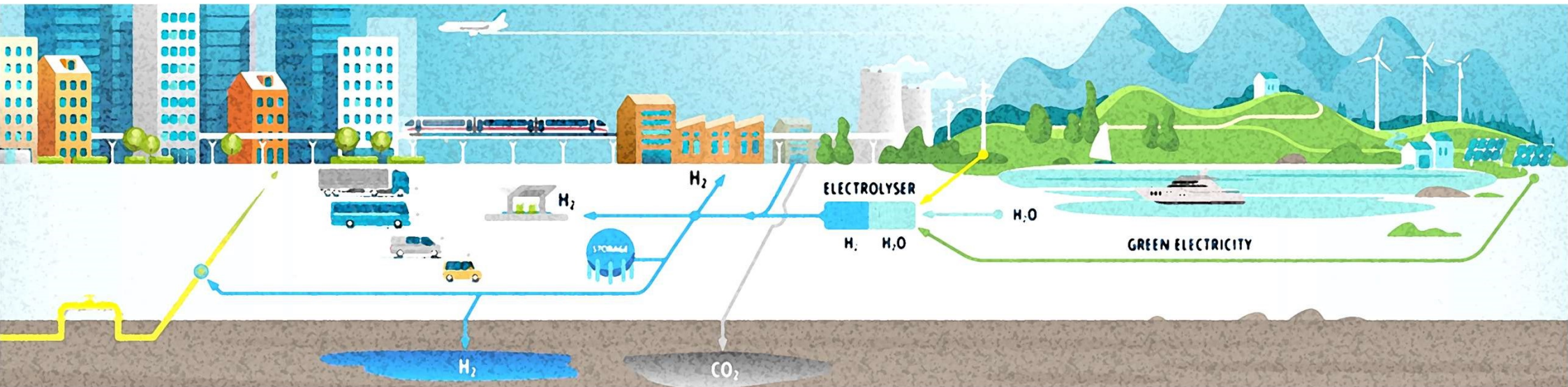




NVAS

Národná vodíková  
asociácia Slovenska

# Potential of hydrogen in Slovakia



- ✓ Research & development in the field of hydrogen technologies.
- ✓ Support of the hydrogen technologies deployment
- ✓ Management of Hydrogen Cluster
- ✓ Identification and removal of barriers preventing hydrogen integration into the energy system




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Activities

- ✓ Encouraging cities and regions to deploy hydrogen technologies
- ✓ Active engaging in the formation of European and national policies and supporting schemes
- ✓ Communicating with the European Commission and European hydrogen agencies to exchange information. Active involvement in international projects.

## Members of NVAS

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*Universities*

Technická Univerzita Košice, Univerzita Pavla Jozefa Šafárika v Košiciach

*Institutions*

Slovenská inovačná energetická agentúra

*Small and medium enterprises*

Environ, HAPEVA, SynCo Group, NAWITAS, IFT InForm Technologies, Probugas, InoBat, Solárny Dom, TCX, DIVKO, E-Group, FARMA FRESH Slovakia, Eurowind energy

*Large companies*

Viesmann, Messer Tatragas, Slovenské elektrárne, TATRAVAGÓNKA Poprad, Air products

# NVAS INTERNATIONAL ACTIVITIES

Members of

14

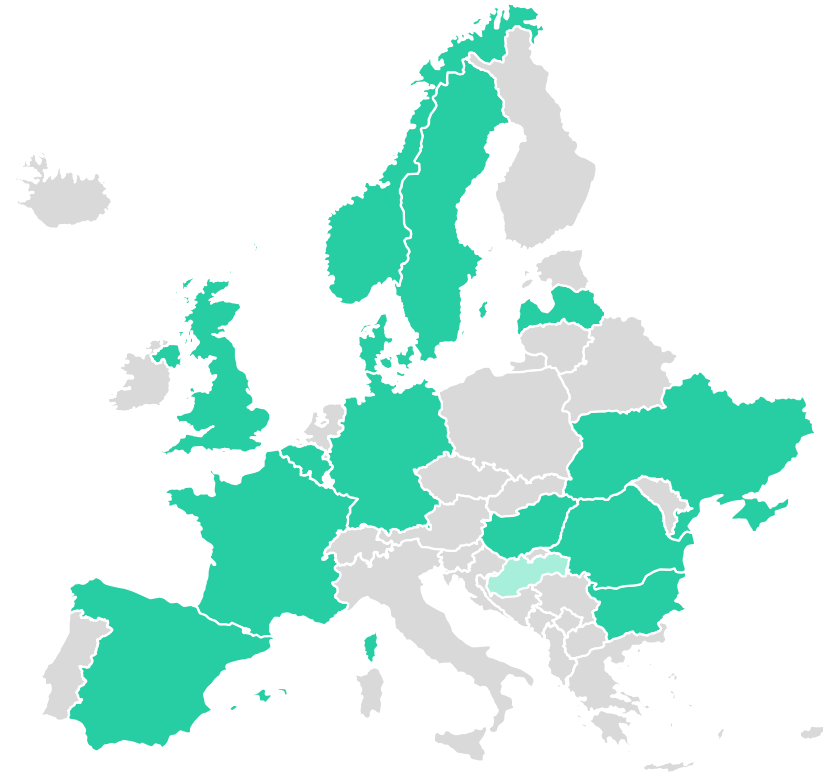


## National Associations

- Spanish Hydrogen Association (AeH2)
- French Association for Hydrogen and Fuel cells (AFHYPC)
- Brintbranchen Hydrogen Denmark
- Deutscher Wasserstoff- und Brennstoffzellen Verband
- H2BG
- Hungarian Hydrogen and Fuel Cell Association
- Hydrogen Sweden
- Latvian Hydrogen Association
- Norwegian Hydrogen Forum
- Romanian Association for Hydrogen Energy
- UK Hydrogen Association
- Ukrainian Hydrogen Council
- WaterstofNet vzw



