

# Regional Hydrogen Trains on Czech Railways

## A techno-economic analysis



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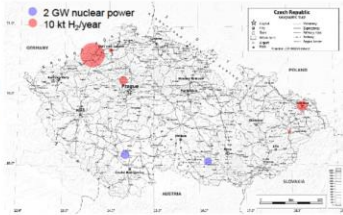
### Project Objective

Identify and quantify potential for hydrogen train technology in Czechia.

### Sources of Hydrogen in Czechia

#### Current status:

- 120,000 ton/year H<sub>2</sub>
- Only "brown" hydrogen
- Partial oxidation (50%)
- Steam reforming
- Chemical by-product

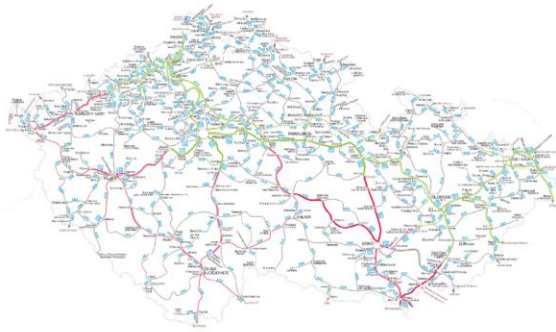


#### Low-carbon hydrogen:

- Local electrolysis from renewables or nuclear
- Import by truck, train or through NG pipelines
- Blue hydrogen with carbon capture of existing sources

### Candidate Rail Lines

- Ideally: multiple non-electrified routes longer than 100 km
- Competing technologies: batteries, biofuels, catenary



### Single-Train Simulations

- Building on experience from Norwegian railway
  - Electrified
  - Non-electrified
- Calculate rolling, air, and gravity resistance
- Quantify regenerative potential
- Full energy profile over line

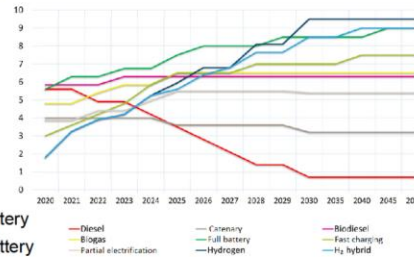


### Techno-Economic Analyses

- Compare multiple technologies for alternative electrification
- Consider CAPEX, OPEX, and progress until 2050
- Compare by Equivalent Annual Cost

#### Technologies:

- Diesel
- Catenary
- Hydrogen
- Battery
- Biodiesel
- Biogas
- Hybrids:
  - Catenary-Battery
  - Hydrogen-Battery



#### Other Criteria:

- Respect of changing environmental regulations
- Availability of each technology on the market
- Availability of regulations, codes and standards
- Flexibility and robustness of the technology

### Schedule

#### Tasks:

1. Identify hydrogen sources in Czechia. Jan 2021-Feb 2023, VSCHT
2. Railway data collection, identify 5 lines. Jan 2021-Jun 2022, VUZ
3. Simulation & techno-economics. Jan 2021-Apr 2023, SINTEF
4. Result analysis & reporting. May 2022 – Apr 2024, ÚJV

#### Deliverables:

- Feasibility study – report (Apr 2024)
- Workshop 1: present selected lines to local authorities (end 2021)
- Workshop 2: present project results to stakeholders (end 2023)

### Partners

- ÚJV Řež (coordinator): *Institute of Nuclear Research*
  - Management, data collection, analysis reporting
- VSCHT: *University of Chemistry & Technology, Prague*
  - Hydrogen source identification and GHG content reduction
- CD VUZ: *Railway Research Institute*
  - Route selection and data gathering
- SINTEF: *Foundation for Industrial and Technological Research*
  - Single-train and techno-economic analyses
- HYTEP: *Czech Hydrogen Technological Platform*
  - Workshop organisation



### Acknowledgements

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