The Future of Hydrogen in the ORLEN Group

Date: March 30th, 2022

Autors: Adam Giurg, Jiří Hájek, Tomáš Herink

ORLEN UniCRE

Infrastructure project Hydrogen Eagle by 2030

Czech Republic

- **28** hydrogen refuelling stations
- **80 MW** of electrolysis

Slovakia

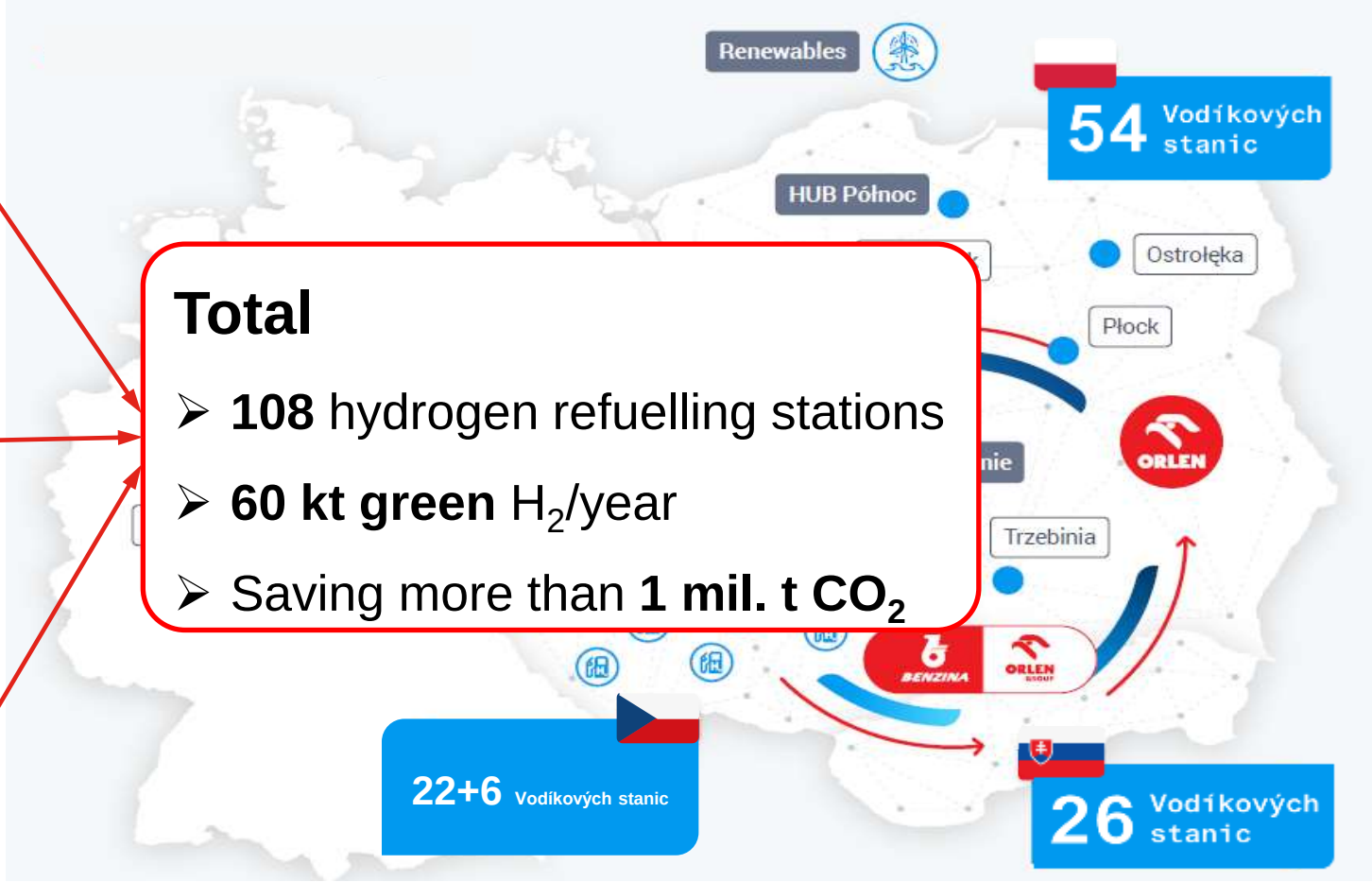
- **26** hydrogen refuelling stations
- **60 MW** of electrolysis

