Demand and production of hydrogen in Germany as well as the current state and recent developments in the German hydrogen sector

H2 DWV

Deutscher Wasserstoff-Verband

More than 180 members along the entire value chain!

German Hydrogen Association

For more than 25 years now, DWV has been advocating the technological development and market introduction of hydrogen technologies.

DWV represents all European member associations of Hydrogen Europe (12 associations - March 2019) on the board of the European Hydrogen Association. Hydrogen Europe is directly involved in the design of the European funding programs of the FCH JU.

The expert commission performing energy is the key market player, which has been working intensively since 2015 to ensure that "green hydrogen" is taken into account in the many regulations on energy system transformation for use in refineries.

We have been able to successfully inspire European, federal and state politicians with our proposals and make a decisive contribution to the consideration of green hydrogen in national and European regulations.

Climate Goals and Ukraine conflict change everything
Driver for RE & green hydrogen in Germany and EU

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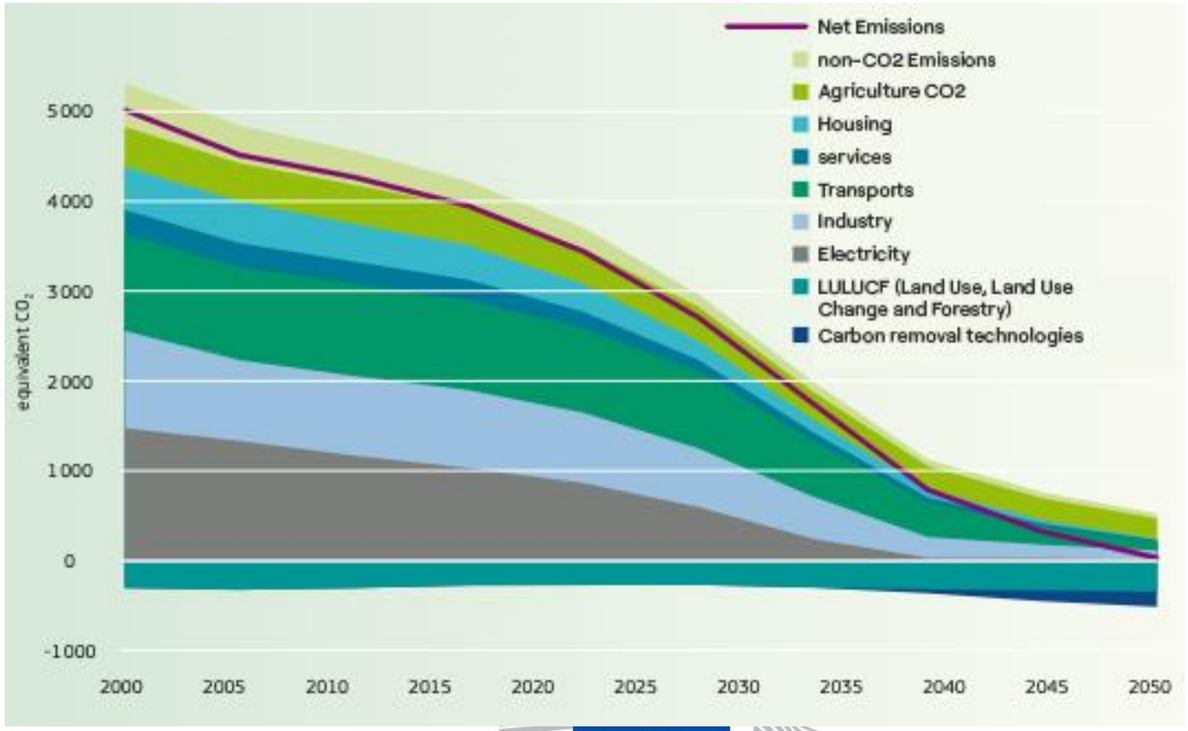

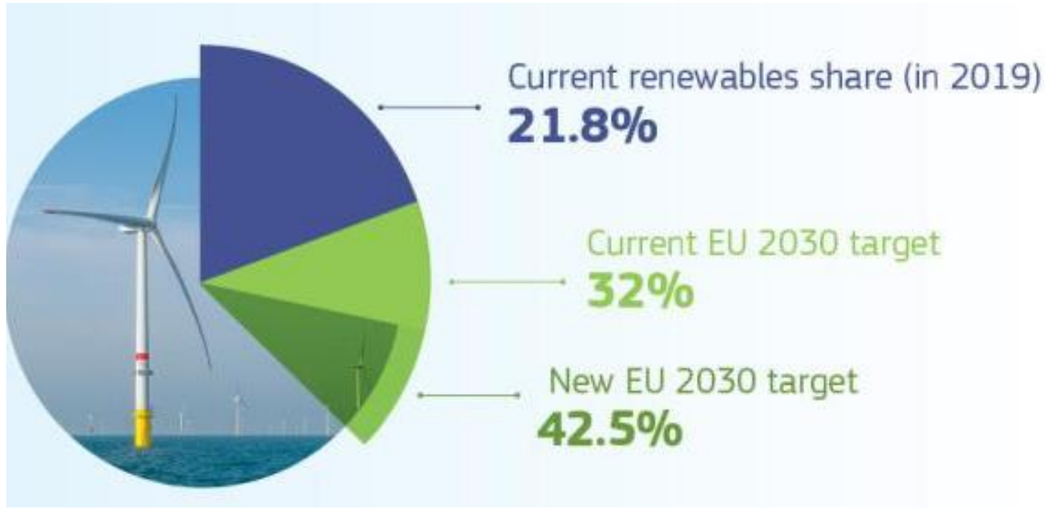

European Commission

REPowerEU: Joint European action for more affordable, secure and sustainable energy

The EU Commission estimates that a 20 million tons of renewable hydrogen could replace 25-50 bcm per year of imported Russian gas by 2030 (10 million tons of imported renewable hydrogen from various sources and 10 million tons more renewable hydrogen produced in Europe.

