



**Regaining the EU energy sovereignty—
the role of Green Hydrogen**

*B2G Roundtable - Deutsch-Chilenische
Industrie und Handelskammer*

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ONLINE, 20 APRIL 2022

Agora Energy – Who we are

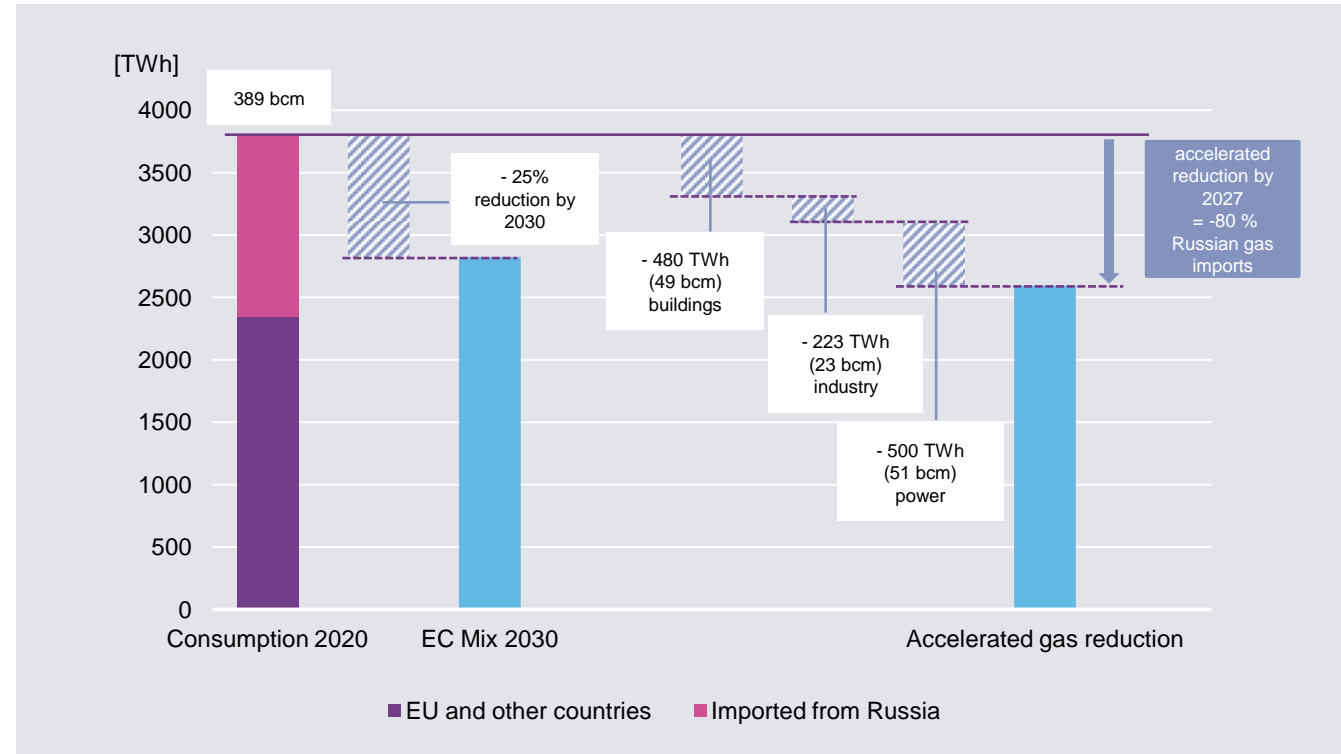
- **Think tank and policy lab**
- Round about **100 energy transition experts**
- **Independent** and non-partisan with diverse financing structure
- **Our vision** - A prosperous and **climate neutral global economy** by 2050
- **Policy advice** to deliver **clean power, heat and industry** –
in Germany, Europe and around the Globe
- **Headquarter in Berlin**, with offices in Brussels, Beijing and Bangkok



The escalation of Russia's war against Ukraine has created a fossil energy crisis and exposed the EU's dependency on fossil gas imports. If the EU fully mobilises all available means to reduce energy demand and switch to renewable energy, Europe can regain its energy sovereignty by 2027.

Energy efficiency measures and fast renewables ramp up can permanently displace 1200 terawatt hours of gas demand by 2027, allowing to avoid 80% of current Russian imports

EU-27 fossil gas consumption and reduction potentials



- The buildings sector can save 480 TWh through energy efficiency, district heating and a heat pump revolution.
- The industry sector can reduce at least 223 TWh through heat pumps, fuel switch and reduction of fossil gas as a feedstock.
- Pulling all stops to scaling renewables, investing into flexible assets and into enhanced power system flexibility will displace around 500 TWh fossil gas in the power sector.

Agora based on modelling from Artelys, Wuppertal Institute and TEP Energy

Buildings can save 480 TWh by improving boiler efficiency, renovating buildings, replacing gas boilers with heat pumps, district heating, and biomass as well as switching fuels

Estimated saving potentials in the buildings sector (TWh)

Sector	Minimum potential (TWh)
Improve energy efficiency of existing gas boilers	72
Renovate buildings	72
Replace gas boilers with heat pumps	140
Replace gas boilers with district heating	125
Replace gas boilers with biomass	47
Switch fuels for existing boilers	24

Agora based on modelling from Artelys, Wuppertal Institute and TEP Energy

- Stop installing new gas boilers, while improving efficiency of existing ones
- Rapidly scale up the production and installation of heat pumps for space and water heating in residential and commercial buildings
- Rapidly scale up building renovation.
- Connect more homes to district heating networks and make them greener and more efficient.

