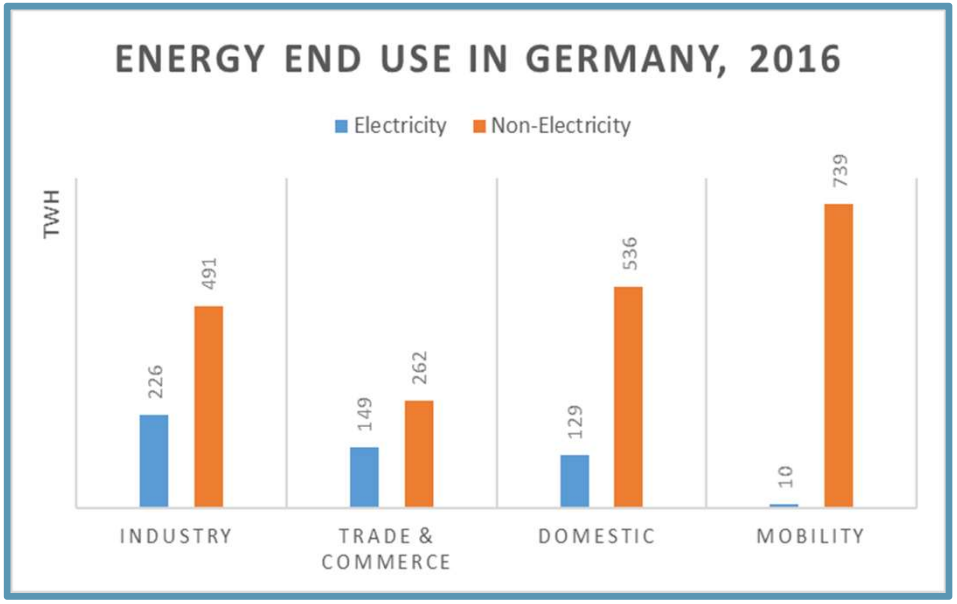
31st MEETING OF THE
EUROPEAN GAS REGULATORY FORUM
16-17 October 2018

DVGW on effective emission reduction in the power, heat and transport sector

Prof Dr Gerald Linke, CEO DVGW, German Gas and Water Association

DVGW

Climate actions focusing merely on the power segment are insufficient



80 %
Molecules

20 %
Electrons

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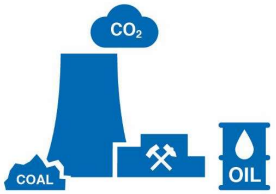
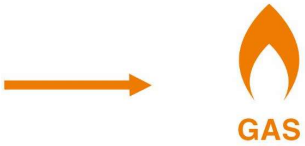
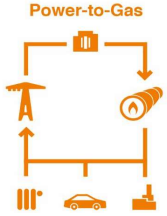
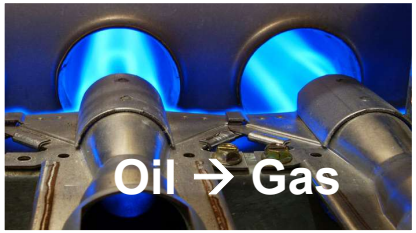
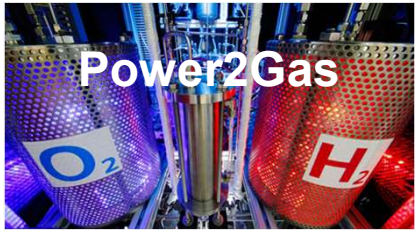
Investigations into effective emission reduction using gases

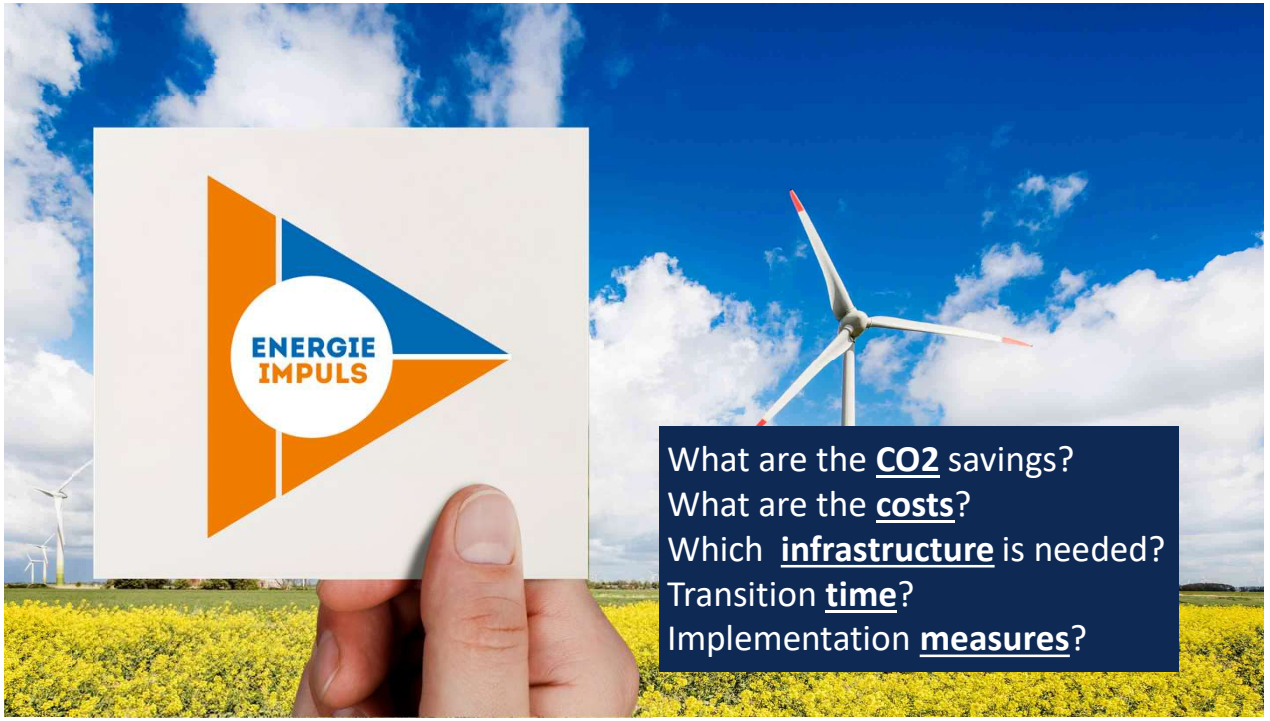
	Power Sector	Heat Sector	Transport Sector
Fuel Switch	 		Replacement of CO_2 intensive energy sources like coal and oil by gas
Content Switch	 		Continuous increase of CO_2 neutral or decarbonised gases
Modal Switch	 		Sectoral coupling of infrastructure; efficient integrated system

