The German “National Hydrogen Strategy”

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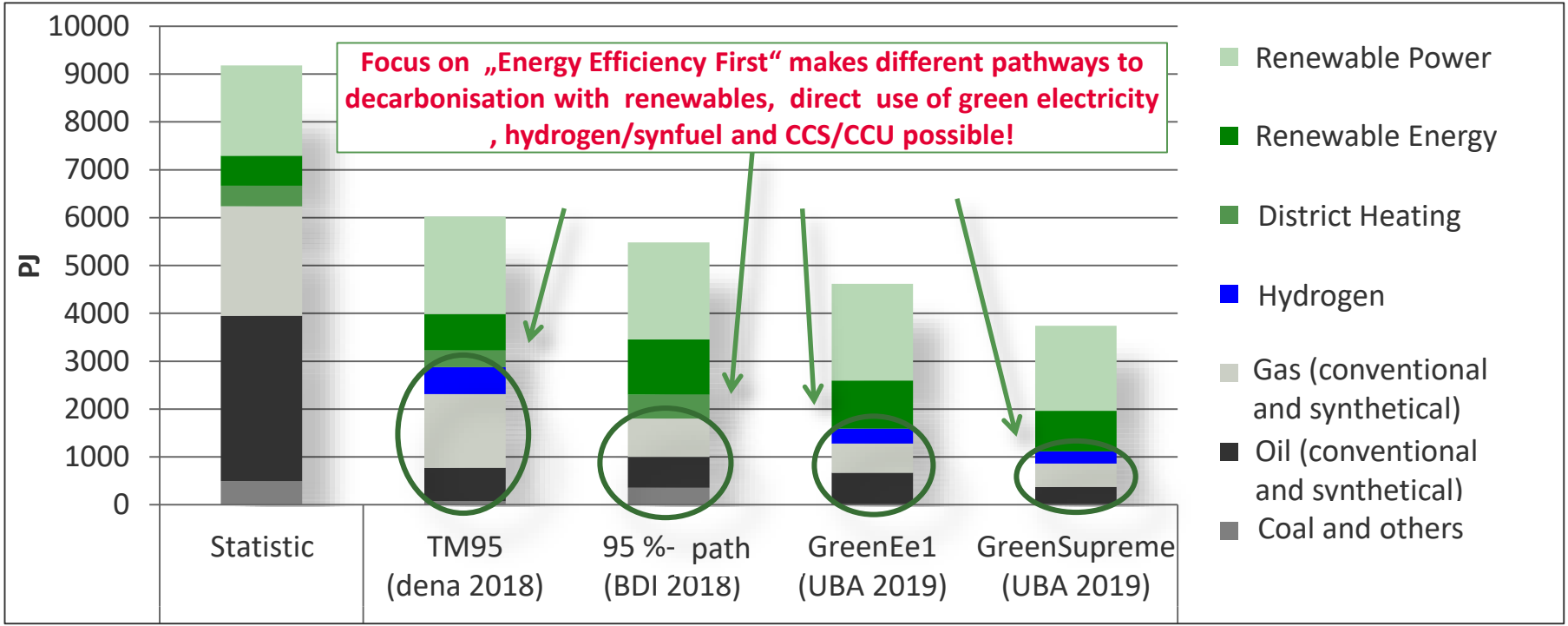
Tokyo, 14. October 2020

Planning for an uncertain future (1)

->the share of H2 oder H2 based synfuels in final energy in Germany (2050) according to respresentative German climate mitigation scenarios

Composition of final demand in decarbonizing scenarios ; 2018 compared to 2050 (in PJ)