Industry can save 223 TWh by installing heat pumps, switching fuels, and reducing & replacing gas as feed-stock

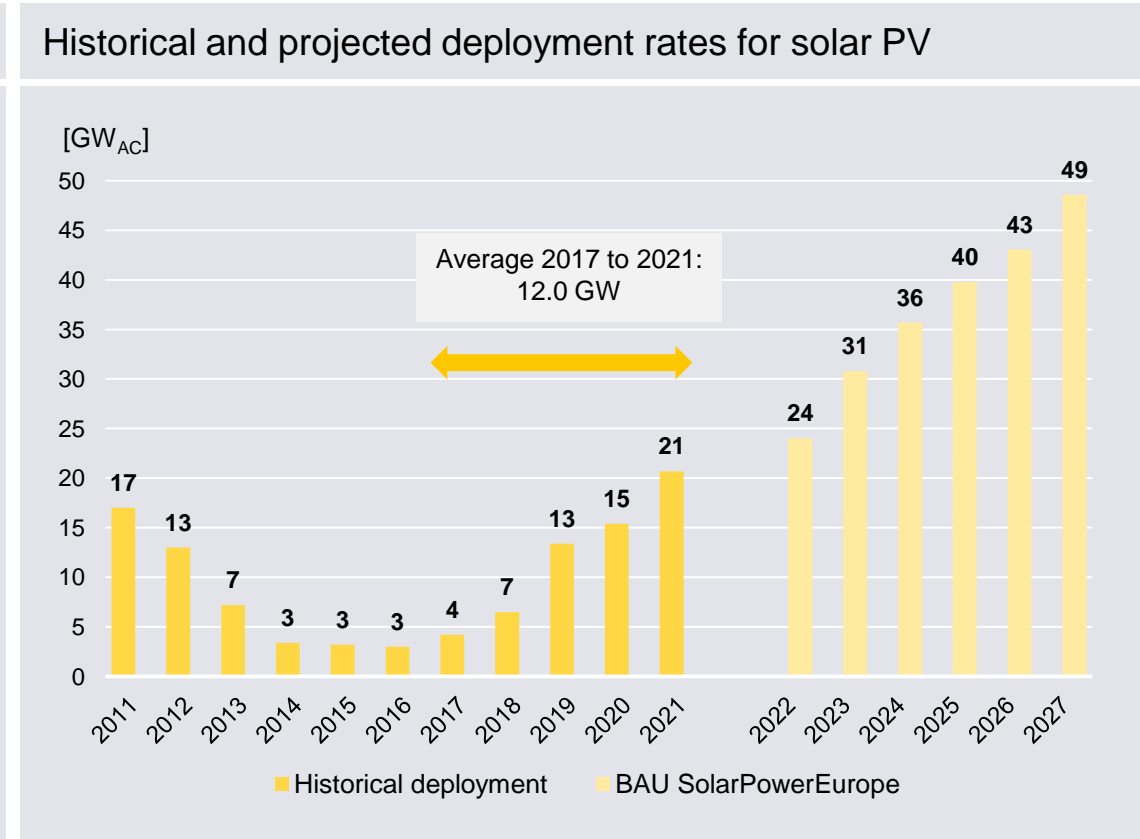
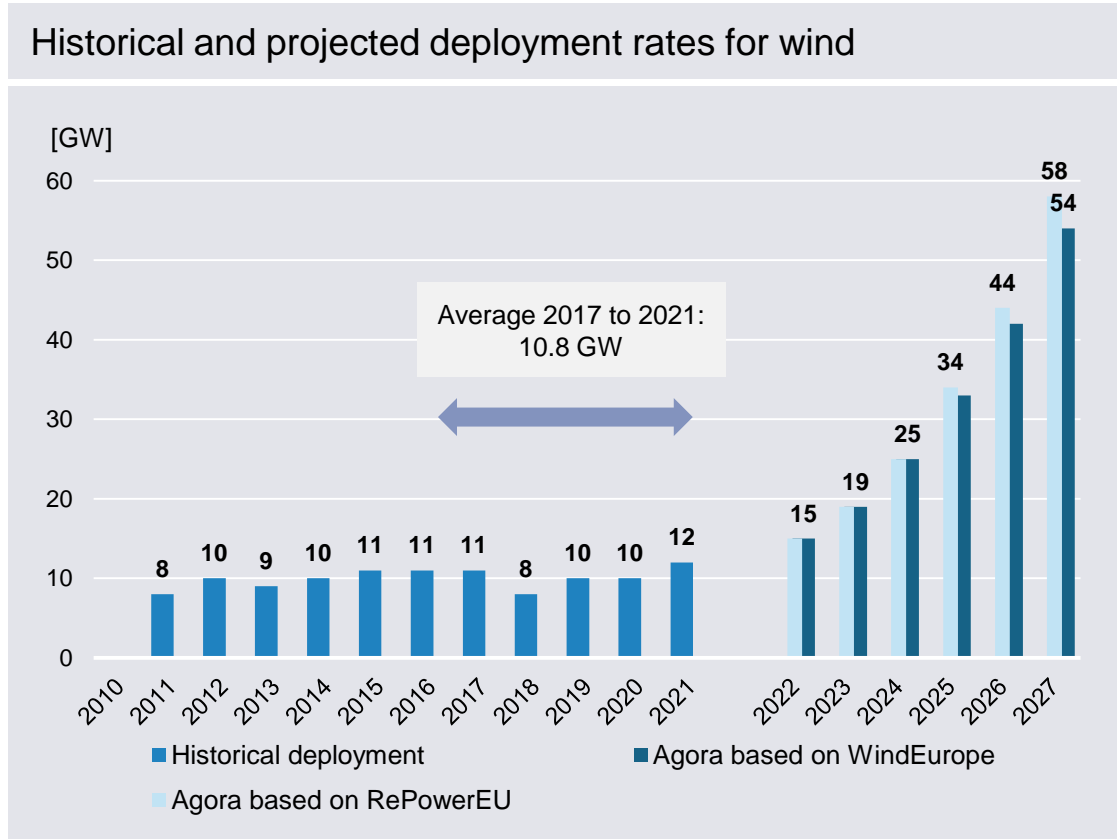
Estimated saving potentials in industry sector (TWh)

