Hydrogen in Europe – The Perspective of the Gas Industry

International Association for Energy Economics

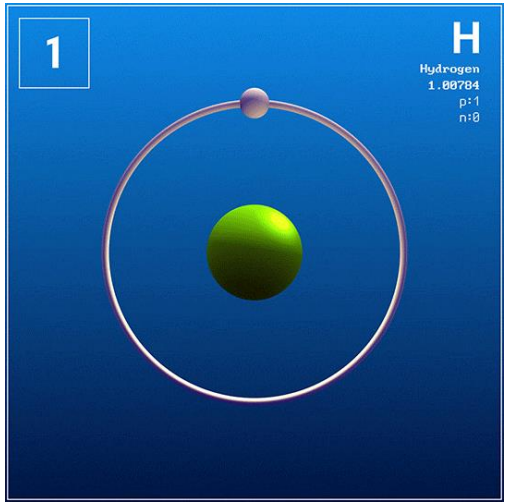
Webinar 02 Nov 2020

GAS FOR CLIMATE
A path to 2050

OGE

Agenda

1. Introduction
2. The big picture - why we are talking about hydrogen
3. Existing gas infrastructure as an enabler
4. The European Perspective
5. Outlook



Source: www.giphy.com

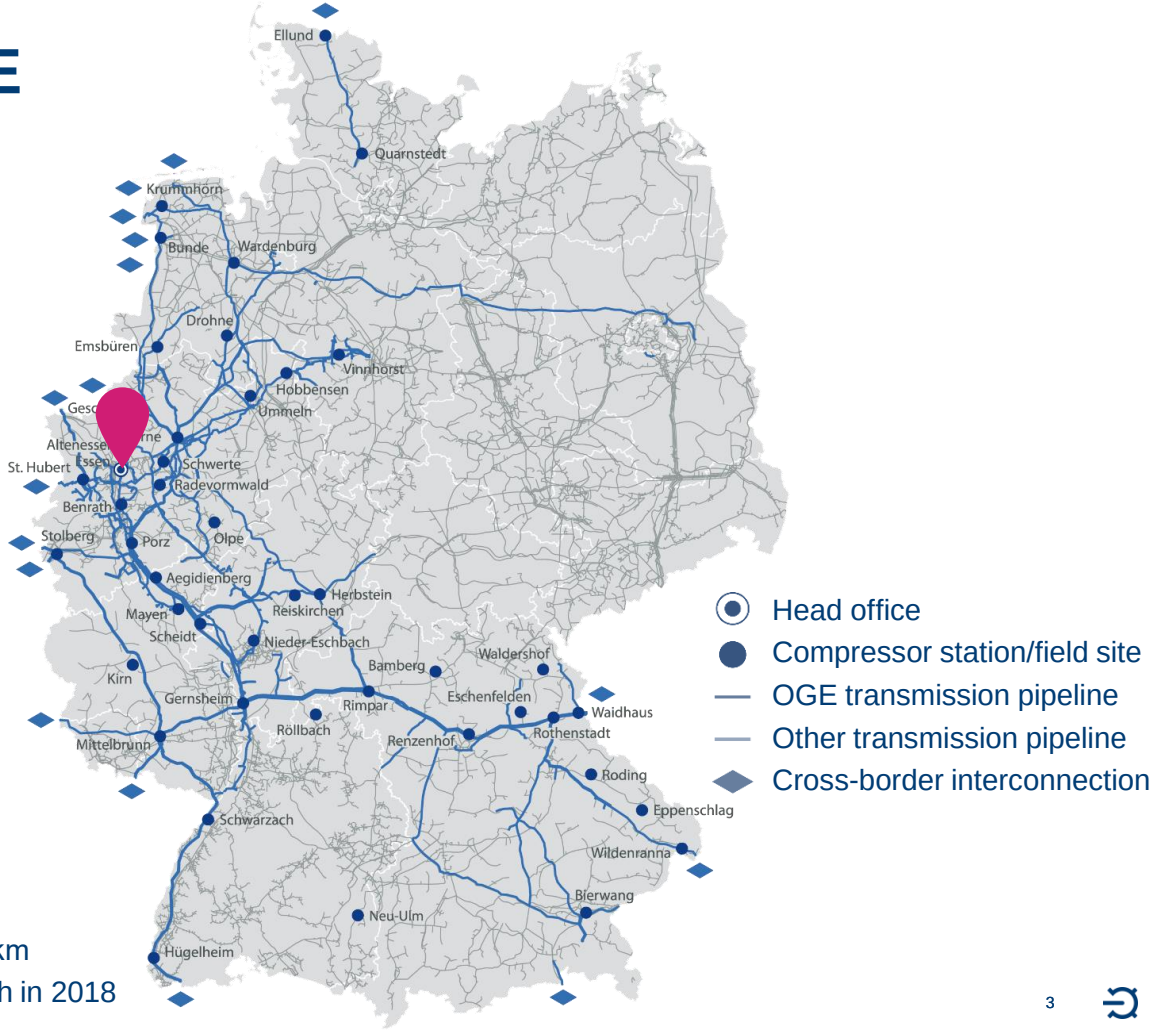