Studies by DVGW and various scientific co-operations (Ecofys, RWTH Aachen …)

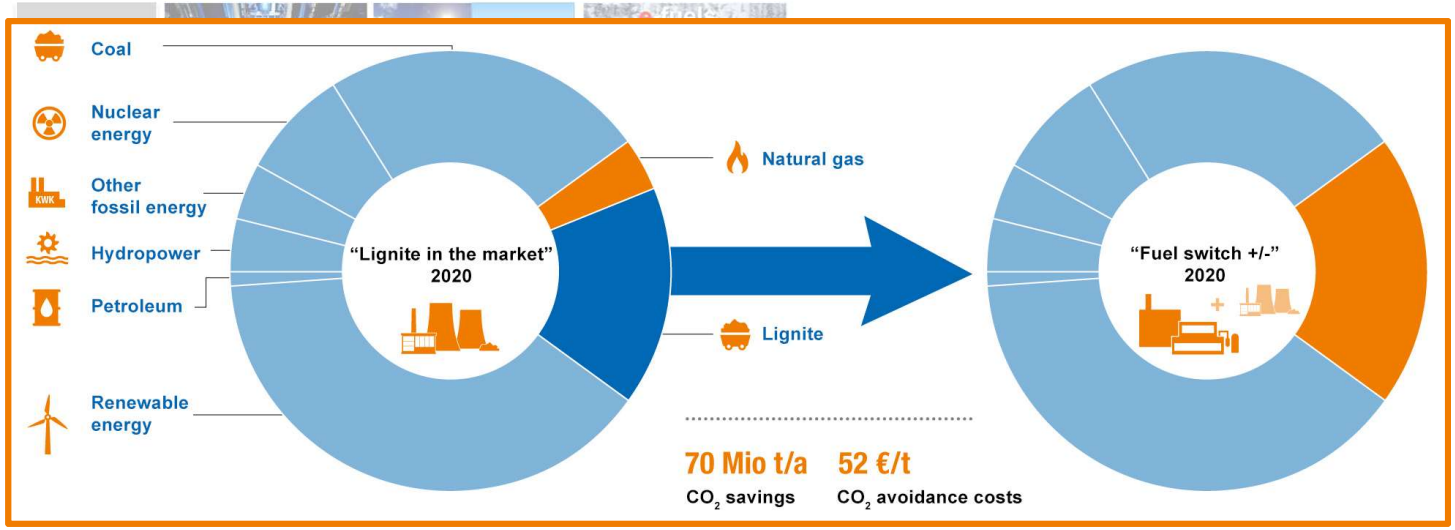
	Power Sector	Heat Sector	Transport Sector
Fuel Switch			
Content Switch			
Modal Switch			

Studies by DVGW and various scientific co-operations (Ecofys, RWTH Aachen …) called ENERGIE-IMPULS

	Power Sector	Heat Sector	Transport Sector
Fuel Switch			
Content Switch			
Modal Switch			



Fuel Switch: CO_2 reductions with lignite → gas switch

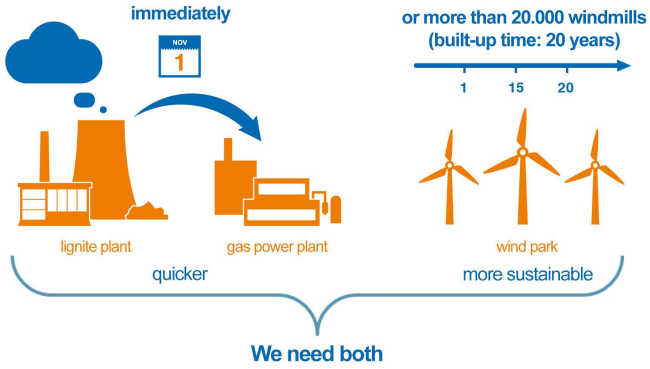


CO_2 reductions of entire Fuel Switch [Million t]

	Power Sector	Heat Sector	Transport Sector
Fuel Switch	lignite & coal → gas -124	oil → gas households: -14 trade & industry: -11 -25	diesel → gas: -23 gasoline → gas: -16 -39

TOTAL
CO_2 reduction:
-188 Million t

Savings 38% of power emissions



Germany's CO_2 emissions in 1990: 1.034 Million t:		
Germany's CO_2 emissions in 2016: 751.6 Million t:		
Power: 326.5	Heat: 260.1 Households: 90.3 Industry: 125.3 Trade: 44.5	Transport: 165.0