>250 GW Electrolyser capacity needed in 2030
>500 Mrd. EUR investment by 2030

National Hydrogen Strategy
Selected targets of the NWS

Develop "home market" for hydrogen technologies in Germany and open the way for imports of green hydrogen

The German government sees a green hydrogen demand of about 110 TWh until 2030.

For a secure energy supply, Germany must produce 28 TWh/a of green hydrogen domestically and around 80 TWh/a must be imported by 2030.

To achieve this goal the NWS must address **40 GW, at least 10 GW domestic market and at least 30 GW import market**.

DWV expects Germany's demand for green hydrogen to reach **150 TWh/a in 2030** and over **900 TWh/a in 2045.**

National hydrogen strategy is the guideline for the regulatory framework for the ramp-up of the green hydrogen economy.

Green Hydrogen
Solution for a secure energy supply for all

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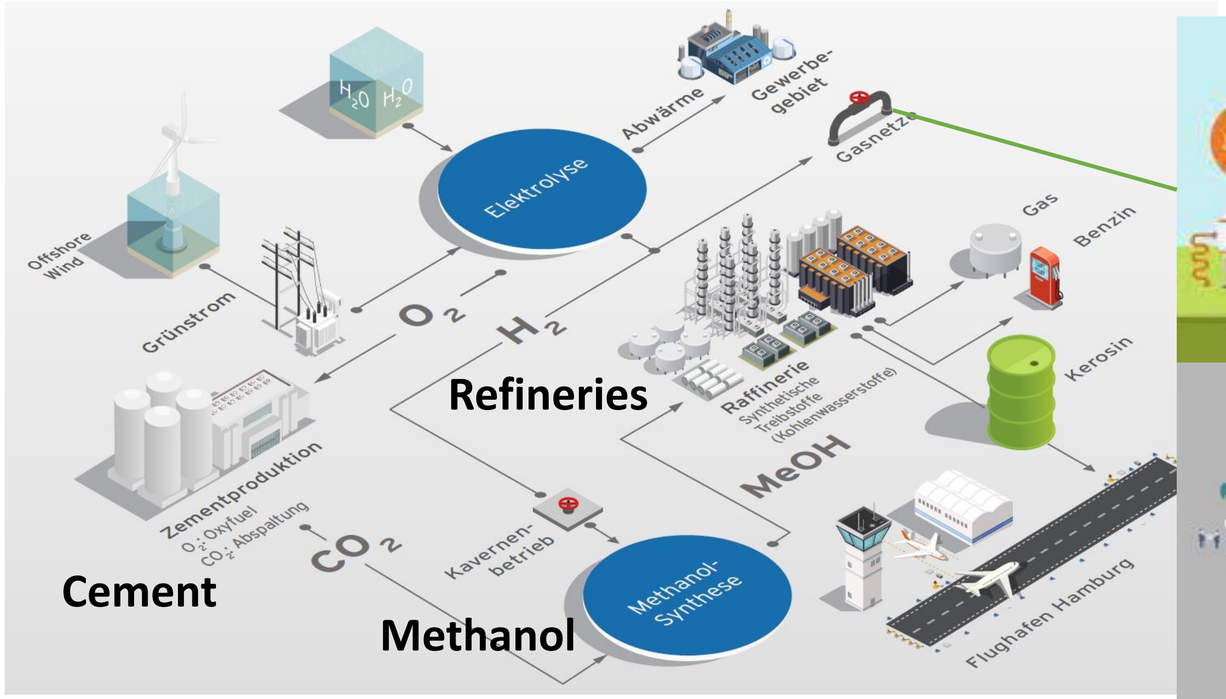