Introduction to OGE

2004
Established as E.ON Gastransport
1 September 2010
Renamed Open Grid Europe

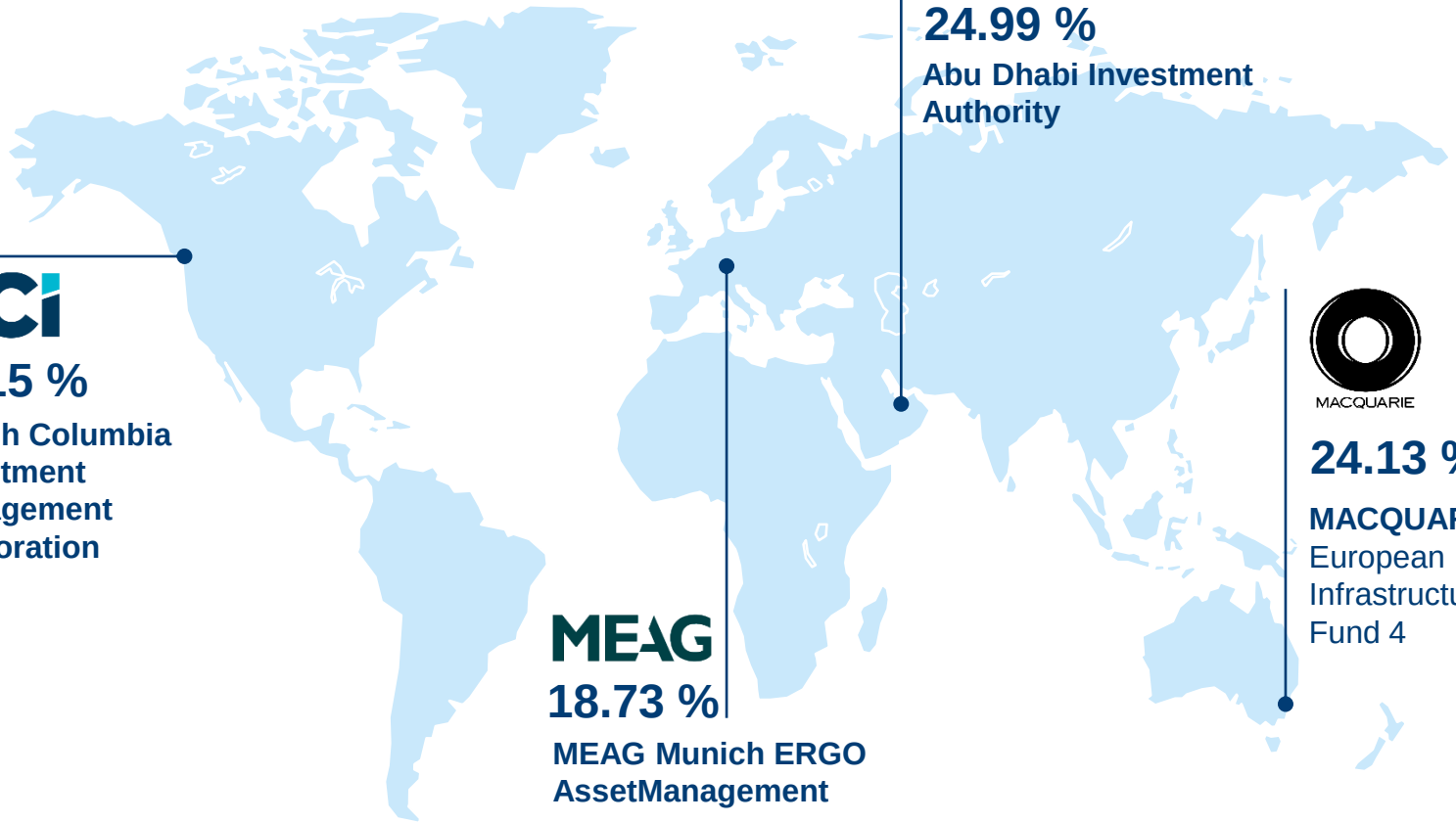
One of Europe‘s **leading gas transmission system operators**

Some **1,450 employees** across Germany;
Head office: Essen / Germany

Sole responsibility for the
operation, control, expansion and marketing
of the company’s pipeline network of 12.000 km high pressure grid (TSO), Send-out ~650 TWh in 2018



