



TRAFFIC USE OF HYDROGEN ON CROATIAN MOTORWAYS

Benchmarking Analysis

Zagreb, 03/04/2025

Legislation

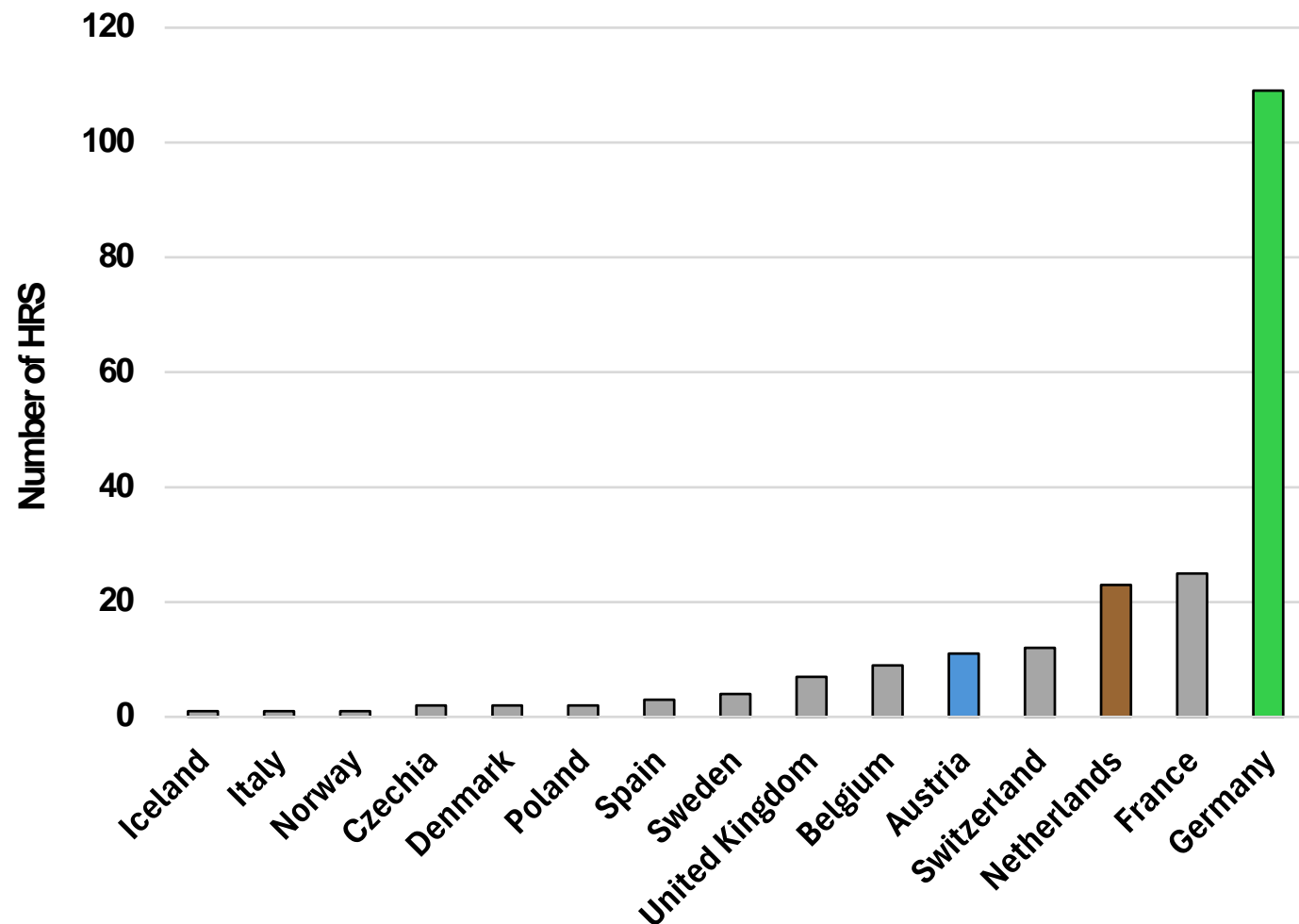


- Croatia **is developing** its policy and legal framework for deploying infrastructure for alternative fuels
- **AFIR** - the fundamental cornerstone
- **Transport Development Strategy** 2017 to 2030
- **Energy Sector Development Strategy** until 2030 (with a view to 2050)
- **National Development Strategy** until 2030
- **Low-Carbon Development Strategy** until 2030 (with a view to 2050)
- **Croatian Strategy for Hydrogen** until 2050
- **National Recovery and Resilience Plan** 2021-2026
- **Integrated National Energy and Climate Plan** for 2021-2030
- **National Policy Framework** for the deployment of the infrastructure and the development of the market for **alternative fuels in transport**