Sector	Minimum Potential (TWh)
Install heat pumps for low temperature heat (<150°C)	170
Install hybrid electricity/fuel systems for medium temperature heat (150-500°C)	30
Switch fuels for high temperature heat processes (>500°C)	3
Reduce and replace natural gas as feedstock in fertilisers and plastics	20

Agora based on modelling from Artelys, Wuppertal Institute and TEP Energy

- Don't regulate industrial gas and energy prices, let the demand signal work.
- Accelerate the uptake of heat pumps, direct electrification and hybrid RES-fossil fuel systems for low and medium-temperature industrial heat.
- Rapidly scale material efficiency and enhanced recycling of energy-intensive materials as well as fossil gas used as a feedstock in industrial processes

Pulling all stops to scaling renewables, investing into flexible assets and enhancing power system flexibility will displace around 500 TWh fossil gas in the power sector

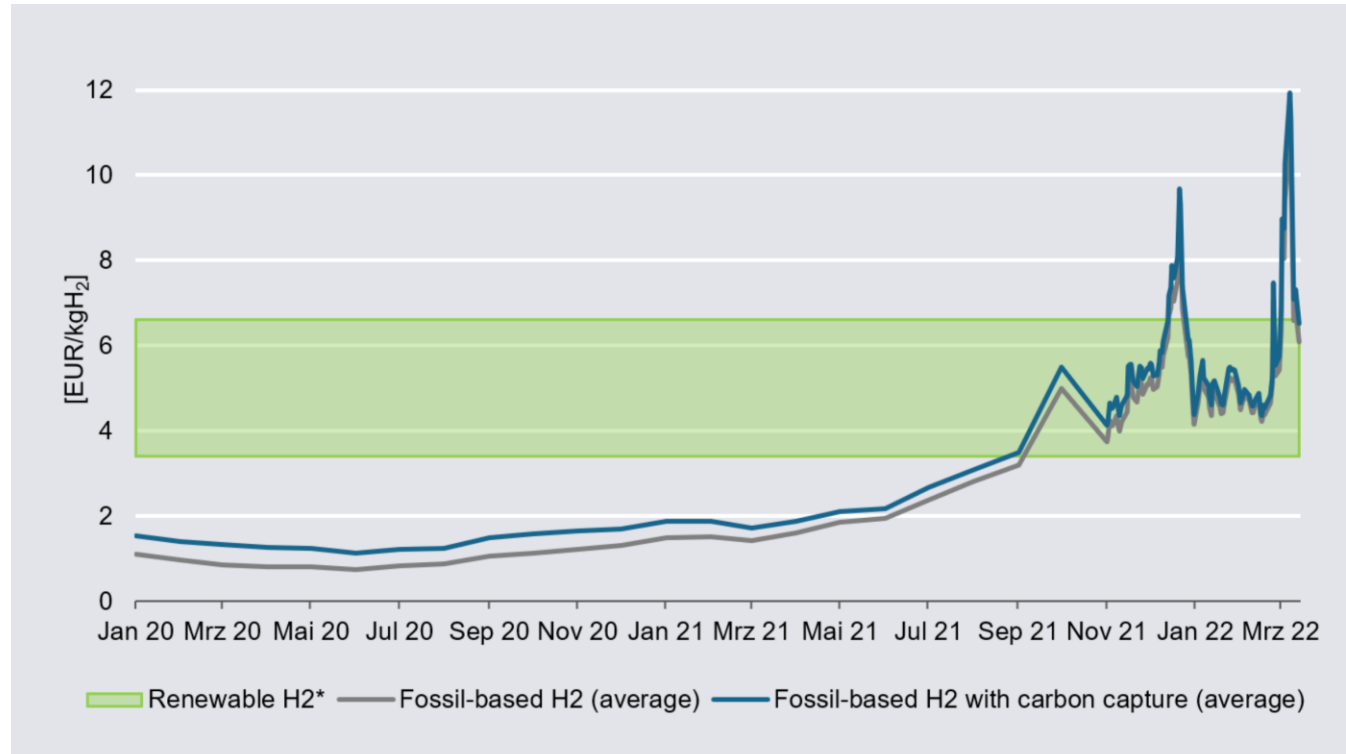


Adapted from the European Commission (2021), WindEurope (2022)

Solar Power Europe (2022); numbers in AC converted from DC numbers with a factor of 1.25

The changing economics and geopolitics of blue hydrogen put even higher pressure on green hydrogen to emerge

Costs of renewable H₂ and fossil based H₂ with carbon capture 2020-2021







*Renewable H₂ production based on RES direct connection / RES PPA. Agora Energiewende and Guidehouse (2022)

- Fossil-gas based blue hydrogen plays a prominent role in net-zero scenarios in a transition phase.
- Due to the fossil energy crisis, blue hydrogen can no longer be considered part of the solution.
- Current gas prices have undermined the business case compared to green hydrogen.
- Renewable hydrogen and additional renewable electricity generation must be accelerated.
- Renewable hydrogen needs to be prioritized for no regret applications.
- No regret applications are steelmaking, basic chemicals, long haul aviation, maritime shipping and back-up power plants.

Now more than ever, no-regret uses of green molecules must be prioritised

Need for molecules in addition to green electrons

Figure 4

Green molecules needed?	Industry 	Transport 	Power sector 	Buildings 
No-regret	<ul style="list-style-type: none"> · Reaction agents (DRI steel) · Feedstock (ammonia, chemicals) 	<ul style="list-style-type: none"> · Long-haul aviation · Maritime shipping 	<ul style="list-style-type: none"> · Renewable energy back-up depending on wind and solar share and seasonal demand structure 	<ul style="list-style-type: none"> · Heating grids (residual heat load *)
Controversial	<ul style="list-style-type: none"> · High-temperature heat 	<ul style="list-style-type: none"> · Trucks and buses ** · Short-haul aviation and shipping · Trains *** 	<ul style="list-style-type: none"> · Absolute size of need given other flexibility and storage options 	
Bad idea	<ul style="list-style-type: none"> · Low-temperature heat 	<ul style="list-style-type: none"> · Cars · Light-duty vehicles 		<ul style="list-style-type: none"> · Building-level heating

