Deutscher Verein des
Gas- und Wasserfaches e.V.

DVGW

www.dvgw.de

Transformation of the European natural gas grid into hydrogen

EERA JP FCH Steering Committee meeting 28 October 2020

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DVGW at a glance

Facts & Figures

Established in **1859** in Frankfurt am Main

→ Headquarters in Bonn

→ Representative offices in Berlin, Brussels and Sarajevo

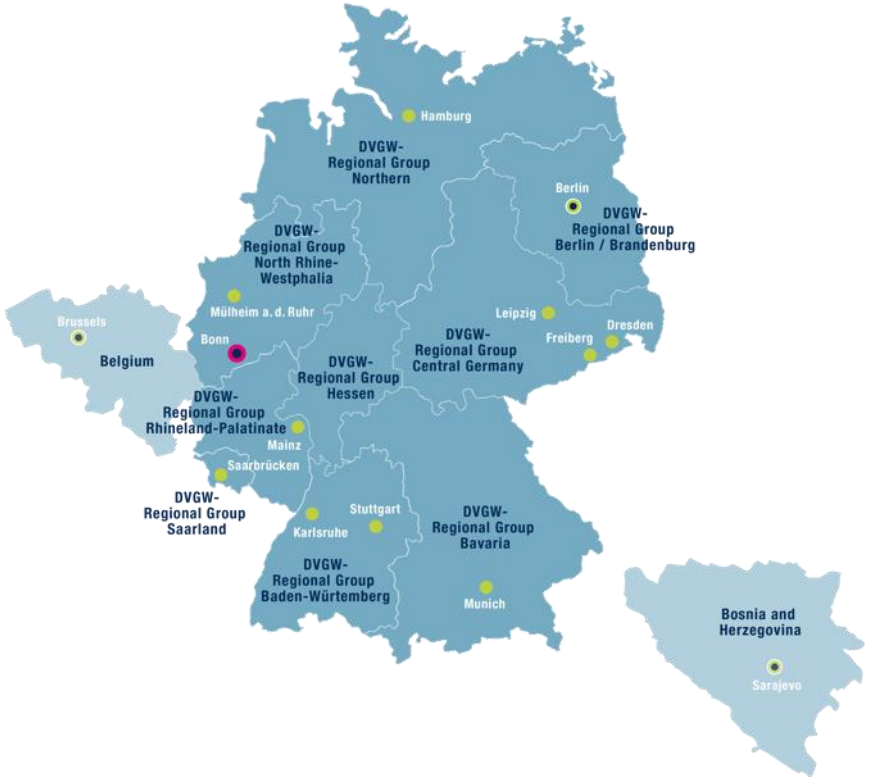
→ **9** regional groups and **62** local groups