Benchmarking



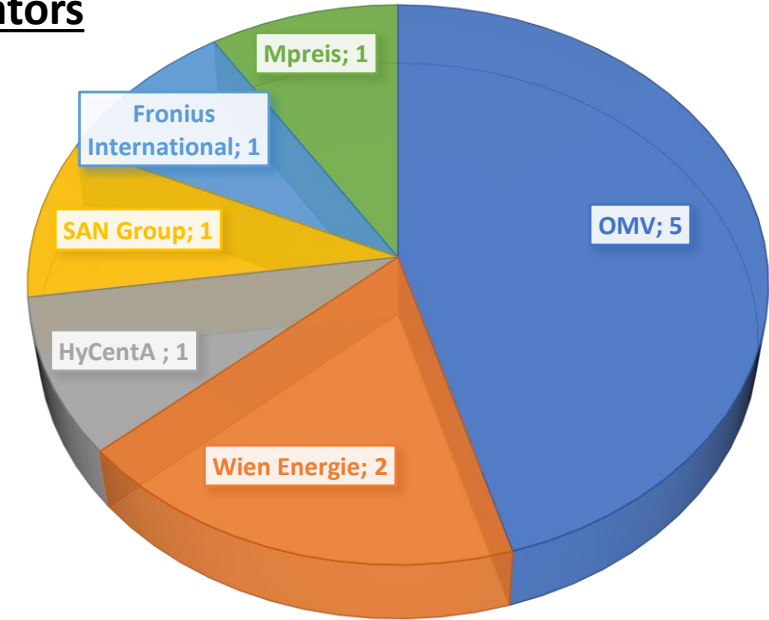
Number of HRS in specific countries



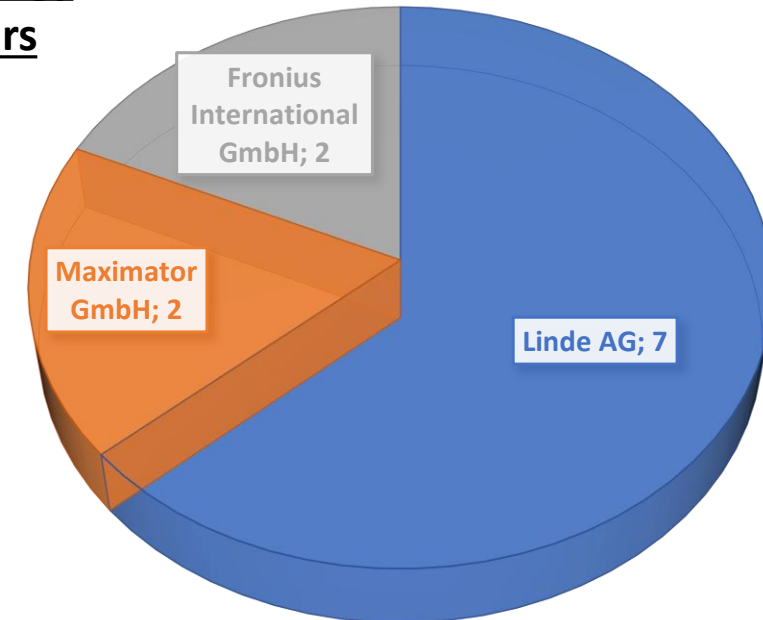
Austria

- Only **11 HRS** (all publicly available, except one)
- The biggest HRS operator: **OMV** (H2 Mobility*)
- The biggest HRS technology provider: **Linde AG**
- Most HRS are **700 bar** stations i.e. CGH2 700 (only one with 350 bar i.e. CGH2 350)
- 4 HRS have on-site electrolysis (2 HRS with **solar power** plant)