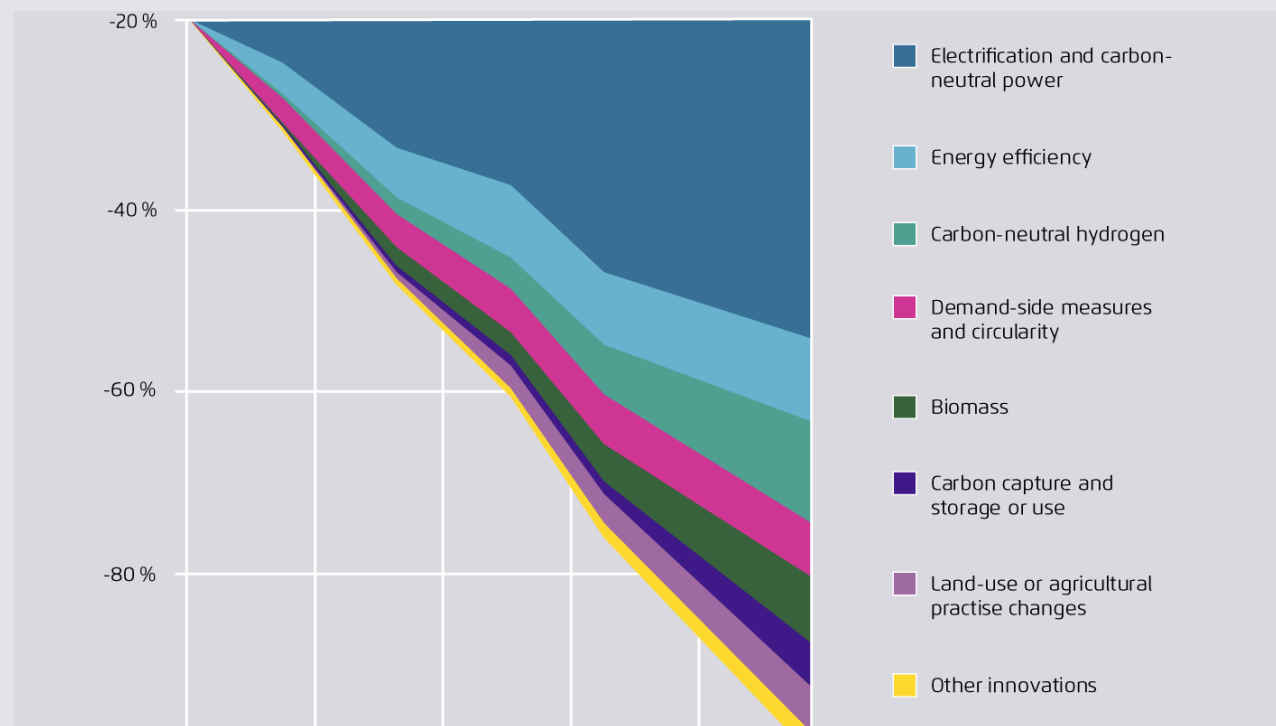
* After using renewable energy, ambient and waste heat as much as possible. Especially relevant for large existing district heating systems with high flow temperatures. Note that according to the UNFCCC Common Reporting Format, district heating is classified as being part of the power sector.

** Series production currently more advanced on electric than on hydrogen for heavy duty vehicles and buses. Hydrogen heavy duty to be deployed at this point in time only in locations with synergies (ports, industry clusters).

*** Depending on distance, frequency and energy supply options

Green hydrogen will play a small but crucial role in Europe's energy transition

Share of greenhouse gas emissions abatement in the EU by mitigation measure



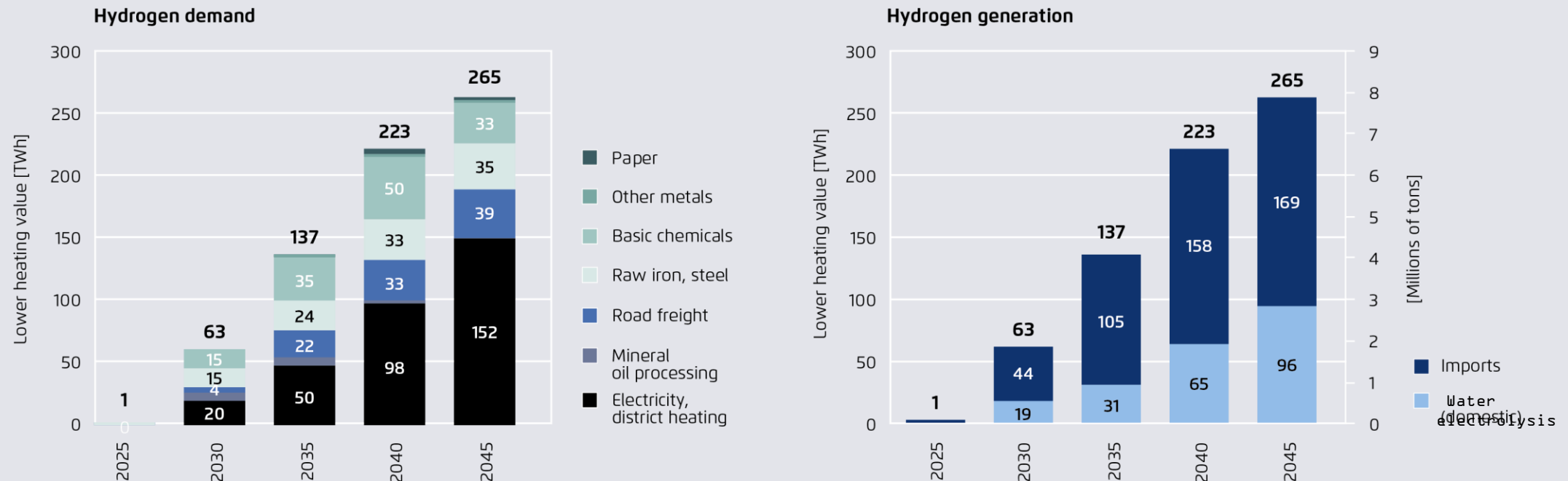
Mckinsey (2020)

