HI EAST 8 (Less-advanced)

H2 Interconnection Ukraine-Slovakia

Reasons for grouping [ENTSOG]

The project group aims at interconnecting future hydrogen infrastructure between Ukraine and Slovakia and extending towards the border of Czech Republic by repurposing existing natural gas infrastructure.

The group includes investments in Ukraine (HYD-N-1137) and Slovakia (HYD-N-1264).

Objective of the group [Promoter]

Group is a part of broader pan-European corridor connecting production areas with demand ones. Objective of the project is to supply hydrogen in a reliable and sustainable manner from perspective hydrogen production areas of Ukraine to potential industrial offtake centers along the project route and for domestic consumption (blend of natural gas and hydrogen as a 1. step) in Slovakia and Ukraine, mainly via repurposed existing gas infrastructure.

HYD-N-1137 **Central European Hydrogen Corridor (UKR part)**

Comm. Year **2029**

HYD-N-1264 **Central European Hydrogen Corridor (SK part)**

Comm. Year **2029**

A. Project group technical information [Promoter/ ENTSOG]

Project technical information [Promoter]

UA (Gas TSO of Ukraine): The Ukrainian part of the project involves the gradual repurposing of the gas transport infrastructure from the western border, primarily to the Transcarpathian regions, and extending it to the rest of Ukraine. The Ukrainian part of the project will be implemented in several stages. The first two stages involve the modification of the existing gas transportation infrastructure for the transportation of 100% H2 and are considered integral parts of the project. The third stage is currently considered as a separate project, as it involves the creation of hydrogen infrastructure in the middle of the country. The third stage in the future may be divided into several more stages.
In the first stage, one section of the main gas pipeline with a length of 43.1 km from the state border to the connection point (pipe jump-over line) with the main pipeline to Hungary (hereafter: 43.1 km of pipline) will be repurposed.
In the second stage, the 125 km long section of the main gas pipeline from the connection point with the main pipeline to Hungary to the CS Bohorodchany will be repurposed.
It's important to note that the cost of each stage may change after conducting R&D or a feasibility study, which might also involve considering alternative pipeline options.

SK (eustream) : Repurposing of one transmission line for 100% H2 ready in Slovakia consists of 2 projects. The first one is the project “Infrastructure repurpose for H2 transmission in Slovakia” connecting non-EU point Veľké Kapušany with IP Baumgarten. The second one is “CEHC (SK part)” connecting non-EU point Veľké Kapušany with IP Lanžhot. Both projects complement each other and technically cannot exist separately. CEHC (SK part) aims to create a corridor for transmission of H2 from production area in Ukraine for needs of Slovakia and also for transit from Slovakia via the Czech Republic to Germany. H2 can be transported via CEHC (SK part) also to Hungary and Poland which are directly connected to Slovak transmission network. Reassessment of the technical solution, resulting in the identification of another line for repurposing has had a positive impact on costs as CAPEX are significantly lower in the estimated amount of 448 M€ and the capacity increment has been updated to 218 GWh/d at the non-EU point Veľké Kapušany. Such a high incremental capacity will need to be covered with 2 newly built compressor stations with a compressor power of 120 MW. The project will create up 144 GWh/d connection capacity at the IP Lanžhot. It is necessary to note that volumes entering the non-EU point Veľké Kapušany will be split into 2 IPs - Lanžhot and Baumgarten up to their technical capacities. The length of the CEHC (SK part) is of 455 km out which 40km belongs to DN 900 and 415 km to DN 1200. Estimated commissioning year is 2029.