→ **2,600** expert volunteers and **400** full-time experts

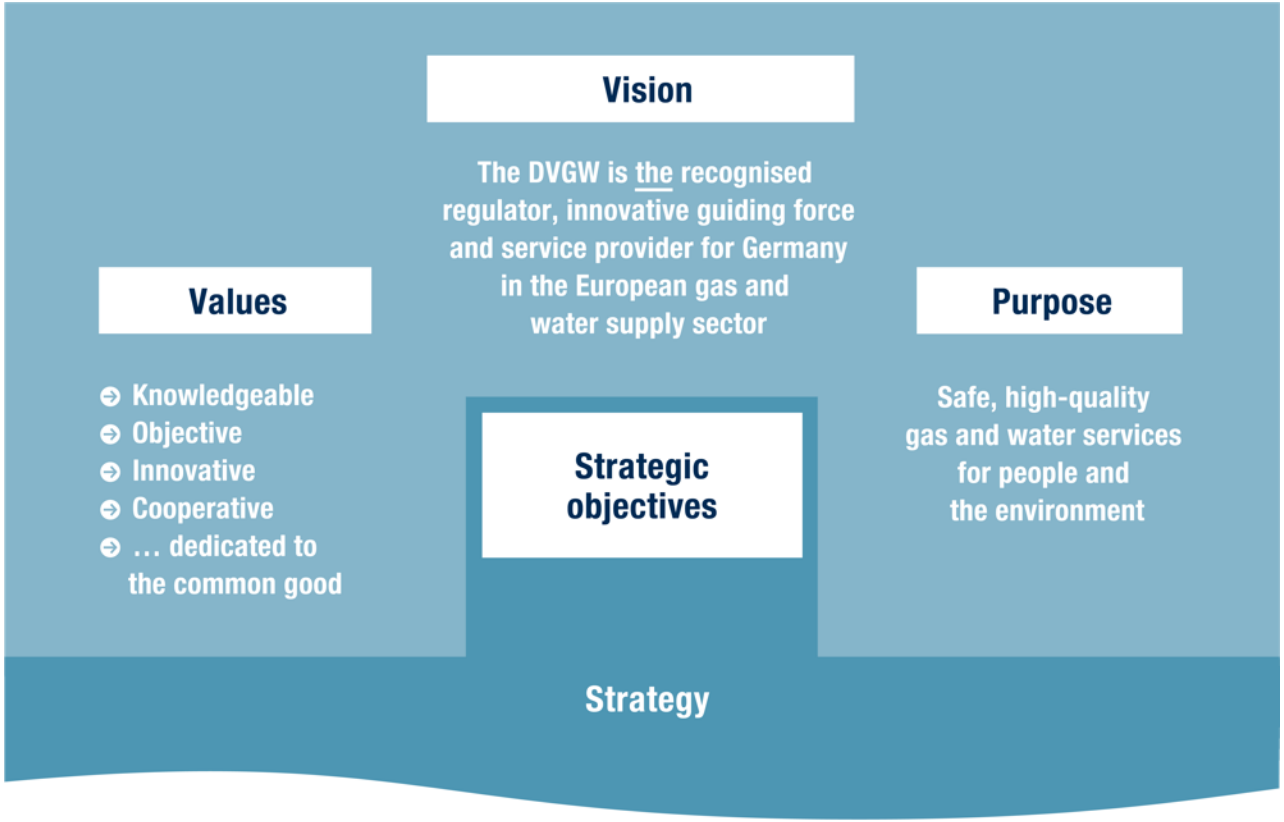
→ **8** subsidiaries and affiliates

→ **9** DVGW research facilities

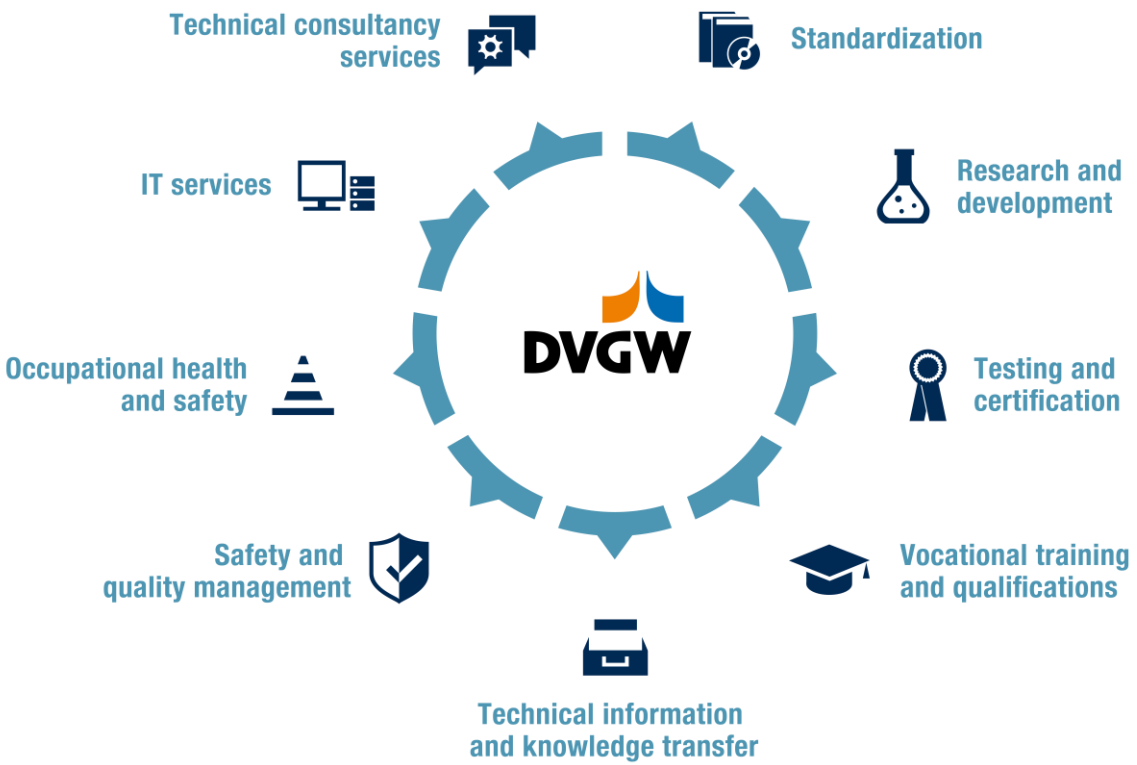
→ **14,000** members



DVGW’s guiding principles



DVGW's service portfolio

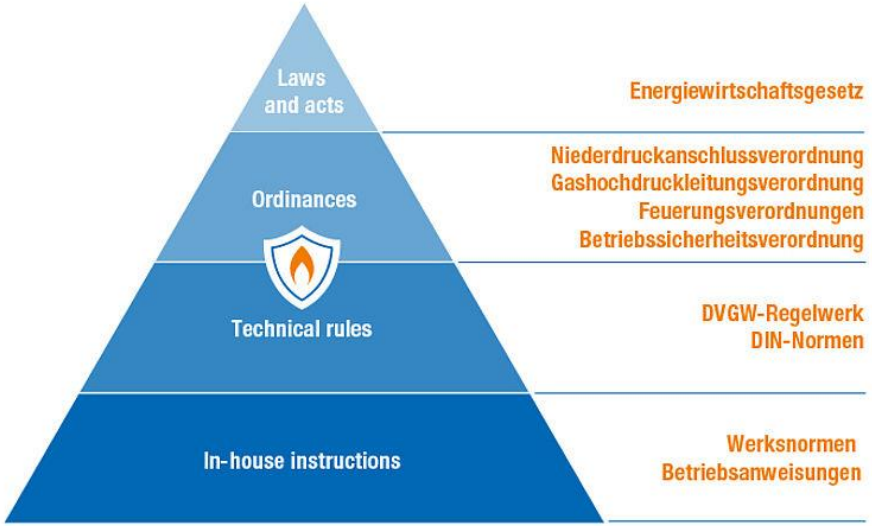


Hydrogen injection into the existing German and European gas grid

Efforts in Germany and European Union

Germany – short background

Gas supply safety components in Germany



German Energy Industry Act

Purpose

- Legal rules for
  - ✓ safe and reliable
  - ✓ budgeted
  - ✓ consumer-friendly
  - ✓ efficient and
  - ✓ environment friendly

  supply of electricity and gas
- Ensure an effective and genuine competition of electricity and gas supply
- 120 articles (§)

§ 49 Requirement for energy facilities

Sentence 2 says that energy facilities

- producing,
- transporting and
- delivering

electricity and gas follow the general recognized technical rules if they are doing so according the Technical Set of Rules

