

How green hydrogen imports from Canada can support Germany's energy transition

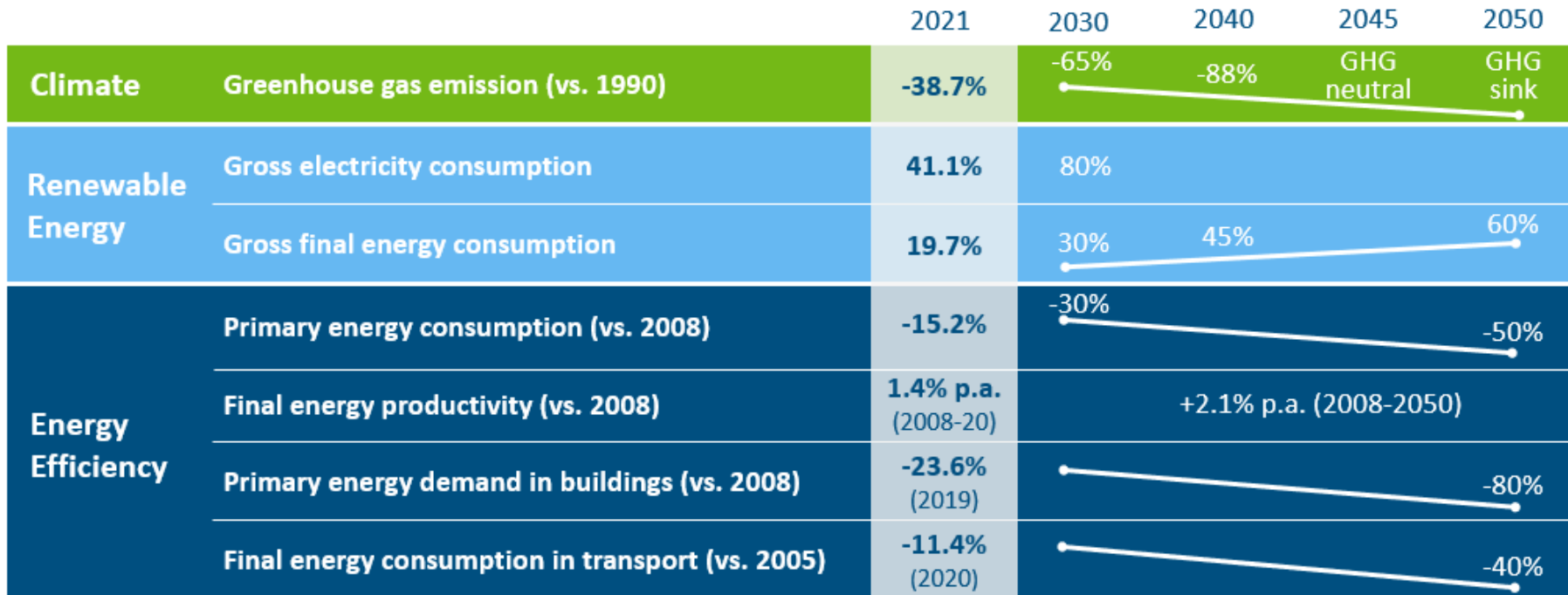
Prepared by adelphi on behalf of the Federal Ministry for Economic Affairs and Climate Action



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Germany's ambitious climate & energy goals