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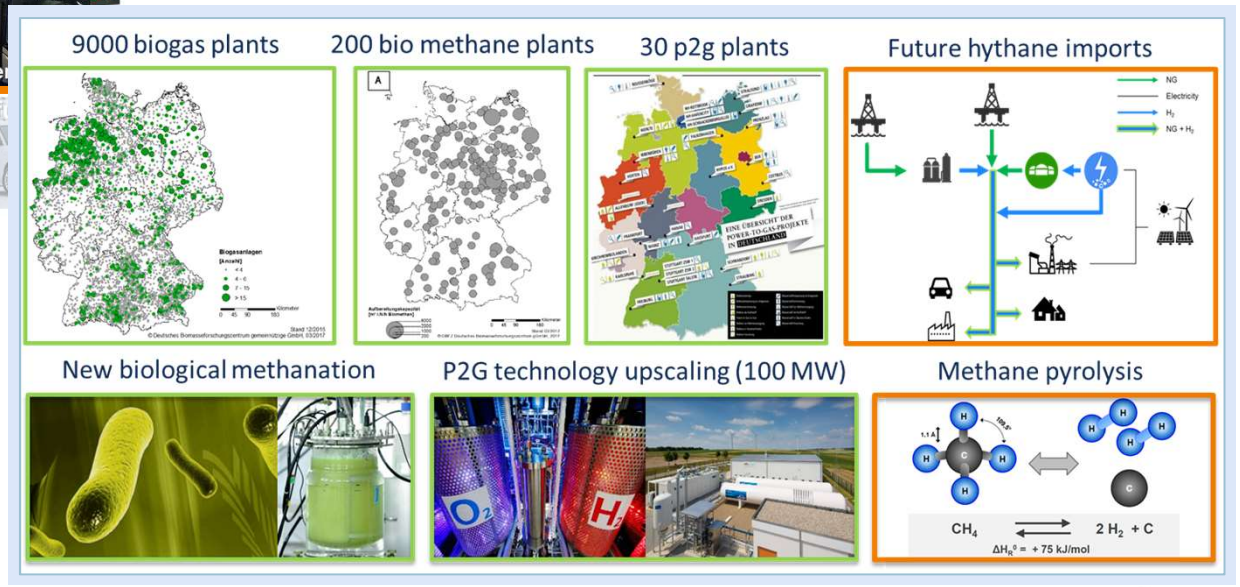
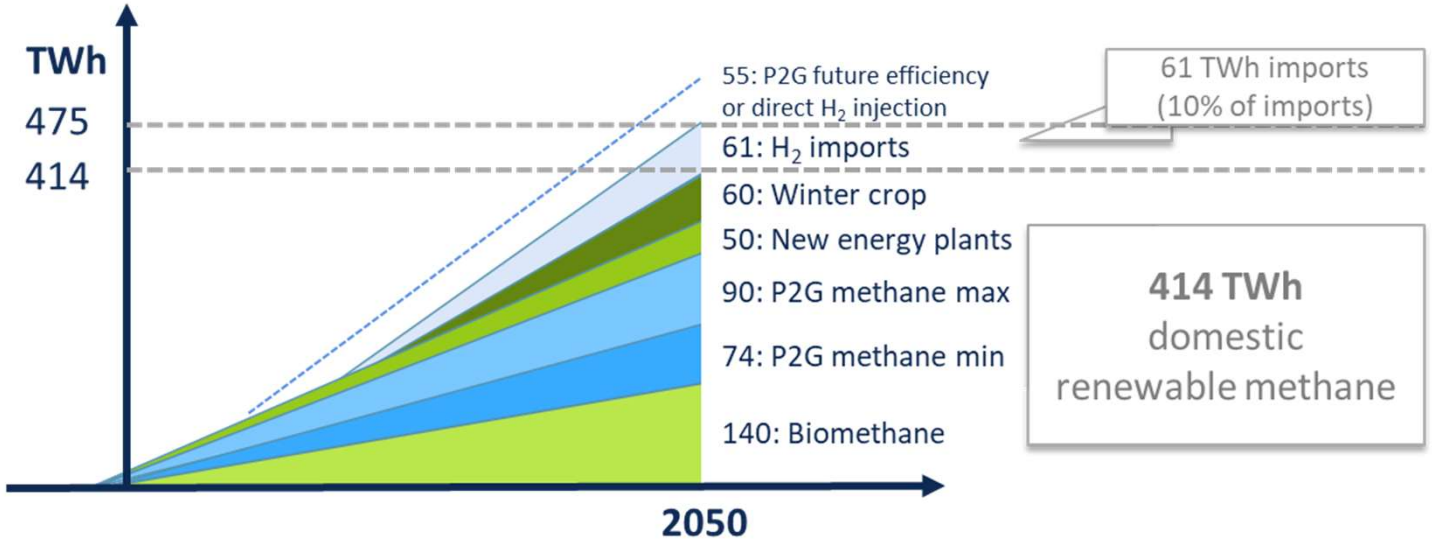
Content Switch: CO_2 savings - how "green" can gas be?