Hydrogen Transmission

TYNDP Project code	Section name	New / Repurposing	Nominal Diameter [mm]	Section Length [km]	Compressor power [MW]
HYD-N-1137	Phase 1: 43.1 km of pipeline to IP Ukraine-Slovakia	Repurposing	1400	43.1	0

HYD-N-1137	Phase 2: 43.1 km of pipeline toCS Bohorodchany)	Repurposing	1400	125	0
HYD-N-1264	CEHC (SK part)	Repurposing	900 1200	40 415	120

Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year
HYD-N-1137	H2_IP_SK-UA	LLC Gas TSO of Ukraine	Transmission Ukraine (UA Hydrogen)	Transmission Slovakia (SK Hydrogen)	240	2029
HYD-N-1264	H2_IP_SK-UA	eustream, a.s.	Transmission Ukraine (UA Hydrogen)	Transmission Slovakia (SK Hydrogen)	240	2029

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€]	OPEX range [%]
Phase 1: HYD-N-1137	29.4	100%	0.25	100%
Phase 2: HYD-N-1137	90.0	100%	1.00	100%
HYD-N-1264	700*	30%	90	30%

Description of the cost and range [Promoter]

* SK part – HYD-N-1264 - Initially, the hydraulic analysis were focused on a different line in a significantly worse technical condition.

Dramatic change of geopolitical situation was the impetus for market hydrogen demand acceleration which would result in faster implementation pace. This also caused a reassessment of the technical solution, the result of which is the identification of another line for repurposing with significantly lower CAPEX in the estimated amount of 448 M€ and the capacity increment has been updated to 218 GWh/d.

Repurposing of one transmission line for 100% H2 ready line in Slovakia consists of 2 projects. The first one is the project „Infrastructure repurpose for H2 transmission in Slovakia" connecting a non-EU point Veľké Kapušany with IP Baumgarten. The second one is „CEHC (SK part)" connecting a non-EU point Veľké Kapušany with IP Lanžhot. Both projects complement each other and cannot exist without each other. It means that the projects are technically interconnected but they are administered separately.

It is necessary to note that both projects share CAPEX and OPEX in significant portion (the section from the UA border to the split point in western part of Slovakia).

UA part: HYD-N-1137 - The Ukrainian part of the project involves the gradual repurposing of the gas transport infrastructure from the western border, primarily to the Transcarpathian regions, and extending it to the rest of Ukraine. In the first stage, one thread of the main gas pipeline with a length of 43.1 km from the state border to the connection point with the main pipeline to Hungary will be repurposed. The expected cost for this stage will be approximately EUR 29.4 million.

In the second stage, the 125 km long section of the main gas pipeline from the connection point with the main pipeline to Hungary to the CS Bohorodchany will be repurposed. The expected cost for this stage will be about EUR 60.5 million. It's important to note that the cost of each stage may change after conducting R&D or a feasibility study, which might also involve considering alternative pipeline options.

C. Project Benefits [ENTSOG]

C.1 Summary of benefits

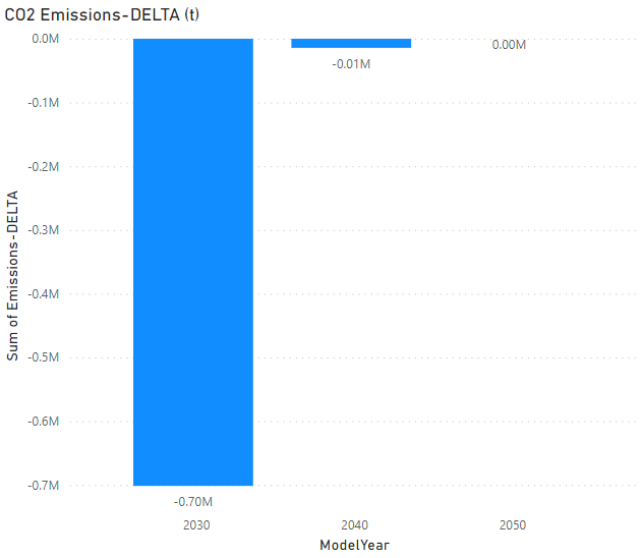
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. More details on the indicators are available in Annex D of TYNDP 2022[1].