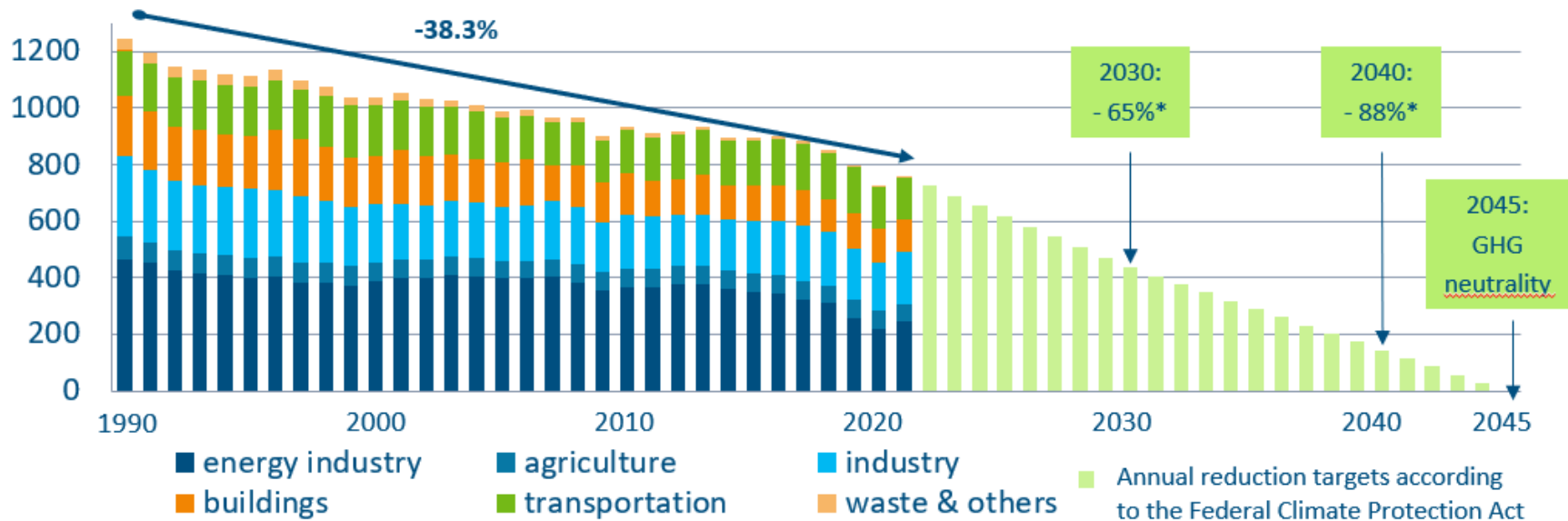


Source: Guidehouse 2022 based on Agora Energiewende 2022, UBA 2022 & BMWK 2021

Germany has cut its GHG emissions by 38%...