Germany is driving Europe's uptake of green molecules:

- It recently increased its domestic electrolysis target from 5GW to 10GW by 2030
- Provides significant funding and policy instruments to promote production of green molecules in the global south

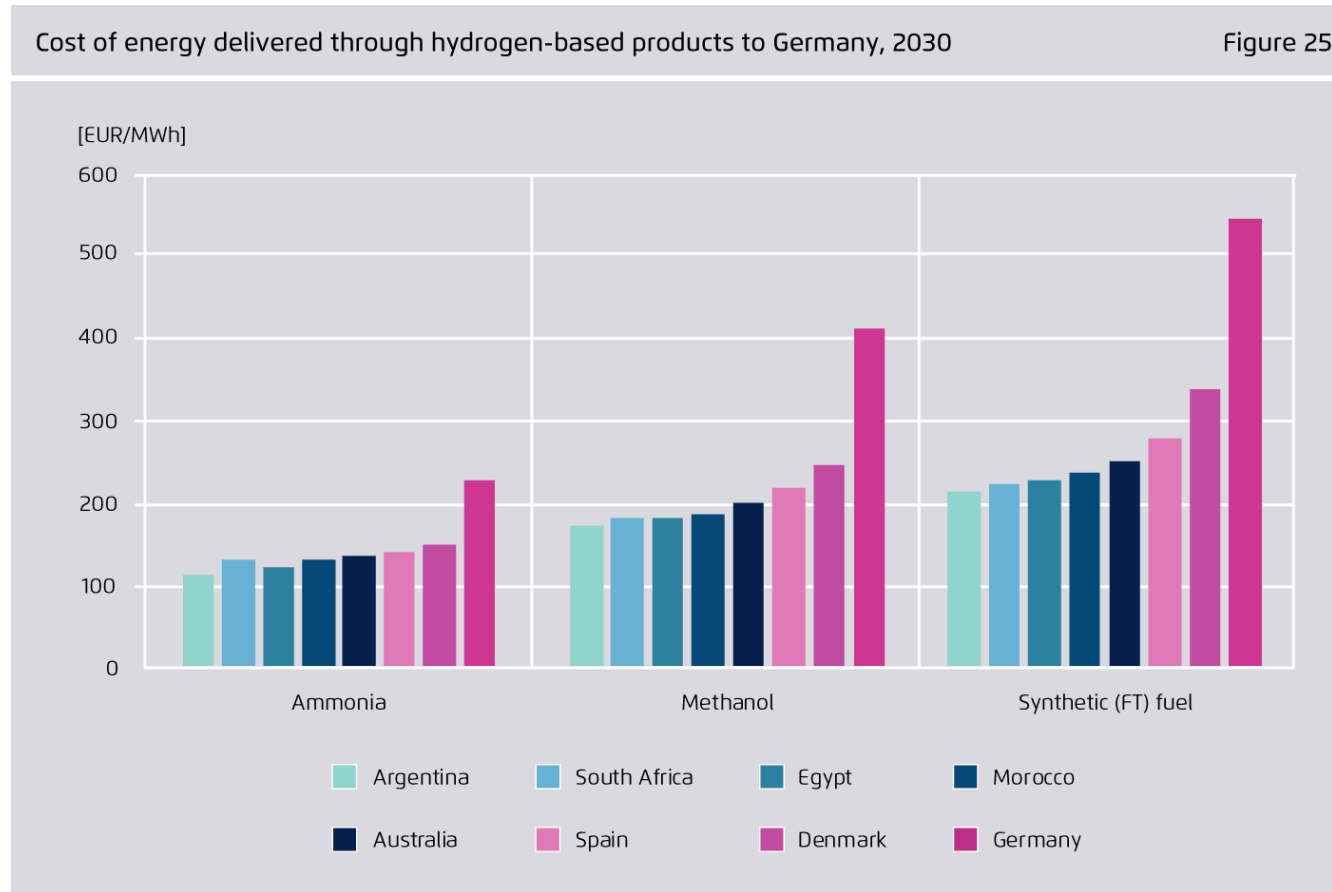
Germany will have to import around 3/4 of the required green hydrogen by 2035 in order to achieve its energy transition