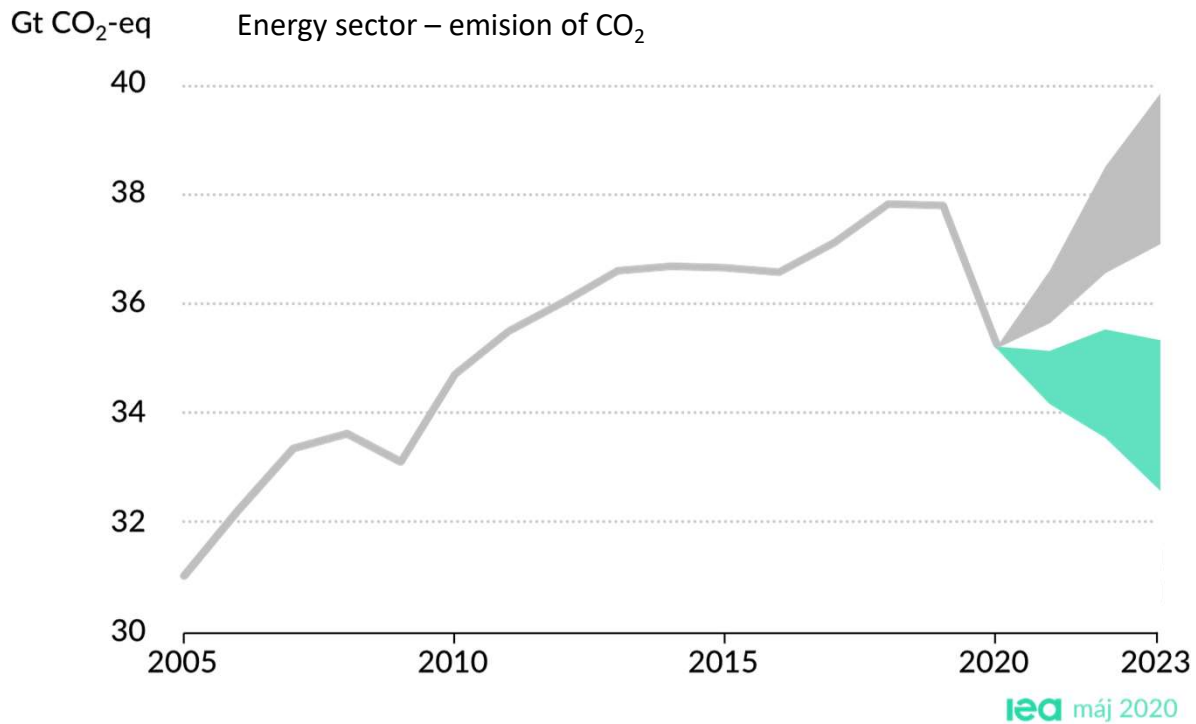
- **Slovak National Hydrogen Association**  
since 21. March 2019



- Slovak National Hydrogen Association  
since 2019

# Global emission of CO<sub>2</sub>

IEA, Global energy-related CO<sub>2</sub> emissions, 1900-2020, IEA, Paris



Year 2019 could be the turning point in global emission



Important authorities and governmental decisions need to be taken that will form the development of global emission for a long period

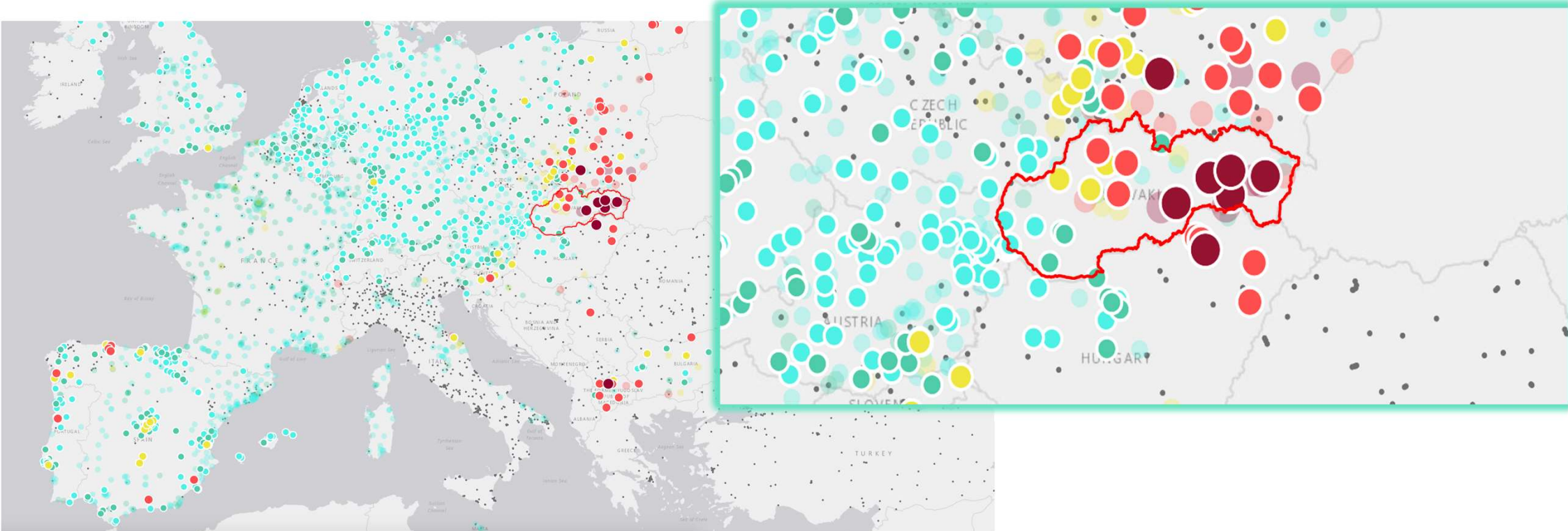


Investment in green economy in the global economy according to the IEA report could:

- Increase the global economic growth by 1,1% annually,
- Create 9 mil. jobs every year.

# Air quality index in Europe

12 January 2019



# HYDROGEN STRATEGIES

EU Hydrogen Strategy

## 01. Priority of clean hydrogen

Investment of 13 to 15 bln. EUR until 2030 into the electrolyzers within the EU a further 50 to 150 bln. EUR into the renewable energy sources with installed capacity of 50-75GW. Together more than 180 bln. EUR invested into the clean hydrogen production and distribution.