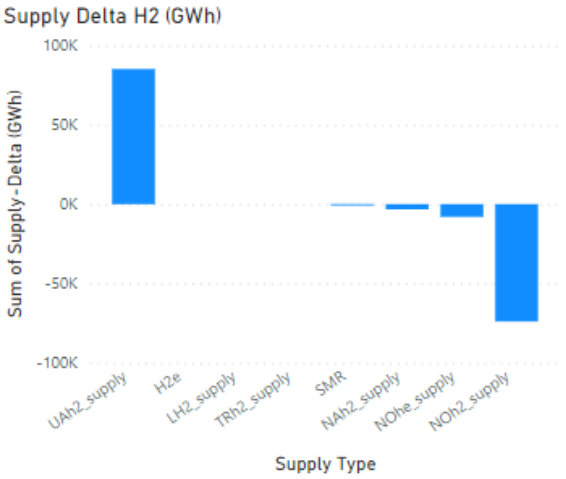
[1] https://www.entsog.eu/sites/default/files/2023-04/ENTSOG_TYNDP_2022_Annex_D_Methodology_230411.pdf

Distributed Energy

Sustainability benefits

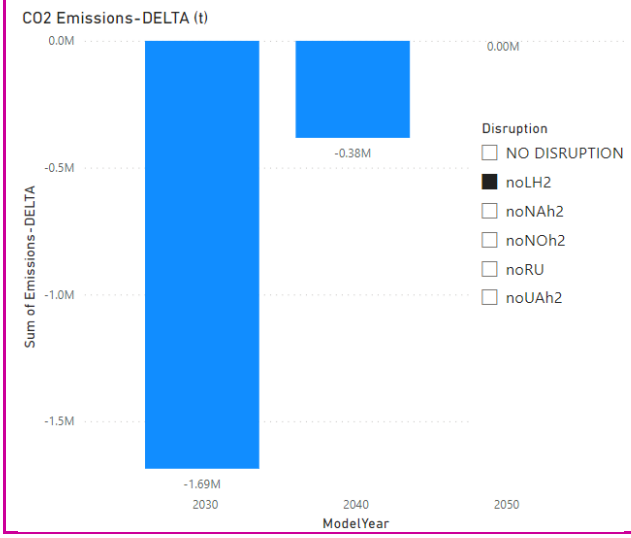
From 2029 onwards the project group brings green hydrogen from Ukraine towards Slovakia and can then flow further to European countries. In the reference case, which analyses yearly demand in two periods (average winter and average summer), the project group will contribute to sustainability by reducing overall CO2 emissions by 0,7 million tons in 2030. The project group will enable transport of green hydrogen producted in Ukraine and therefore, will reduce blue hydrogen imports from Norway.

