

## HI EAST 4 (Less-advanced)

### H2 Interconnection Hungary - Slovakia (repurposing)



#### Reasons for grouping [ENTSOG]

The project group aims at interconnecting future hydrogen infrastructure between Hungary and Slovakia.

The group includes investments in Slovakia (HYD-N-661) and in Hungary (HYD-N-732).

#### Objective of the group [Promoter]

Project will increase the capacity of the HI EAST 5 hydrogen corridor. Slovakia and Hungary. Project will also contribute to development of hydrogen economy in the involved countries. Increased interest in domestic hydrogen production and consumption in both countries is expected since this project will enable access to hydrogen transmission system and allow export and import of hydrogen. With this project Slovakia and Hungary will gain access to North Africa region via Italy and South-East hydrogen corridor GR/BG/RO/HU/SK. North Africa and South-East Europe region have vast RES potential and significant hydrogen quantities are expected to be imported from this region. Project will contribute to diversification of energy sources and supply routes, which would result in increase of energy (hydrogen) supply from third countries and EU member states as well. Project will establish a new hydrogen IP between Slovakia and Hungary. Hydrogen additional capacity in both SK-HU and HU-SK directions will be up to 100 GWh/d. Group is a part of broader pan-European corridor connecting production areas with demand ones.



**HYD-N-661** Adjustment of existing eus pipeline SK-HU

Comm. Year **2040**



**HYD-N-732** HU hydrogen corridor IV HU/SK

Comm. Year **2040**



## A. Project group technical information [Promoter/ ENTSOG]

### Project technical information [Promoter]

#### Hydrogen Transmission

TYNDP Project code	Section name	New / Repurposing	Nominal Diameter [mm]	Section Length [km]	Compressor power [MW]
HYD-N-661	SK part	Repurposing	800	20	0
HYD-N-732	Balassagyartmat-Vecsés	Repurposing	800	92	9+20
HYD-N-732	Vecsés-Városföld	New	800	76	
HYD-N-732	Vecsés-Ercsi	New	600	40	

### Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year
HYD-N-661	H2_IP_SK-HU	eustream, a.s.	Transmission Hungary (HU Hydrogen)	Transmission Slovakia (SK Hydrogen)	100	2040
HYD-N-661	H2_IP_SK-HU	eustream, a.s.	Transmission Slovakia (SK Hydrogen)	Transmission Hungary (HU Hydrogen)	100	2040
HYD-N-732	H2_IP_SK-HU	FGSZ Ltd.	Transmission Hungary (HU Hydrogen)	Transmission Slovakia (SK Hydrogen)	100	2040
HYD-N-732	H2_IP_SK-HU	FGSZ Ltd.	Transmission Hungary (HU Hydrogen)	Transmission Slovakia (SK Hydrogen)	100	2040

## B. Project Cost Information

During the TYNDP 2022 Project Data Collection, promoters were asked to indicate whether their costs were confidential or not. The following tables display the non-confidential costs provided by the promoters (as of December 2022, end of PCI project collection). The amounts provided can differ from the figures used by the project promoters in other contexts, where costs can be updated and/or evaluated using different methodologies or assumptions.

### [ENTSOG]

TYNDP Project code	CAPEX [M€]	CAPEX range [%]	OPEX [M€/y]	OPEX range [%]
HYD-N-661	1	30 %	1	30 %
HYD-N-732	365	30 %	20	30 %

#### Description of the cost and range [Promoter]

##### For project HYD-N-661

- CAPEX includes the cost for repurposing of the existing 20 km long pipeline suitable for hydrogen and one ball valve station. No compressors are installed.
- OPEX includes cleaning and diagnostic pigging, maintenance of control valves and ball valves, inspection of insulation, maintenance of cathodic protection

##### For project HYD-N-732

- Description of CAPEX: the cost and range based on pre-feasibility study. During the preparation of TYNDP project submission ACER unit cost was not available for hydrogen project. FGSZ applied ACER based HU NRA guideline unit cost for natural gas 2022 multiplied by 1.3 in case of new pipeline and new compressor unit, in case of repurposed pipeline multiplied by 0.3 and in case of repurposed compressor station multiplied by 0.5.
- Description of OPEX: the most significant impact on operating cost is the energy consumption of compressor stations. OPEX is estimated for max. capacity and electricity price 2022Q4, because FGSZ planned electric driven compressor units.