HRS Operators

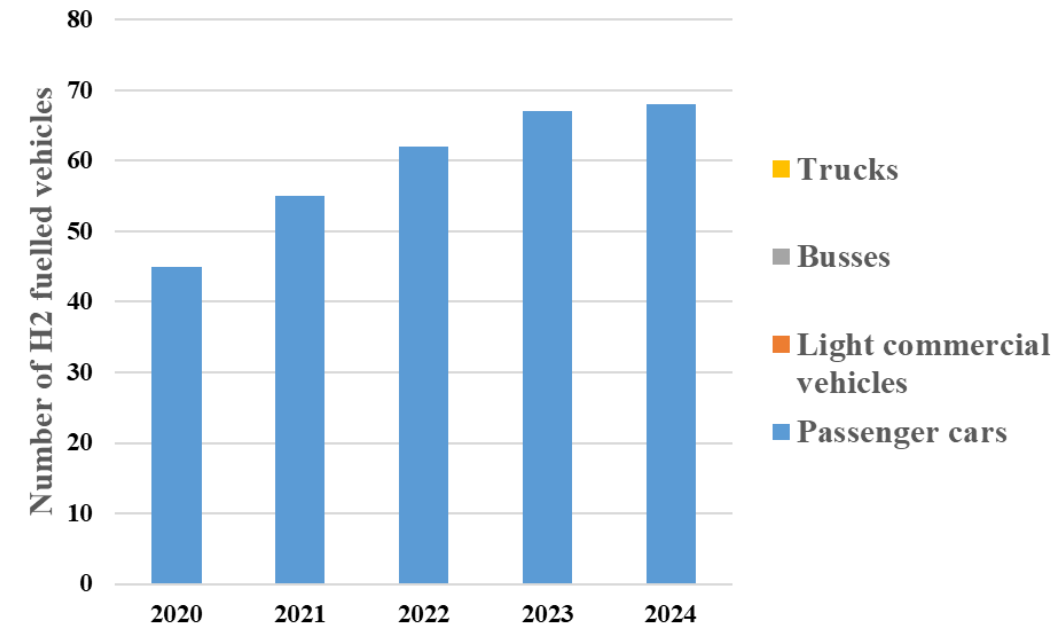


Technology Providers



Austria

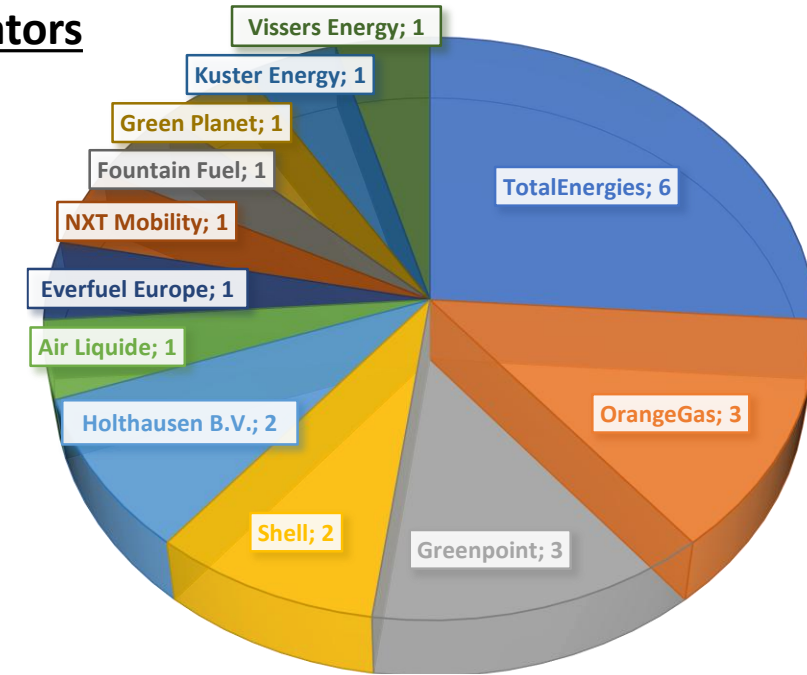
- **68** registered hydrogen vehicles on Austrian roads (passenger cars)
- Main constraints:
 - low hydrogen consumption** (number of vehicles),
 - expensive technology** (infrastructure and vehicles),
 - lack of refueling protocol**
- Most of the HRS in Austria are part of **EU-funded** projects