CO₂ free hydrogen production and consumption in Germany

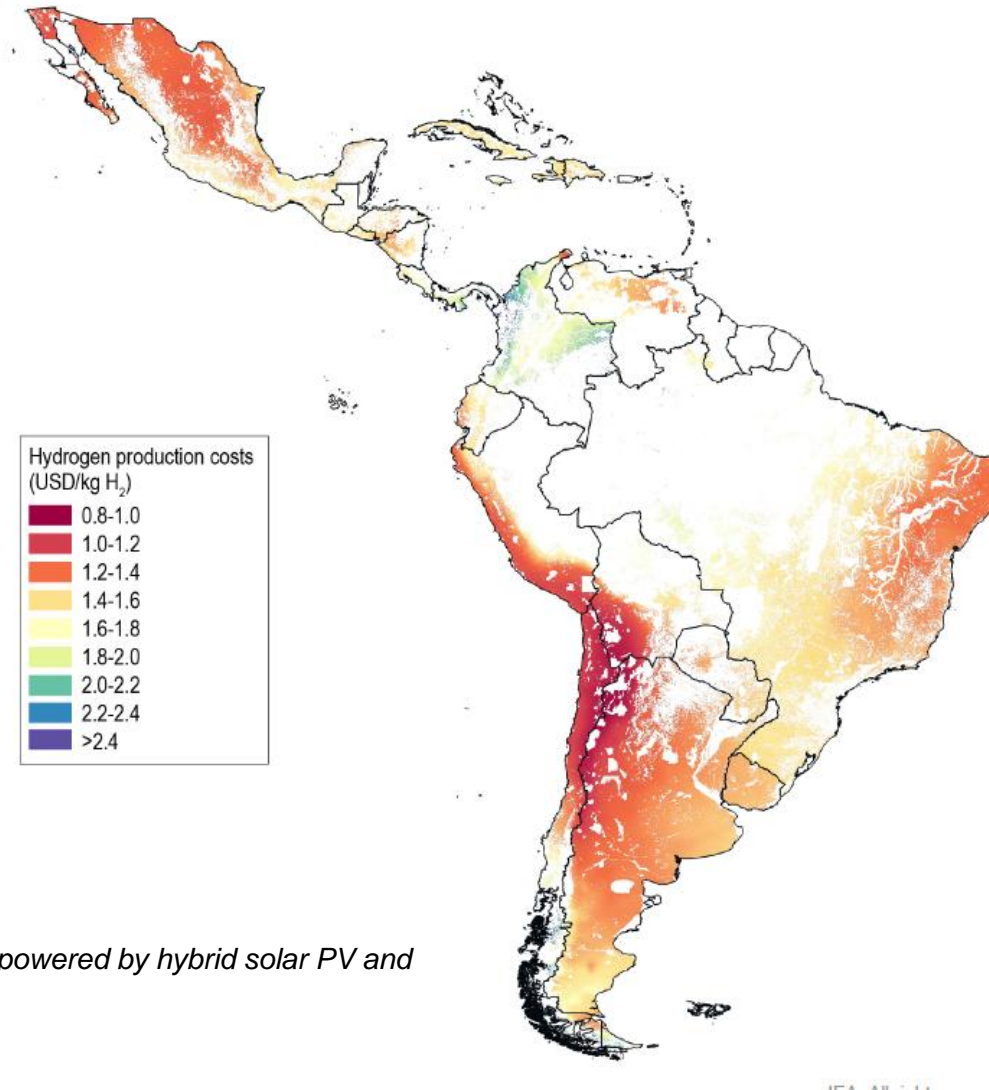


Prognos, Öko-Institut, Wuppertal-Institut (2021). Note: Hydrogen only. In addition, Germany will need 158 TWh of Power-to-Liquid by 2045.

Countries in the global south have potential to export cost competitive green molecules to Germany



Latin America has the potential to reach competitive LCOH via electrolysis





Levelised cost of hydrogen production via electrolysis powered by hybrid solar PV and onshore wind, 2050

Key findings

- 1 The escalation of Russia's war against Ukraine has created a fossil energy crisis and exposed the EU's dependency on fossil gas imports. If the EU fully mobilises all available means to reduce energy demand and switch to renewable energy, Europe can regain its energy sovereignty by 2027.
- 2 Climate protection and energy security go hand in hand, as actions to meet the EU climate targets also reduce fossil gas consumption.
- 3 Regaining Europe's energy sovereignty by 2027 requires a collective European effort based on joint commitments and solidarity.
- 4 A new EU Energy Sovereignty Fund, modelled on NextGenEU and equipped with 100 bn EUR until 2027, should be set up as part of a dedicated investment framework to deliver RePowerEU.

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Questions or Comments? Feel free to contact us:

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Three core messages are central to understanding Green Hydrogen's role in the energy transition

1

The role of green hydrogen for climate neutrality is crucial but secondary to direct electrification coupled with renewable energy deployment.

2

Countries should find a balance between using green electricity domestically and creating molecules for export.

3

Future participation in global PtX markets will require compliance with sustainability production standards.

An Investment Framework for RePowerEU based on European Solidarity

Public funding needs of the proposed 15 priority actions

bn EUR (2022--2027)	Public funding needs (total)	Public funding needs (per year)	National budgets	EU funds (EU budget, RRF, other)
Power sector and H2	103	11	31	72
District heating	210	35	176	34
Building and heating renovations	337	56	253	84
Industry	30	5	4	26
TOT	680	113 (0.81% EU GDP)	464	216

Agora Energiewende (2022)

- Just transition considerations and public ownership of key assets require a high share of public financing of the total investment needs.
- The lion's share of public financing will come from national budgets, but the highly gas dependent and fiscally fragile countries need solidarity.
- Our estimates suggest that a new EU Energy Sovereignty Fund should be equipped with 100 bn EUR until 2027; supporting investment needs not covered by existing EU funds with priority on fiscally fragile Member States.
- Commitments around establishing the Fund should ensure existing funds are repurposed where possible and that governments smartly combine price signals and protection for poor households and industry.

Effects of RePowerEU on trade, employment and economic activity

Employment in the gas, clean energy and heating equipment sectors

Sector	EU27 employment, thousands (*)
Natural gas (2018)	
Extraction of gas	15
Manufacture of gas	12
Distribution and trade of gas and gaseous fuels	104
Electricity generation	28
Total natural gas	159
Clean energy (2019)	
Energy efficiency	1,104
Renewables	617
Renewables (direct and indirect employment, 2020)	1300
Of which: solar and wind power	453
Heating equipment manufacturing (2018)	
Manufacture of central heating radiators and boilers	56
Heat pumps (direct and indirect employment, 2020)	319