Assessment of sources and technologies



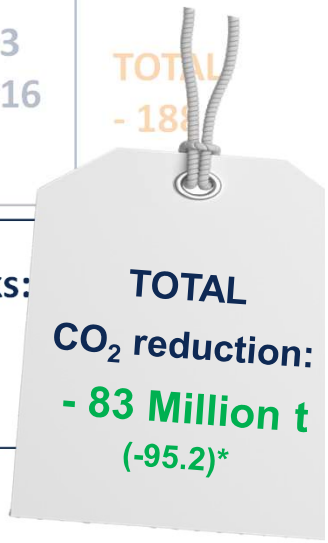
Domestic green gas potential - exceeds 414 TWh



Source: ECOFYS 9/2018

Green gases applicable to heavy vehicles & high-temp industry plus additional capacity for household peak power and heat

	Power Sector	Heat Sector	Transport Sector
Fuel Switch	lignite & coal → gas -124	oil → gas households: -14 trade & industry: -11 -25	diesel → gas: -23 gasoline → gas: -16 -39
Content Switch	clean power: -12 (-13.8)	households: -21 high-temp industry: -36 -57 (-65.4)	heavy duty trucks: -14 (-16.1)



*including minor imports

Modal Switch: Power2Gas lowers total energy system costs

Power2Gas:

- ✓ **Integrates renewable excess** power that otherwise has to be cut-off
- ✓ **Enables growth of generation** from renewables
- ✓ Provides nearly **unlimited storage capacity**
- ✓ Is a means to **transport power** via the gas grid with lowest losses

€€€ PRICE €€€

CO_2 : **Equivalent to 164 TWh**

COST:

System savings of 12 – 18 Billion € pa from 2030 onwards

INFRASTRUCTURE:

Up to 40 GW P2G

TIME:

Gradually till 2050

MEASURES:

Sector coupling policy

Saving in heat market through new technology and efficiency

€€€ PRICE €€€

CO_2 : ~642 Million t total till 2050

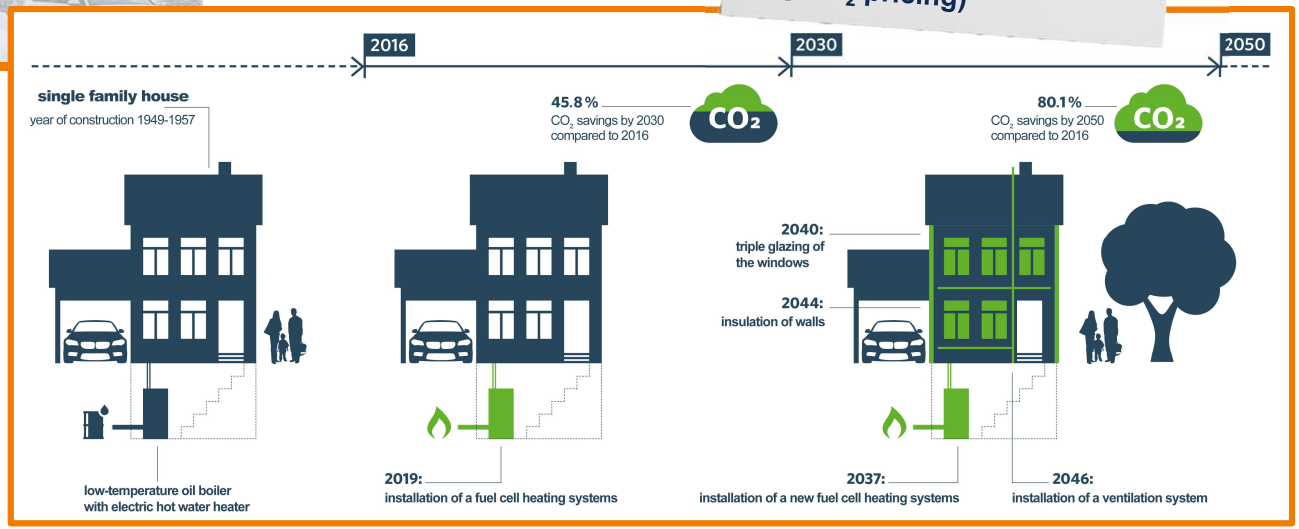
COST: No additional costs when included in KfW aid

INFRASTRUCTURE: Replacement of old heater

TIME: Gradually till 2050

MEASURES: National impulsion (eg CO_2 pricing)

Modernisation with up to 80% CO_2 savings



All three switches sum up to more than 546 Million t CO_2 reduction

	Power Sector	Heat Sector	Transport Sector	
Fuel Switch	lignite & coal → gas -124	oil → gas households: -14 trade & industry: -11 -25	diesel → gas: -23 gasoline → gas: -16 -39	TOTAL: - 188
Content Switch	clean power: -12 (-13.8)	households: 21 high-temp industry: 36 -57 (-65.4)	heavy duty trucks: -14 (-16.1)	TOTAL: - 82
Modal Switch	Minimum efficiency increase through sector coupling: 35% (even low heating systems replacement rates of 1% pa would provide this drop)			