## C. Project Benefits [ENTSOG]

### C.1 Summary of benefits

This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. More details on the indicators are available in Annex D of TYNDP 2022<sup>1</sup>.

#### Distributed Energy

Project group has no benefit. Indeed, it is important to mention that the benefits of this project group are limited due to a competing project group (HI EAST 5, in 2029), located in the same geographical area connecting Slovakia and Hungary via the same route.

#### Sustainability

Project group is not reducing CO2 emissions in reference case and in all disruptions case.

#### Security of Supply:<sup>2</sup>

##### > Reference case

2040 DE - Benefits



2050 DE - Benefits



In the reference case, the project is not contributing to further mitigation of hydrogen demand curtailment risk in average summer and average winter.

##### > Climatic stress cases

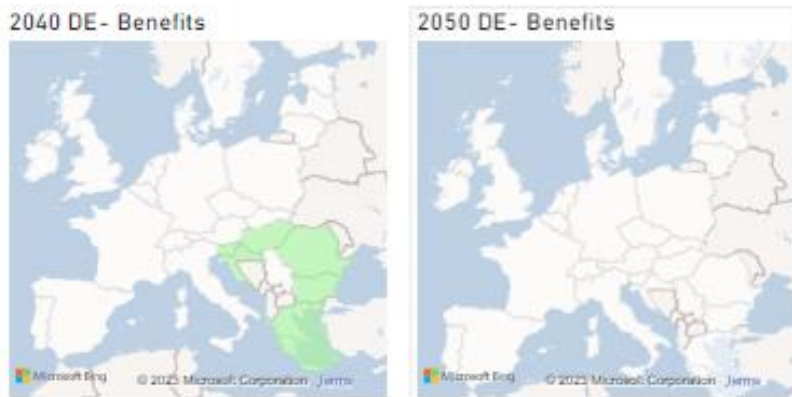
<sup>1</sup> [https://www.entsog.eu/sites/default/files/202304/ENTSOG\\_TYNDP\\_2022\\_Annex\\_D\\_Methodology\\_230411.pdf](https://www.entsog.eu/sites/default/files/202304/ENTSOG_TYNDP_2022_Annex_D_Methodology_230411.pdf)

<sup>2</sup> As for the hydrogen system there is no existing infrastructure level available yet, ENTSOG has identified a possible hydrogen network according to the information provided by promoters in their project submission for the TYNDP/PCI process (i.e., H2 Infrastructure level). Therefore, the System Assessment shows the results that could be reached (for different timestamps) under the hypothesis of a full commissioning of the H2 infrastructure projects that were submitted by project promoters but that are not yet in place. Therefore, even in configurations where no demand curtailment is identified (e.g., average winter in 2030) these results should not be read as an absence of H2 infrastructure needs for the given scenario. On the contrary, the full availability of the planned infrastructures composing the H2 infrastructure level is assumed to avoid the potential demand curtailment.

Under 2-week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group is also not showing security of supply benefits.