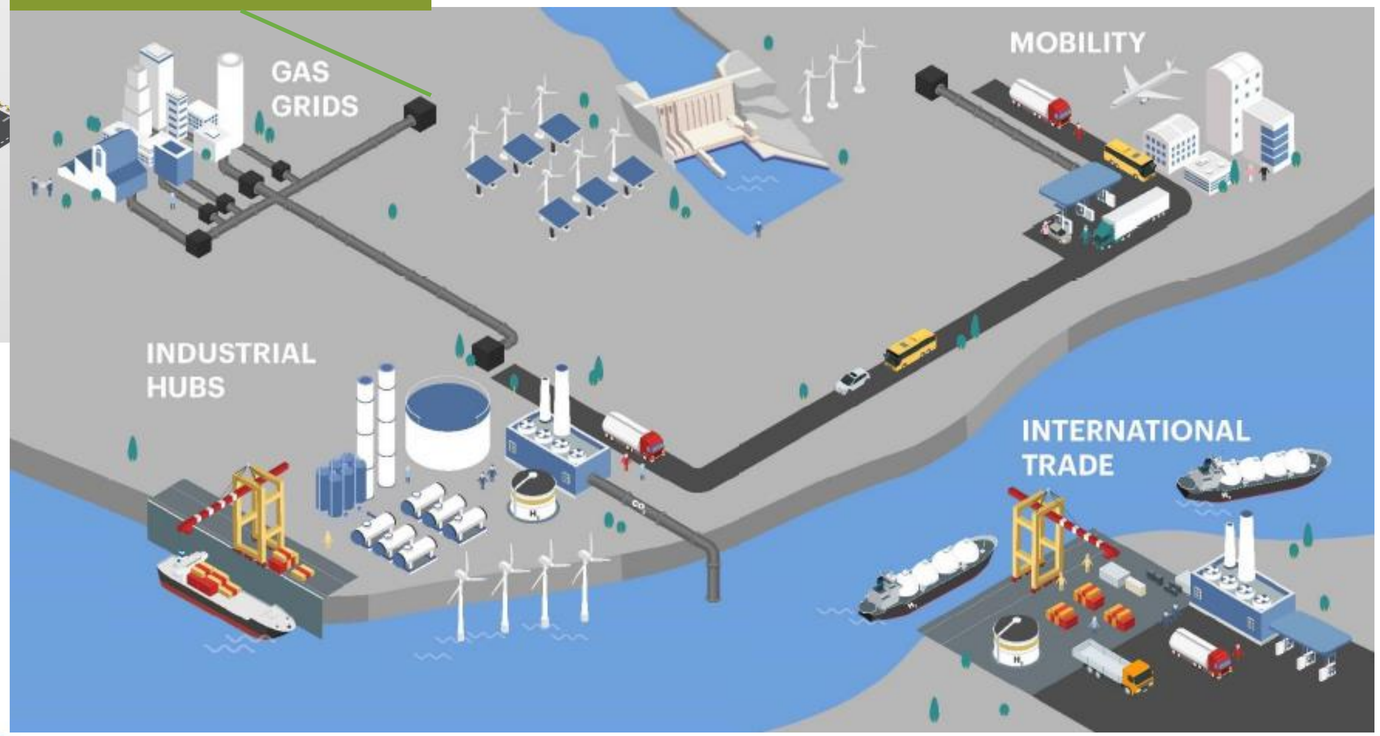

Which sectors need green hydrogen and which technologies are ready for scale?

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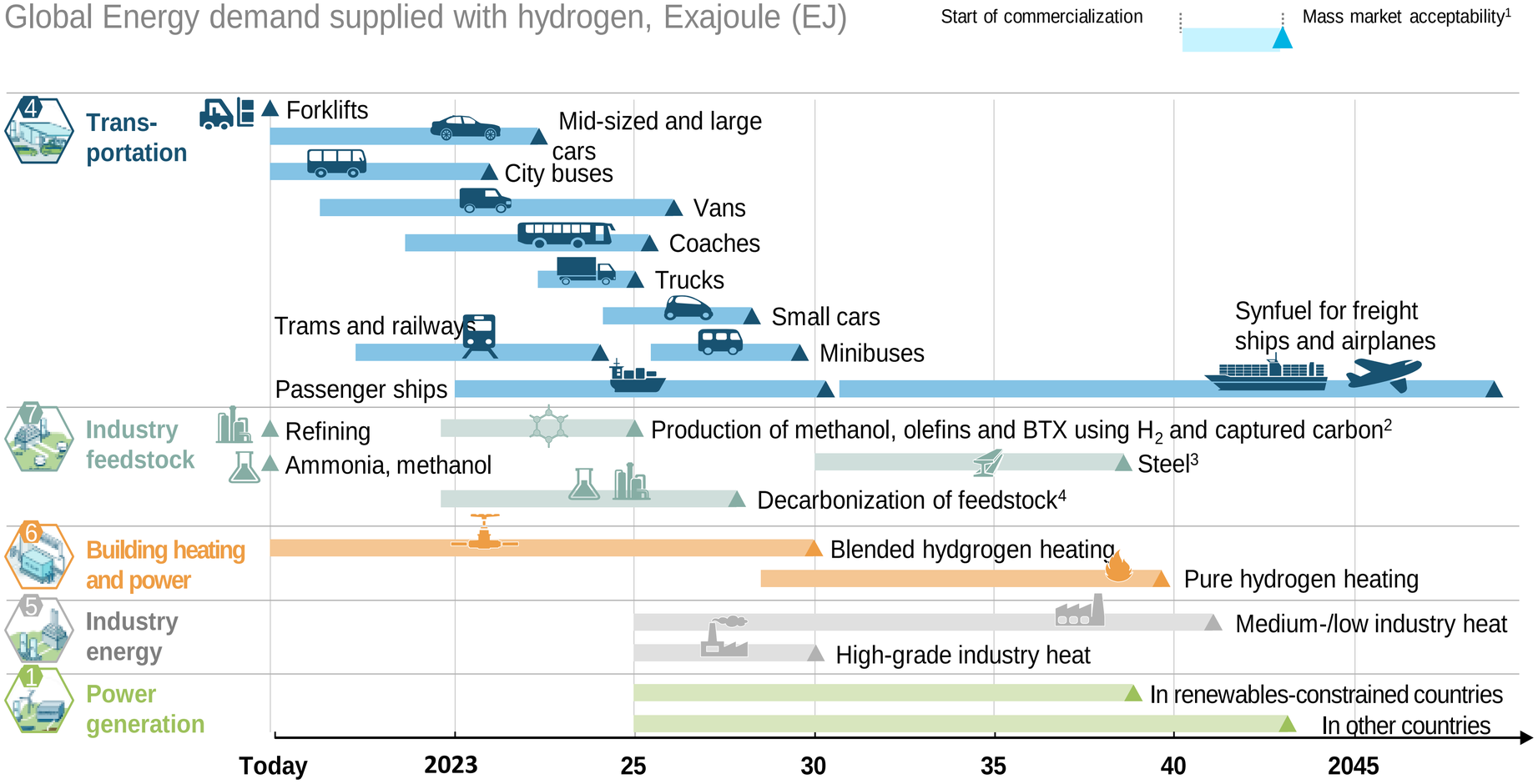
Global Energy demand supplied with hydrogen, Exajoule (EJ)



1 Mass market acceptability defined as sales >1% within segment in priority markets
2 Market share refers to the amount of production that uses hydrogen and captured carbon to replace feedstock
3 DRI with green H_2, iron reduction in blast furnaces and other low-carbon steel making processes using H_2
4 Market share refers to the amount of feedstock that is produced from low-carbon sources

SOURCE: Hydrogen Council

Opportunity for a strong global economic partnership?

Share your Wind and PV resources! Hydrogen makes it possible!

Green Hydrogen gives wind and solar an economic value. Selling solar and wind to the global industrial centers could be an **opportunity for tomorrow's global trade**.

Securing the industrial location
Maintaining value chains

Climate, industrial and geopolitical policies must be considered as a whole.