OGE shareholders



32.15 %

British Columbia Investment Management Corporation

24.99 %

Abu Dhabi Investment Authority

18.73 %

MEAG Munich ERGO AssetManagement

24.13 %

MACQUARIE
European Infrastructure Fund 4

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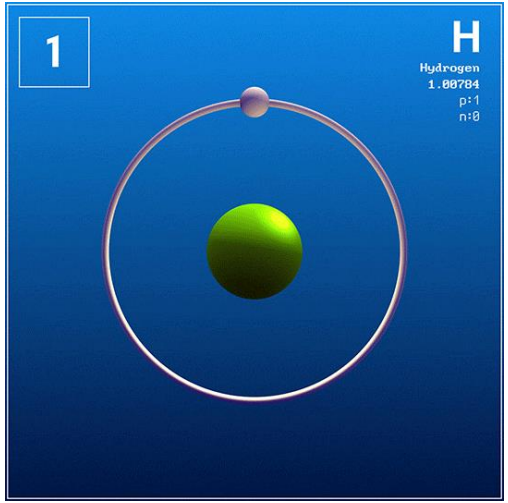
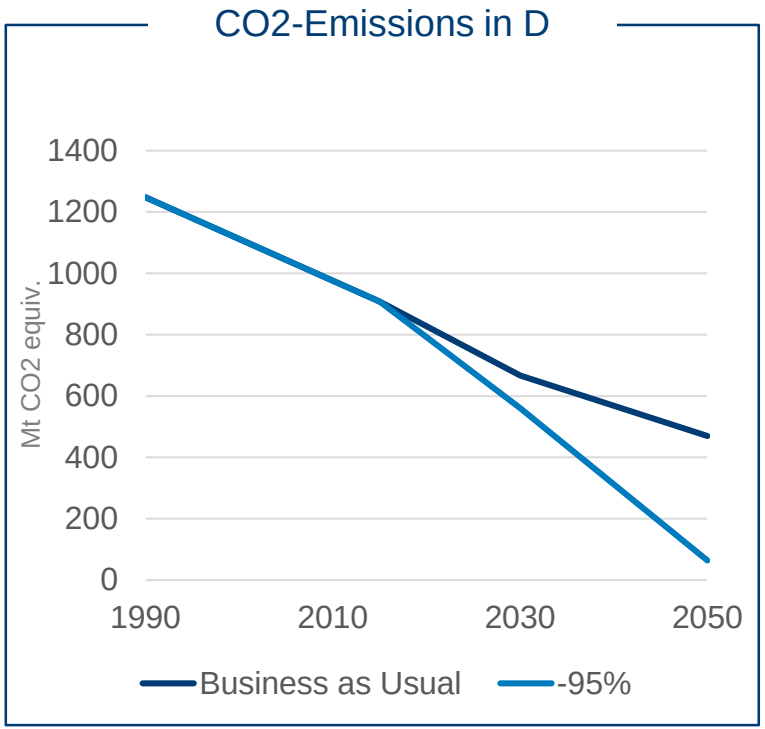


Source: www.giphy.com

It is all about climate targets and avoiding CO2…!



- Paris agreement set ambitious target for CO2 reduction
- Strong increase in decarbonisation efforts needed to reach targets
- Currently discussed „climate neutrality“ would require even more determined action
- Governments are enshrining CO2 ambitions into law

Substantial efforts required

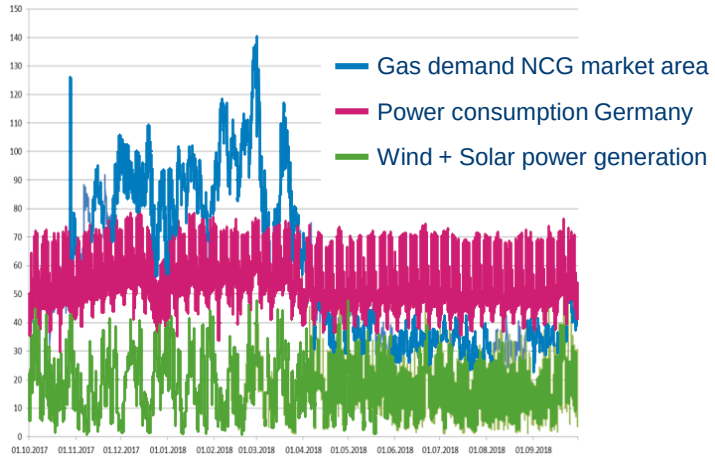
Key question: How can we really achieve that?

Source: Dena Leitstudie 2018

The future energy system requires molecules
H2 one of very few available alternatives (Germany)

The future energy system requires molecules H2 one of very few available alternatives

Energy Capacity Requirement in Germany (in GW)



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H2 one of very few available alternatives

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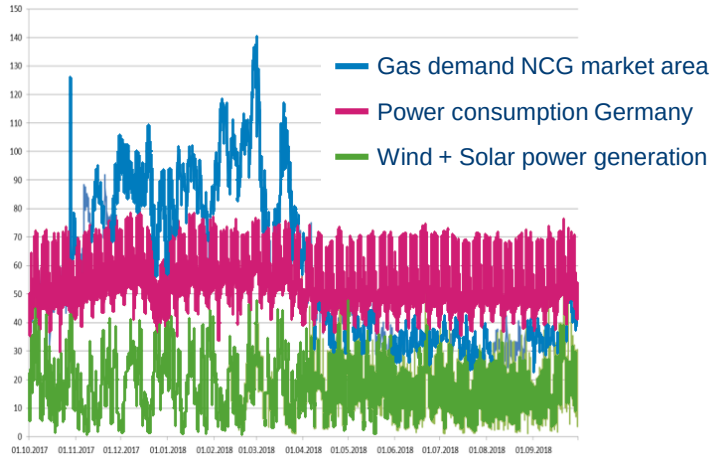
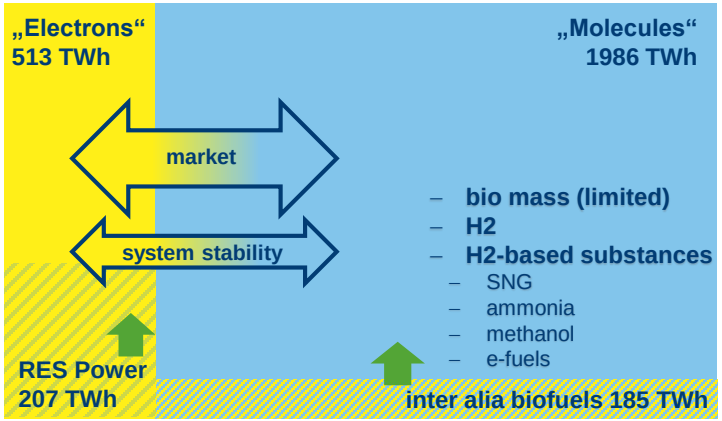