Poland

- **54** hydrogen refuelling stations
- **110 MW** of electrolysis
- **15 kt H_2** from municipal waste

Total

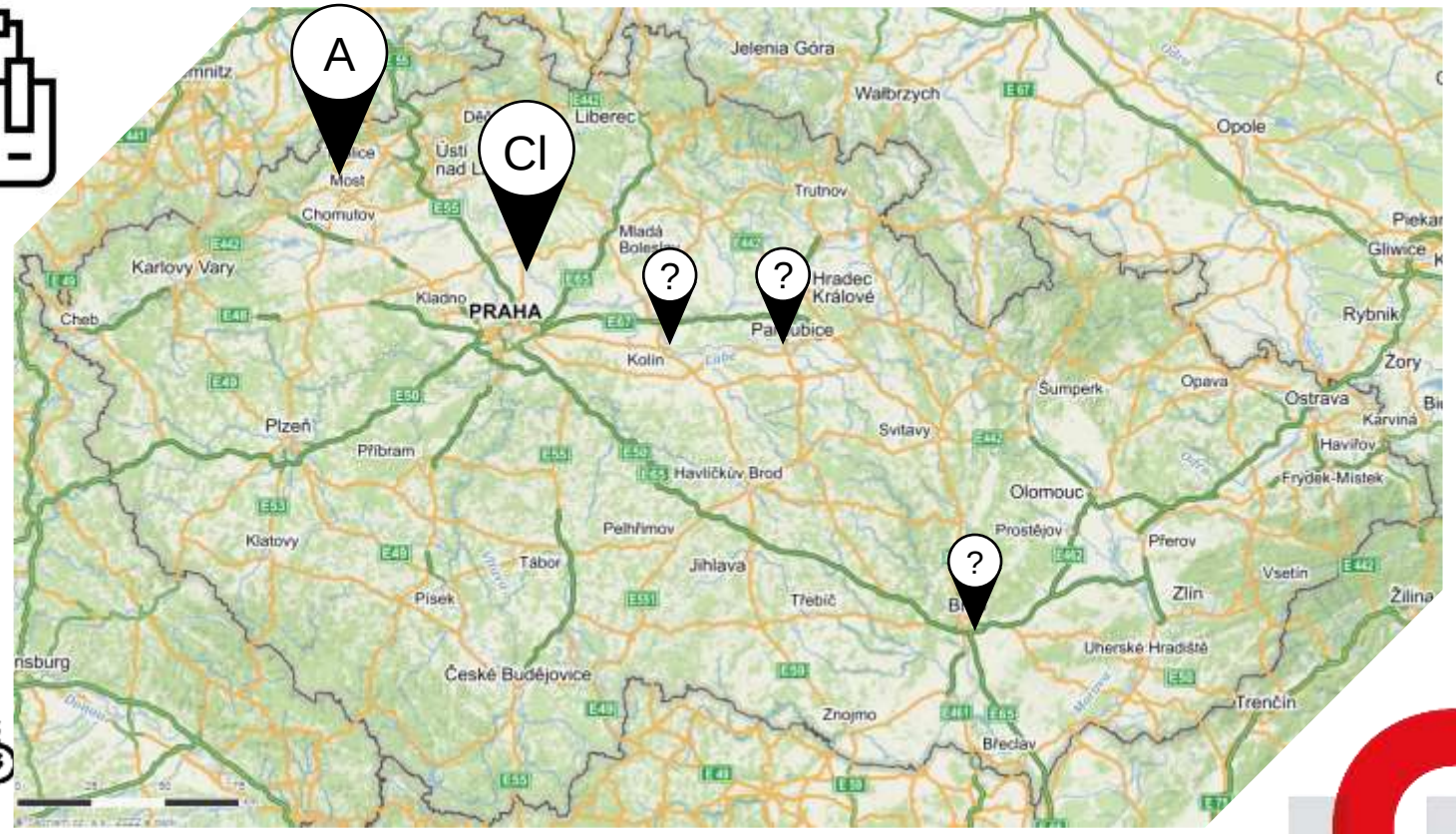
- **108** hydrogen refuelling stations
- **60 kt green** H_2/year
- Saving more than **1 mil. t CO_2**