But more action is needed, especially in hard-to-abate sectors

Greenhouse gas emissions and reduction targets in Germany

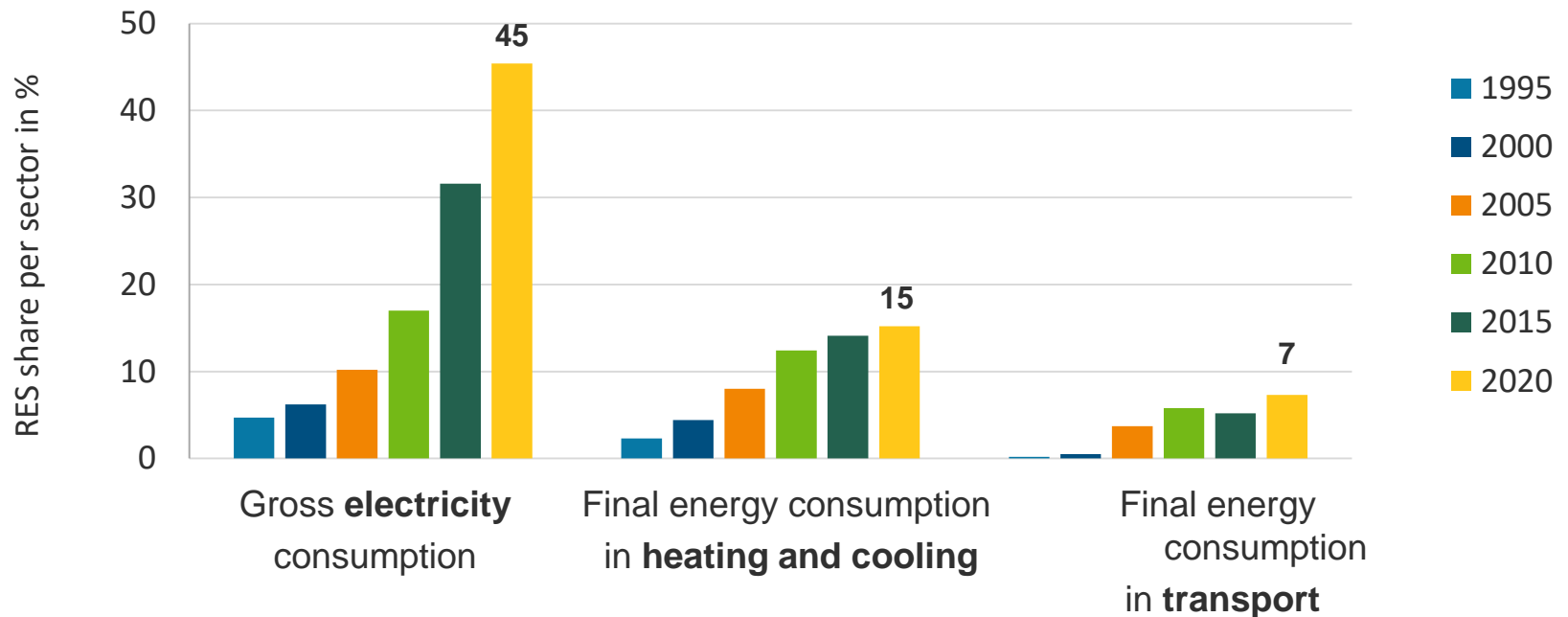


*Greenhouse gas reduction compared to 1990

Source: Guidehouse 2022 based on BMWK 2022, UBA 2021 & Agora Energiewende 2021

...based on massive growth of renewables

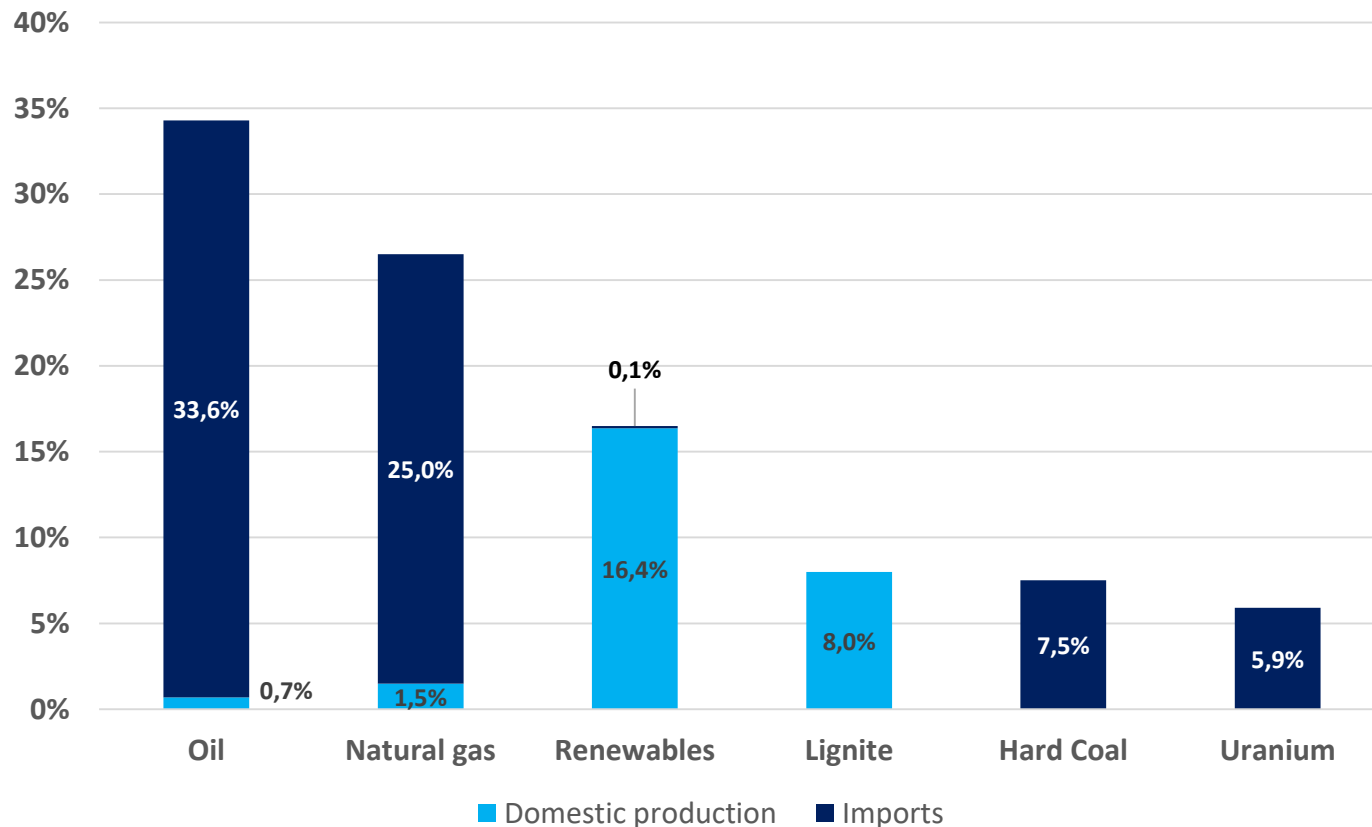
Share of renewable energy sources (RES) per sector in Germany