## 02 Low carbon hydrogen

Hydrogen produced from natural gas or coal gasification with CCS/CCU and/or hydrogen produced in electrolyzer using electricity from the grid with low carbon footprint.  
Very important role in the transition period until 2030.

## 03. Fossil hydrogen

Hydrogen produced from fossil fuels – natural gas and coal without any CCS/CCU  
Production of „grey“ hydrogen will not be supported.

Slovak Hydrogen Strategy - draft

Priority in government support of clean hydrogen production.  
Limited potential of renewable energy sources.

Biggest potential in Slovakia due to the energy system – low carbon footprint of energy mix due to the big share of nuclear power generation and large hydro power plants. Big potential in well developed gas infrastructure.

Currently producing around 220 t of hydrogen /year – steam reformation.  
Important source of hydrogen in transition period to balance the fluctuation of clean hydrogen production from renewables. The goal is to transform from „grey“ to „blue“ hydrogen

**2x 40 GW of Electrolyzers Initiative until 2030** – 40 GW of electrolyzers within the EU member states + 40 GW of electrolyzers outside EU with import of the clean hydrogen using modified gas infrastructure (North Africa and **Ukraine**)

# 7 roles of hydrogen in decarbonization

*With renewable energy sources*  *Decarbonization of final demand*

**1/** Integration of large renewables



**2/** Sector coupling



**3/** Buffer for energy system



**4/** Decarbonization in transport sector



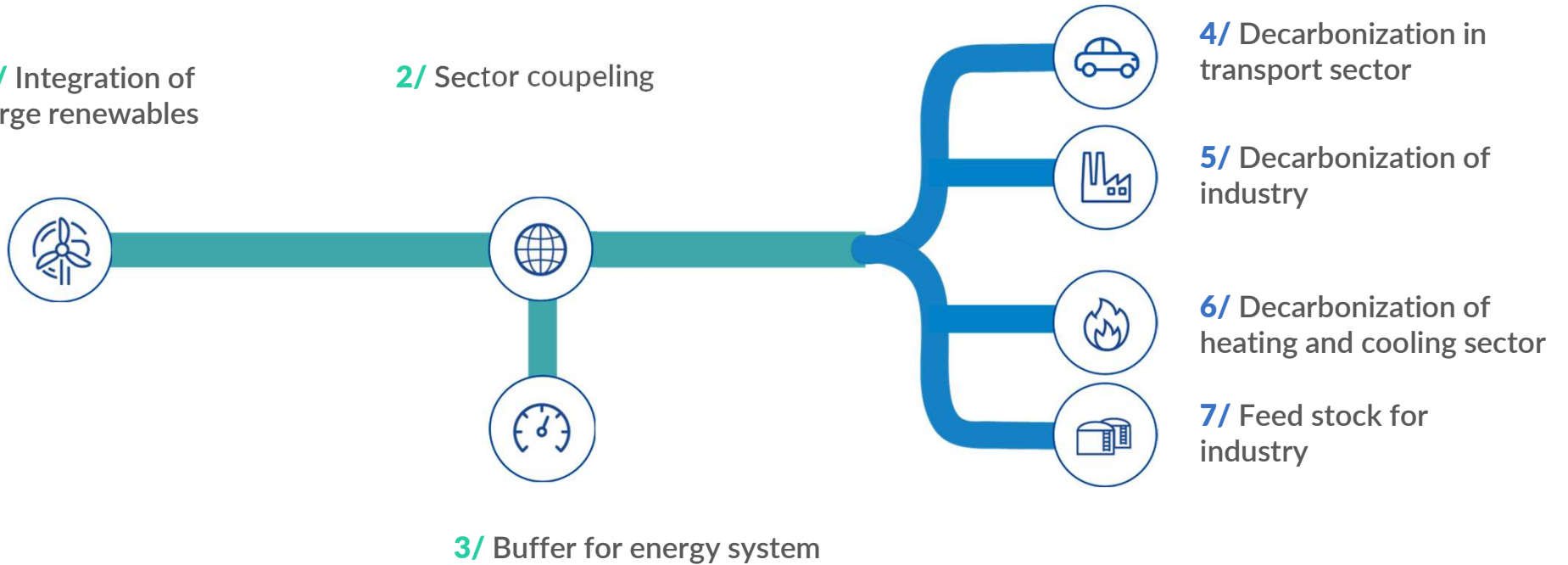
**5/** Decarbonization of industry



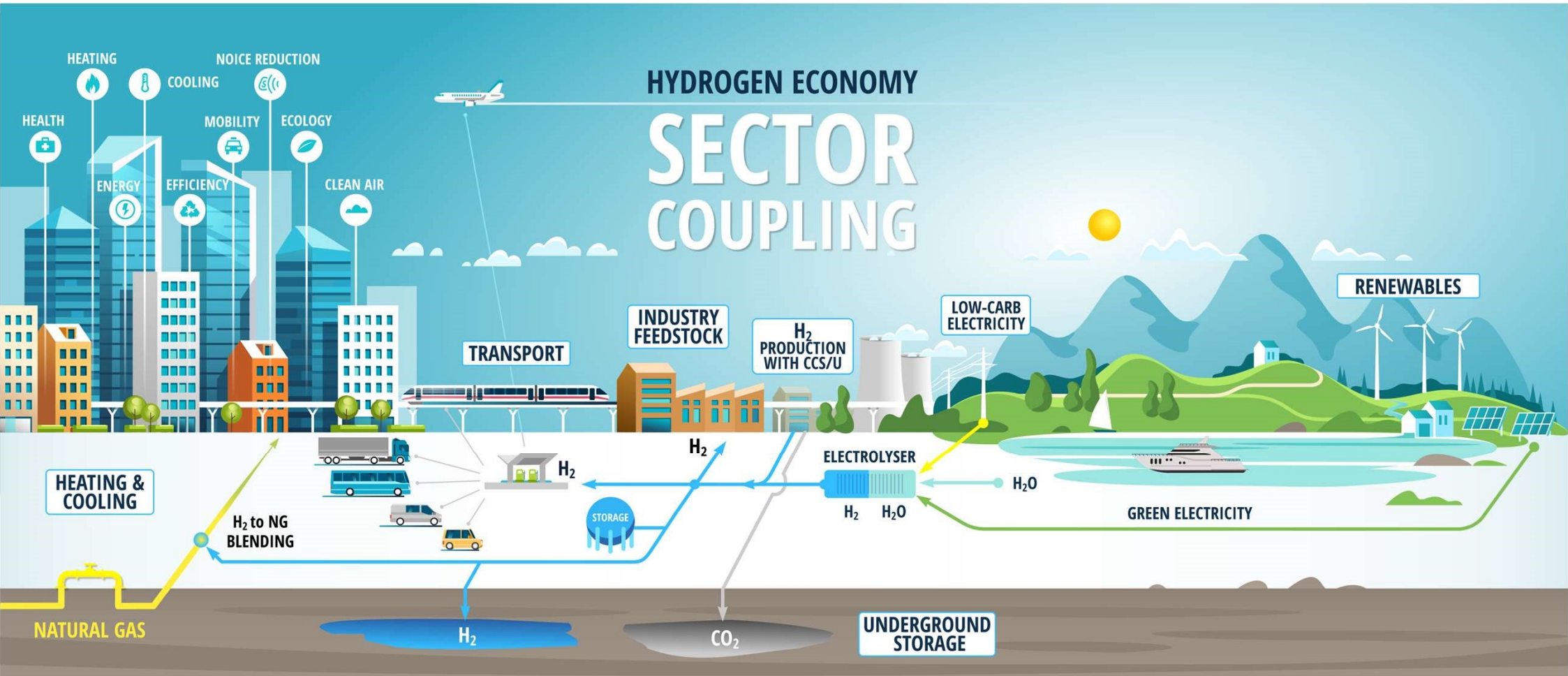
**6/** Decarbonization of heating and cooling sector