ORLEN UniCRE

Plans in Czech Republic

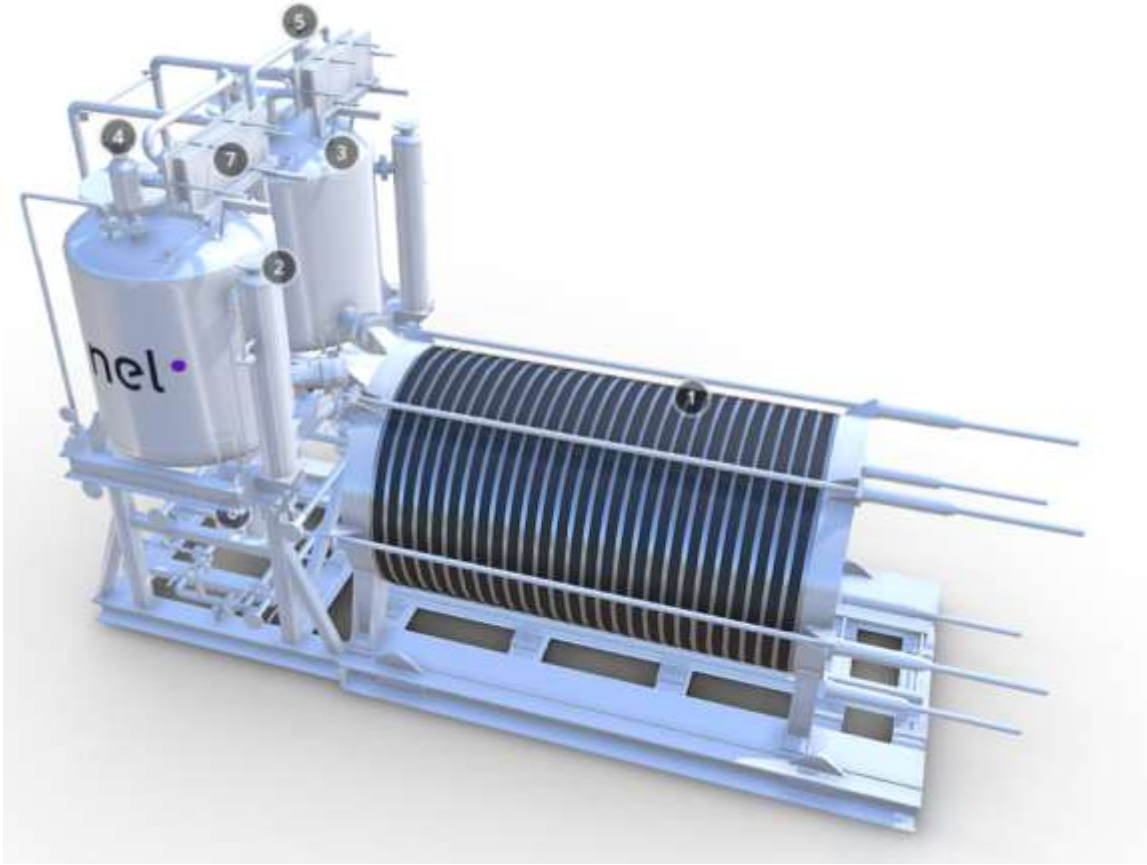
- **Production of „green“ hydrogen**
  - Alkaline electrolysis of water - Litvínov
  - Chlor-alkali process – Neratovice
  - Kolín-Pardubice, Brno
  - Renewable energy
- **Hydrogen mobility**