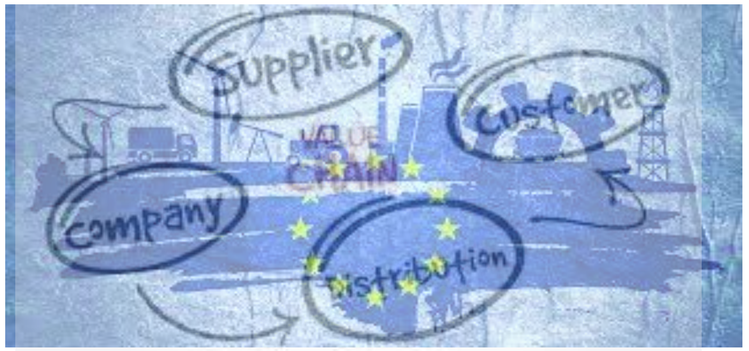
Where, when and how will enough green hydrogen reach the industrial sites?

Derivatives or hydrogen imports?

Production costs are not the dominant variable of tomorrow. The question is rather what green hydrogen or derivatives produced from it will cost when delivered to the consumer?

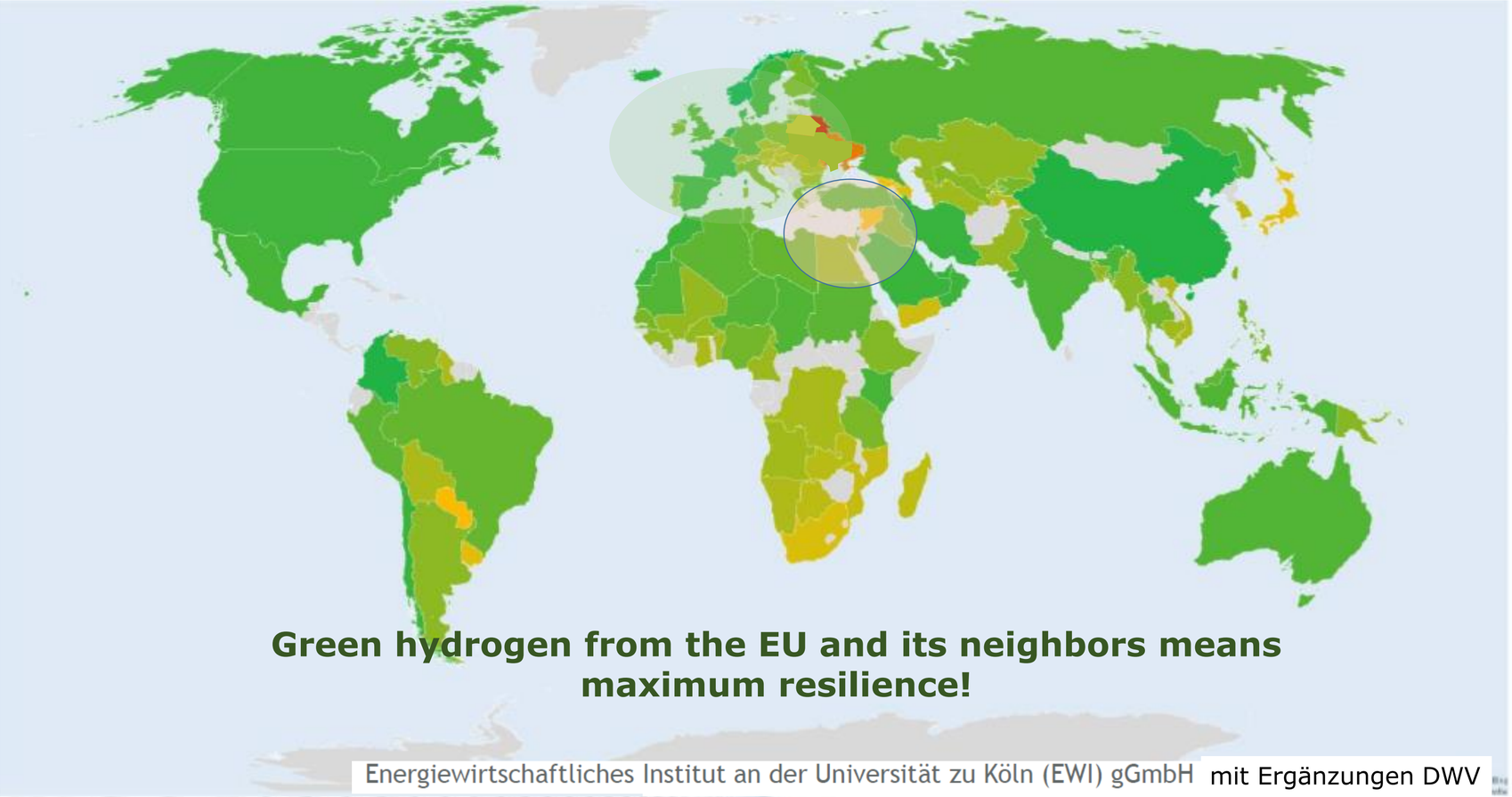
What economic effects and what costs will society incur as a result of the disruption of value chains?

Security of supply is not just an energy supply issue. A resilient supply of all sectors is the basis for prosperity and social justice.



Advantage of a European Green Hydrogen Union

There are many places around the world where green hydrogen production costs are low – lower than fossil energy.