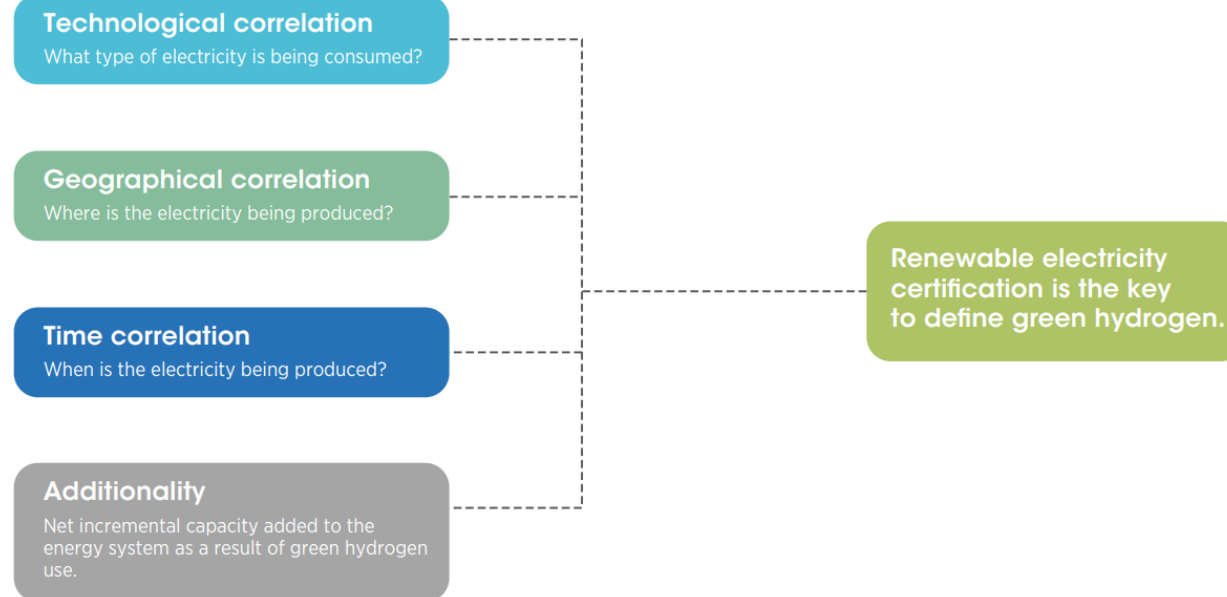
Eurostat, IRENA, EUROSEVER and calculations by Agora Energiewende

- Investments required to meet the Fit for 55 targets and additional RePowerEU efforts are significant.
- But the economic benefits are real, large, and they last. This is much preferable to paying many billion euros per year to autocratic regimes to purchase and then burn fossil fuels.
- Gas cost savings worth 130-320 billion EUR should already accrue in 2022-2027, the same amount could finance the full renovation of 3 to 8 million homes.
- Investing into clean energy creates many times more jobs and economic value than continuing our current fossil fuel dependency.
- Adding 418 GW of solar and wind by 2027 means 418.000 new jobs (FTE) in construction of new plants and 46.000 new jobs in O&M.

Countries should incorporate sustainability criteria for green hydrogen production, complementing the EU import requirements

Requirements for Green Hydrogen Tracking Certificates

Figure 1: Requirements for green hydrogen tracking certificates



→ Sustainability criteria should address:

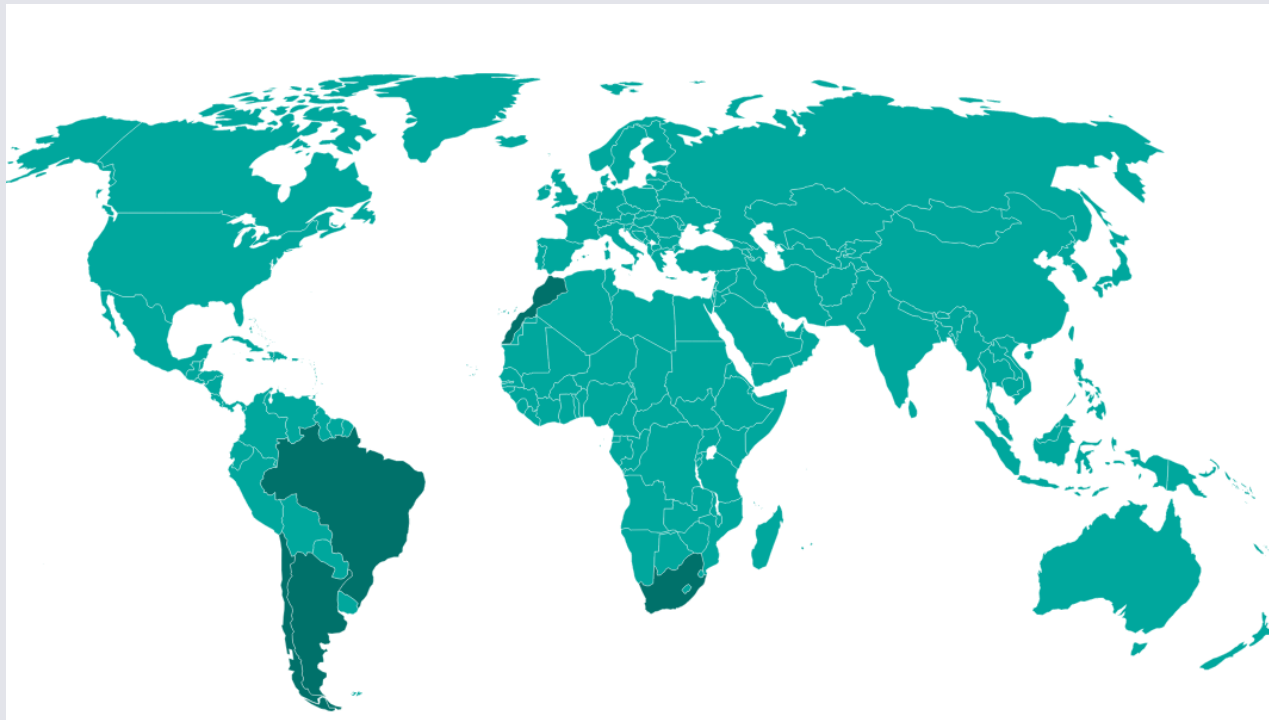
- Water supply (and access)
- Energy Access
- Job creation and upskilling of local communities
- Land use change

EU RED II requirements around additionality are currently applicable to H2 imports, however notes that country specific arrangements can be made.

