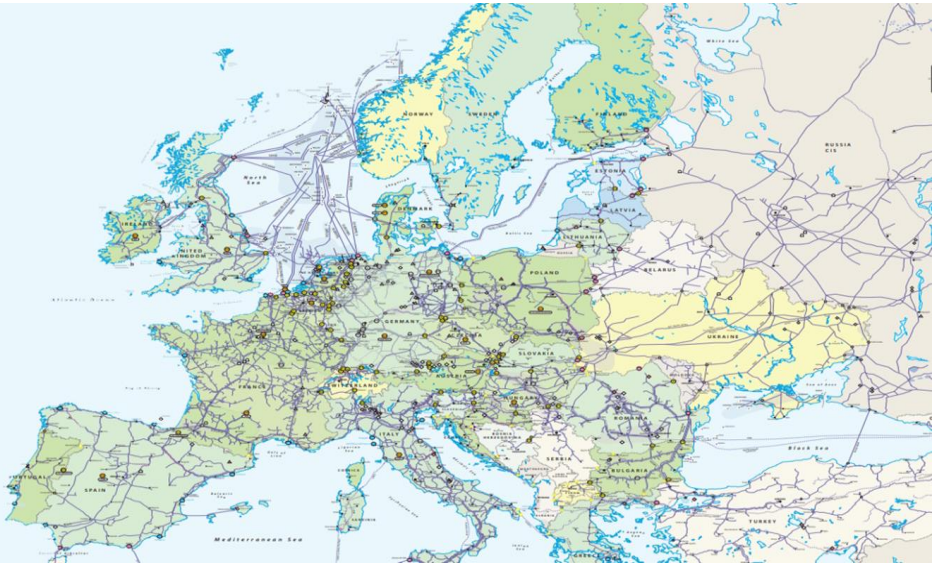
evida

Benefits of a more digital grid

- Flexible grid – better opportunities for operating/optimising the grid, compressors etc.
- Brings in new opportunities of developing the grid and to solve problems with meters etc.
- Better communication of the implementation of green gases and transition towards a more sustainable gas grid

24/06/21

'Making European gas grids ready for the energy transition'



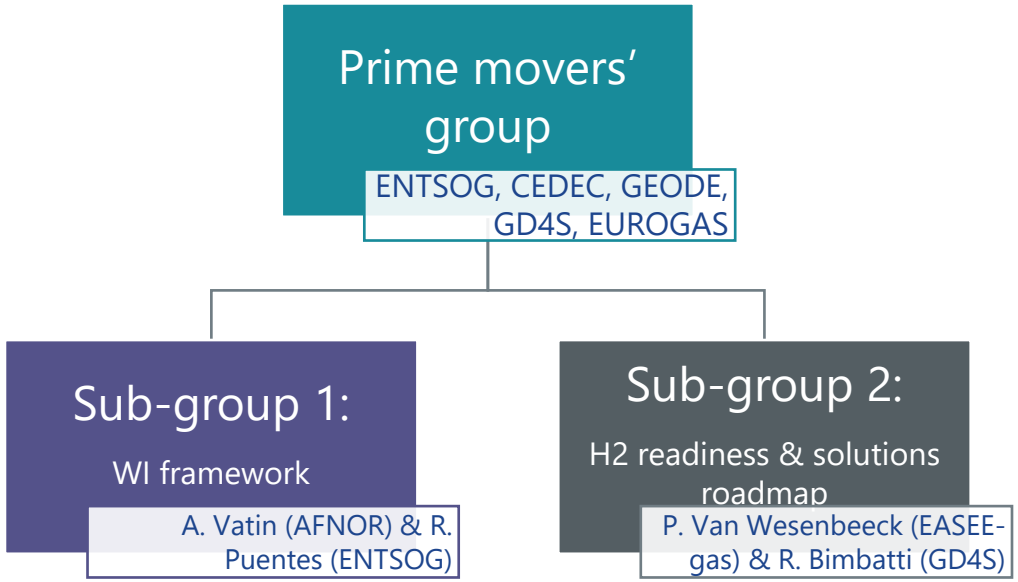
Prime movers' group Gas Quality & H2 handling – Updates