1. For Electricity of VDE e.V and for
2. Gas of DVGW e.V.

DVGW's main Technical Set of Rules for the gas sector

- Working Documents for gas pipelines (design and construction)
  - **GW 541** stainless steel tubing
  - **GW 335** ff plastic tubing
- Working Document **G 600** Technical Rules for Gas Installations (TRGI)
- Working Document **G 260** Gas Quality
- much more Working Documents linked to the mentioned WDs

Accompanied and accomplished with DVGW Certificate on Technical Safety Management according **G 1000** (gas network on public ground) and **G 1010** (gas network on industrial ground)

DVGW manages Standardization Committee for Gas of DIN (NA-Gas)
→ active participation at CEN and ISO

Studies on the transformation of the German and European gas grid

- German gas grid – transport and distribution systems excluding end customers and gas transit (cross-border):

  DVGW project G 201624 “Transformationspfade zur Treibhausgasneutralität der Gasnetze und Gasspeicher nach COP 21“ (Transformation pathways for climate-neutral gas grids and gas storages according COP21) – released November 2018

- European gas grid – transport and distribution systems including end customers

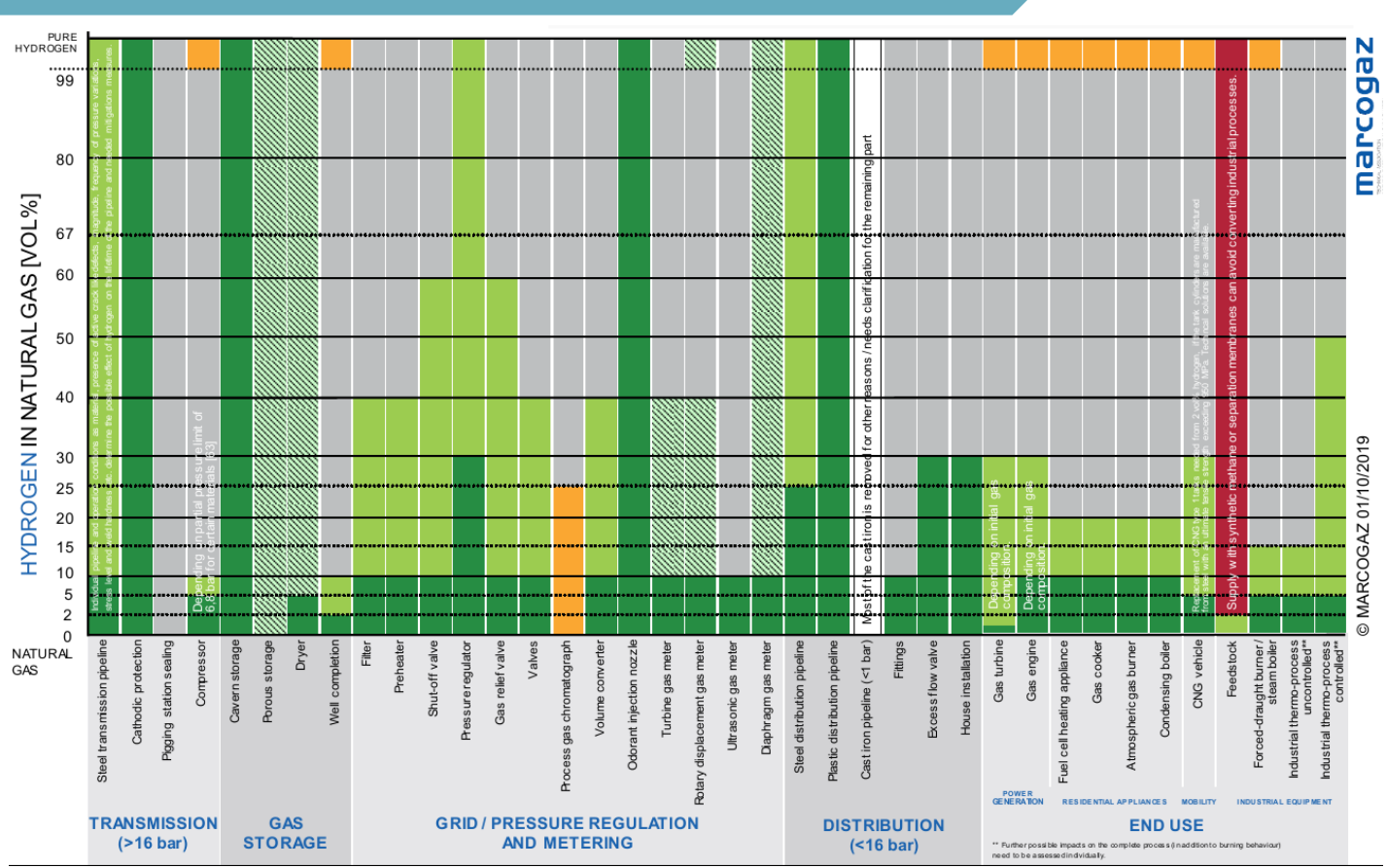
  Marcogaz “Overview of available test results and regulatory limits for hydrogen admission into existing natural gas infrastructure and end use” – released October 2019
  www.marcogaz.org/publications-1/documents/hydrogen-infographic/