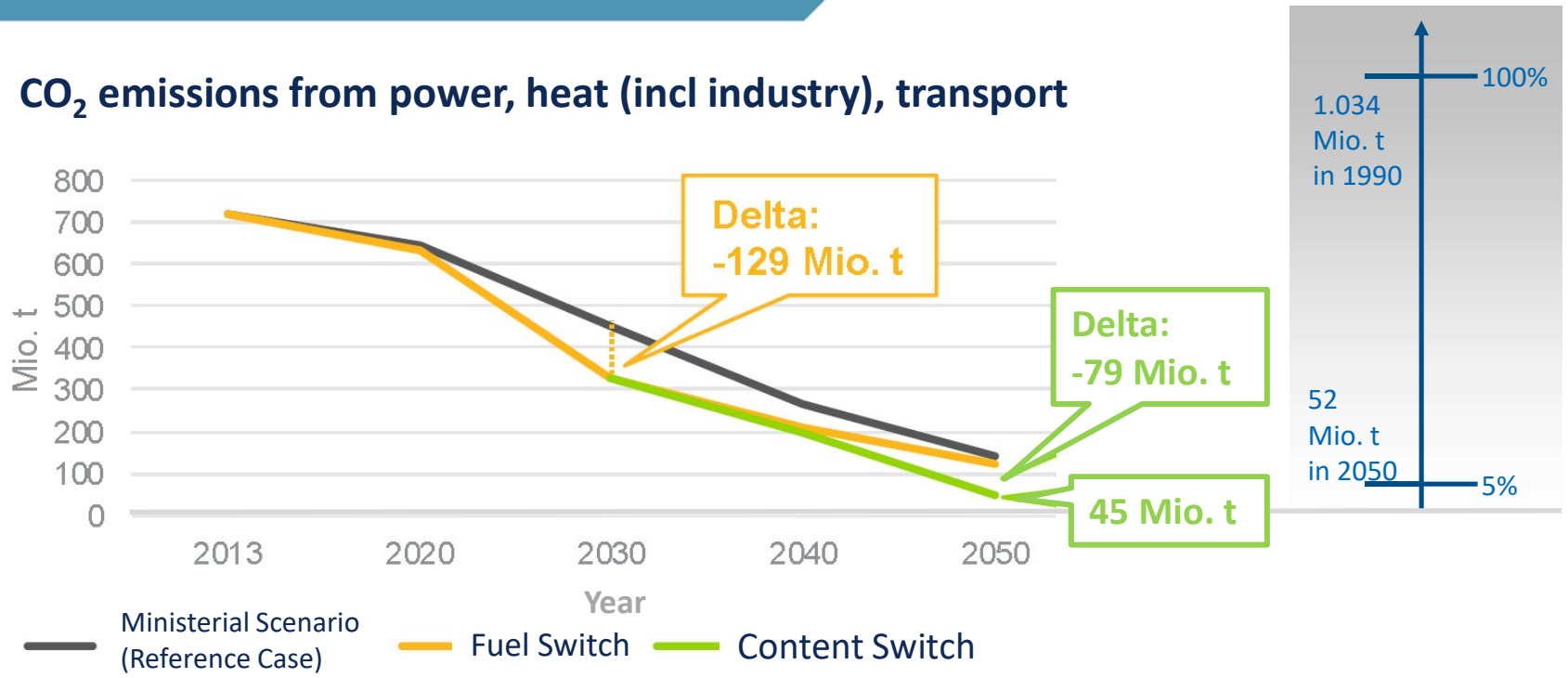
TOTAL
CO_2 reduction:
- 263 Million t

Cashing-up

If additional { *electrification* / *renewable* / *efficiency* } *measures would be stopped and merely gas and the three switches would be the German de-carbonisation strategy, we would be able to deliver* ***80% CO2 reduction.***

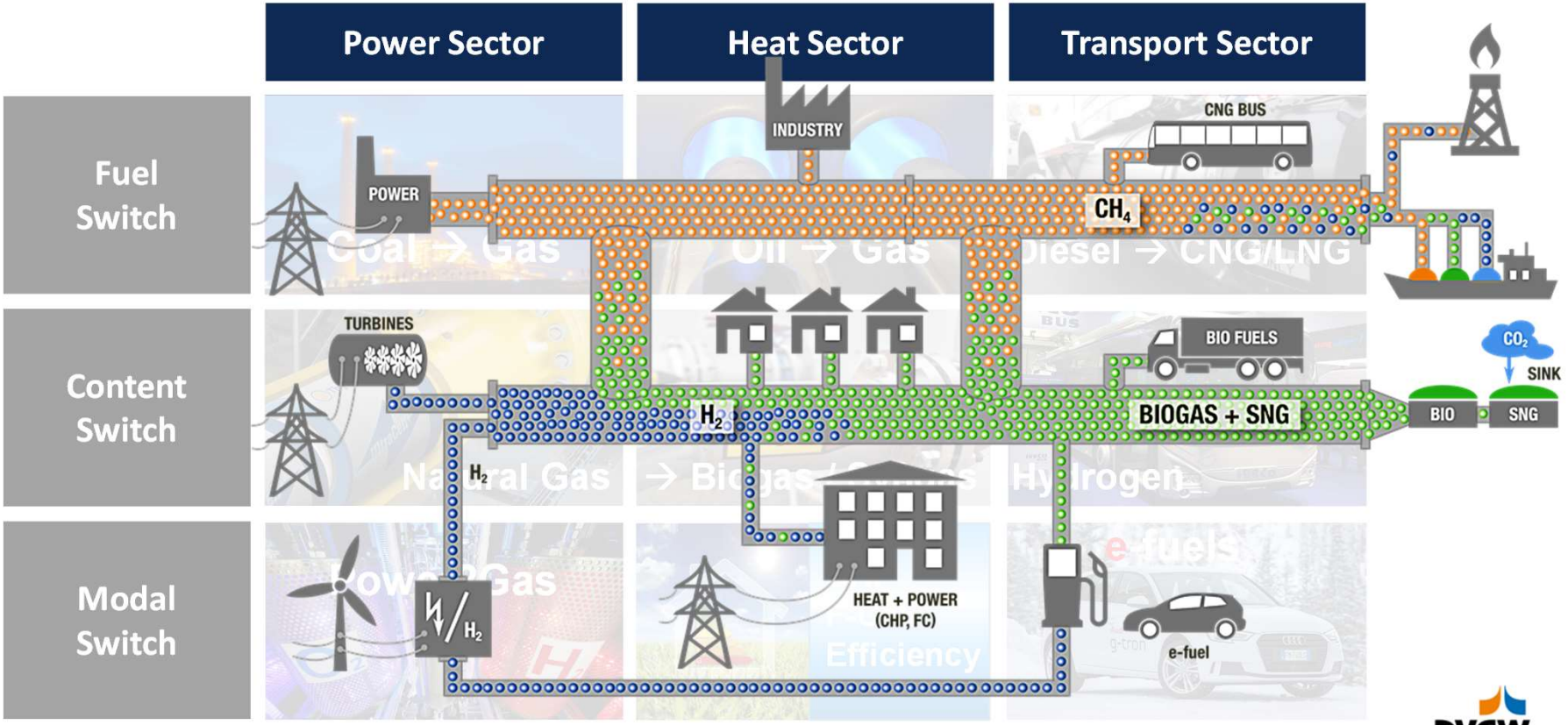
But together with further electrification, growth of renewable power and increase of efficiency the three gas switches provide a faster and cheaper road towards ***95% CO_2 reduction.***