Source: Guidehouse 2021 based on BMWK 2020 & AGEE-Stat 2016

Today, Germany still relies on fossil energy imports

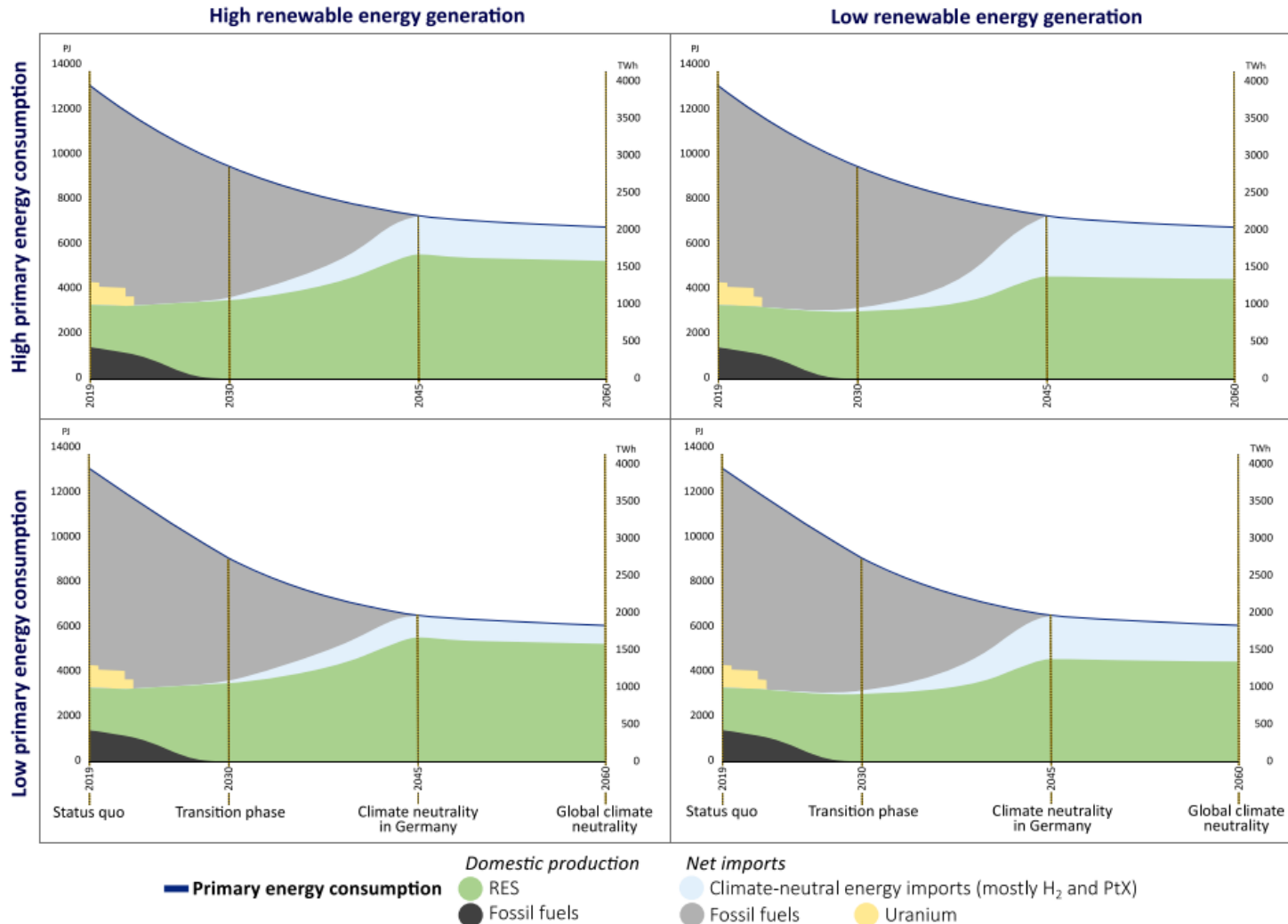
Imports / domestic production as share of total primary energy consumption, 2020



Note: The overall share of renewables is much higher than these values when looking at final, instead of primary energy consumption.

Source: German Environment Agency, based on data AG Energiebilanzen (2021)

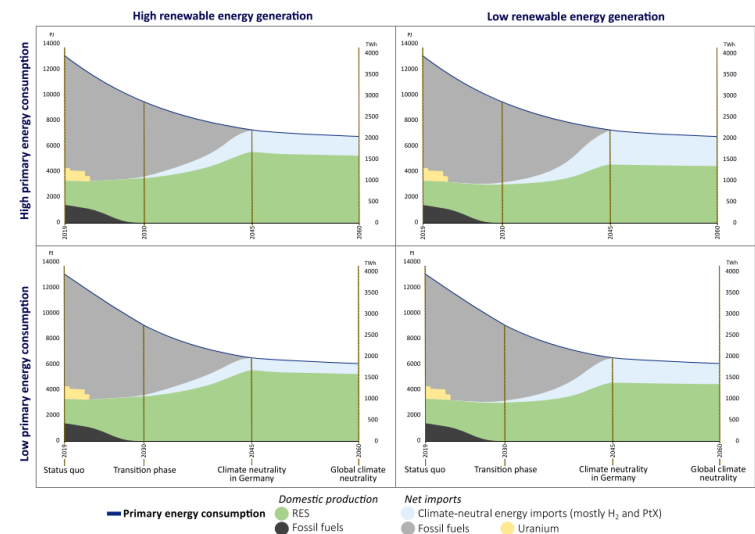
The energy transition will strongly reduce, but not eliminate Germany's import needs (1/2)