Final Energy Demand in Germany (in TWh/a)



Source: Arbeitsgemeinschaft Energiebilanzen für das Jahr 2018 (09/2019)

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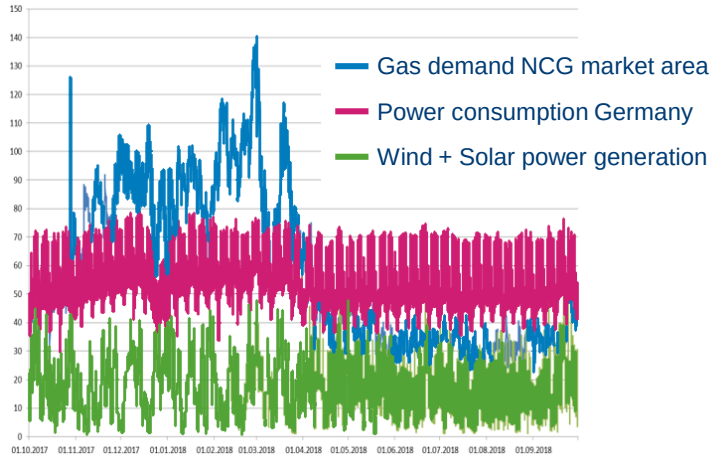

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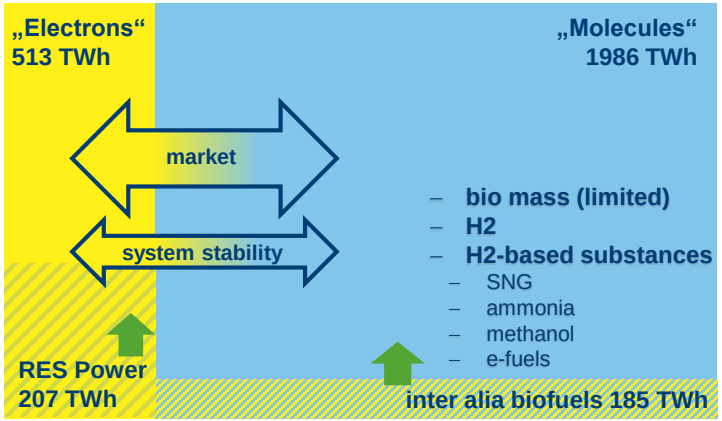

Source: Arbeitsgemeinschaft Energiebilanzen für das Jahr 2018 (09/2019)

Storing / Transporting large quantities of green energy, additional decarbonizing options all sectors, resilience in energy supply

H_2

So what is different this time compared to previous times when hydrogen came onto the agenda?

So what is different this time compared to previous times when hydrogen came onto the agenda?

1. **Awareness**: Ample renewable energy available on our planet to be made available in the form of molecules (transported and stored)

2. **No acceptable alternative**: Given climate change efforts, hydrogen (and synthesized products of it) today the only feasible carrier to overcome challenges

3. **Economies of scale**: Technology development and scale-up potential both in production technology as in renewable power generation could provide competitive prices within 10-15 years

4. **Front running option**: Europe with high energy demand and well interconnected gas infrastructure is best placed to develop H_2 market (also for imports)

5. **Industry leadership**: H_2 offers industry leadership opportunities

Many studies confirmed: Significant societal cost benefits from mix of renewable power & green gas

Gas and gas infrastructure have a significant role to play – but gas has to be decarbonized (including competitive prices & security of supply) and infrastructure transitioned

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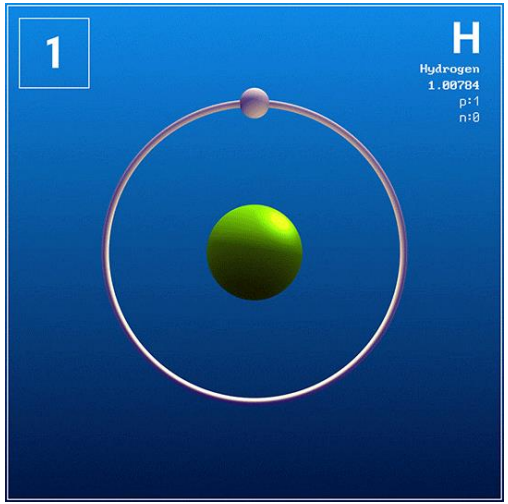


Source: www.giphy.com

The USP of existing gas infrastructure for making hydrogen work large scale

— **To a large extent there, permitted, in the ground**

— **One 48 inch pipeline** has energy transport capacity of up to 24 GW equivalent to 8 high voltage power lines (up to 3 GW each). Even if re-purposed to hydrogen up to 19 GW could be possible!

— Existing gas storage facilities in Germany are able to provide gas supply for 3 months, all power storages aggregated less than one hour of power supply.