**7/** Feed stock for industry

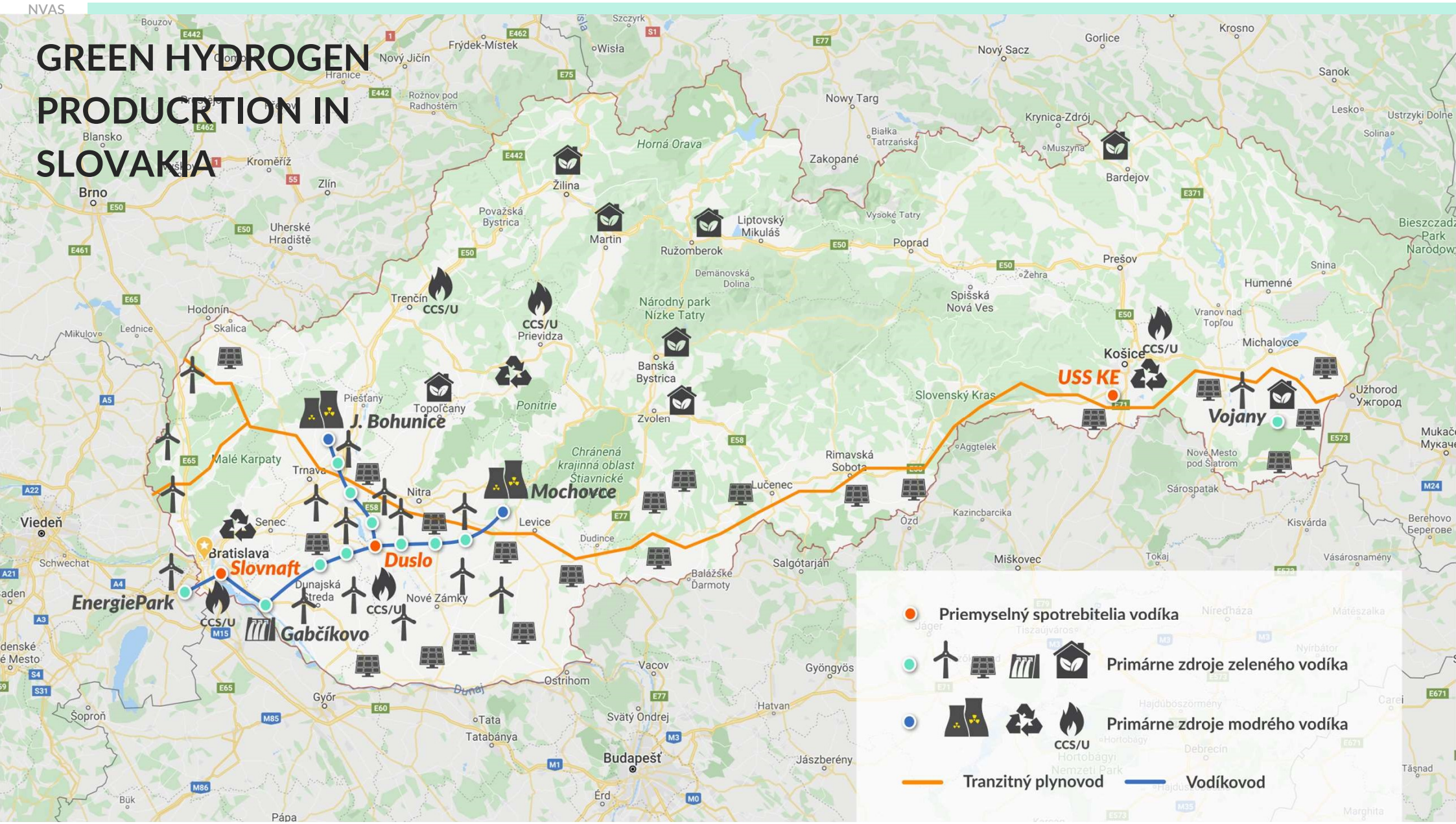


# SECTOR COUPLING





# GREEN HYDROGEN PRODUCTION IN SLOVAKIA



**● Priemyselný spotrebiteľ vodíka**

**● Primárne zdroje zeleného vodíka**

**● Primárne zdroje modrého vodíka**

**— Tranzitný plynovod — Vodíkovod**

# 2x40 GW initiative

Proposed and managed by Hydrogen Europe.