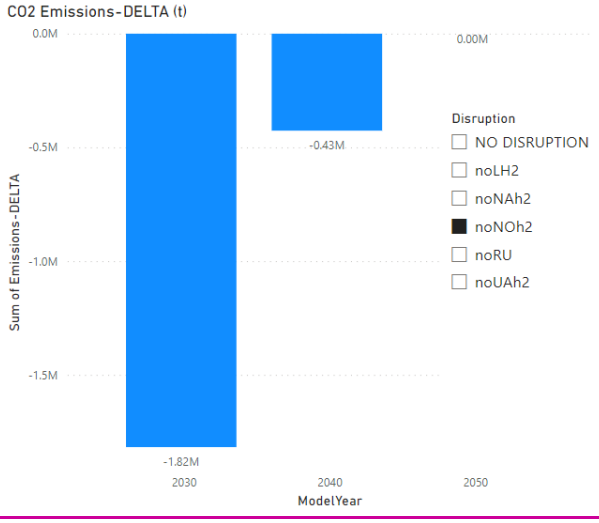


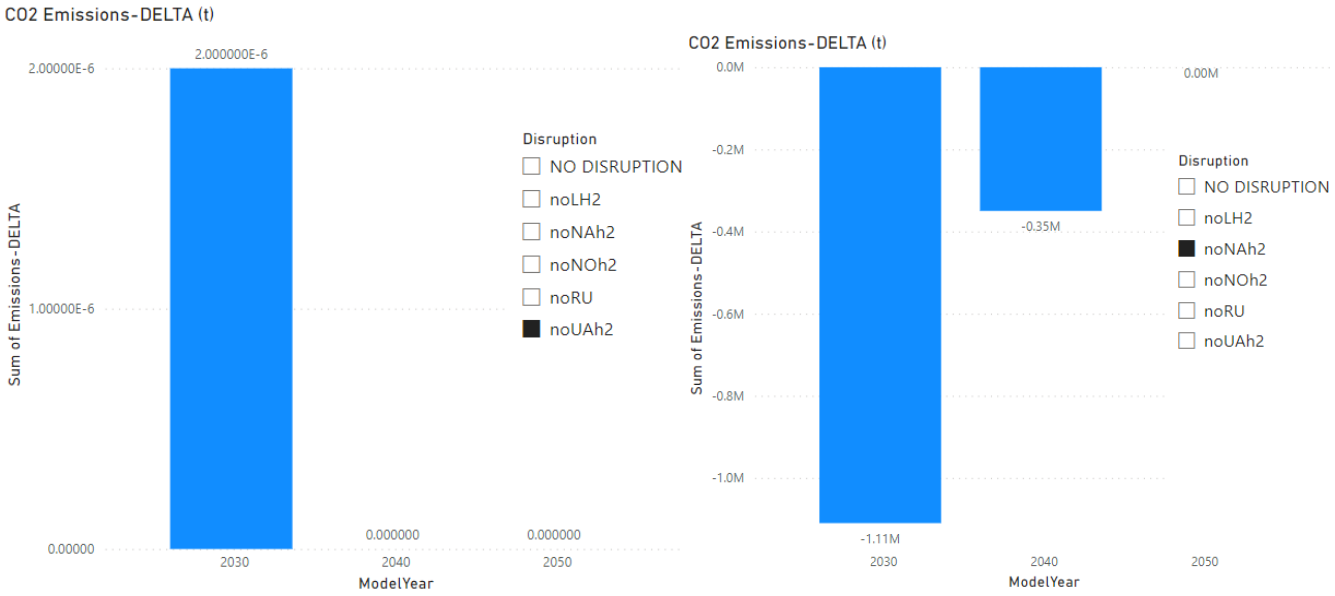


Increased benefits are expected under disruption cases besides of Ukraine disruption in 2030.

1 noLH2 : LH2 disruption / 2 noNOh2 : Norway disruption / 3 noUAh2 : Ukraine disruption/ 4 noNAh2 : North Africa disruption



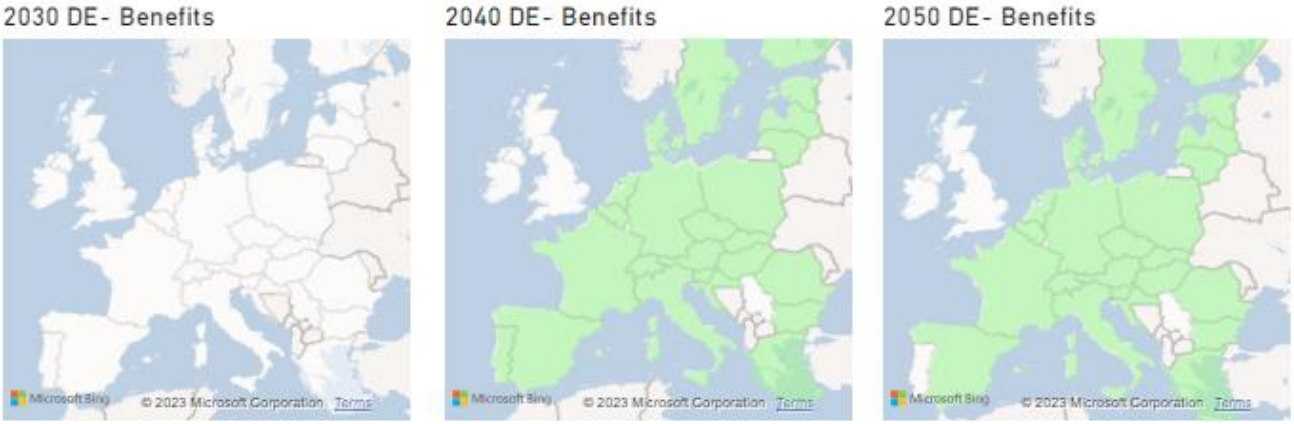




Security of Supply:[2]

> Reference case:

The conversion of the existing natural gas infrastructure doesn't impact the methane demand and will bring positive security of supply benefits for almost all European countries. The project group mitigates the risk of hydrogen demand curtailment in many European countries in 2040 in average winter by 2-6% and by 2-14% in 2050.