Understanding our asset - Project „H2 Suitability“

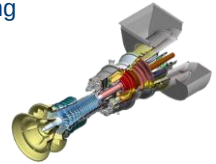
Pipe material/
welds

Gaskets

Flow
measuring

Quality
measuring

Mountings



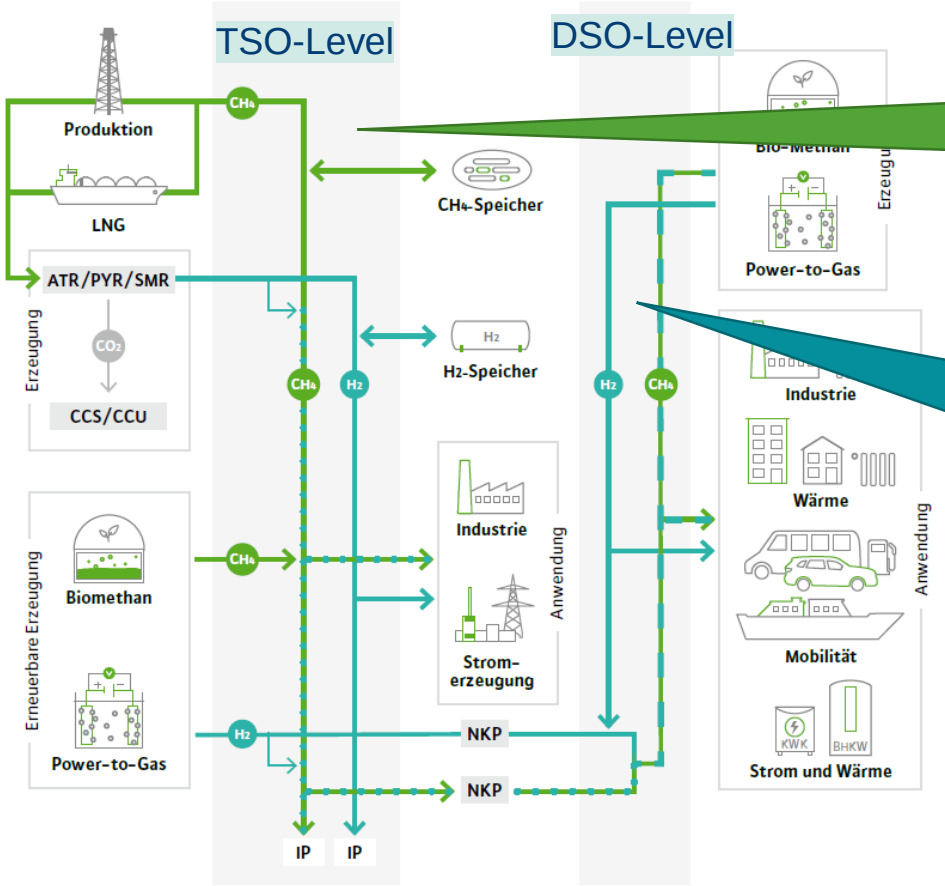
Gasturbines

Compressors

2% / 10% BLENDING	EXISTING PIPES
100% HYDROGEN	NEW BUILT PIPES

Supplemented by exchange and extensive association work

A Longterm vision of gas infrastructure in Germany



Quelle: BDEW 2020

TSO-Level:
- Parallel structures 100% H2/CH4
- Blending limited
- Europe wide backbone system
- Access Point for Imports
- Big „highways“ N/S/W/E

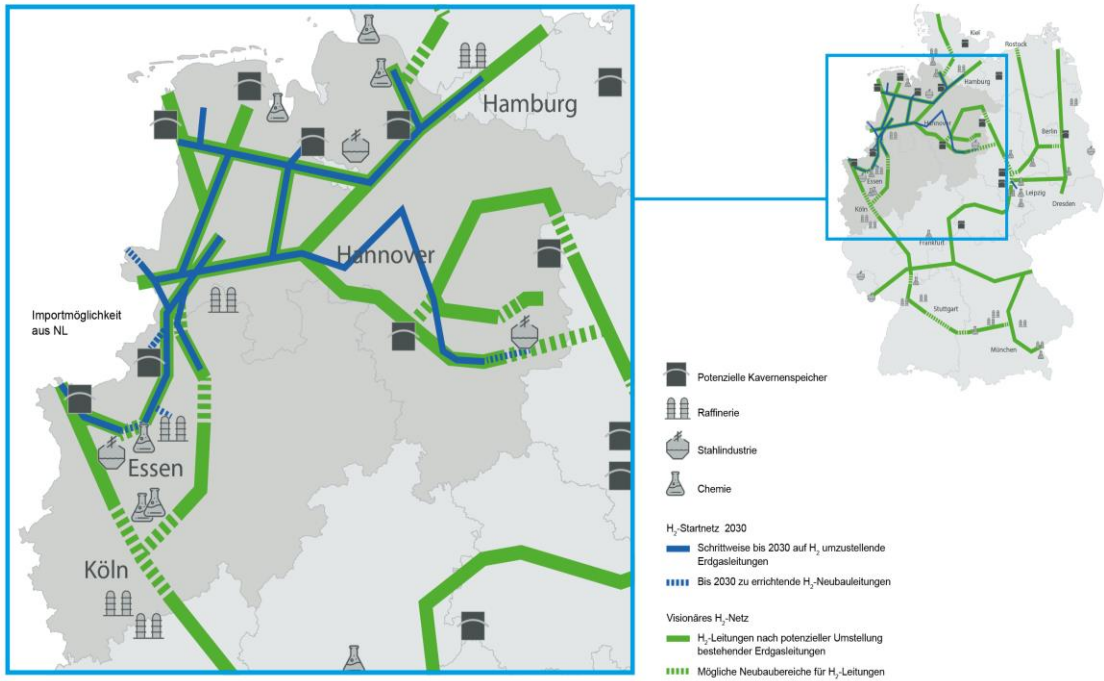
DSO-Level:
- Regional variety
- 100% H2, blended systems, 100% biomethane
- Benefitting from parallel TSO infrastructures
- Close cooperation of infrastructures