> **Disruption cases (S-1):**

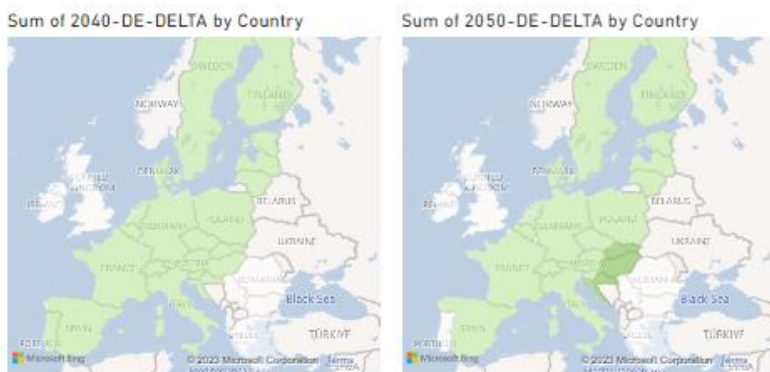
Under Ukrainian disruption case, the project group mitigates in Slovenia, Croatia, Hungary, Romania, Bulgaria and Greece, the risk of curtailment by 1-3% in 2040.



> **Single largest capacity disruption (SLCD):**

From 2040, the project group mitigates risk of demand curtailment in almost all European countries by 1-2%. More benefits are expected in 2050 in Slovakia, Hungary and Croatia by 8%.

Benefits 100% - 20% 20% - 5% 5% - 0%



## Global Ambition

Project group has no benefit. Indeed, it is important to mention that the benefits of this project group are limited due to a competing project group (HI EAST 5, in 2029), located in the same geographical area connecting Slovakia and Hungary via the same route.

## Sustainability

Project group is not reducing CO2 emissions in reference case and in all disruption's cases.

## Security of supply benefits

### > Reference case

2040 DE- Benefits



2050 DE- Benefits



In the reference case, the storage is not contributing to further mitigation of hydrogen demand curtailment risk in average summer and average winter.

### > Climatic stress cases

Under 2 -week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group is also not showing security of supply benefits.

### > Disruption cases (S-1)

Under Ukrainian disruption case, the project group mitigates in Slovenia, Croatia, Hungary, Romania, Bulgaria and Greece, the risk of curtailment by 3-4% from 2040.

2040 GA- Benefits



2050 GA- Benefits



> Single largest capacity disruption (SLCD)

In 2040, the project group mitigates risk of demand curtailment in almost all European countries by 1-2%.

Benefits  100% - 20%  20% - 5%  5% - 0%

Sum of 2040-GA-DELTA by Country



Sum of 2050-GA-DELTA by Country



## C.2 Quantitative benefits [ENTSOG]

The following tables display all the benefits quantified by ENTSOG through specific indicators and stemming from the realisation of the considered project group.

### CO2 Emissions:

ModelYear	Disruption	Scenario	Unit	Emission Delta	Emission Plus	Emission Minus
2030	NO DISRUPTION	DE	tonne	0	538.677.299	538.677.299
2030	NO DISRUPTION	GA	tonne	-5	592.910.448	592.910.454
2030	noLH2	DE	tonne	0	540.175.890	540.175.890
2030	noLH2	GA	tonne	0	594.817.481	594.817.481
2030	noNAh2	DE	tonne	0	539.785.356	539.785.356
2030	noNAh2	GA	tonne	0	594.141.433	594.141.433
2030	noNOh2	DE	tonne	0	538.877.198	538.877.198
2030	noNOh2	GA	tonne	0	593.310.994	593.310.994
2030	noUAh2	DE	tonne	0	539.378.772	539.378.772
2030	noUAh2	GA	tonne	0	593.627.618	593.627.618
2040	NO DISRUPTION	DE	tonne	0	392.077.044	392.077.044
2040	NO DISRUPTION	GA	tonne	0	396.523.252	396.523.252
2040	noLH2	DE	tonne	0	392.213.883	392.213.883
2040	noLH2	GA	tonne	0	397.455.197	397.455.197
2040	noNAh2	DE	tonne	0	392.188.098	392.188.098
2040	noNAh2	GA	tonne	0	397.301.977	397.301.977
2040	noNOh2	DE	tonne	0	392.144.023	392.144.023
2040	noNOh2	GA	tonne	0	397.450.977	397.450.977
2040	noUAh2	DE	tonne	1.809	392.399.183	392.397.374
2040	noUAh2	GA	tonne	0	397.478.498	397.478.498
2050	NO DISRUPTION	DE	tonne	0	232.557.735	232.557.735
2050	NO DISRUPTION	GA	tonne	0	228.306.707	228.306.707
2050	noLH2	DE	tonne	0	232.557.735	232.557.735
2050	noLH2	GA	tonne	0	228.306.707	228.306.707
2050	noNAh2	DE	tonne	0	232.557.735	232.557.735
2050	noNAh2	GA	tonne	0	228.306.707	228.306.707
2050	noNOh2	DE	tonne	0	232.557.735	232.557.735
2050	noNOh2	GA	tonne	0	228.306.707	228.306.707
2050	noRU	DE	tonne	0	232.557.735	232.557.735
2050	noRU	GA	tonne	0	228.306.707	228.306.707
2050	noUAh2	DE	tonne	0	232.557.735	232.557.735
2050	noUAh2	GA	tonne	0	228.306.707	228.306.707