Potential acceleration and benefits of the three switches in combination with allocated climate measures are shown



The difference of the initial emissions for 2016/17 between the table on slide 7 and the curve presented here are caused by the use of different references (UBA and BMWI) and can be classified as "other emissions"

Based on the gas grid, three switches together provide a robust, affordable, sustainable energy carrier system and quicker “pathway towards Paris”



Recommendations

	Power Sector	Heat Sector	Transport Sector
Fuel Switch	• Capitalise budget and time **benefits of natural gas** in all sectors • Set **fair benchmarks** (such as “Well to Wheel” NGVA)		
Content Switch	• Define a **green gas target** per country • Stimulate green gas growth through **annual quota** or **CO_2 pricing** • Prepare gas infrastructure for **hydrogen**		
Modal Switch	• **Remove barriers** between power and gas systems • Design a **P2G ramp-up program** and foster sector coupling • Stimulate increase of heating **efficiency** (via KfW aid) • Utilise **e-fuels** in HT industry and other critical areas		

Thanks for your attention and have a look at 40 real scale installations of the fuel, content and modal switch

www.dvgw-energie-impuls.de

http://www.wvgw.de/dyn_pdf/energie-impuls/

Prof. Dr. Gerald Linke, CEO DVGW, German Gas and Water Association

Back-up

The German Gas & Water Association

159 Years DVGW is the **first** Technical-Scientific Association of the World

Independent & scientific

Deutscher Verein des Gas- und Wasserfaches (DVGW)

DVGW
is authorised through
German Energy Act as
The Standard Setting Body and Certifying Body

DVGW
holds independent
R&D Centres

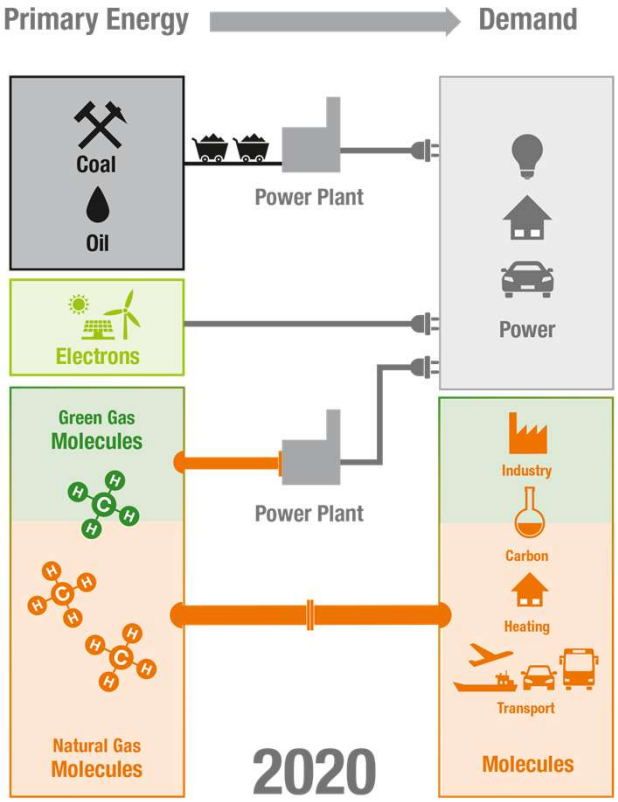
DVGW
is a
non-profit organisation

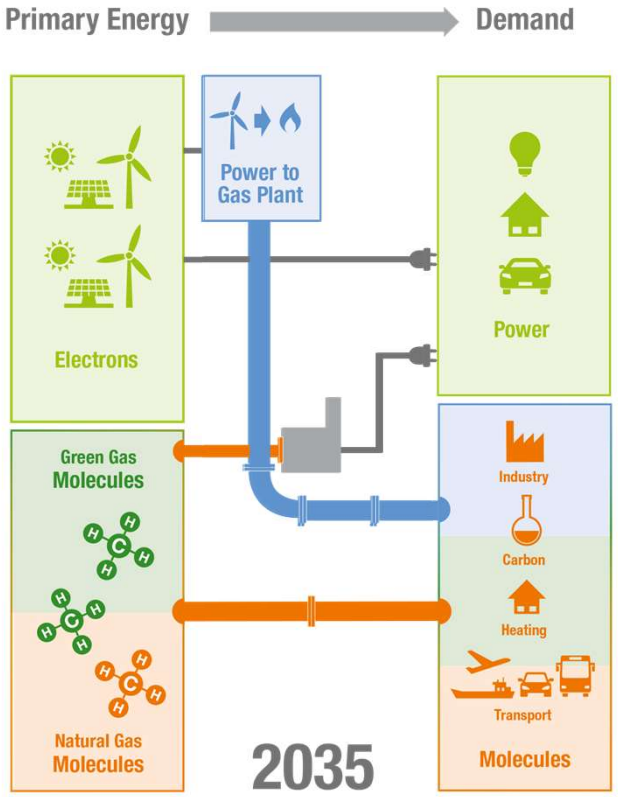
80 million € annual budget 700 FTE

9% Member's fee
13% free R&D fee

78% **through independent activities**
such as studies, **R&D**, training, dissemination, IT-services (safety, security, ...)

Society needs and will need “electrons” and “molecules”.
→ How to lower emissions from and with (gaseous) molecules?