## 40 GW of elektrolyzers in EU

## 40 GW of elektrolyzers in North Africa and Ukraine

Transport of the green hydrogen using existing gas transport infrastructure

Modifications of the existing transport natural gas infrastructure need to be implemented

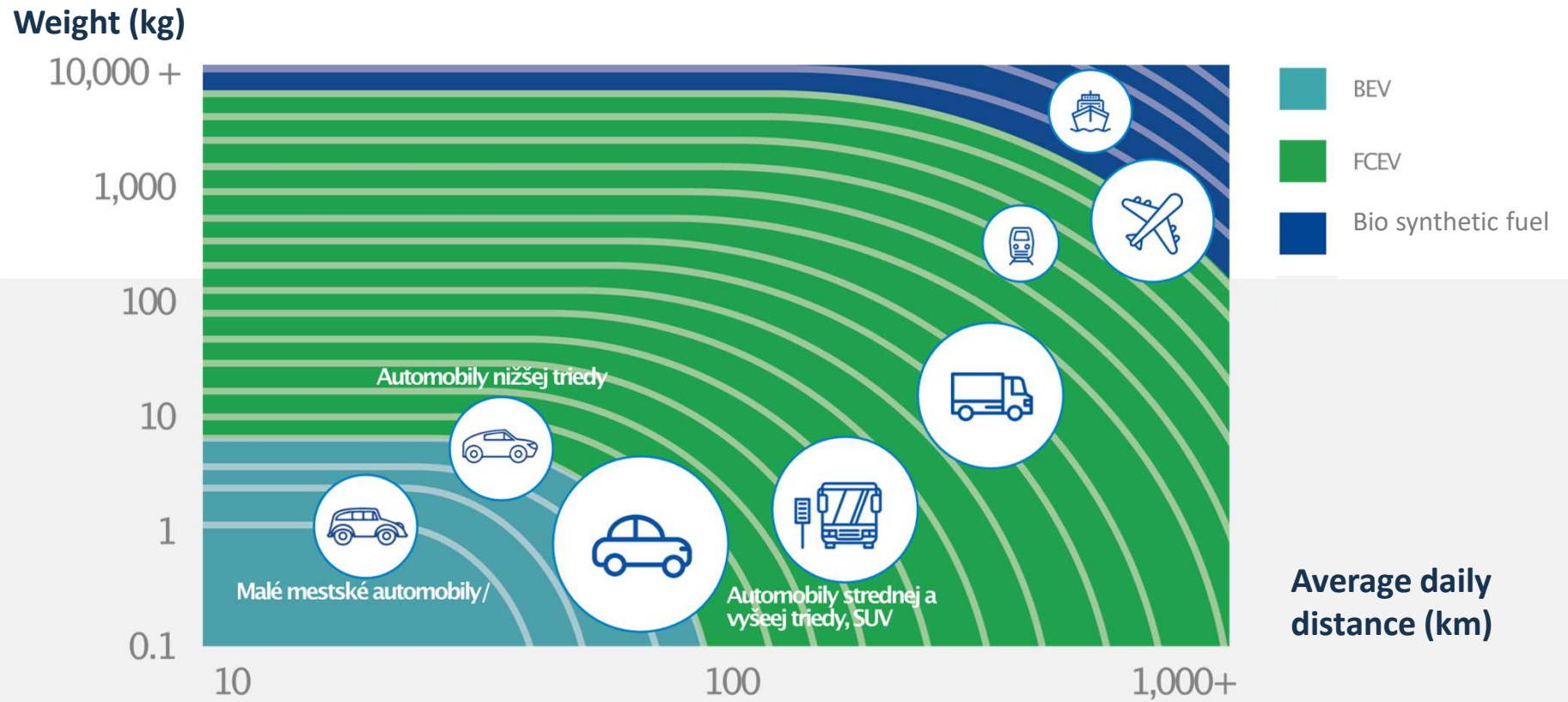
Investment of 20 bln. EUR until 2030

The goal is to decrease of CO<sub>2</sub> production by 82 millions of tons every year



# FCEV transport sector

The biggest potential in heavy duty and long distance transport



# INTERNATIONAL TARGETS and SLOVAKIA

source: [International Energy Agency](#), 15. March 2019

National FCEV targets

	2020	2022	2023	2025	2028	2030
US	13 000	40 000				
California						1 000 000
Japan	40 000			200 000		800 000
France		5 000			20 000-50 000	
China	5 000			50 000		1 000 000
Netherlands	2 000					
Korea*			81 000			1 800 000
<b>Slovakia**</b>				<b>160</b>		<b>3 600</b>

National hydrogen fuelling station targets

	2020	2022	2023	2025	2028	2030
US	80	100				
California				200		1 000
Japan	160			320		
France		100			400-1 000	
China	100			300		500
Germany	100			400		1 000
Korea			310			
<b>Slovakia</b>				<b>10</b>		<b>25</b>