> Climatic stress cases:

[2] *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)*

Under 2 -week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group increases mitigation of risk of hydrogen demand curtailment in almost all European countries from 2030 by 6 - 17%. This can go up to 23% in Slovakia and Hungary in 2050.

> Disruption cases (S-1):

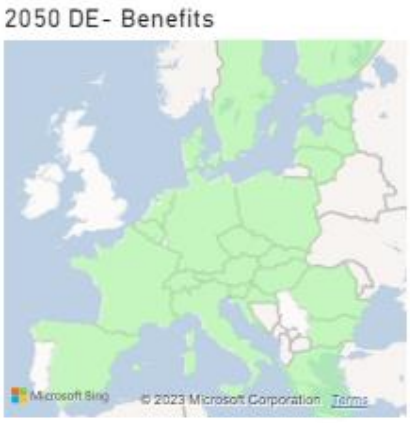
Similarly, under supply disruption cases besides Ukraine disruption, the project group shows improved benefits for mitigating the risk of demand curtailment by 2-12% from 2040 and up to 21% in Slovakia in 2050. In case of North Africa disruption countries in central southeast Europe are already benefitting in 2030.

Maps for specifics disruptions: 1 noLH2 : LH2 disruption / 2 noNOh2 : Norway disruption / 3 noUAh2 : Ukraine disruption/ 4 noNAh2 : North Africa disruption

1 noLH2: LH2 disruption

2 noNOh2: Norway disruption

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.



3 noUAh2: Ukraine disruption

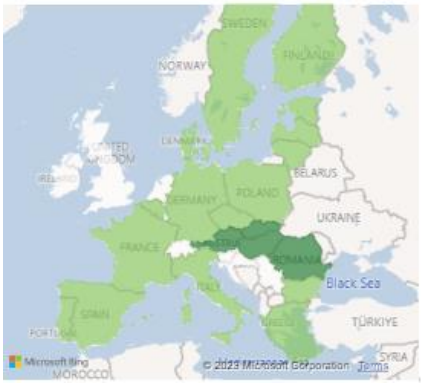
4 noNAh2: North Africa disruption

> Single largest capacity disruption (SLCD):

In case of SLCD all European countries benefitting from this project group by mitigating the risk of demand curtailment. The highest benefits are recorded in 2030, including 25-30% for Austria, Slovakia, Hungary and Romania and around 8-15% for the other European Countries.

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

SLCD Benefits - 2030 - Distributed Energy



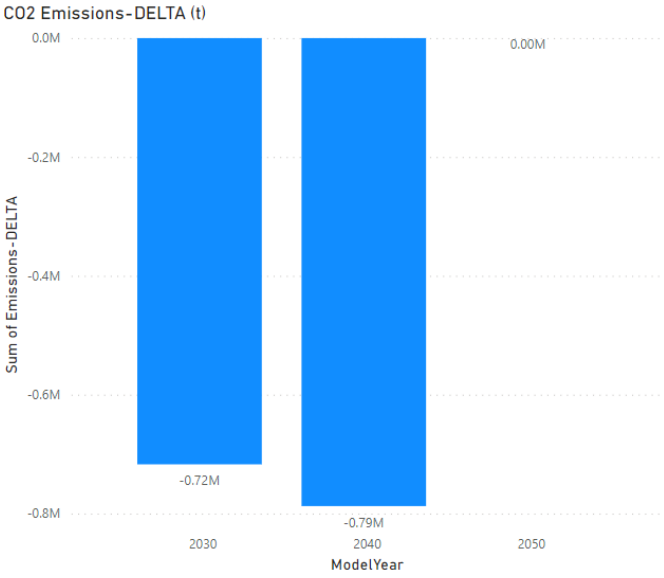
SLCD Benefits - 2040 - Distributed Energy