IRENA (2022): Certification

Agora contributes to the International Power-to-X Hub, supporting countries to become green molecule exporters

Countries with projects under the PtX Hub as of February 2022



<https://ptx-hub.org/projects/>

- The PtX Hub is implemented by GIZ, the German Agency for International Cooperation
- Agora contributes to projects with
 - Morocco,
 - South Africa
 - Argentina
- Objective:
To develop sustainable hydrogen and PtX markets as building blocks for the energy transition

Agora & the PtX Hub create an offline 'Business Opportunity Analyser' to promote the development of global PtX markets

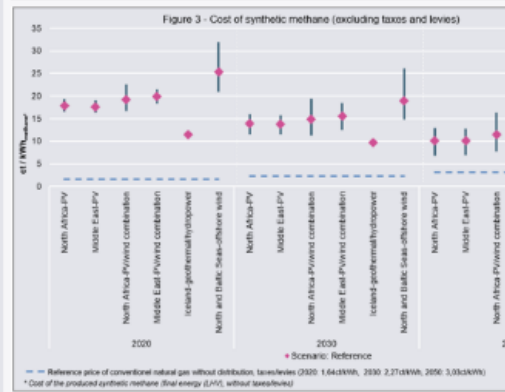
PtG/PtL calculator: An interactive tool to determine the cost of Power-to-Gas (methane) und Power-to-Liquid

→ Interactive Excel tool, evaluating PtG (Methane) and PtL (Synfuels)

CONTROL PANEL	
Scenario	Reference
Origin of the synthetic fuel (country/region)	North Africa
Renewable energy source	PV
Method of CO ₂ extraction	Direct Air Capture - TSA
Cost of capital (WACC)	6%
PtL - Fossil fuel for blending	Premium petrol

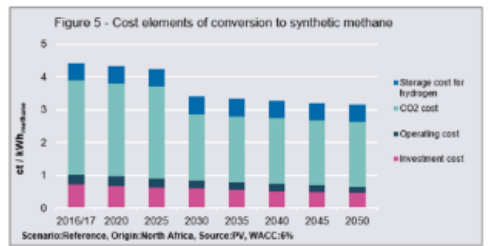
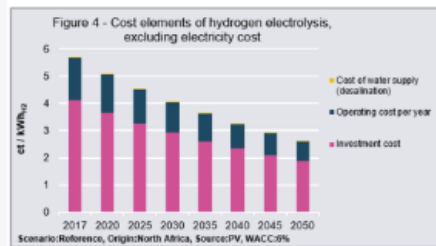
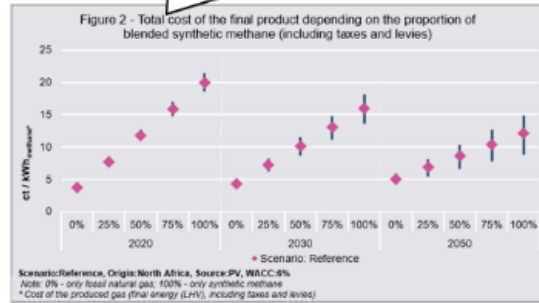
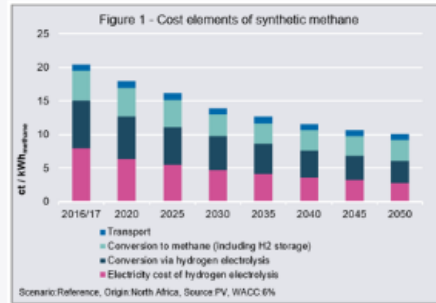
The renewable energy source must always be selected after changing the country or region of origin - as the energy resources available depend on the respective country chosen.

Click on this button after adjusting scenarios. This updates figure 3 in the results with the 'cost of methane' and 'cost of synthetic liquid fuel' according to the assumptions selected here.



Benchmarking with conventional NG and with different countries of origin

Development over time according to different scenarios



The „traffic light“ government is committed to climate protection in a "social-ecological market economy": Germany is committed to the 1.5 degree path.

Press conference of the „traffic light“ parties on 24.11.2021



→ **Ambition level (1.5° path)** higher than in the current climate protection law (significantly below 2° path, Paris formulation)

Key points in power sector (selection):

- Increase the **share of renewable energies** in the electricity sector to **80% by 2030 & phase out coal „if possible“ by 2030**
- **2% of land for onshore wind**
- Comprehensive **reform of the electricity market design** incl. grid charges, taxes, levies, surcharges
- Immediate commissioning of **planning for climate neutral network**

The coalition agreement partly contains very detailed specifications (e.g. expansion of renewables), but some sections remain vague (e.g. hydrogen).

Coalition Agreement 2021-2025
between SPD, Alliance 90/The Greens and FDP



Key points industry, heat and overarching (selection)

- "Given the current price level" **no increase in the CO₂ price** on petrol, diesel, heating oil and natural gas
- **Minimum price in European emissions trading of 60 EUR/t**, national if necessary
- Closing the economic efficiency gap in (primary) industry, e.g. with **Carbon Contracts for Difference (climate contracts)**
- **Comprehensive municipal heating planning** and expansion of heating networks
- **Heat target: 50% "climate neutral" by 2030**
- **Transport: doubling of rail transport; 15 million electric vehicles + 1 million public charge points by 2030**

Publications on climate-neutrality, hydrogen and industry

12 Insights on Hydrogen	Making renewable hydrogen cost-competitive	No-regret hydrogen: Charting early steps for H ₂ infrastructure in Europe	Towards a climate-neutral Germany by 2045	Breakthrough Strategies for Climate-Neutral Industry in Europe
				
<ul style="list-style-type: none"> > <u>impulse</u> 	<ul style="list-style-type: none"> > <u>main study</u> > <u>legal analysis</u> 	<ul style="list-style-type: none"> > <u>full study</u> 	<ul style="list-style-type: none"> > <u>summary (EN)</u> > <u>full study (DE)</u> 	<ul style="list-style-type: none"> > <u>summary</u> > <u>full study</u>
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