### Curtailment Rate (SLCD):

Country	2030-DE-DELTA	2030-GA-DELTA	2040-DE-DELTA	2040-GA-DELTA	2050-DE-DELTA	2050-GA-DELTA
Belgium	0%	0%	-2%	-1%	-1%	0%
Czechia	0%	0%	-2%	-2%	-2%	0%
Estonia	0%	0%	-2%	-1%	-2%	0%
Finland	0%	0%	-2%	-1%	-2%	0%
Germany	0%	0%	-2%	-1%	-1%	0%
Latvia	0%	0%	-2%	-1%	-1%	0%
Lithuania	0%	0%	-2%	-1%	-1%	-1%
Poland	0%	0%	-2%	-1%	-1%	0%
Portugal	0%	0%	-2%	-1%	0%	0%
Slovenia	0%	0%	-2%	-1%	-1%	0%
Sweden	0%	0%	-2%	-1%	-2%	0%
Switzerland	0%	0%	-2%	-1%	-1%	-1%
France	0%	0%	-2%	-1%	-1%	0%
The Netherlands	0%	0%	-1%	-1%	-2%	0%
Austria	0%	0%	-1%	-1%	-2%	0%
Croatia	0%	0%	-1%	0%	-8%	0%
Denmark	0%	0%	-1%	-1%	-1%	0%
Hungary	0%	0%	-1%	0%	-8%	0%
Italy	0%	0%	-1%	-1%	-2%	0%
Slovakia	0%	0%	-1%	0%	-8%	-1%
Spain	0%	0%	-1%	-1%	-1%	0%

### Curtailment Rate (Climatic Stress):

SimulationPeriod	Country	2030-DE-DELTA	2030-GA-DELTA	2040-DE-DELTA	2040-GA-DELTA	2050-DE-DELTA	2050-GA-DELTA
Average2W	Austria	0%	0%	0%	0%	0%	0%
Average2W	Belgium	0%	0%	0%	0%	0%	0%
Average2W	Bulgaria	0%	0%	0%	-1%	0%	0%
Average2W	Croatia	0%	0%	0%	0%	0%	0%
Average2W	Cyprus	0%	0%	0%	0%	0%	0%
Average2W	Czechia	0%	0%	0%	0%	0%	0%
Average2W	Denmark	0%	0%	0%	-1%	0%	0%
Average2W	Estonia	0%	0%	0%	0%	0%	0%
Average2W	Finland	0%	0%	0%	0%	0%	0%
Average2W	France	0%	0%	0%	0%	0%	0%
Average2W	Germany	0%	0%	0%	0%	0%	0%
Average2W	Greece	0%	0%	0%	0%	0%	0%
Average2W	Hungary	0%	0%	0%	0%	0%	0%
Average2W	Ireland	0%	0%	0%	0%	0%	0%
Average2W	Italy	0%	0%	0%	0%	0%	0%
Average2W	Latvia	0%	0%	0%	0%	0%	0%