G 201624 Transformation pathways

- Goal:
  Identification of optimum cost for climate-neutral gas grids

- Results:
  - 45 bill. € until 2050 needed for the adaptation of the gas grid
    (equals to twice annual Renewable Energy Fee (EEG-Umlage) of 25 bill. €)
  - 5 years delayed start increases costs by 25%
  - Revision and adaptation of the Technical Rules G 260 (Gas Quality) and G 262 (Usage of gases from renewable sources in the public gas supply) required

Marcogaz study



OVERVIEW OF AVAILABLE TEST RESULTS* AND REGULATORY LIMITS FOR HYDROGEN ADMISSION INTO THE EXISTING NATURAL GAS INFRASTRUCTURE AND END USE

New and ongoing activities in Germany

Technical Rules

- G 260 (Gas Quality)
  - presently 10 vol.-% H_2 allowed without any problems
  - revision to allow 20 vol.-% hydrogen injection
  - next step then 30 vol.-%

  → technology switch to 100%

- G 600 (TRGI)
  - 20 vol.-% H2 without limitations, including safety, gas tightness and equipment design aspects
  - metering units need to be approved (in responsibility of German Weights and Measure Office - Eichamt

National projects (by DVGW)

- G 201824 Roadmap Gas 2050
- G 201901 H_2 compendium
- G 201902 H2-20 (Avacon project)
- H_2 Vorort

First results of DVGW projects

Project	Goal	Information and first results (if already available)
G 201824 Roadmap Gas 2050	Holistic concept for the complete value chain of the gas energy system (well-to-wheel) from production of renewable gasses, transport in the German gas grid and the usage in gas applications (existing and new)	- Some gas applications present in the network tested - first tests performed by adding up to 40 vol.-% of H_2 to natural gas - No failure or safety problems observed
G 201901 H_2 compendium	Setup of holistic and complete inventory of the German gas transport and distribution network from materials, gas network, building connections and installation to gas applications up to 100% hydrogen	- Assessment of the Set of Technical Rules performed - Recommendations to revise Technical Rules given - Inventory of hydrogen sensitivity of distribution network ready to 60%
G 201902 H2-20 (Avacon project)	Approval of 20 vol.-% H_2 admixing in a **real** environment (region Flämig in Saxony-Anhalt) with 400 private customers	- 35 km pipeline length - age of pipeline 26 years (1994) - age of installed applications up to 25 years - Local test about to begin
H_2 Vorort	Development of decarbonization strategy for the German gas distribution grid (comparable to the TSO strategy), supply for domestic heat provision and gas supply for SMEs	- 32 participants from DSOs and public utilities - cross-check with German TSO strategy - Final results envisioned by W40 2020