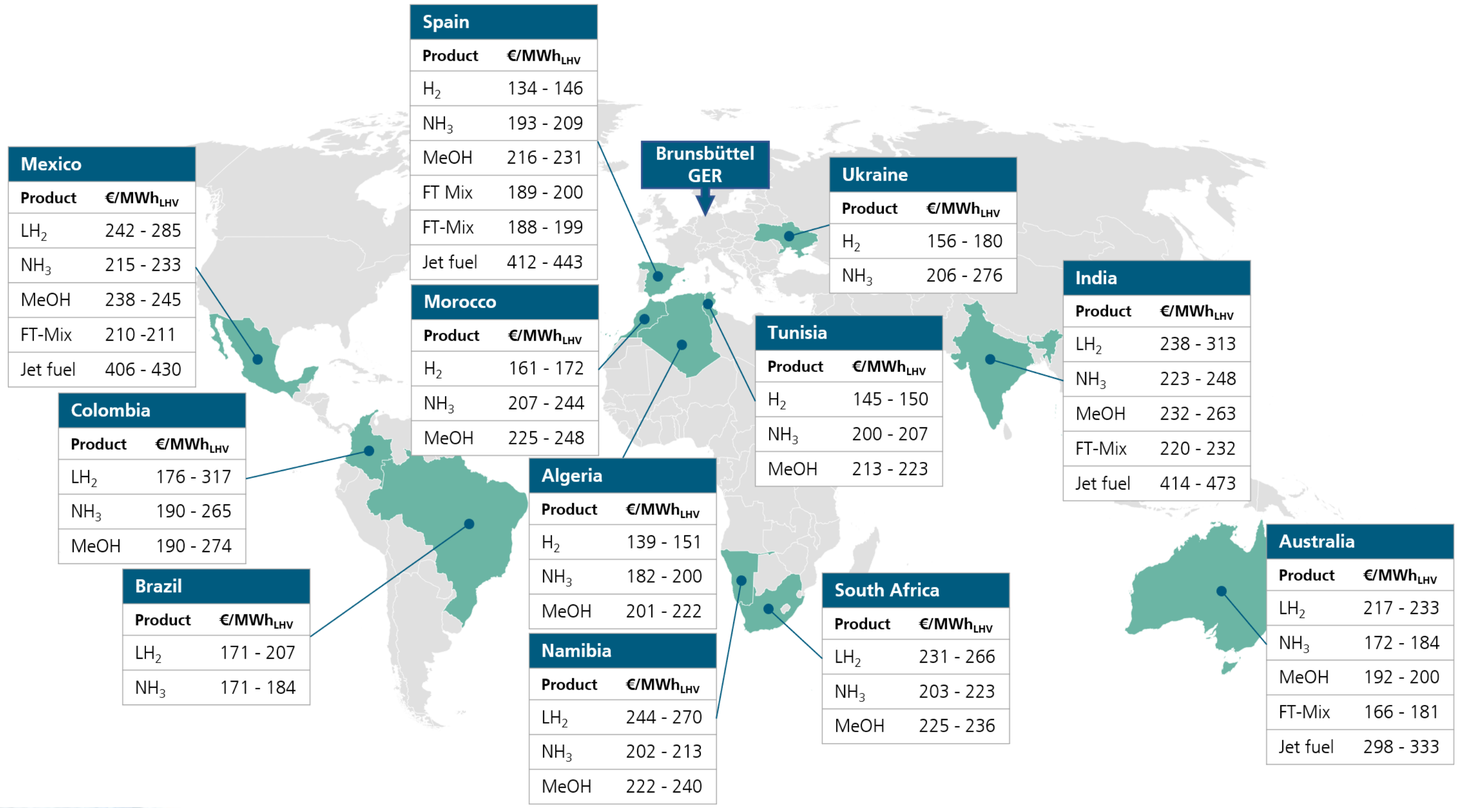
But production costs are not everything!

We need a wider view of this!

- Transport costs
- Sustainability
- Security of supply
- Geopolitical aspects

Hydrogen costs delivered to Germany

- Lowest PtX cost achieved for **countries with high solar and wind full load hours and low capital cost.**
- **Combination of favorable wind and PV potential advantageous** for reasons of high full load hours.
- Total product **transport distance** can have a decisive influence but is **not a knock-out criterion**(e.g. Australia).
- **South- and Eastern Europe, Northern Africa** will become key-players for production and export of gaseous hydrogen transported via the European Hydrogen Pipeline Backbone.
- **South America, Gulf Region, Australia** are becoming the most important players for domestic demand and exports in countries with limited renewable energy potential.



Energy systems - impact on overall efficiency

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In mobility, importing green hydrogen is more efficient than using electricity directly.

Kraftstoffpfade: Strom - Wasserstoff	1: Solarstrom aus Deutschland	2: Wasserstoff aus Nordafrika
Herstellung und Transfer PV Modul pro Jahr (PV Modul aus China, Lebensdauer: 20 Jahre)	250 kWh/kWp/Jahr	250 kWh/kWp/Jahr
Stromerzeugung (PV Strom pro kWpeak)	**1000** kWh/kWp/Jahr	**2000** kWh/kWp/Jahr
Stromtransfer (100 km, PV Anlage zur Ladesäule)	6 kWh/kWp/Jahr	-
Wasserstofferzeugung (Elektrolyse)	-	50 kWh/kg H_2
Wasserstoff Verflüssigung (100 t/Tag)	-	9 kWh/kg H_2
Wasserstofftransport per Schiff (5000 km) inkl. Entladung	-	1,93 kWh/kg H_2
Wasserstofftransport Hafen - Tankstelle (800 km)	-	0,69 kWh/kg H_2
Betankung (CcH_2 / LH_2) / Schnelladen (1 MW)	35 kWh/100km	0,25 kWh/kg H_2
Batteriespeicher an der Ladesäule	nicht bewertet	-
Fahrzeug (Lkw)	140 kWh/100km	7,5 kg H_2/100km
Gesamtenergiebilanz Kraftstoffbereitstellung	**425 km/kWp/Jahr**	**377 km/kWp/Jahr**
Antriebe: Batterie - Brennstoffzelle	**1: Batterie-Lkw**	**2: Wasserstoff-Lkw**
Energieaufwand Fahrzeugantriebsherstellung (Lebensdauer 10 Jahre)	41 kWh/100km (große Batterie!)	20 kWh/100km (Brennstoffzelle + kl. Batterie + LH_2 / CcH_2 Tank)
Gesamtenergiebilanz Kraftstoff & Fahrzeug	**344 km/kWp/Jahr**	**361 km/kWp/Jahr**