Source: adelphi/PIK/Fraunhofer IEG 2021 (Ariadne-Analyse)

The energy transition will strongly reduce, but not eliminate Germany's import needs (2/2)

- All climate neutrality scenarios show a massive reduction of energy import needs, thanks to energy savings, energy efficiency and domestic renewables.
- Depending on the scenarios, energy imports fall to between 17% and 40% of primary energy consumption by 2045, compared to 75% in 2019
- This corresponds to renewable energy imports of 305 to 800 TWh/y for Germany in 2045, the target year for reaching climate neutrality
- These imports will to a large extent consist of hydrogen or hydrogen-based derivative products (e.g. synthetic fuels)



Green hydrogen for Germany's Energiewende

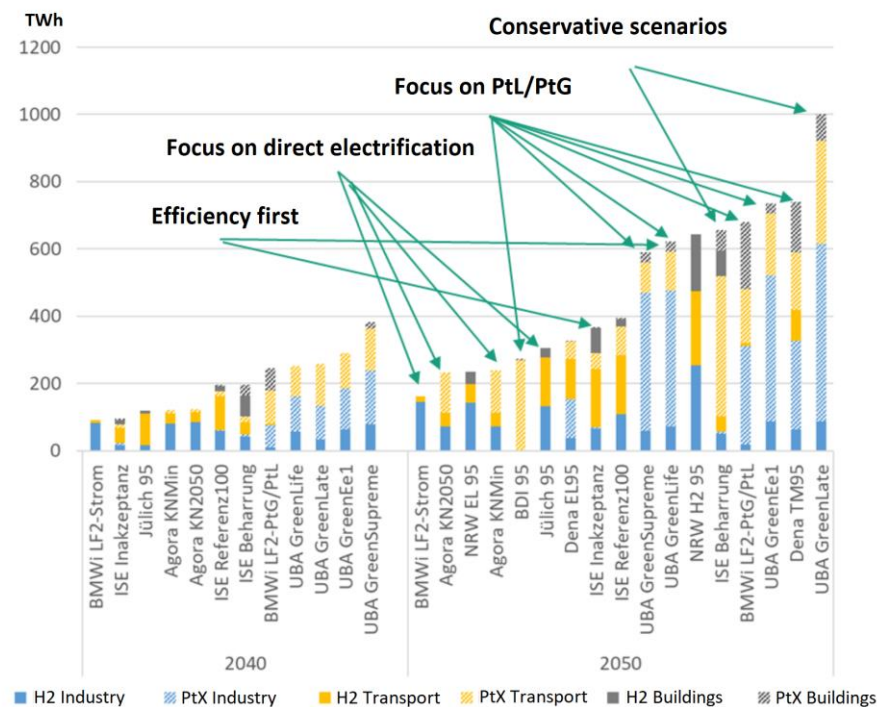
- Status quo in Germany: 55 TWh of annual hydrogen demand, mainly for ammonia and methanol production. Nearly all of it is grey hydrogen (from methane, without CCS).
- In 2020, Germany released its National Hydrogen Strategy, identifying **green hydrogen as key in its energy transition.**
- Hydrogen to be **used primarily in hard-to-abate sectors** such as steel and chemicals, maritime transport and aviation, and for seasonal electricity storage.
- In other sectors (road transport, low temperature heating), direct electrification and direct use of renewables are more efficient.
- Domestic electrolysis target was increased by new Federal Government from 5 to 10 GW by 2030, **Hydrogen Strategy to be updated later in 2022.**



Future hydrogen demand in Germany

- GER government forecast: hydrogen demand in 2030 at 90-110 TWh (2.7-3.3 Mt). With 10 GW of domestic production, a gap remains of **70-75% hydrogen to be imported by 2030**.
- Meta-analysis¹ of National Hydrogen Council finds GER's projected demand for hydrogen and synthetic fuels in a range of **400-800 TWh/y by 2050** in most scenarios (excluding extreme outliers).
- Average of scenarios' projections for hydrogen (without synthetic fuels) share in final energy demand: 4.5% in 2040, 10.8% in 2050.
- To meet this demand, Germany will – due to its limited RE potential and high population density – have to rely largely on hydrogen imports² – likely becoming **the EU's largest hydrogen importer in the future**.³