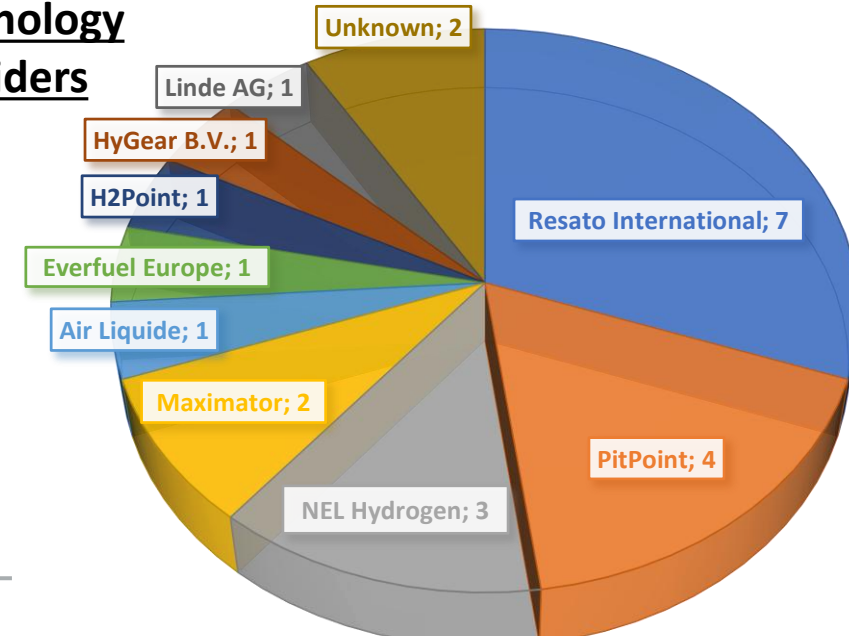
Netherlands

- **23 HRS** (all publicly available, except one)
- The biggest HRS operator: **TotalEnergies**
- The biggest HRS technology provider: **Resato Internacional**
- Almost all HRS have **350 bar** and **700 bar** stations
- 8 HRS have on-site electrolysis (4 HRS with **SPP**, 2 HRS with **WPP**, 2 HRS with other **RES**)
- Most HRS projects are **EU-funded** (6 HRS), some are also part of **Dutch government-funded** projects (10 HRS)