Molecules used for
- ✓ High temperature processes
- ✓ Chemistry
- ✓ Non-energetic purposes
- ✓ Transport

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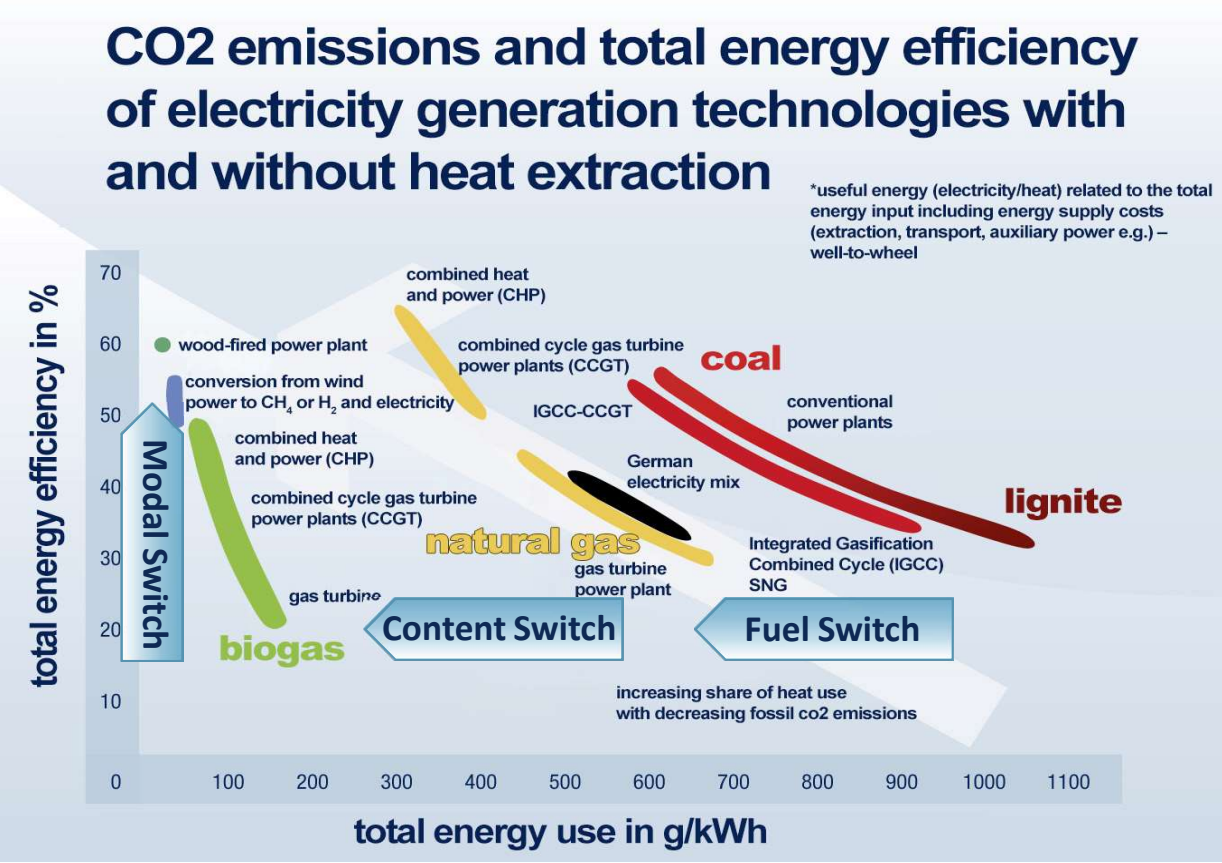
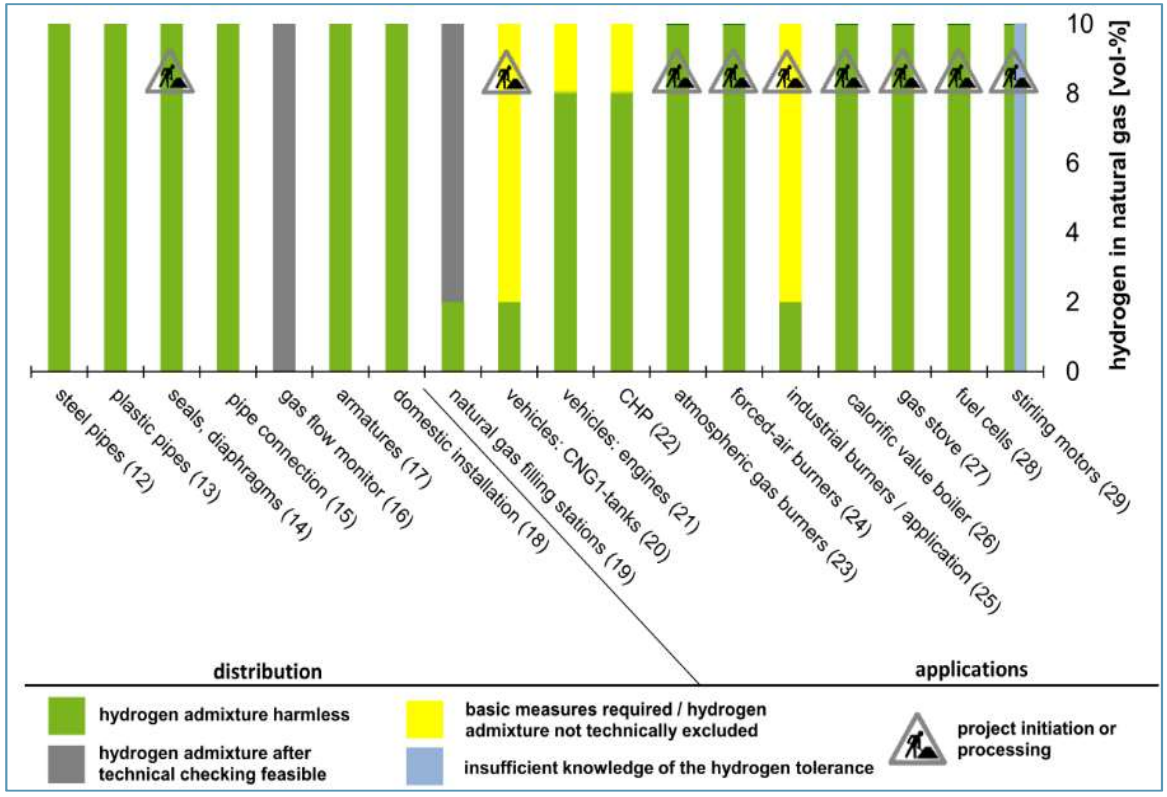
Fuel Switch, Content Switch and Modal Switch: Three moves in the right direction towards less emissions and higher efficiency