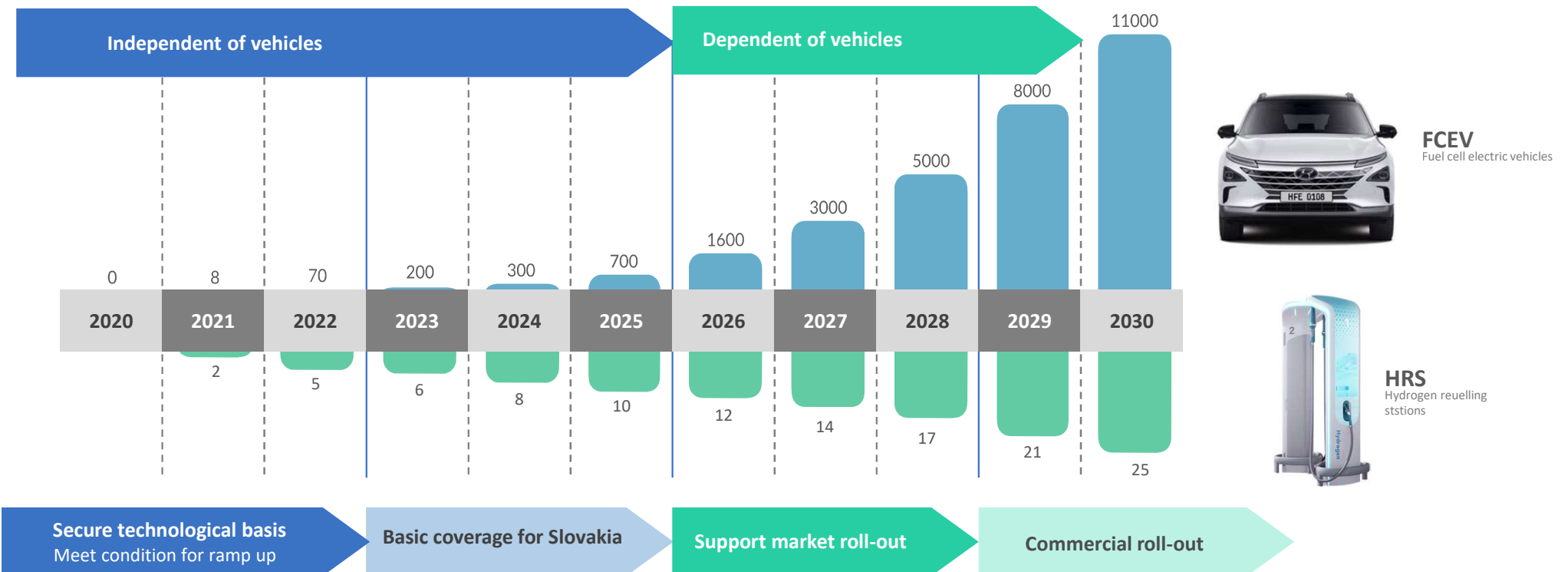
\* Production target

\*\* National political frame for alternative fuels

# TARGETS for SLOVAKIA - proposal

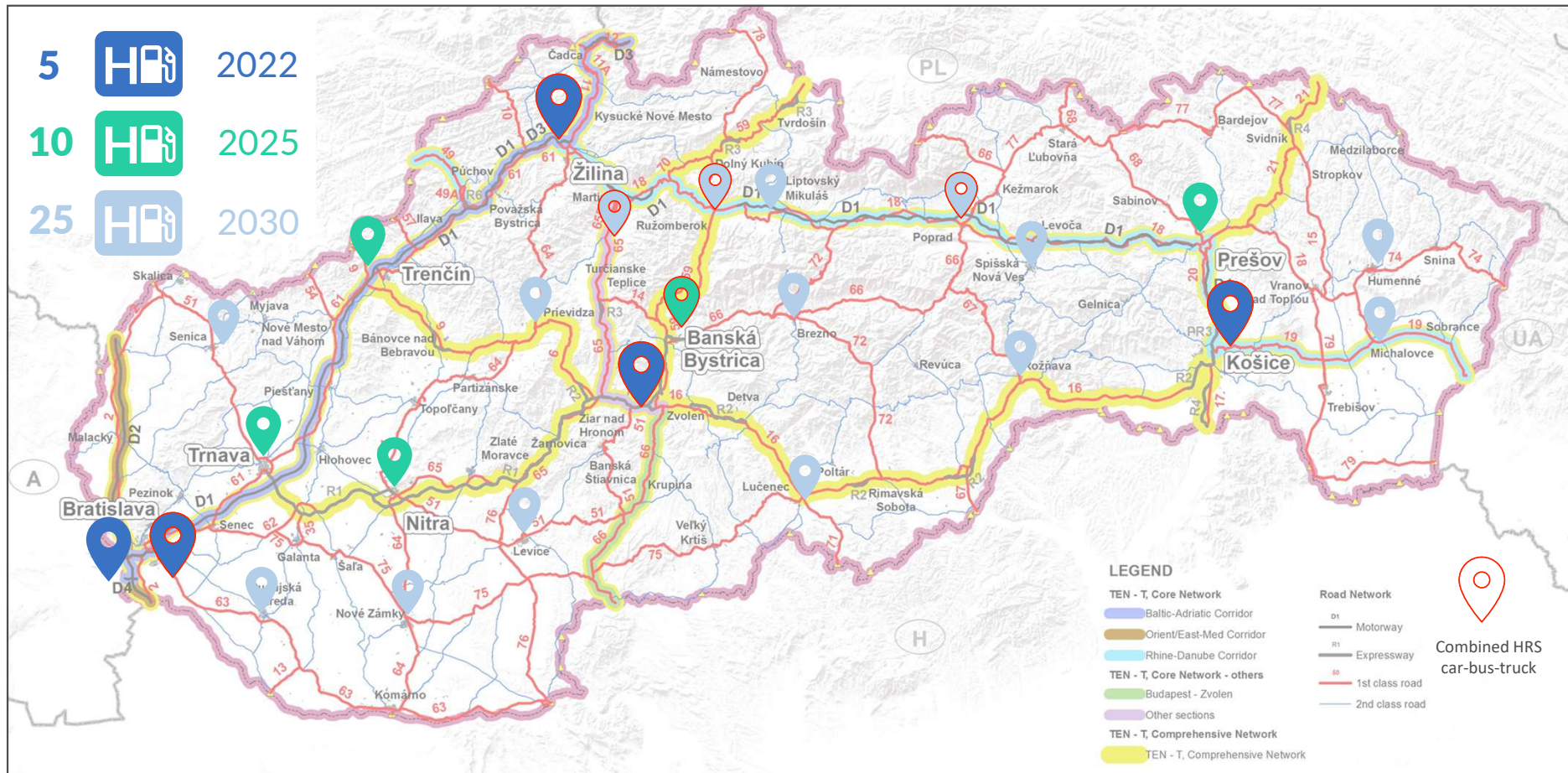
by NVAS

Proposal is based on the on German (70%) and Korean (30%) targets. Decreased by ration of GDP per capita compared to Germany and divided by population ratio. We assume a 4 years delayed ramp up of the HRS dissemination compared to Germany. We assume slower increasing during following 4-5 years than in Korea and Germany.