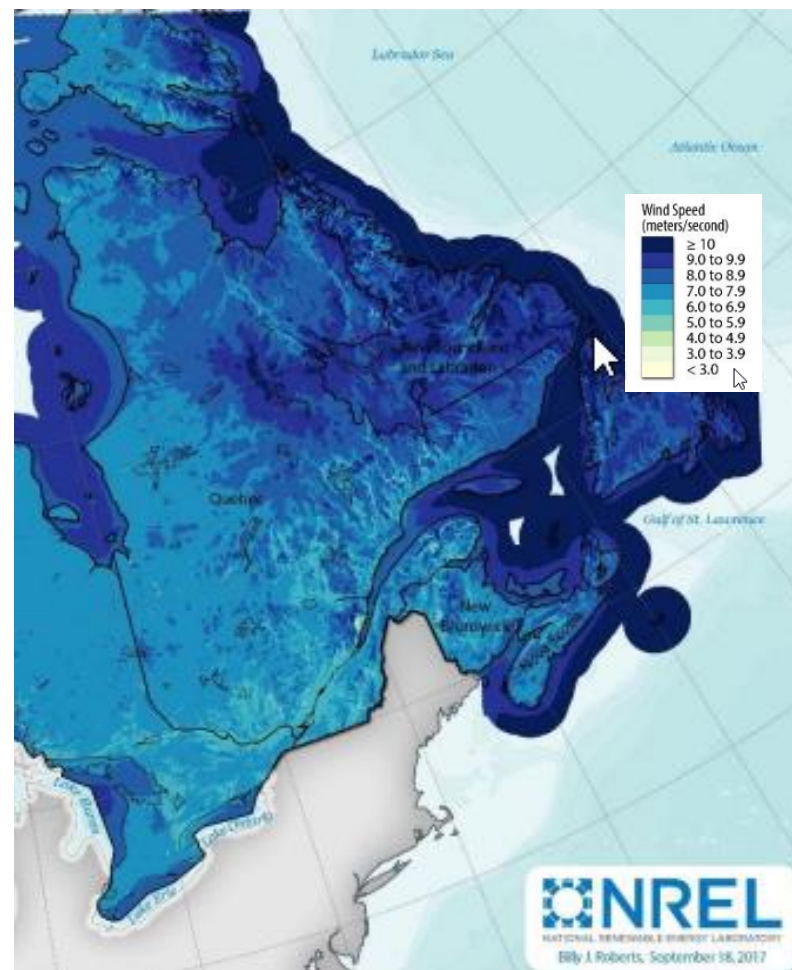
Germany's demand for hydrogen and synthetic fuels by sector (Wietschel et al. 2021)



Source: Wietschel et al. (2021): Metastudie Wasserstoff – Auswertung von Energiesystemstudien. Studie im Auftrag des Nationalen Wasserstoffrats. Karlsruhe, Freiburg, Cottbus: Fraunhofer ISI, Fraunhofer ISE, Fraunhofer IEG (Hrsg.).