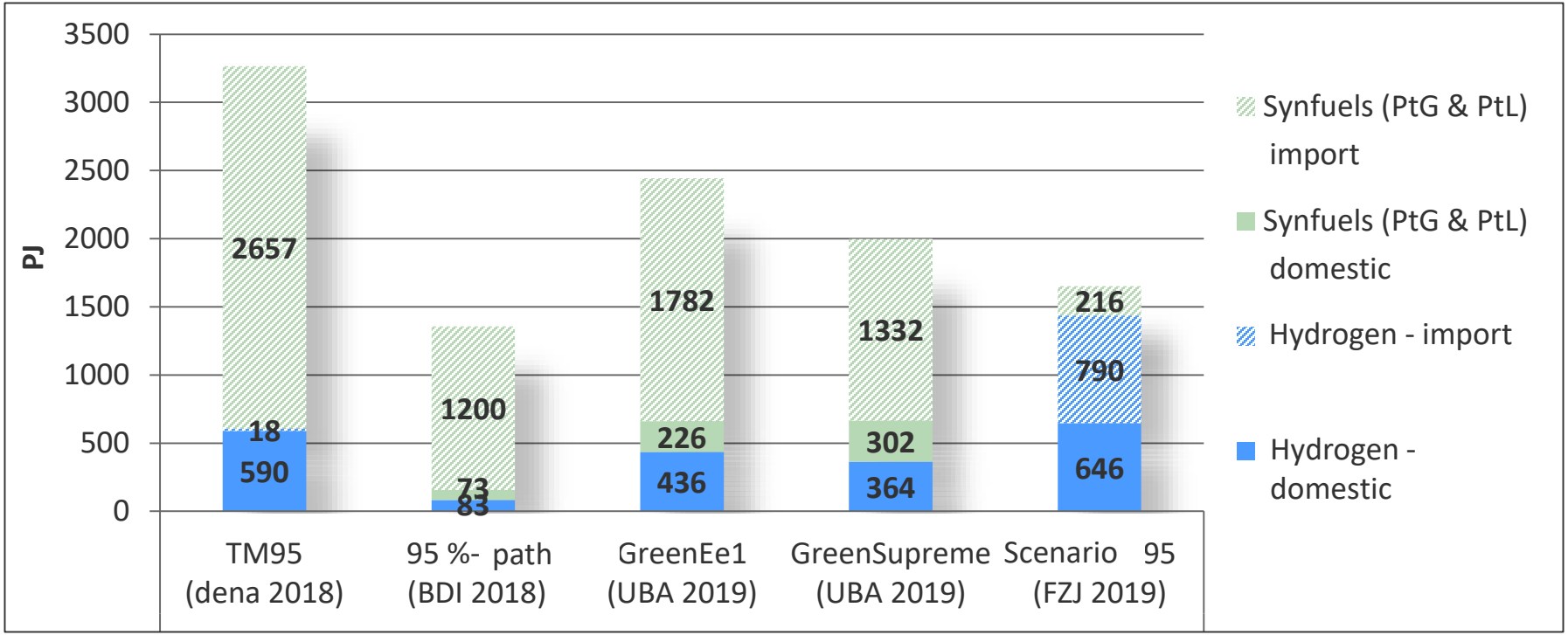


Quelle: Statistik-Daten nach AG Energiebilanzen 2020; Samadi, S., Wuppertal Institute 2020

Planning for an uncertain future (2)

→domestic and imported H2 oder H2 based synfuels in Germany (2050) according to respresentative German climate mitigation scenarios

Demand for domestic or imported hydrogen/synfuels in 2050 (in PJ)



Source: Samadi, S., Wuppertal Institute 2020

German „National Hydrogen Strategy“ (1)

Minister of Economic Affairs Peter Altmaier:
“We want Germany to become number 1 in the world when it comes to hydrogen technologies.”

- **Main facts:**
  - **Green hydrogen**: Blue/Turquoise hydrogen for transition phase
  - Corona Stimulus Package: **7 bn Euros** for German market starting phase, **2 bn Euros** for international partnerships
    (9 bn Euros = 1,100 bnYen)
  - **Sectors**: **Industry** (steel, chemistry, refinery),**Transportation** (bus and train, heavy duty trucks, logistics, also passenger cars), **Heat** (long-term)
  - **Two phase scheme**: Develop a **domestic market** until 2023, after 2023 focus on an **European and international dimension**
  - The **main volume of hydrogen** has to be **imported** (North and Baltic Sea, South Europe, energy partnerships and development collaboration)

Source: Energieagentur.NRW 2020

German „National Hydrogen Strategy“ (2)