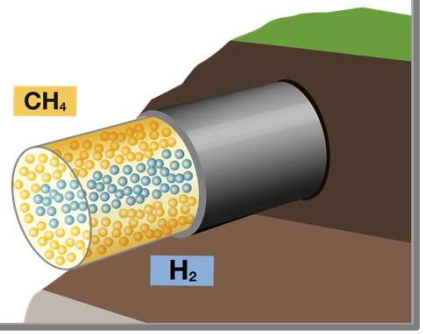


BYTHEWAY

DVGW permits 10% H_2 in the gas grid and is preparing the transition to higher double-digit concentrations



TARGET:
Hydrogen transport within the NG grid creates a new virtual energy grid - everywhere



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Carbon-neutral methane (syngas) will be the response if hydrogen production exceeds ~ 20% of the content of the gas grid

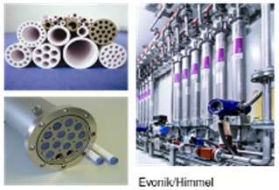
CH_4

$$4\ H_2 + CO_2 \rightarrow CH_4 + 2\ H_2O$$

Adsorptive CO_2 separation

Mahler AGS GmbH, „Mahler AGS – Gaserzeugung und Gasreinigung", 2015

Membrane separation



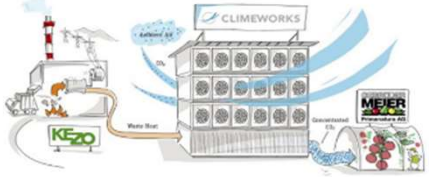
Evonik/Himmel Gastechnik

Gas washing

Ingenieurburo fur Umwelttechnik und Maschinenbau GmbH

Air Liquide Engineering & Construction; Rectisol™ - Syn gas cleaning

New innovative processes



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Studies and hyperlinks

1 Albert Moser: „Bewertung der Netzsicherheit bei einem „Fuel Switch“ von Braunkohle zu Erdgas in Deutschland in 2020“, 20. Juli 2018, Studie im Auftrag des DVGW e.V., https://www.dvgw.de/der-dvgw/aktuelles/presse/presseinformationen/dvgw-presseinformation-vom-30072018-braunkohleverstromung-durch-gaskraftwerke-ersetzen/

2 DVGW e.V.: „Der Energie-Impuls – ein Debattenbeitrag für die nächste Phase der Energiewende“, Mai 2017, DVGW e.V., http://www.dvgw-energie-impuls.de/

3 https://www.dvgw.de/der-dvgw/aktuelles/presse/presseinformationen/dvgw-presseinformation-vom-26092018-lng-taskforce/

4
- Potenzialanlyse Gas im Rahmen des DVGW Energie-Impulses, ECOFYS, 9/2018
- https://www.dbi-gut.de/biogaspotentialanalyse.html
- Wehling, Anja, et.al. „Technisch-ökonomische Modellierung eines sektorengekoppelten Gesamtenergiesystems aus Gas und Strom unter Fortschreibung des regulatorischen Rahmens“, Oktober 2018, DVGW e.V.
- Bründlinger Thomas et.al.: „dena-Leitstudie Integrierte Energiewende“, Juni 2018, Deutsche Energie-Agentur GmbH (dena), https://shop.dena.de/sortiment/detail/?tx_zrwshop_pi1[pid]=604

5
- https://www.google.com/search?q=wasserstofftoleranz+der+erdgas&ie=utf-8&oe=utf-8&client=firefox-b-ab
- https://www.vulkan-shop.de/praxiserfahrungen-mit-der-wasserstoffeinspeisung-in-ein-erdgasverteilnetz-2015-10-01

6 http://vbt.ebi.kit.edu/index.pl/proj_steckb/HELMETH

7 Kjell Bettgenhäuser, Jenny Cherkasky, Carsten Peterdorff, Jan Grözinger: „Metaanalyse aktueller Studien zum Thema „Sektorenkopplung“ – Welchen Beitrag kann Power-to-Gas für die Erreichung der Klimaziele leisten?“, 11. Juli 2018, DVGW e.V. und Zukunft Erdgas

8 https://zukunft.erdgas.info/studien/gebaeudestudie

9 https://www.dvgw.de/leistungen/publikationen/publikationen-gas/mobilitaet-kompakt/

STORE&GO-Project

STORE&GO-Project: 27 partner organisations and companies from all over Europe collaborate in the STORE&GO project to integrate Power-to-Gas technology into the future European energy system. The project is funded by the European Union's "Horizon 2020 research and Innovation program". DVGW coordinates the international project through its research centre at the Engler-Bunte-Institute of the Karlsruhe Institute of Technology (KIT)

Link to an explanatory film on power to gas:

https://www.storeandgo.info/