Canada's potential and strengths

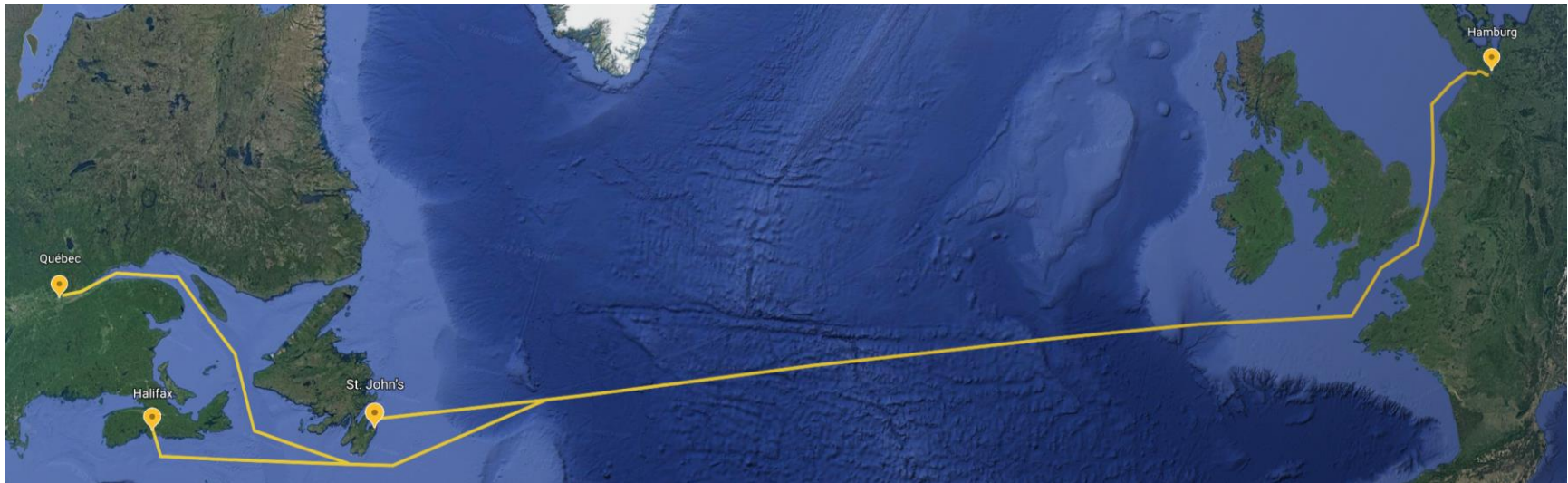
- For geographical reasons, Germany focuses particularly on Eastern Canada as a hydrogen partner
- **Eastern Canada's renewable energy potential largely exceeds its own energy needs**, especially in the Atlantic provinces, with large hydropower capacities and enormous low cost wind potential⁴.
- This potential could be harnessed for domestic decarbonisation and to **produce green hydrogen** and export it to Europe.
- **Eastern Canada's strengths:**
 - Electricity mix already largely renewable
 - Technology leadership, skilled workforce
 - Low cost of renewables deployment thanks to world class resources, low capital costs, good infrastructure, effective administration and governance
 - Opportunity for Germany to diversify its future hydrogen import sources
 - Reliable democratic partner, reduced geopolitical risks for Germany and Europe



NREL 2017: Wind Resource Data, Tools, and Maps.

So far and yet so close

Germans often do not realize that Eastern Canada is at a relatively close shipping distance