Average2W	Lithuania	0%	0%	0%	0%	0%	0%
Average2W	Luxembourg	0%	0%	0%	0%	0%	0%
Average2W	Malta	0%	0%	0%	0%	0%	0%
Average2W	Poland	0%	0%	0%	0%	0%	0%
Average2W	Portugal	0%	0%	0%	0%	0%	0%
Average2W	Romania	0%	0%	0%	0%	0%	0%
Average2W	Serbia	0%	0%	0%	0%	0%	0%
Average2W	Slovakia	0%	0%	0%	0%	0%	0%
Average2W	Slovenia	0%	0%	0%	-1%	0%	0%
Average2W	Spain	0%	0%	0%	0%	0%	0%
Average2W	Sweden	0%	0%	0%	0%	0%	0%
Average2W	Switzerland	0%	0%	0%	0%	0%	0%
Average2W	The Netherlands	0%	0%	0%	0%	0%	0%
Average2W	United Kingdom	0%	0%	0%	0%	0%	0%
Average2WDF	Austria	0%	0%	0%	0%	0%	0%
Average2WDF	Belgium	-1%	0%	0%	0%	0%	0%
Average2WDF	Bulgaria	0%	0%	0%	0%	0%	0%
Average2WDF	Croatia	0%	0%	0%	0%	0%	0%
Average2WDF	Cyprus	0%	0%	0%	0%	0%	0%
Average2WDF	Czechia	0%	0%	0%	0%	0%	0%
Average2WDF	Denmark	0%	0%	0%	0%	0%	0%
Average2WDF	Estonia	0%	0%	0%	0%	0%	0%
Average2WDF	Finland	0%	0%	0%	0%	0%	0%
Average2WDF	France	0%	0%	0%	0%	0%	0%
Average2WDF	Germany	0%	0%	0%	0%	0%	0%
Average2WDF	Greece	0%	0%	0%	0%	0%	0%
Average2WDF	Hungary	0%	0%	0%	0%	0%	0%
Average2WDF	Ireland	0%	0%	0%	0%	0%	0%
Average2WDF	Italy	0%	0%	0%	0%	0%	0%
Average2WDF	Latvia	0%	0%	0%	0%	0%	0%
Average2WDF	Lithuania	0%	0%	0%	0%	0%	0%
Average2WDF	Luxembourg	0%	0%	0%	0%	0%	0%
Average2WDF	Malta	0%	0%	0%	0%	0%	0%
Average2WDF	Poland	0%	0%	0%	0%	0%	0%
Average2WDF	Portugal	0%	0%	0%	0%	0%	0%
Average2WDF	Romania	0%	0%	0%	0%	0%	0%
Average2WDF	Serbia	0%	0%	0%	0%	0%	0%
Average2WDF	Slovakia	0%	0%	0%	0%	0%	0%
Average2WDF	Slovenia	0%	0%	0%	0%	0%	0%
Average2WDF	Spain	0%	0%	0%	0%	0%	0%
Average2WDF	Sweden	0%	0%	0%	0%	0%	0%
Average2WDF	Switzerland	0%	0%	0%	0%	0%	-1%
Average2WDF	The Netherlands	0%	0%	0%	0%	0%	0%
Average2WDF	United Kingdom	0%	0%	0%	0%	0%	0%
DC	Austria	0%	0%	0%	0%	0%	0%