Alkaline Electrolyser

K: $2\ H_2O + 2\ e^- = \mathbf{H_2} + 2\ OH^-$

A: $2\ OH^- = ½\ \mathbf{O_2} + H_2O + 2\ e^-$



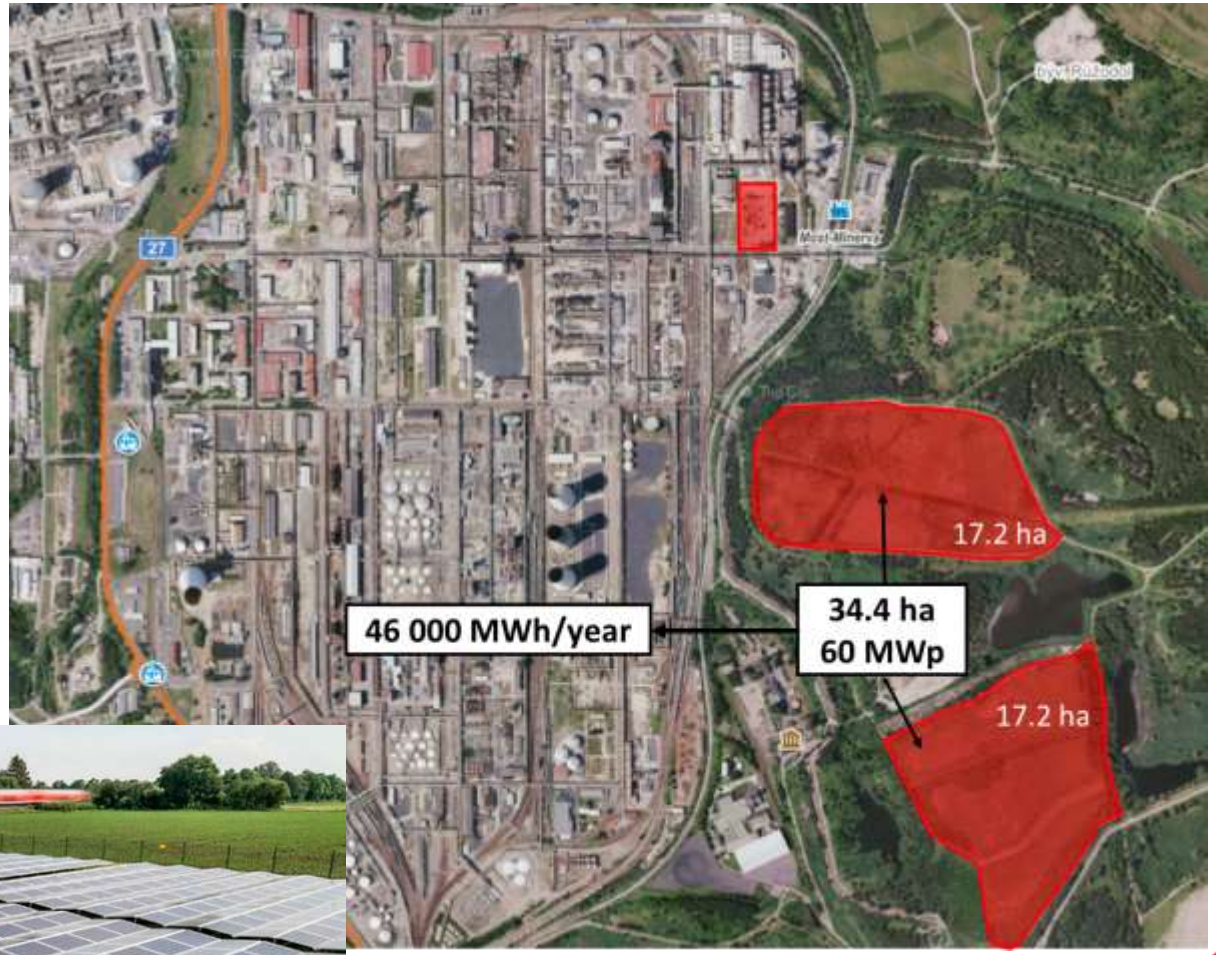
https://nelhydrogen.com/product/atmospheric-alkaline-electrolyser-a-series/

- **26.4 MW**
- **4 500 t H_2**
- Using – H_2 mobility, biofuels, NH_3, fuel cells, heat…

ORLEN UniCRE

Photovoltaic Power Plant

- **Ash dumps** next to the plant
- Area **34.4 ha**
- Orientation – **east-west**
- **46 000 MWh/year**