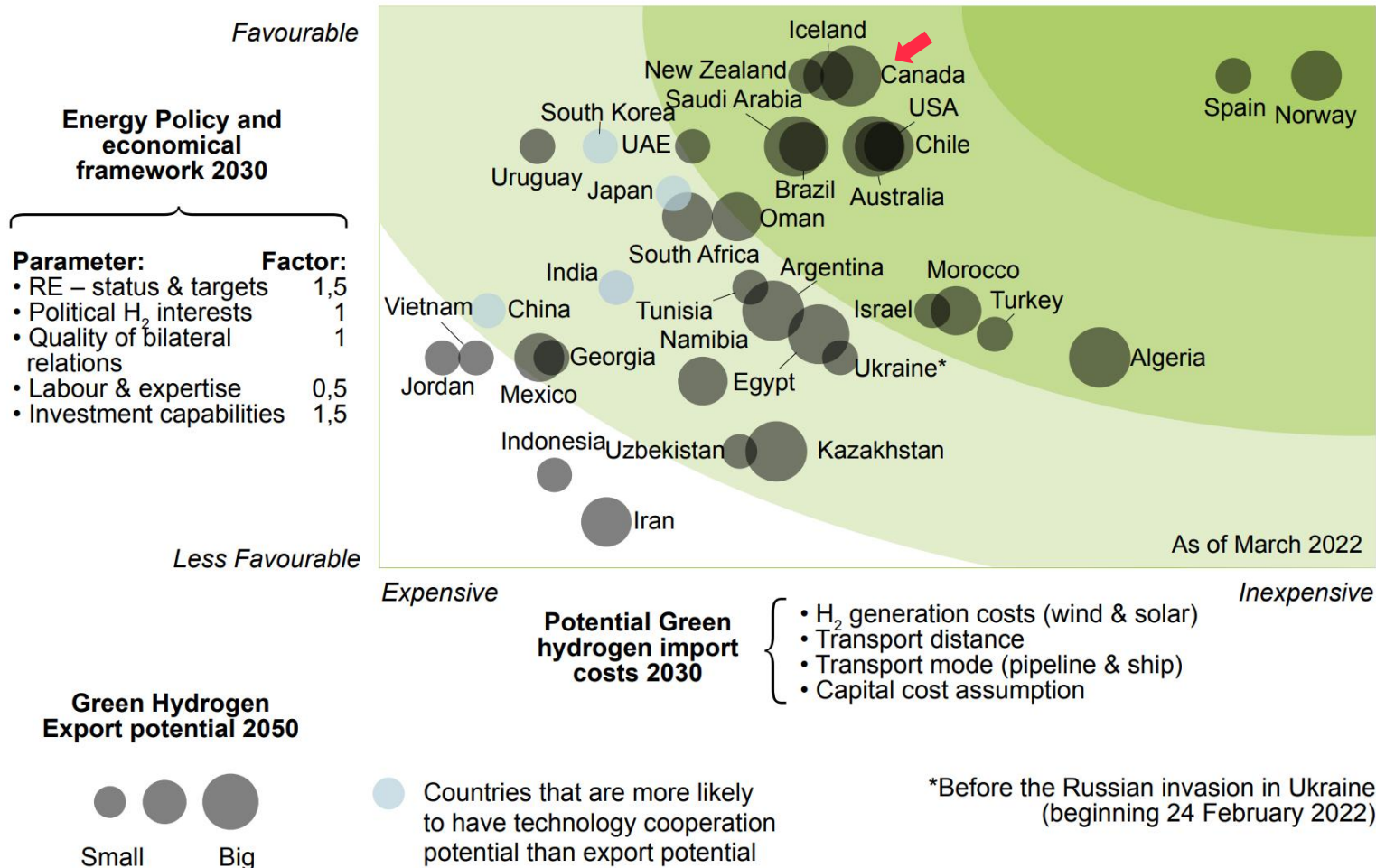


Port	Miles to Hamburg
Agadir, Morocco	1,829
St John's, NL	2,516
Halifax, NS	2,975
Tobruk, Lybia	3,118
Jeddah, Saudi Arabia	4,250
Houston, USA	5,262

- Sea routes in the North Atlantic are geopolitically more stable than e.g. routes through the Persian Gulf or the Suez Canal
- No transit fees or delays

Canada ranked in the top 5 of potential green hydrogen exporters to Germany

International cooperation and export potential on green hydrogen with Germany



Germany's international hydrogen support tools

The German federal government committed 9 billions EUR to promote the market ramp-up of hydrogen based on renewable energies, of which 2 billions for projects abroad. The following programs are being implemented:

- **H2 Global:** Auctions for purchase and sale of H₂/derivatives and compensation by government for difference in purchase and sale prices
 - First auction to start around August 2022, coordinated by HINT.CO. Total of €900 million in funding for three projects worldwide that can supply by 2024/2025
- **Funding guideline** for PtX production facilities abroad
 - First round completed (October 2021 – February 2022), winners will be announced soon. Next round not before 2023
- **H2 Uppp:** Programme to support smaller private sector projects through accompanying services
- **Individual subsidies** (including for Siemens Energy project in Chile, and Thyssen Krupp project in Saudia Arabia)

German-Canadian hydrogen cooperation

December 2021

- Inaugural meeting of Canadian-German Hydrogen Working Group

February 2022

- 2nd meeting of the Working Group, with focus on challenges and opportunities of transatlantic hydrogen trade, supported through adelphi study

March 2022

- Joint workshop on hydrogen applications in energy-intensive industry, focus on steel and chemicals

April 2022

- Virtual hydrogen study trip for Canadian stakeholders

May 2022

- Energy Partnership's Steering Group adopt Action Plan for 2022/23 and decide on various joint hydrogen activities for the following 12 months (ports exchange, techno-economic supply chain analysis, workshop on shipping technologies and hydrogen certification, etc.)
- Virtual matchmaking event with around 10 Canadian green hydrogen project developers and several German off-takers, + H2-Global info session

August 2022

- Canada-Germany Hydrogen Alliance founded by Minister Habeck (BMWK) and The Honourable Minister Wilkinson (NRCan)
- First Canadian-German green hydrogen trade deals announced

EU sustainability criteria for hydrogen

Approximately by the end of 2022, the EU will have established:

- Detailed criteria to determine under which conditions hydrogen and hydrogen based fuels can be considered of renewable origin, e.g. in relation to the use of fossil based electricity
- A methodology to determine the GHG savings for hydrogen based fuels
- A minimum threshold for GHG emission savings of recycled carbon fuels

Advanced drafts available, valid legislation announced by the EU Commission for 4Q 2022.

Hydrogen producers intending to export to the EU will have to:

- Understand implications for business model, technology choices, project development, operation, and marketing of the products
- Certify their products if they want their hydrogen or derivatives recognized as of renewable origin and as low carbon

Policy makers, regulators and power system operators of the exporting countries and constituencies will have to:

- Ensure that the hydrogen producers are able to provide the information required, e.g. on power system operation

More details in a separate slide set