- **Domestic market aims:**
  - Electrolysis capacity:
    - **Until 2030**: **5 GW** (for 14 TWh/a green H2, at a total demand of 90 to 110 TWh/a, today 55TWh/a)
    - **Until 2035**: additional **5 GW –** if feasible, at latest 2040
- **Measures (38 in total) – Hydrogen Production:**
  - Seeking to **exclude hydrogen from the feed-in-tariff surcharge**, use **CO2 pricing**, revisit the costs induced by the government
  - Consider **electrolyser** funding and checking new tendering models
  - Examine **cooperation strategies** between electrolysis operators and power/gas grid operators
  - Regulatory basis for the **repurposing and expansion of a hydrogen infrastructure** will be prepared

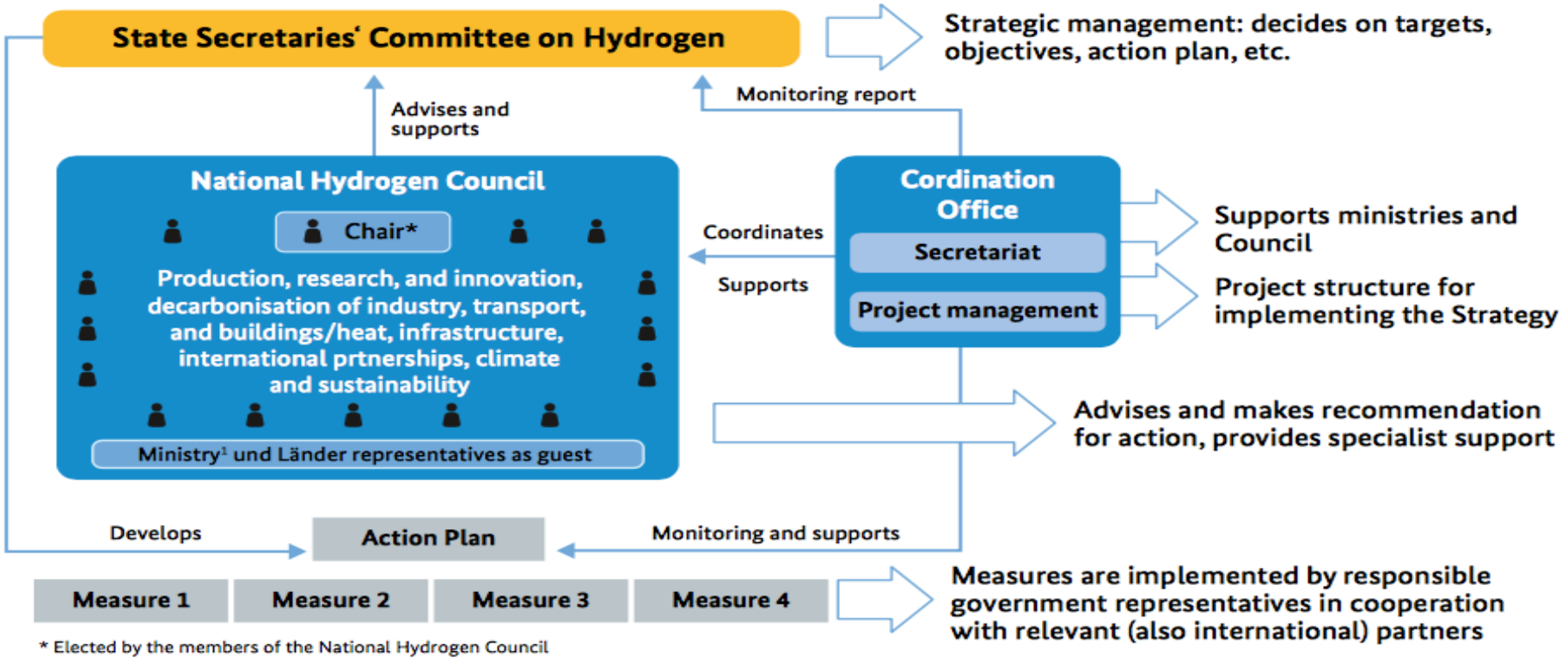
Source: Energieagentur.NRW 2020

German „National Hydrogen Strategy“ (3)