HRS Operators

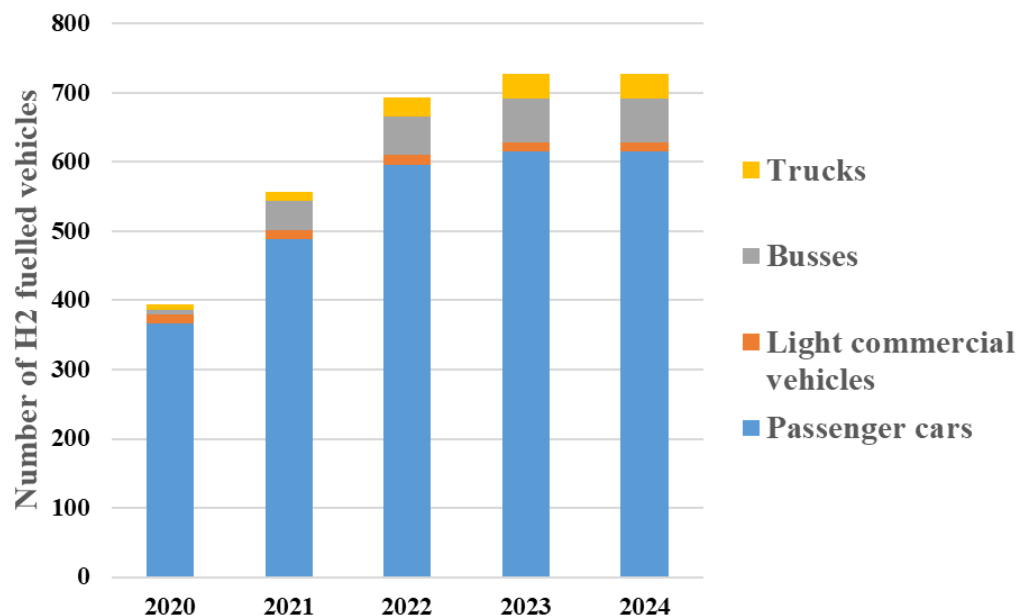


Technology Providers



Netherlands

- Cca 700 hydrogen registered vehicles



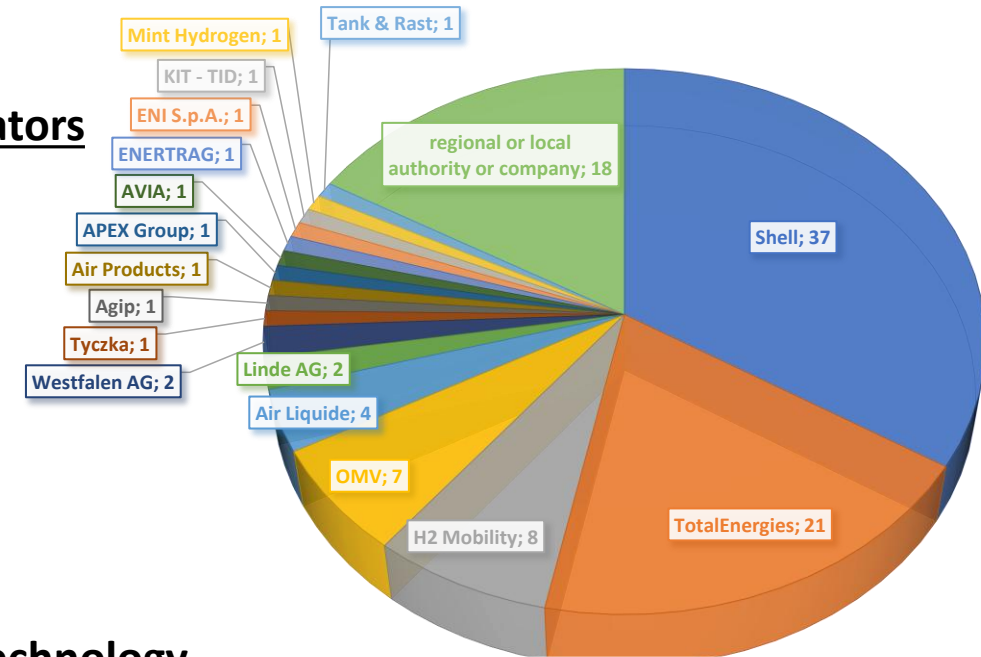
- **Challenges:** high production costs, infrastructure development, market development, public acceptance, complicated permits obtaining



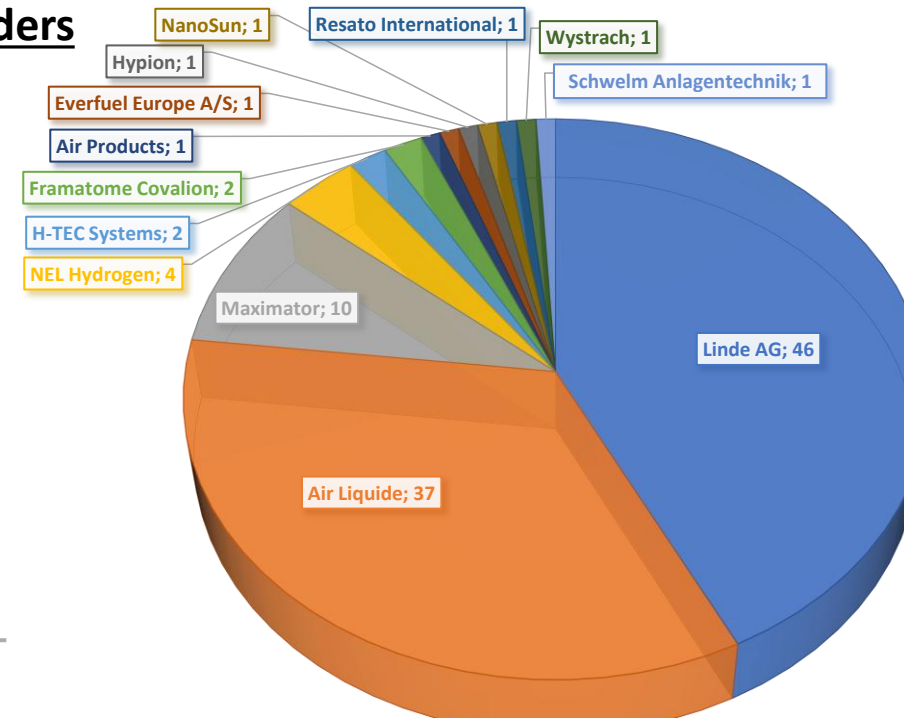
Germany

- **109 HRS** (89% are publicly available)
- The biggest HRS operator: **Shell**
- The biggest HRS technology provider: **Linde AG**
- **H2 Mobility*** is Germany's biggest partner in HRS projects (involved in 79% of all HRS projects)
- Most HRS have **700 bar** and **350 bar** stations
- 12 HRS have on-site electrolysis (5 HRS with **SPP**, 4 HRS with **WPP**, 3 HRS with other **RES**)
- Most of the HRS projects are part of the **German government-funded** projects (56 HRS) or **EU-funded** projects (32 HRS)