IP Interconnection Point; Verbindungspunkt

Geringe Beimischquote

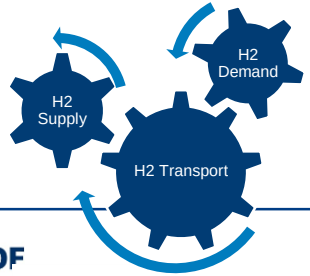
Hohe Beimischquote

Network Development Plan includes 1,200 km of H2 grid to be converted between 2022 and 2030 („Startnetz“)



- 1,200 km of H2 grid
- 90% conversion of existing pipelines
- Low cost: €~660m until 2030
- However: adaptation of German Energy Act prerequisite for implementation

Start here & now, think big: OGE green gas projects to enable full value chain



WESTKÜSTE 100

30 MW

- Regional Infrastructure
- Utilisation of H2 in industry, transport & heating sector

RAFFINERIE HEIDE · EDF · Holcim · thyssenkrupp · Ørsted · STADTWERKE HEIDE GmbH · REGION HEIDE · FH Westküste

GETH2 Nukleus

100 MW

- Supra-regional infrastructure
- Focus on industrial customers in Ruhr area

bp · Wir transportieren Gas. nowega · EVONIK Leading Beyond Chemistry · RWE

H2morrow

1.000 MW

- Starting point for national/international infrastructure
- Blue hydrogen
- Decarbonisation of steel

equinor · thyssenkrupp

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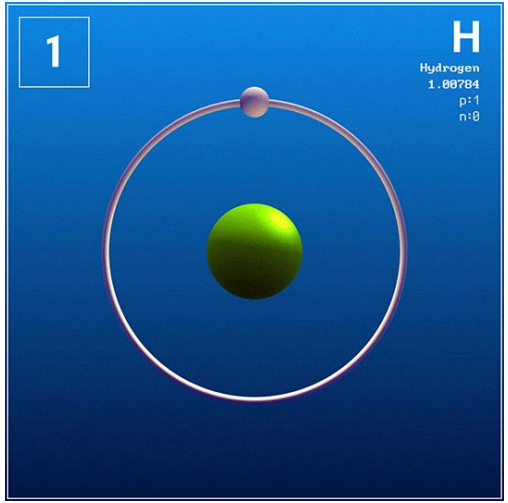
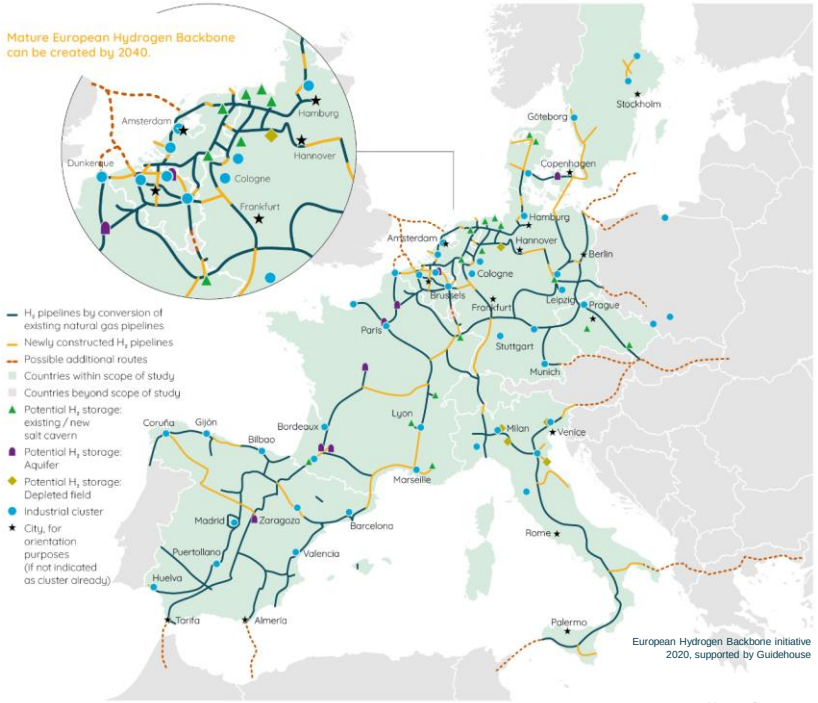


Source: www.giphy.com

2040 – The big picture: A European hydrogen backbone

A pan-EU backbone stretching into all directions, with a length of almost 23,000 km



1. Preliminary estimation, the actual capacity of the meshed grid requires more detailed analysis

1 A **pan-European dedicated 100% hydrogen infrastructure** connecting supply and demand from North to South and East to West

2 **Starting with a 6,800 km** long initial grid connecting different Hydrogen areas **by 2030**, hydrogen infrastructure will further develop in all directions **reaching 23,000 km in 2040**, further growing and extending up to 2050. On average **consisting 75% re-purposed, 25% new built** capacity.

3 Re-purposed 36 inch and 48 inch natural gas pipelines (usual on TSO level) will provide **7 / 13 GW** of hydrogen transportation capacity per pipeline on average.