- **Measures – Transport:**
  - **Vehicles and refuelling** (until 2023, for low emission drive trains):7 bn Euros for passenger, heavy duty vehicles, buses and related refuelling infrastructure
  - Extension **H2 refuelling stations** for street, rails, waterways
  - **NIP** and „**Hyland -** Hydrogen regions in Germany“ (continuation planned)
  - Implementation of **RED II**: 2 GW electrolysis for refineries (goal)
    2% green kerosene by 2030 (consideration)
- **Measures – Industry:**
  - Steel/Chemistry: Supporting investments, **carbon contracts for difference** and **demand quota**
- **Measures – International:**
  - Integration of **hydrogen into existing energy partnerships** and the establishment of **new partnerships** with strategic exporting and importing countries

Source: Energieagentur.NRW 2020

Steering the „National Hydrogen Strategy“:
The Governance Structure



* Elected by the members of the National Hydrogen Council
[1] e.g at Director-General level

Source: BMWi 2020 „The National Hydrogen Strategy“

European Union Hydrogen Strategy (July 2020)

Vice President EU Commission Frans Timmermans:
"In developing and implementing a clean hydrogen value chain, Europe will be a front runner and maintain its leading position in the field of clean technologies."

- **Mainfacts:**
  - **Green Hydrogen**, however, in the short and medium term, other forms of **low carbon hydrogen** are needed
  - **1st phase by 2024**: At least **6 GW** of renewable hydrogen electrolysers in the EU and up to **1 million tonnes** of renewable hydrogen
  - **2nd phase by 2030: 40 GW** of renewable hydrogen electrolysers and the production of up to **10 million tonnes** of renewable hydrogen; reaching cost-competitiveness of renewable hydrogen
  - **3rd phase by 2030 to 2050**: renewable hydrogen technologies should be mature and deployed on a large scale in all sectors

Source: Energieagentur.NRW 2020

The perspective of industry (e.g. thyssenkrupp)

Why is green hydrogen not yet big business?

Until now – decentral small units only

- most green hydrogen projects are decentral with small (max single MW) electrolysis units
- green hydrogen pilots focused mainly on supply of hydrogen for mobility
- but, mobility will take time to pick up and relevant markets have not been addressed yet

→ small scale electrolyzer equipment without equipment scale effect

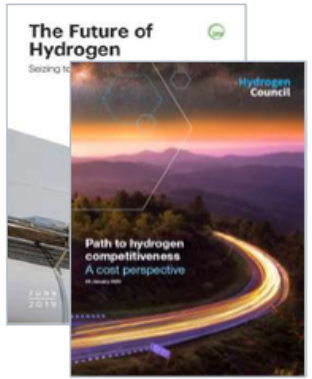
→ no feasible business cases available → no scale up of supply chain

Hydrogen cost are still too high!

But, We need green hydrogen < 2€/kg

to reduce cost of green hydrogen we need:

- large scale equipment
- high efficiency equipment
- large scale supply chains



We need central / industrial applications!

Source: thyssenkrupp Green Hydrogen 2020

The perspective of the industry

Global cost degression of power from PV (and wind)

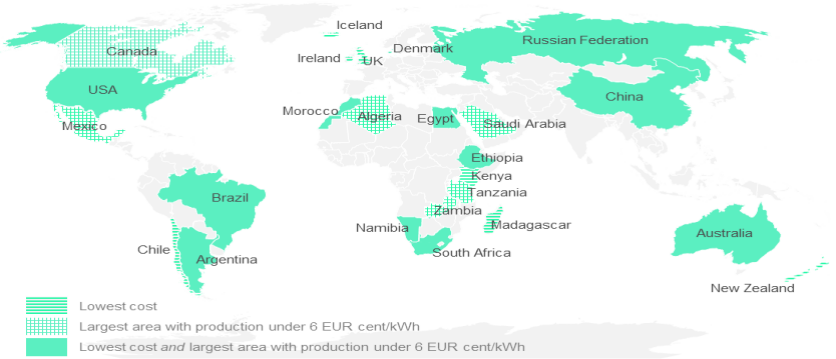
Source: thyssenkrupp Green Hydrogen 2020