HRS Operators

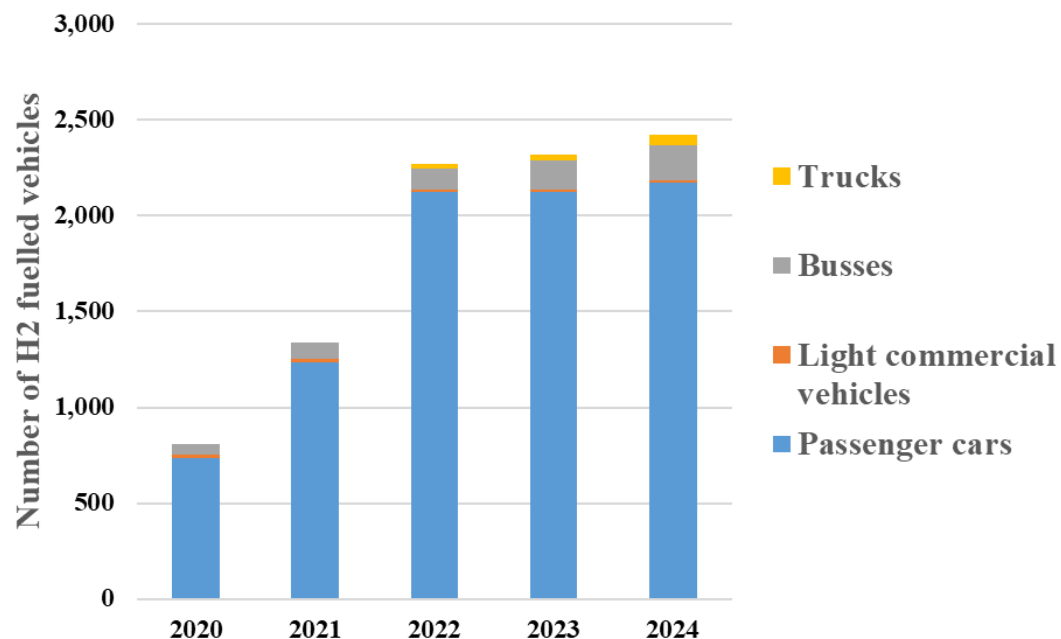


Technology Providers



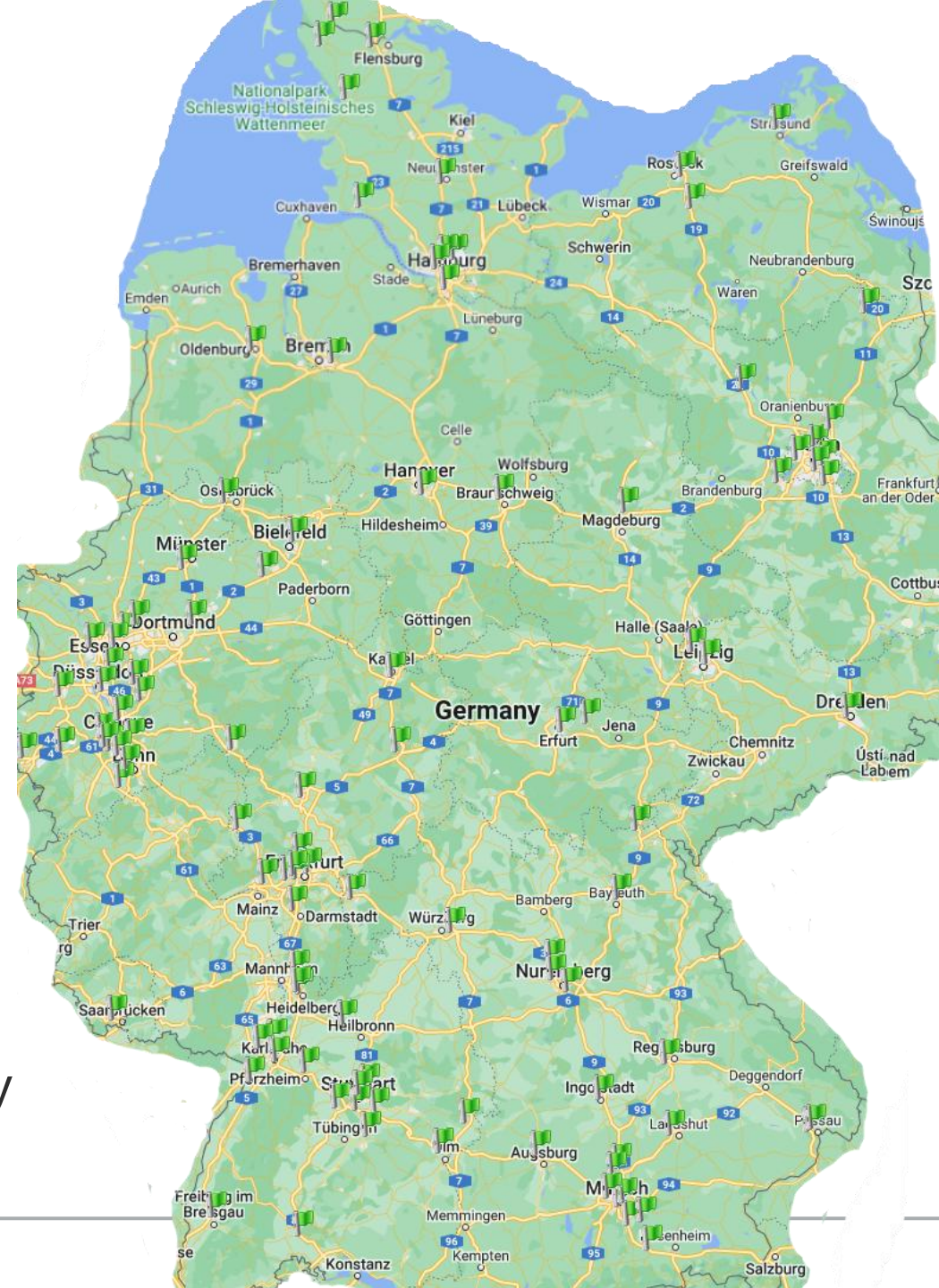
Germany

➤ Cca **2400** hydrogen registered vehicles



➤ **Challenges:**

costs, infrastructure, regulation, market development, intermittent nature of RES vs reliable hydrogen supply



Challenges



- **Low** hydrogen **consumption** (number of vehicles)
- **Expensive** technology
- High **extra costs** for infrastructure, vehicles, and hydrogen in comparison to traditional fossil fuels
- Lack of refueling **protocols** (Austria)
- **Permitting** is quite complicated (Netherlands)
- **Integration** with RES (green H₂ is primarily produced through electrolysis powered by RES such as wind and solar - the **intermittent** nature of these sources presents challenges in ensuring a **consistent and reliable** hydrogen supply)

Lessons learned



- **Hydrogen market's immaturity** - low hydrogen consumption (number of vehicles), expensive technology (HRS infrastructure and fuel-cell vehicles)
- To develop the hydrogen market in transport **significant resources** will be needed
- **Public funding** for HRS infrastructure, vehicles, and fuel (hydrogen)
- Support **integration** with RES
- The **government** must be **involved** by supplying funding and helping with the permitting

Preliminary recommendation of best practice



- It is necessary to carry out **activities in several domains** to put the hydrogen in transport and put it on track to successful development in Croatia
- Although the legislative framework exists, it is still necessary to develop more **concrete plans** for the rollout of hydrogen infrastructure
- Increasing the **demand** for HRS is essential to commercialize hydrogen mobility
- **National government support:** providing incentives (*), fuel credits, the equitable treatment of hydrogen options in transport, as well as vehicle purchase subsidies

Next steps



- **Hydrogen demand*** for transport on Croatian motorways
 - **NECP** (2024)
 - Demand **scenarios**
- **Supply** analysis
- **Optimum HRS locations**
 - **Urban** nodes, **motorway** nodes
 - Geographic **map** of HRS
- **HRS Investment Plan**
 - CAPEX
 - OPEX

Thank you for your attention!



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