# HYDROGEN REFUELLING STATION PLAN

Deployment - proposal by NVAS



# H2 TRAIN

Alstom - Coradia iLint

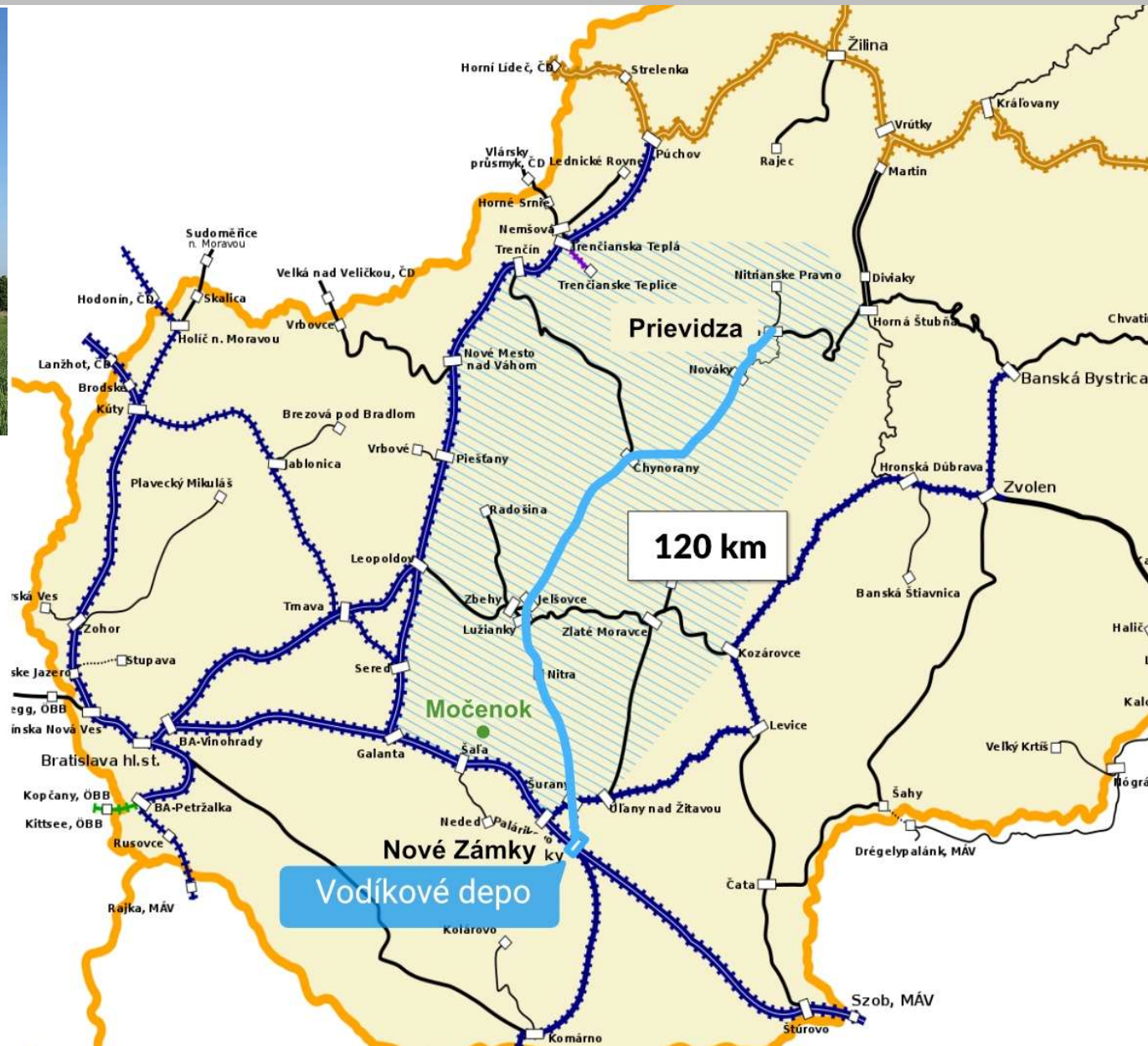


## Nové Zámky - Prievidza

12 trains planned on non electrified railroads

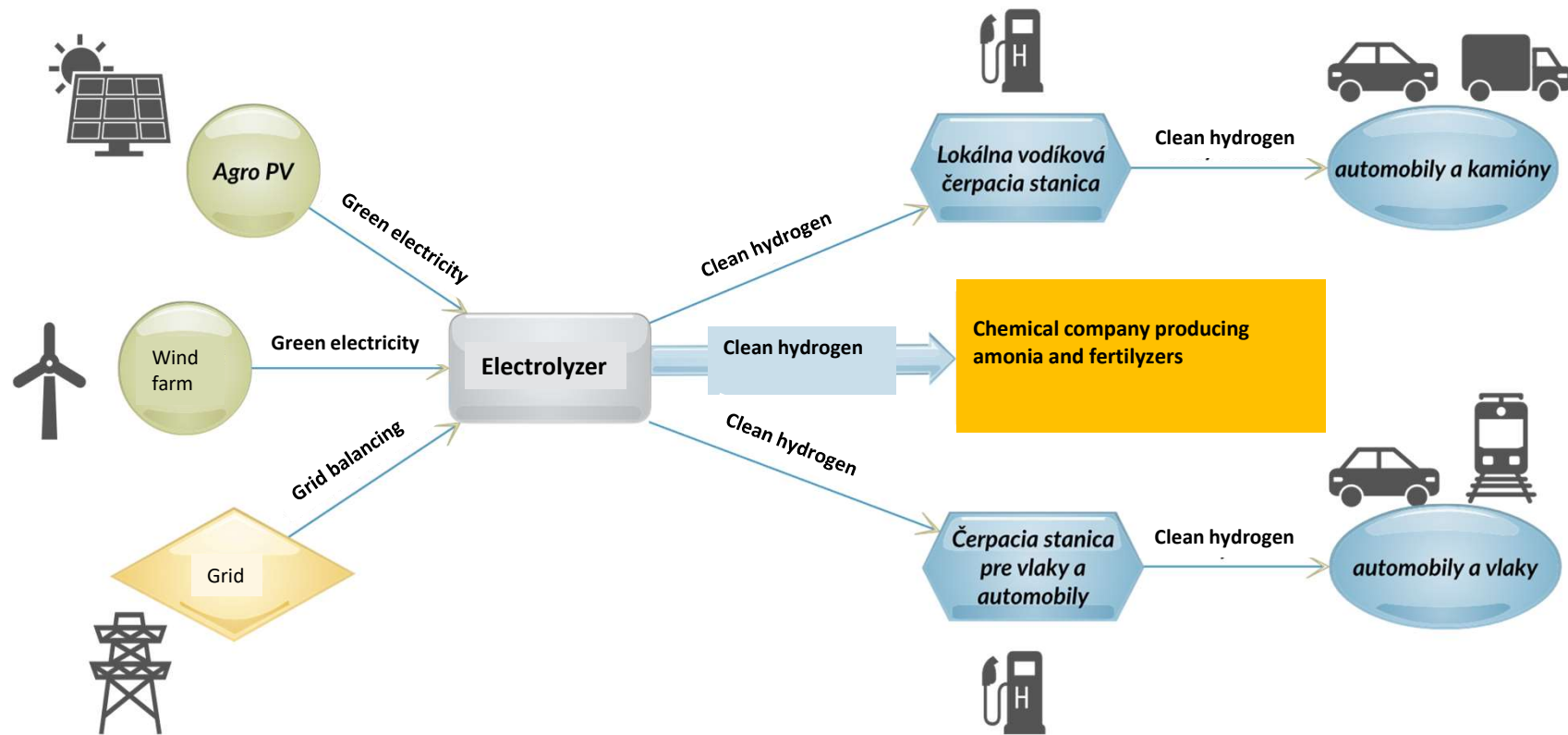
Cost comparison with electrification of the railroads