GJETC: Comparing Germany and Japan

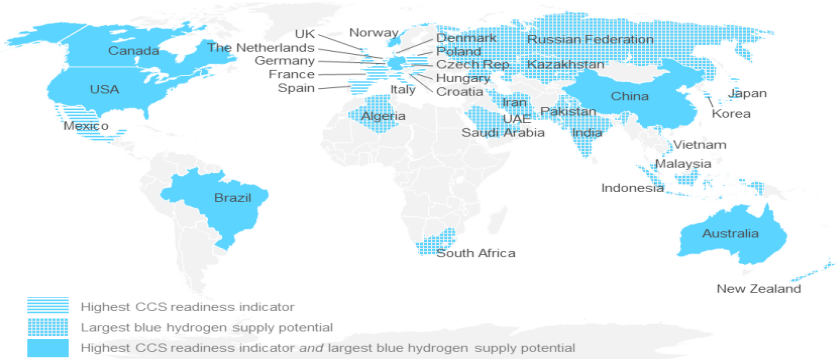
Potential partner countries

Country	Shared characteristics
Canada, US, Australia, China	Likely future blue and green hydrogen producers and technology providers
Saudi Arabia, Russia	Resource-rich countries with potential of both blue and green hydrogen production
Peru, Iceland, Ethiopia	Potential supplier of low-cost green hydrogen; no incentive to use hydrogen domestically, enabling green hydrogen export
Ireland, Chile, UK	Potential supplier of low-cost green hydrogen; a need to enhance energy self-sufficiency, thus likely facing competition between domestic consumption and export of green hydrogen
Netherlands, UK, Switzerland, France, Germany, Spain, Portugal, Israel, Italy, Belgium, Korea, Japan	Potential demand for low-carbon hydrogen; high-income, high dependence on primary energy imports, and likely future users with technology competence

Potential green hydrogen producers



Potential blue hydrogen producers



Source: adelphi, Wuppertal Institute, dena, IEEJ 2019

GJETC: green, blue and grey hydrogen

Criteria for sustainable and low-carbon hydrogen

Criteria for further development

- Minimum level of GHG emissions reduction
  - For green H_2: Electricity demand and additionality of renewables
  - For blue H_2: Sustainability of CC(U)S
- Product lify cycle coverage
- Sustainable water usage
- Sustainable land use
- Sustainable social and economic impacts

Existing certification schemes (e.g. EU CertifHy) do not fully cover these criteria

Sustainability criteria	EU Guarantees of Origin Scheme by CertifHy	Suggestions for future certification scheme
1. GHG balance	At least 60% compared to hydrogen produced by natural gas	At least 60-75% compared to natural gas or conventional hydrogen, depending on use; constant monitoring of technology and market development for respective tightening of thresholds over time
2. Life cycle of the hydrogen production chain covered	Only production	Production, transport, storage of hydrogen (also of natural gas); for use in fuel cells/transport, also including the use
3. Energy source / definition of clean hydrogen	Green and blue hydrogen	Green and blue hydrogen meeting the criteria
4. Additionality of renewable electricity generation	-	Criteria and monitoring processes for GoO (details tbd)
5. CCUS for blue H_2	-	Special sustainability criteria (details tbd)
6. Water demand	-	Additional disclosure of information on water use in GoO
7. Land use	-	Additional disclosure of information on (sustainable) land use in GoO
8. Social impacts	-	Involvement of local actors, additional investment and reduction of poverty (details tbd)

GJETC: certification scheme for clean hydrogen

Adequate criteria for blue and green H_2

a) Potential specific GHG emission threshold level for internationally traded clean H_2

- Blue hydrogen production could be achieved with GHG emissions as low as ca. **20 gCO_{2eq}/MJ_{H2}** (Green hydrogen production is assumed to be 0 gCO_{2eq}/MJ_{H2})
- The extra GHG emissions allowed for transport to the border gate should not exceed **10g CO_{2eq}/MJ_{H2}**
- => Potential maximum threshold level of specific GHG emissions until border gate **of 30g CO_{2eq}/MJ_{H2}**

b) Potential well-to-wheel GHG reductions and corresponding specific GHG emissions requirements for clean hydrogen

- Case 1: Uses, in which green or blue hydrogen replaces fossil fuels in the same combustion technology or process.
- Case 2: Using green or blue hydrogen as a feedstock.
- Case 3: Uses in transport or other sectors, in which fuel cells are replacing internal combustion engines or combustion turbines.

Thank you for your attention

Please visit our website

http://www.gjetc.org/