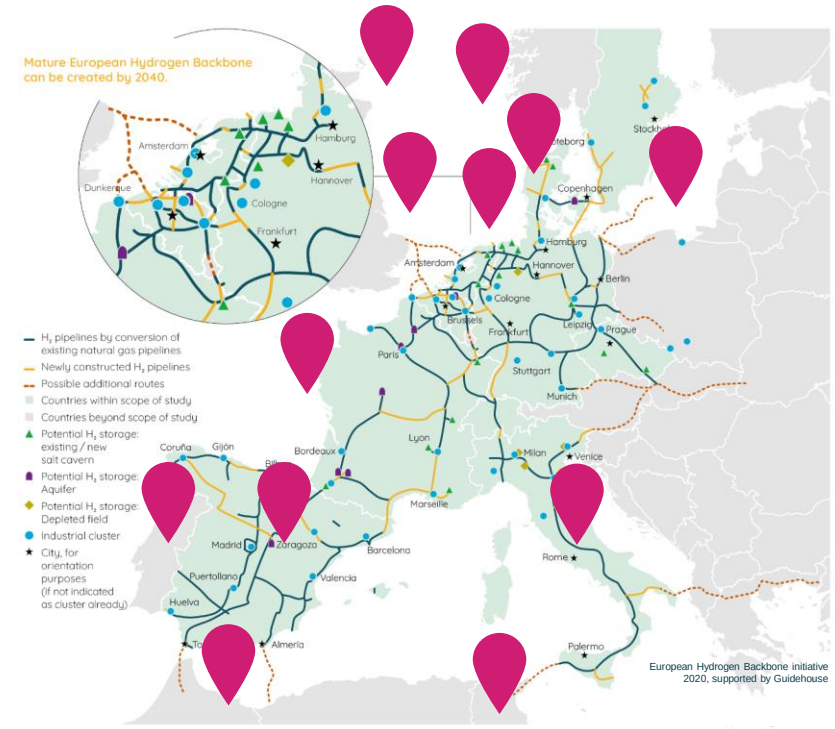
4 Proposed backbone required **CAPEX of 27 – 64 billion Euros until 2040** given existing/new-built split outlined

5 Transportation costs of **0.09 – 0.17 Euros/kg per 1000 km**, thereby very efficient long-distance transport througou Europe

6 **EHB provides basis for a European hydrogen market**, access to **supply** potential across Europe and imports for **demand** centers across Europe, **competition and security of supply**

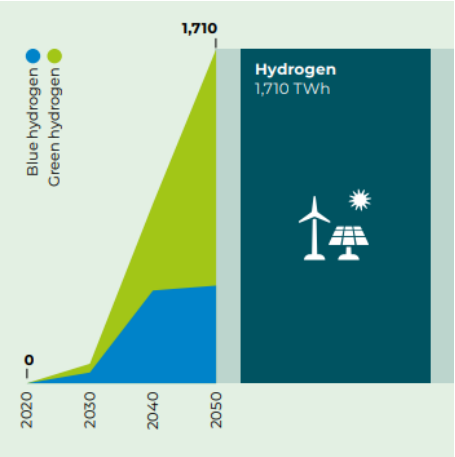
2040 – The big picture:
Ample hydrogen resources potential in/around Europe

Imports



Imports

Supply perspective: renewable and hydrogen scale-up
Again start here & now AND think big!



Source: Gas for Climate 2020

- Gas-for-Climate study April 2020: 1300 TWh/a of green hydrogen demand EU in 2050
- ***Demonstration example*** - assumption 50%/50% wind/pv
  - 650 TWh/a hydrogen @ 4000 h and 70% efficiency
    → 230 GW equals 23.000 wind turbines (10 MW class)
    → EU - offshore wind potential ~ 500 GW (Agora)
  - 650 TWh/a hydrogen @ 2000 h and 70% efficiency
    → 465 GW requires ~ 4,650 km^2 of solar PV area (1 GW = 10 km^2)
    → equals e.g. 0,45% of area of Spain, Portugal, Italy and Greece
    → equals e.g. 1% of area of Morocco

Conclusions on the enabling role of existing gas infrastructure for hydrogen in Europe

- Physical access to multiple supply sources (European and imports) and connections to demand areas across Europe through dedicated hydrogen grid
- Non discriminatory access to transportation, import and storage sites
- TSO experts in efficient gas transportation (re-purposing & new built), integrated infrastructure planning, cross border cooperation
- TSO/DSO cooperation offers decarbonization options (alongside power) for all sectors

  - Existing Gas infrastructure provides the basis for a European Hydrogen market with multiple sources, security of supply and competition

- What are necessary next steps to get going?