New and ongoing activities in Europe

Standardization and regulation

- CEN (European Committee for Standardization) level
  - CEN/TC 234 - Gas infrastructure
  - CEN/TC 235 - Gas pressure regulators and associated safety devices for use in gas transmission and distribution
  - CEN/TC 236 - Non industrial manually operated shut-off valves for gas and particular combinations valves-other products
  - CEN/TC 237 - Gas meters

- CEN/CENELEC (CEN for Electrotechnical Standardization)
  - Sector Forum Energy Management/Working Group Hydrogen – preparation of standardization processes in hydrogen
  - Task Force 3 Natural gas system and usage

Gas infrastructure projects (FCH 2 JU)

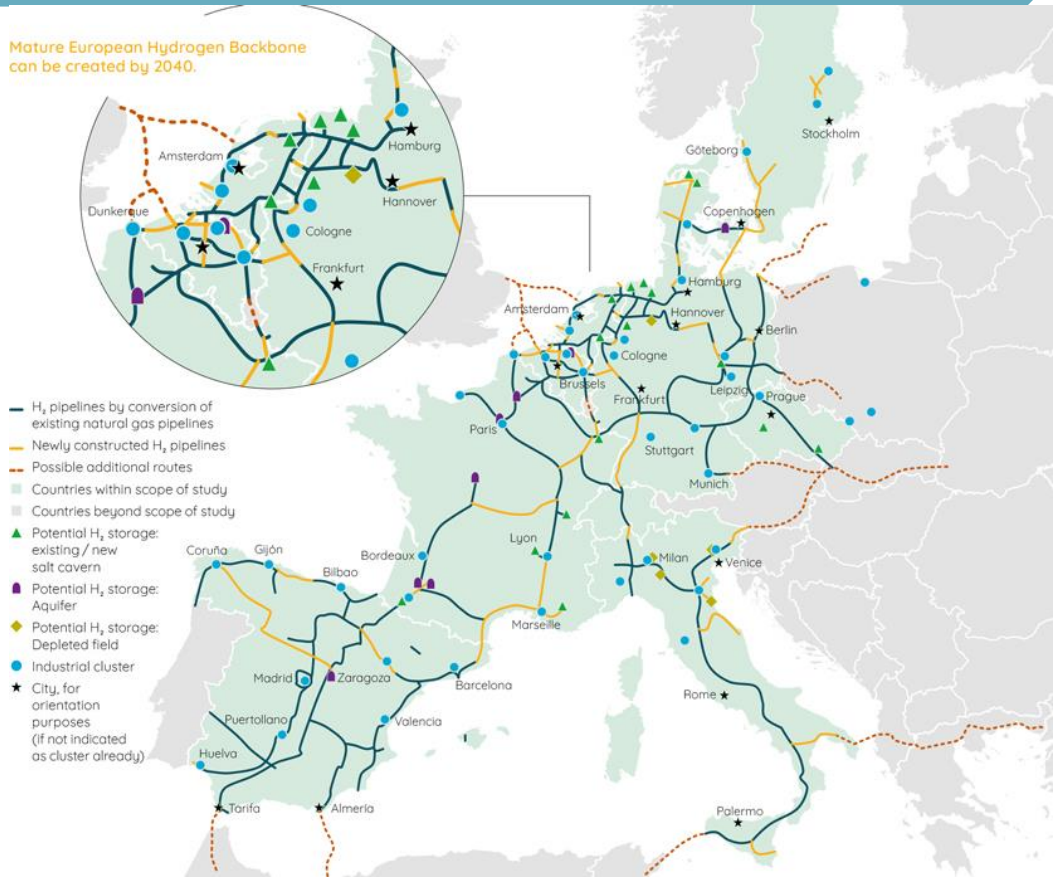
- HIGGS – Hydrogen In Gas Grids
  - Funded under Grant Agreement 875091
  - Gas infrastructure, its component and management in high-pressure transmission gas grid
  - Hydrogen concentrations at elevated levels
  - DVGW responsible for regulation, certification and standardization tasks
  - https://www.higgsproject.eu/