DC	Belgium	0%	0%	0%	0%	0%	0%
DC	Bulgaria	0%	0%	0%	0%	0%	0%
DC	Croatia	0%	0%	0%	0%	0%	0%
DC	Cyprus	0%	0%	0%	0%	0%	0%
DC	Czechia	0%	0%	0%	0%	0%	0%
DC	Denmark	0%	0%	0%	0%	0%	0%
DC	Estonia	0%	0%	0%	0%	0%	0%
DC	Finland	0%	0%	0%	0%	0%	0%
DC	France	0%	0%	0%	0%	0%	0%
DC	Germany	0%	0%	0%	0%	0%	0%
DC	Greece	0%	0%	0%	0%	0%	0%
DC	Hungary	0%	0%	0%	0%	0%	0%
DC	Ireland	0%	0%	0%	0%	0%	0%
DC	Italy	0%	0%	0%	0%	0%	0%
DC	Latvia	0%	0%	0%	0%	0%	0%
DC	Lithuania	0%	0%	0%	0%	0%	0%
DC	Luxembourg	0%	0%	0%	0%	0%	0%
DC	Malta	0%	0%	0%	0%	0%	0%
DC	Poland	0%	0%	0%	0%	0%	0%
DC	Portugal	0%	0%	0%	0%	0%	0%
DC	Romania	0%	0%	0%	0%	0%	0%
DC	Serbia	0%	0%	0%	0%	0%	0%
DC	Slovakia	0%	0%	0%	0%	0%	0%
DC	Slovenia	0%	0%	0%	0%	0%	0%
DC	Spain	0%	0%	0%	0%	0%	0%
DC	Sweden	0%	0%	0%	0%	0%	0%
DC	Switzerland	0%	0%	0%	0%	-1%	0%
DC	The Netherlands	0%	0%	0%	0%	0%	0%
DC	United Kingdom	0%	0%	0%	0%	0%	0%

## D. Environmental Impact [Promoter]

Any gas infrastructure has an impact on its surroundings. This impact is of particular relevance when crossing some environmentally sensitive areas. Mitigation measures are taken by the promoters to reduce this impact and comply with the EU and National regulations.

TYNDP Code	Type of infrastructure	Surface of impact	Environmentally sensitive area
HYD-N-661	N/A	N/A	N/A
HYD-N-732	N/A	N/A	N/A

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs
HYD-N-661	N/A	N/A	N/A
HYD-N-732	N/A	N/A	N/A

### Environmental Impact explained [Promoter]

#### SK part

This project uses the repurposed natural gas pipeline. No compressor station, no noise emissions on SK side are foreseen. Considering the relief of the country, no investments in anti-flooding measures are expected nor landslide remediation measures. Environmental impact is expected only during the construction phase.

#### HU part

This project uses partially the repurposed natural gas pipeline and compressor station, and new pipeline sections and new compressor unit as well. All new pipelines will be built parallel with existing ones. Environmental impact on the Hungarian side is expected only during the construction phase, but not envisaged major difficulties. In case of repurposing the environmental impact is more modest. Compressor will be electricity driven compressor.

## E. Other benefits [Promoter]

Missing benefits are all benefits of a project which may be not captured by ENTSG analysis.

As a necessary condition a missing benefit cannot have discrepancies with the benefits already covered by the assessment run by ENTSG and this condition needs to be proved and justified.

### Description of Other benefits [Promoter]

#### SK part

- Project will give positive signals to the future hydrogen market development and could decrease uncertainty of other parts of hydrogen value chain to further invest into the hydrogen industrial technology or final customers' appliances.
- Connecting the project to another production area reduces Europe's dependence on a limited number of hydrogen producers with a positive impact on sustainability, hydrogen availability and affordability.

#### HU Part

- Along the pipeline route hydrogen producers will have the possibility to establish electrolyzer and hydrogen entry points in both countries.
- The project group will help development of hydrogen economy in Central part of Hungary.
- Together with HI EAST 4 creates the RO>HU>SK hydrogen corridor and the South-Eastern EU region excess H2 supply from TR, GR, BG and RO can be delivered towards Slovakia and downstream countries, and also possible to deliver H2 from the Slovak system toward HU, RO, BG.

## F. Useful links [Promoter]

### Useful links:

HU/SK hydrogen corridor: [FGSZ Földgázszállító Alcím dia 1](#)

[Central European Hydrogen Corridor \(cehc.eu\)](#)

[European Hydrogen Backbone Maps | EHB European Hydrogen Backbone](#)