  - Fast adjustments of legal / regulatory framework to enable:
    - TPA, maintain permits and rights of way, framework for financing / business model
    - incentivize/enable hydrogen demand

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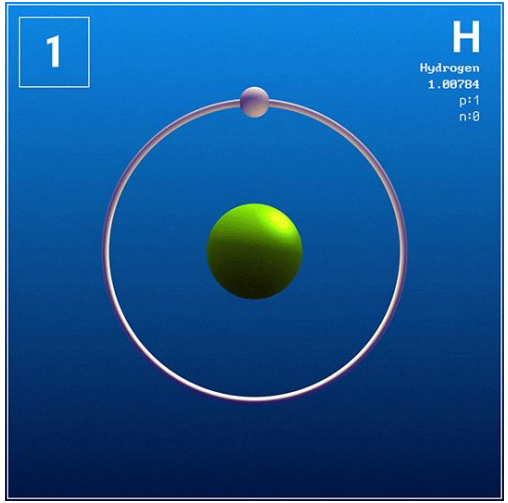
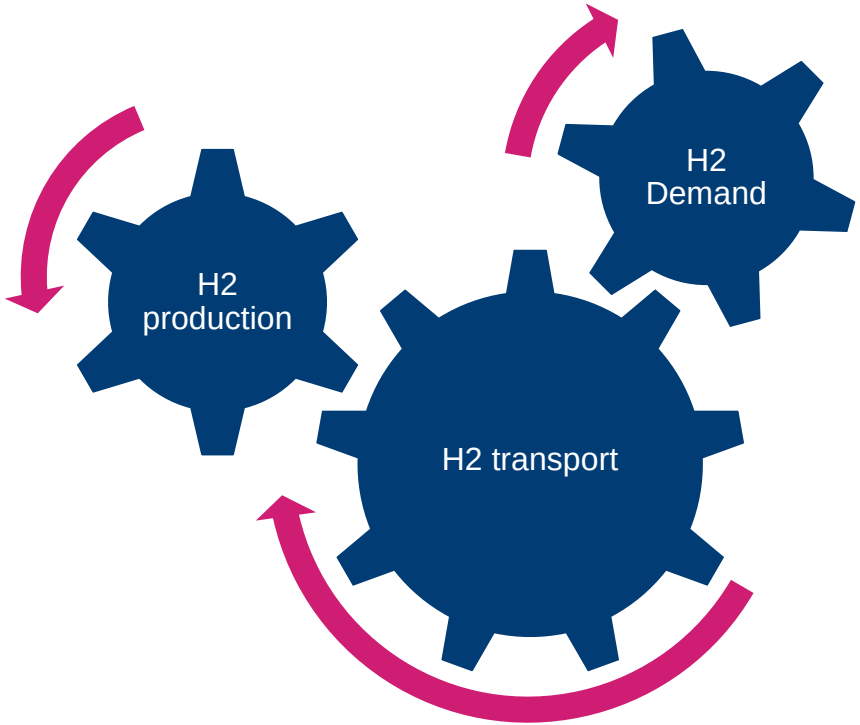


Source: www.giphy.com

Aligning value chain to achieve scale-up - cooperation is the only way, regulatory frameworks essential



- Manageable challenges along the value chain
- Topics are of technical, economic, political and (business) cultural nature
- Numerous „chicken-and-egg“ hurdles
- Knowledge how to build long-term value chains still around (gas/LNG business)

The Hydrogen era is dawning … and a global market

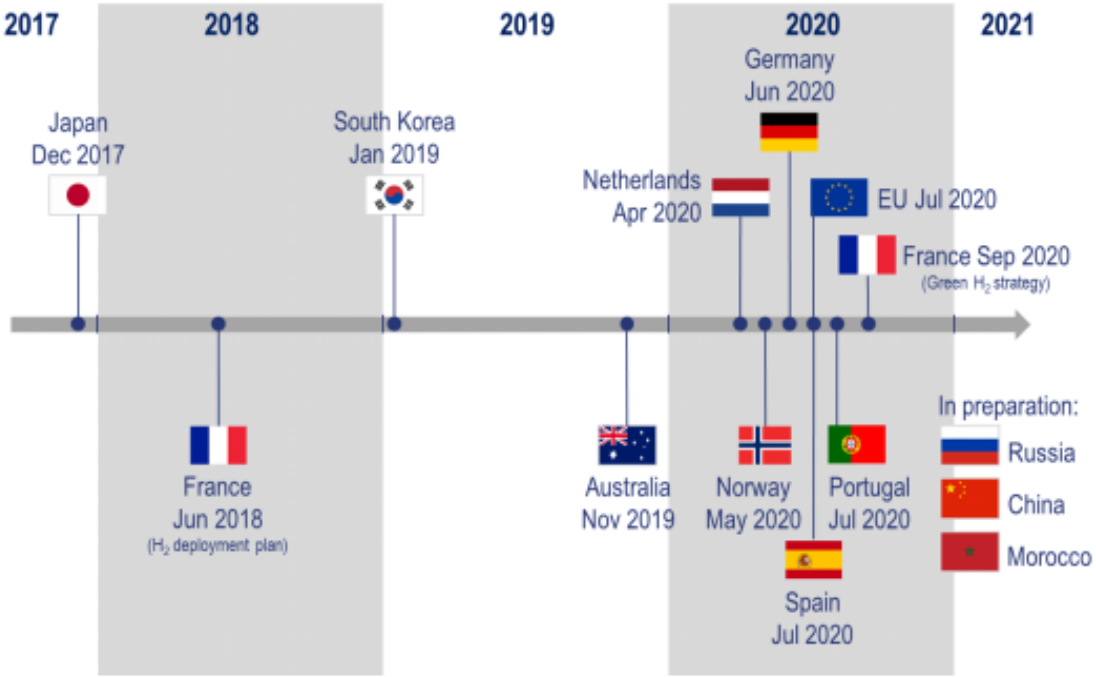


Figure 3: Timeline of national hydrogen strategies publication

Source: World Energy Council Germany Sep 2020

We enable energy supply.
Today and in the energy mix of the future.

OGE