3rd meeting of Advisory Panel for Future Gas Grids

Hendrik Pollex, Director System Operation at ENTSOG

Online

Prime movers' group structure



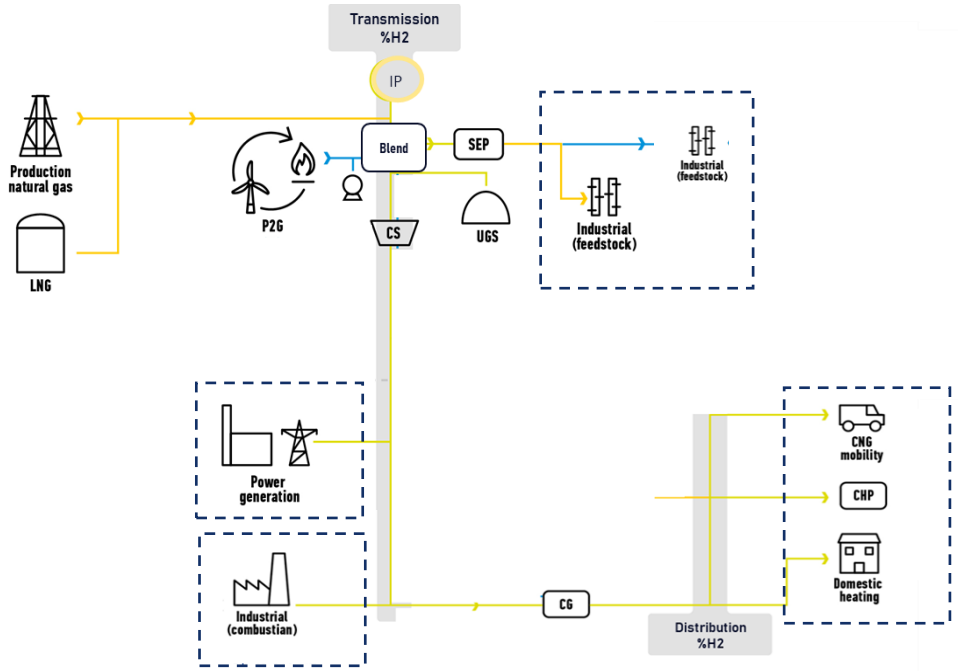
- **Prime movers' group (plenary meeting)**
  - Steering sub-groups activities
  - Knowledge sharing sessions about implemented solutions
  - Understanding of concerns & possibilities from different parts of gas value chain
  - Discussions on lessons learnt
  - Dissemination of project results & ongoing work by different stakeholders
- **Sub-group 1) WI framework discussion**
  - First deliverable ready. It will serve as input to:
    - EC for the gas package revision (regulatory principles)
    - CEN TC 234 WG 11 for the revision of their H-gas standard (EN 16726) which has started mid 2021
  - Further work to be defined
- **Sub-group 2) Value chain H2 readiness roadmap & solutions for GQ&H2 handling**

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 GQ&H2 handling**, as well as best practices and lessons learned
- Identification **of the possibilities** for implementing gas quality & H2 management tools at different interfaces
- Seek to sketch out a cost-efficient **'step-by-step' approach** to connect each individual sector or area within a future 'decarbonized' gas system (what can be done and by when)

*The goal is to assess the challenges & **solutions** for gas quality and H2 handling under different scenarios and for different part of the gas value chain (TSO/DSO, mobility, domestic heating, feedstock industry, engines, turbines, etc)*

Case studies: Possibilities & expected developments



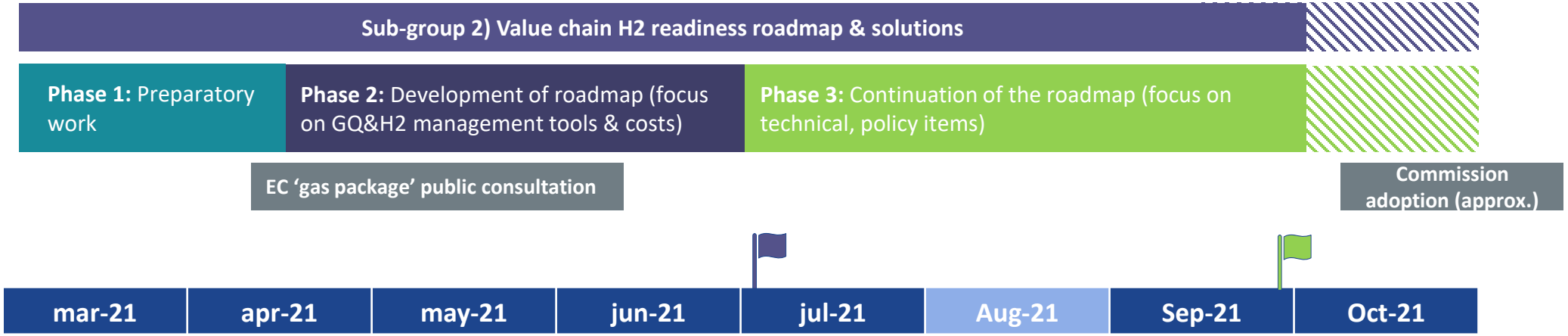
For each part of the gas value chain, the following estimated cost ranges are assessed:

- GQ management & information provision tools for TSOs/DSOs
- Modification vs replacement appliances/ applications
- Deblending facilities

Installed application	Which H2% vol. can installed stock handle? Is it also possible with fluctuating blends or only steady flow?
Modification of application	Costs for handling higher H2NG volumes?
Replacement	Costs for full replacement? When is a replacement necessary?
Information provision	Which information is expected to be needed from the DSO/TSO?
Industry Recommendations	Recommendations on modification vs replacement? Are deblending facilities an option?

First results to be presented during next prime movers' meeting (30th June)!

Proposed plan for sub-group 2



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 results

Public material is available in the process website: prime-movers-group-gas-quality-and-hydrogen-handling

Thank you for your attention

Hendrik Pollex, Director System Operator at ENTSOG

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ENTSOG - European Network of Transmission System Operators for Gas
Avenue de Cortenbergh 100, 1000 Bruxelles

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Discussion

Questions for debate

1. How can digitalisation help achieving the decarbonisation goals in the gas sector (from producers to end consumers)?

2. Which should be the priorities to make the deployment of smart gas grids effectively happen?

3. Which seem to be the challenges to achieve a smarter system integration?

4. Which smart tools for GQ & H2 handling do customers expect to be using in the future?

Summary and next steps

Next steps


Next meeting
October 2021
(Quarterly)
Input to Madrid, Copenhagen, Florence Fora
Recommendation Report
(End 2021)

Thank you for your attention

ENTSOG

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