Datenquelle: Hynergy, Bildquellen Hynergy, IEA

Pipeline
Backbone of a cost efficiency energy supply

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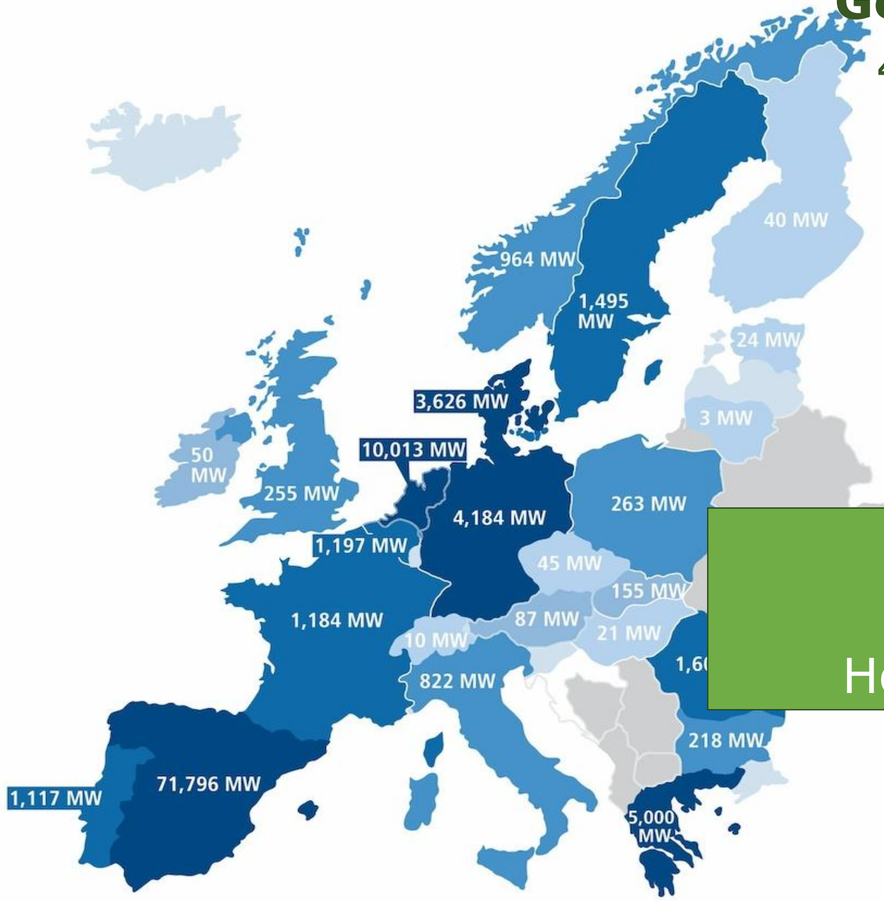
Planned electrolyzer capacity by 2030 (MW)



Notes: Displayed elecrolyzer capacities reflect projects that have an official starting date by 2030. There are numerous other projects with unknown starting dates that could be finished by 2030, but are not included in this analysis