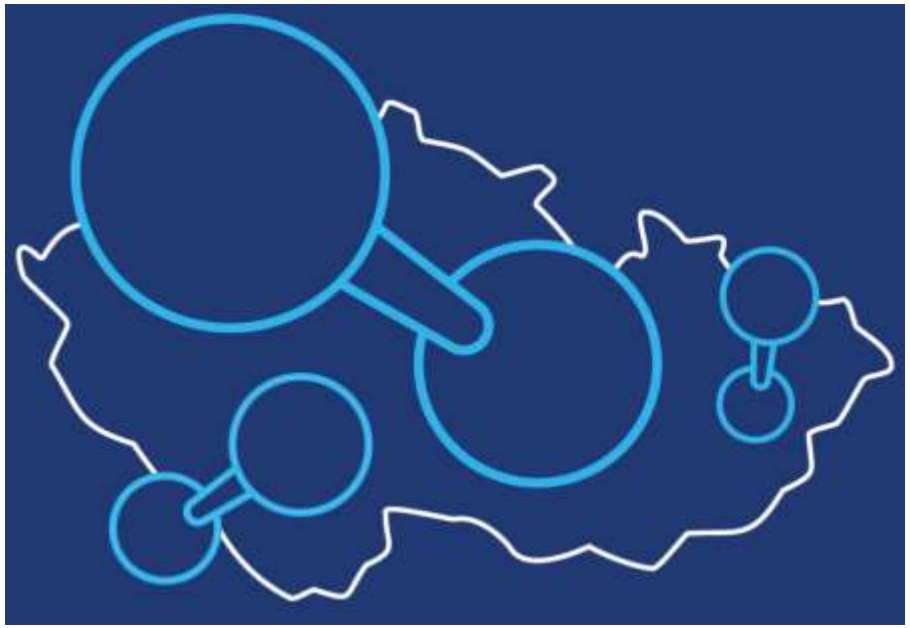


ORLEN UniCRE

Hydrogen Strategy in CR by 2030

- **45 000** hydrogen cars
- **900** hydrogen busses
- **4 000** hydrogen trucks

- Production of **59 kt H_2** – 2 800 GWh
- Lower CO_2 emissions by **632 kt**

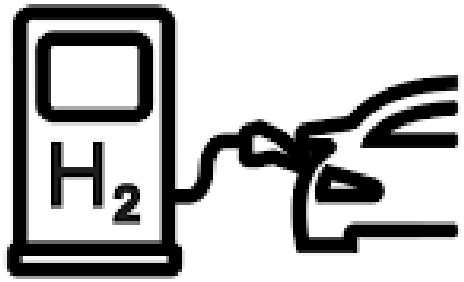


https://www.mpo.cz/assets/cz/prumysl/strategicke-projekty/2021/8/Vodikova-strategie_CZ_G_2021-26-07.pdf

ORLEN UniCRE

Hydrogen Mobility

- **6 refuelling stations in realization**
  - Praha - Barrandov, Litvínov
  - Brno, Plzeň, Praha – Horní Počernice, Ostrava
- Another **22** refuelling stations by **2030**
- **Hydrogen storage and transport**
  - Zeolite battery and NH_3
  - H_2 trailers and hydrogen pipeline



ORLEN UniCRE

Hydrogen Mobile Filling Station

- Low density of hydrogen refuelling stations - compared to liquid fuels for many years
- Coverage of places as needed
- Backup for possible failures
- Filling pressure 350 bar
- Dispensing up to 50 kg of hydrogen

https://h2.live/en/

ORLEN UniCRE

Hydrogen Shunters

- Vision – 5 to 6 hydrogen shunters at Chempark Litvínov by 2030
- Refuelling station in complex
- Possibilities:

  A) Retrofit of diesel locomotive to hydrogen locomotive

  B) New shunters

https://www.fch.europa.eu/sites/default/files/07-Rail-Cargo-Karl-Zoechmeister.pdf

ORLEN UniCRE

Accredited Hydrogen Laboratory

- Determination of impurities in hydrogen according to **ISO 14 687-2**
- Obligation to control at **source, transport and dispensing**
- Do you need to determine the purity of hydrogen for mobility? Contact us:
  adam.giurg@orlenunicre.cz
  karla.cerna@orlenunicre.cz

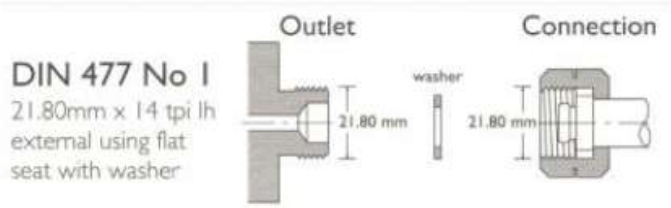
ORLEN UniCRE

Accredited Hydrogen Laboratory

- **Samples of hydrogen:**

A) Pressure bottle (10 L, max. 200 bar)

Thread DIN 477 No I



B) Sample cylinder (up to 3 L, max. 124 bar)

Quick connects QF4-B, S

Quick connects QC4-B, S, D

SS-QF4-S-400

SS-QF4-B-400

C) Possibility to lend the sample cylinder (1 L, max. 124)

ORLEN UniCRE

Thank you for your attention