- THyGA – Testing Hydrogen admixture for Gas Applications
  - Funded under Grant Agreement 874983
  - End-user applications in the distribution network
  - Hydrogen concentrations at elevated levels
  - DVGW-EBI participant at test campaigns
  - https://thyga-project.eu/

Link between German and European activities (not complete)

Transport System Operators' vision on hydrogen network(s)

European Hydrogen Backbone



20200716_European Hydrogen Backbone slide deck.pdf

Building electrification for heating purposes

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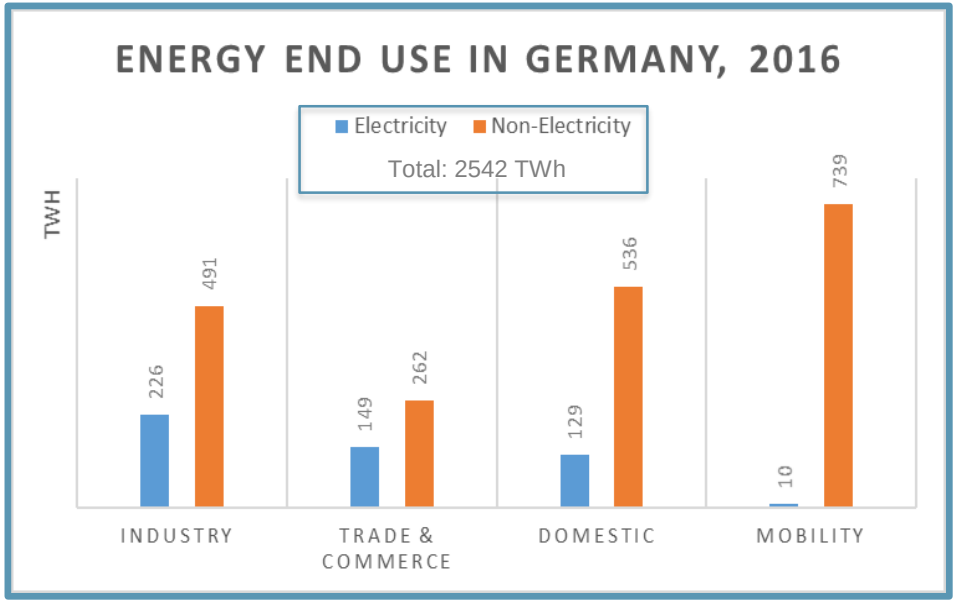
DVGW’s view on decarbonizing the domestic heating sector

80% of energy demanded as molecules - 20 % as electrons



80 % molecules

20 % electrons

Building electrification – “Pro” and “Con”?

Pro

1. German Buildings Energy Act (Gebäudeenergiegesetz – GEG) supports electrical heating, also in combination with **low energy** buildings (**new** buildings)
2. direct usage of renewable electricity
3. in new buildings easy to apply
4. high efficiency (> 90 % conversion into heat)
5. lower CAPEX compared to gaseous heating depending on chosen technology (single family house)
   - gas boiler ~ 8 k€
   - electrical heat pump ~ 8 k€ (35% subsidy in Germany)

Con

1. **very good insulation** of the building **required**
2. for existing buildings insulation expensive or not applicable (historical buildings – regulations according historic monuments protection authority
3. operational costs very often higher than expected (due to higher energy demand – insulation, building size etc.)
4. **no sufficient storage** capacities for renewable electricity
5. electrical distribution network has to be upgraded and extended (in Germany at least 90 bill. €)
6. renewable electrons can be transferred to molecules through Power-to-Gas (also SNG or liquid fuels) or other technologies
7. gas can be **easier transported** and **stored** using the existing and already paid assets in the gas network
8. re-electrification of gas using fuel cells produces heat
9. renewable gas enables all customers to contribute to climate-neutral energy usage w/o replacing gas boilers