Graphic: ©Solar Promotion GmbH | As of August 2021 | Source: Hydrogen Europe

German import demand 2030

40 GW for 80 Mio. inhabitants

110 TWh/a

REPower EU 2030

125 GW in EU planned

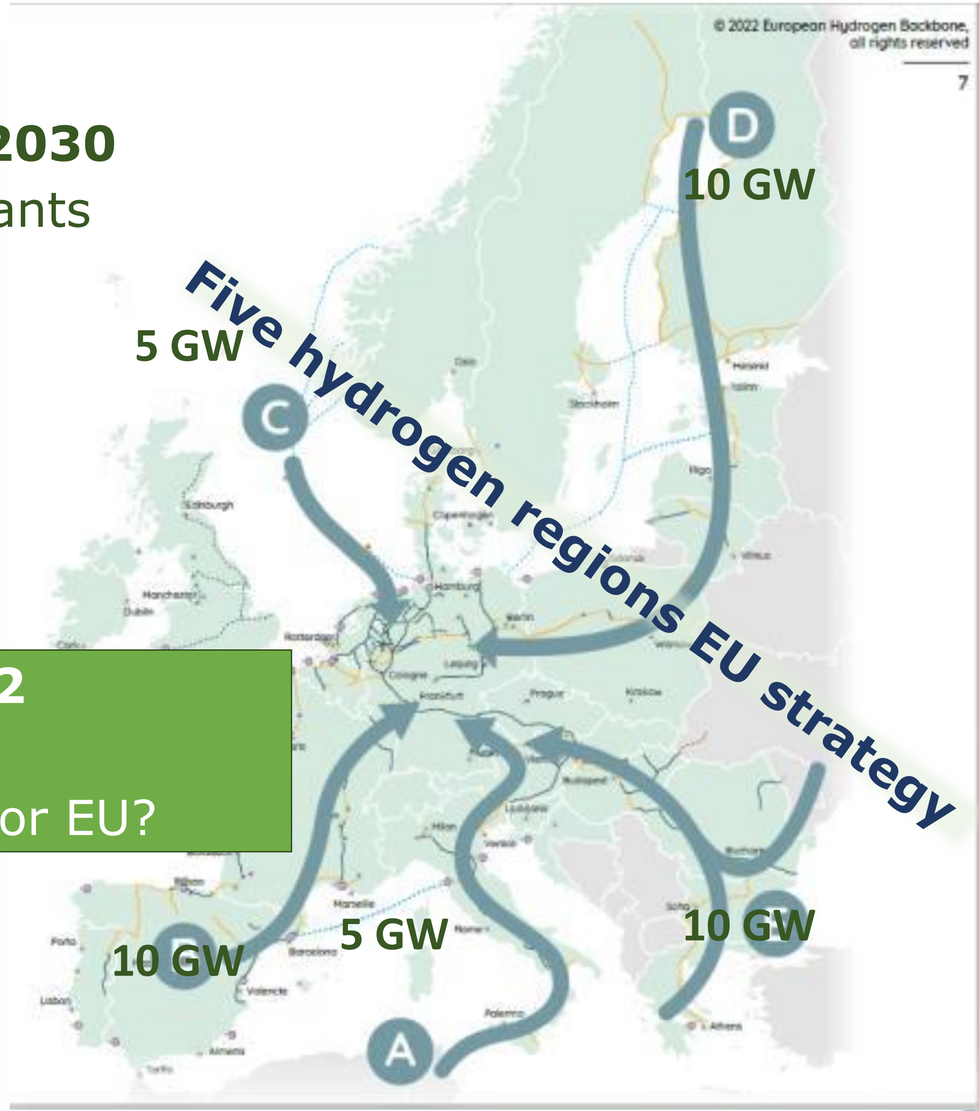
350 TWh/a

448 Mio. inhabitants

Import 10 Mio. to H2

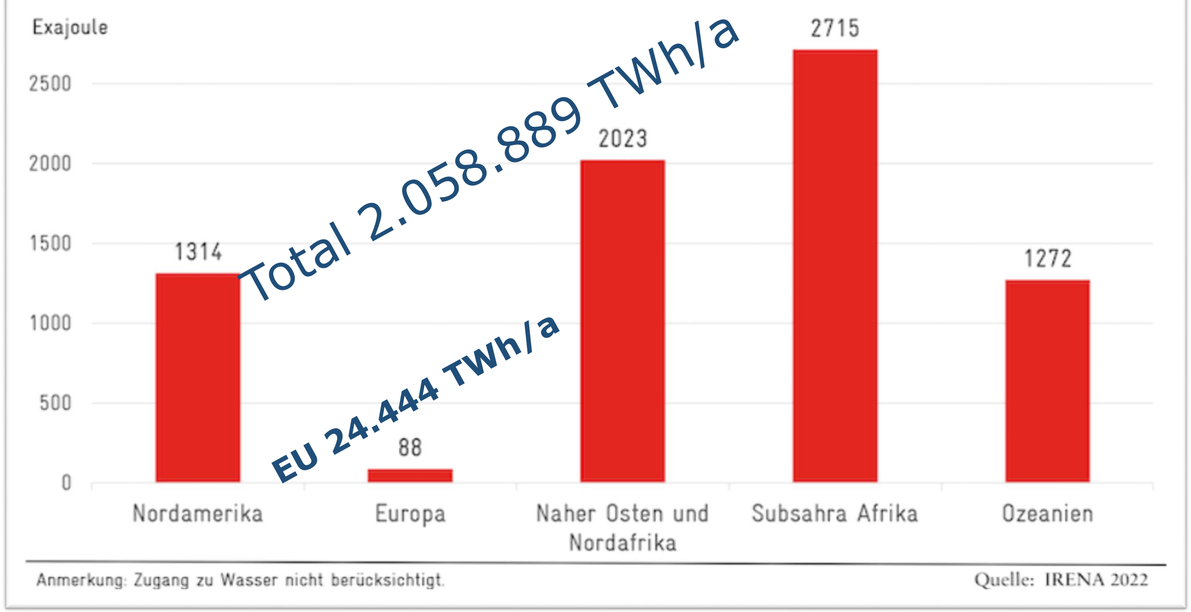
125 GW Electrolyzer

How are the best partners for EU?

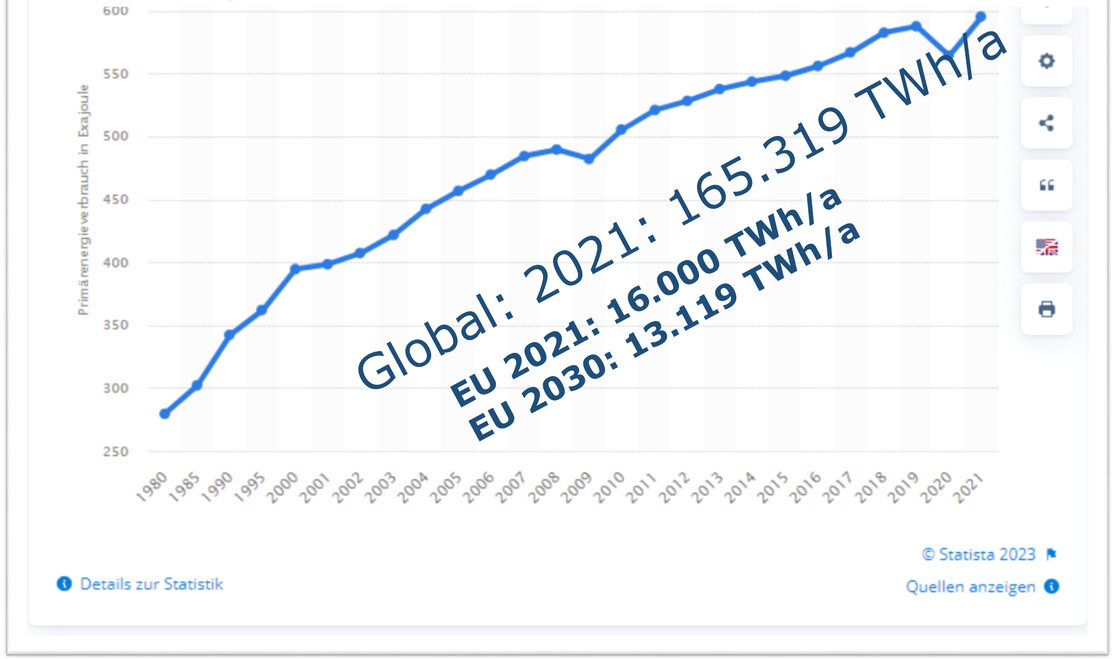


Green hydrogen
Not a rare and expensive commodity!

Technical potential for green hydrogen production below 1.5 USD/kg by 2050



Global primary energy consumption in the years from 1980 to 2021 (in exajoule)



More than 12 times as much energy as currently needed globally could be made available under 0.045 €/kWh* of green hydrogen. All that is needed to tap the potential is the right regulatory framework.