Selected railroad connecting reliable and cost effective hydrogen production site with coal region where transformation process has been developed



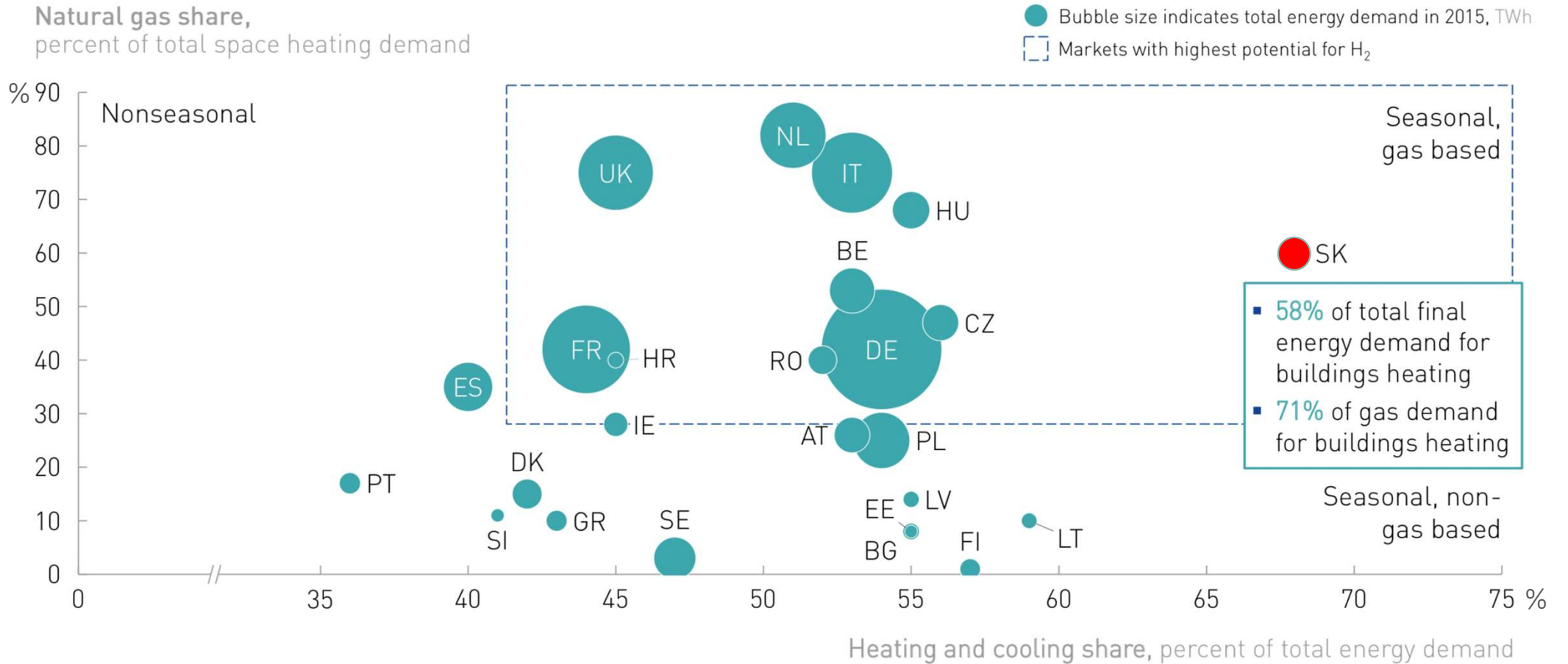
# HYDROGEN IN CHEMICAL INDUSTRY

## Projekt H2MUCTYNIC





# Potential of hydrogen in heating and cooling sector



Source: FCH JU 2019, Hydrogen Roadmap - Europe: A sustainable pathway for the European Energy Transition, <https://www.fch.europa.eu/publications>



**16,5 GWh** clean electricity daily production using wind, solar and hydro

**270 H<sub>2</sub>** hydrogen refuelling stations in V4 countries (25 in Slovakia) 5 of them already under construction

**40 hydrogen electrolyzers** able to produce 320 tons of hydrogen daily

**10 000 hydrogen heavy duty trucks** on the roads in V4 countries annually saves 890 000 tons of CO<sub>2</sub>

**IPCEI project 2020 - 2030**



20 spoločností

5 797 mil EUR investície

16,5 GW

270 VČS

12.500 nových + 40.000 udrжанých

116.800 t/rok

Wind, Solar, Hydro

- 4.212.000 t/rok komplet projekt

10.000 kamiónov

- 890 000 t/rok len kamióny

Renewables



Clean hydrogen production



Hydrogen refuelling stations



Hydrogen trucks

WWW.NVAS.SK

*Hydrogen will play a pivotal role in reaching  
the cost effective and clean EU economy*



**Thank you**

Prepared by NVAS Peter Hegeduš and Ján Weiterschütz  
October 2020