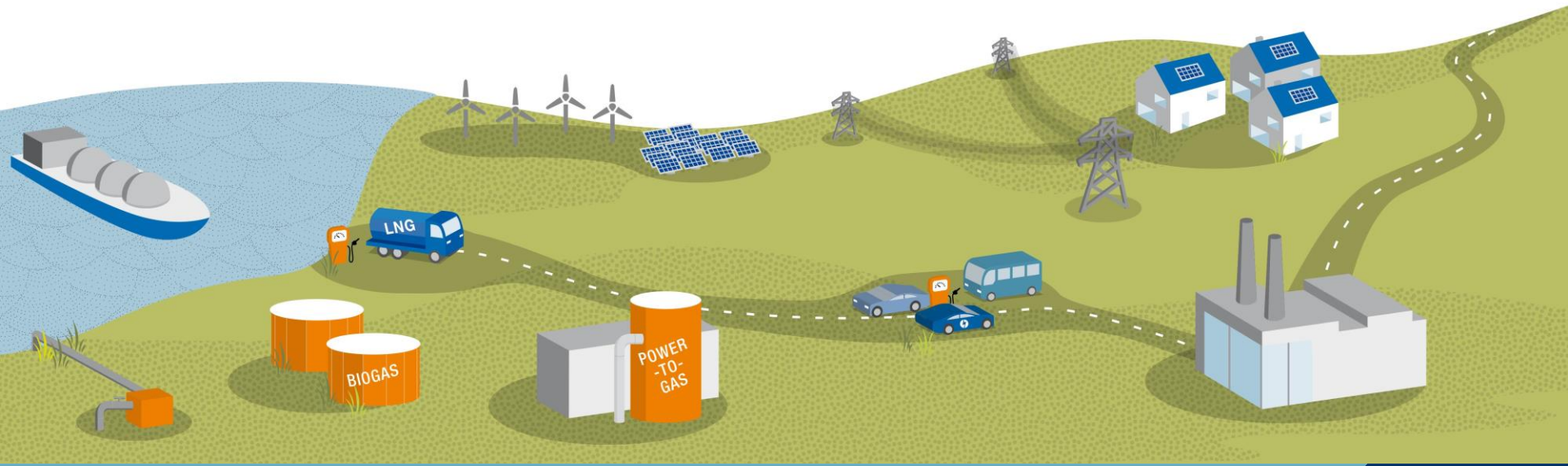
DVGW's 2-Energy-Carrier-World

Electrons and **molecules** (electricity and gas) as pillars of
- ✓ decentralized
- ✓ renewable energy

based energy supply

Natural gas in the beginning and later climate-neutral gasses like
- ✓ hydrogen
- ✓ biogas
- ✓ synthetic methane

ensure the **security** of **energy supply**



CO_2 emissions reduction in three steps

energy sector (CO_2 emissions in 2016)	Electrical power 327 Mio t CO_{2eq}	Heating 327 Mio t CO_{2eq}	Mobility 327 Mio t CO_{2eq}	CO_2-savings per switch (Mio t CO_{2eq})
Fuel Switch From coal and oil to gas 	coal → natural gas ~ 124	oil → natural gas ~ 25	gasoline and gas oil → natural gas ~ 39	~ 188
Content Switch Increase content of renewable gasses 	re-electrification ~ 12	private and industry ~ 57	heavy duty transport ~ 14	~ 83
Modal Switch Cross-sectoral infrastructure connection and increase of energy efficiency 	Power-to-Gas ~ 114	efficiency increase + combined heat & power ~ 91	heavy duty transport ~ 58	~ 263
CO_2-savings per sector (Mio t CO_{2eq})	**~ 250**	**~ 173**	**~ 111**	**~ 534**

“We are building the road, the next generation will walk on.”

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