*0,045 €/kWh = 72 €/Barrel Opec-Crude oil

100 €/to CO_2 = 0,026 €/kWh CO_2 Opec-Crude oil

0,045 €/KWh – 0,026 €/kWh = 30 €/Barrel Opec-Crude oil

Kick off for a green hydrogen economy in Europe

H2Global

Best practice model for a market incentive programme!

Kick off for a green hydrogen economy in Germany

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BMWK

Phase I
Non EU countries
900 Mio. EUR
First completion expected in Q1/24

Phase II
Germany
EU countries
Non EU countries

3.530 Mio. EUR

BMVD

Phase A
Germany
EU countries
Non EU countries

1.400 Mio. EUR

BMBF/BMZ

EU countries
Non EU countries

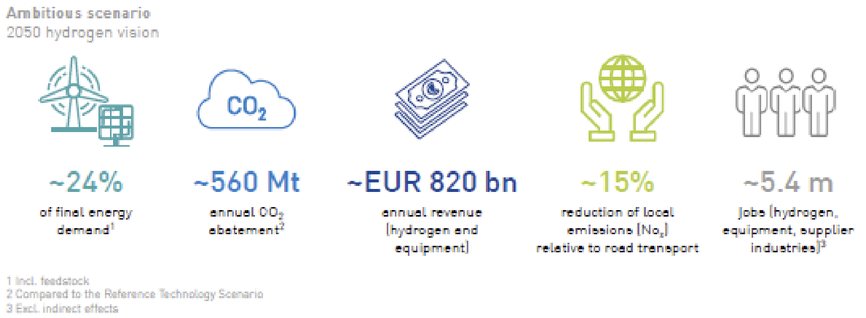
300 Mio. EUR

Best practice for Thailand to push the national hydrogen economy!

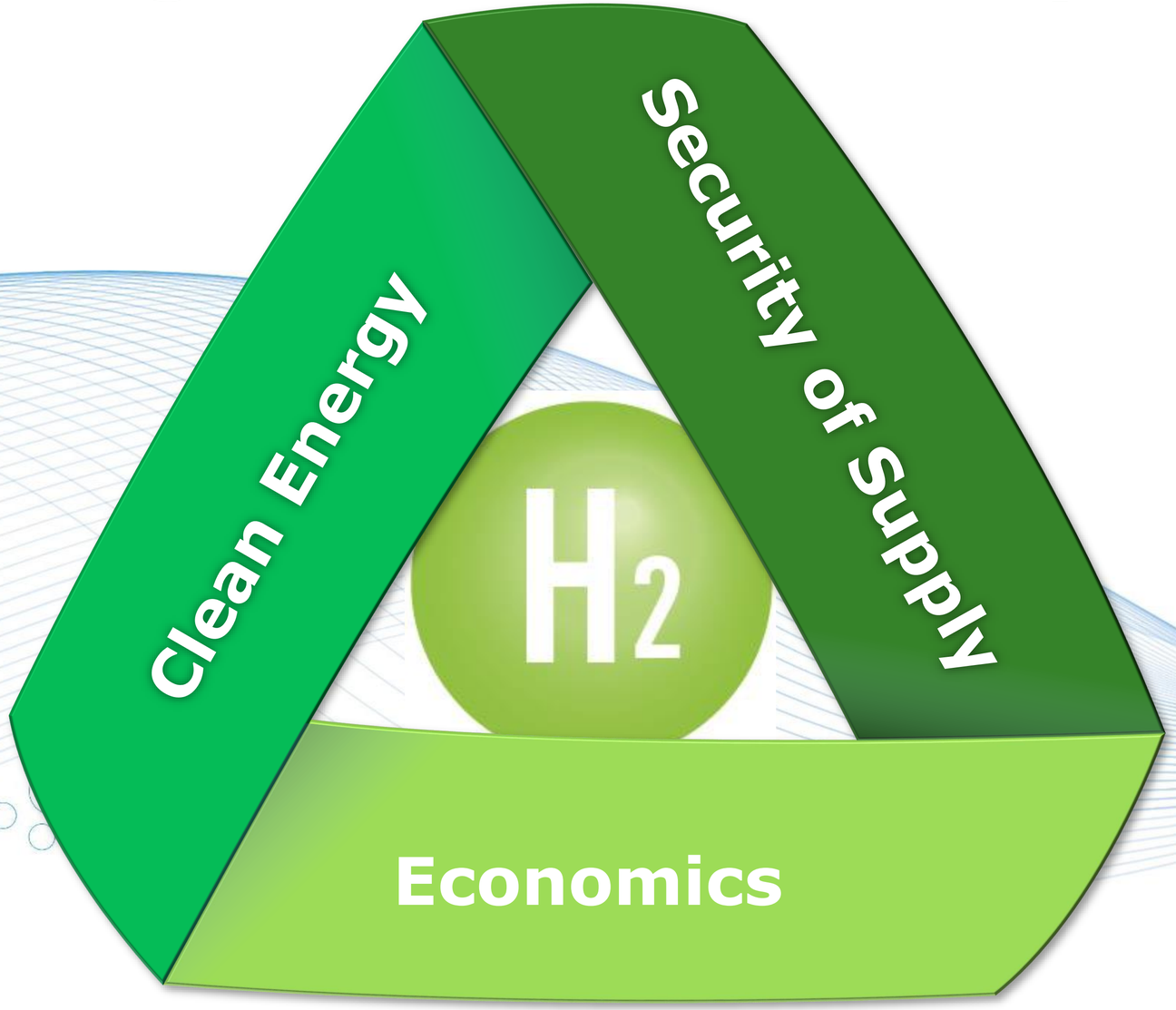
Global market – EU market

Global: The McKinsey study "Hydrogen, Scaling Up" has identified a market potential of more than $2,500 billion for 2050 with over 30 million jobs.

Europe: Hydrogen Roadmap Europe – **Near and middle east?**



Let's start a green hydrogen market economy together now!



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