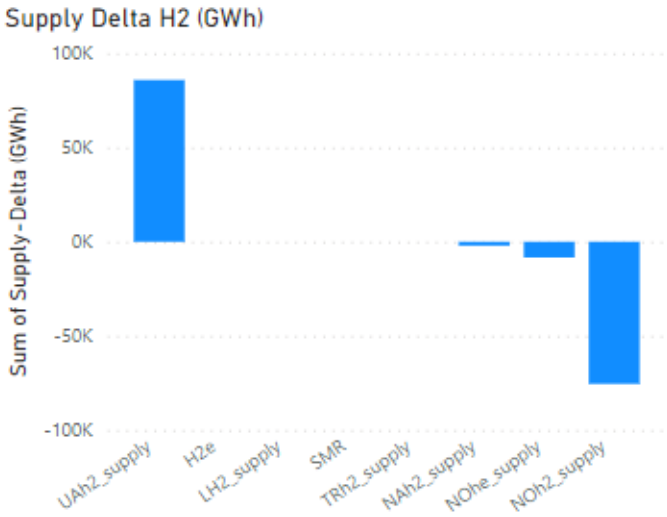
SLCD Benefits - 2050 - Distributed Energy

Global Ambition

Sustainability benefits

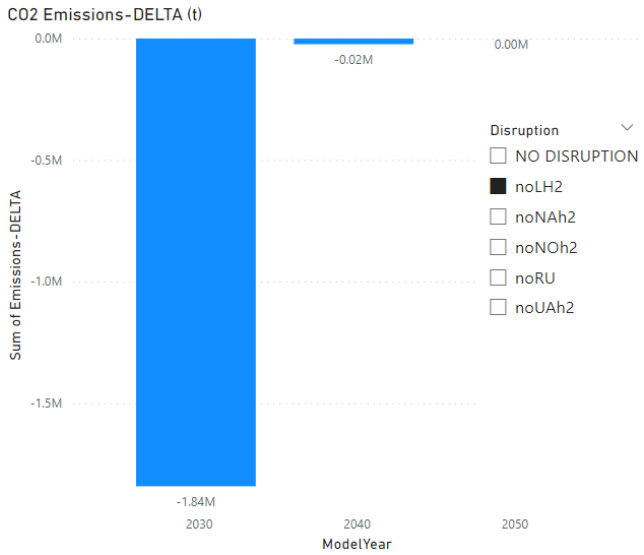
In the reference case, which analyses yearly demand in two periods (average winter and average summer), the project group will contribute to sustainability by reducing overall CO2 emissions by 0.72 million tons in 2030 and 0.79 million tons in 2040. The project group will enable transport of green hydrogen producted in Ukraine and therefore, will reduce blue hydrogen imports from Norway.

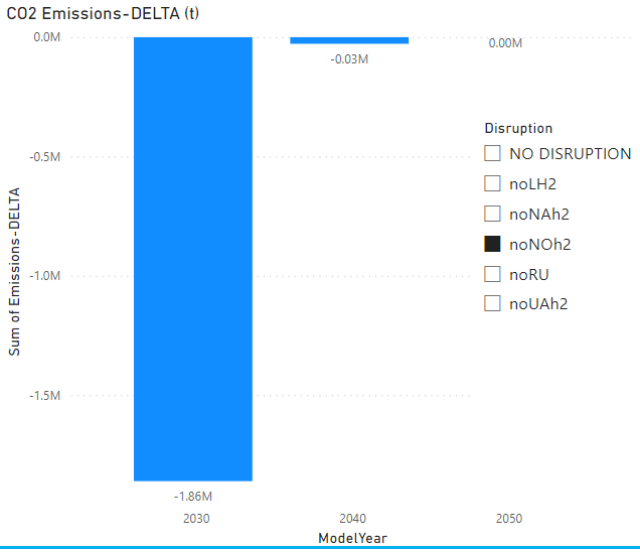


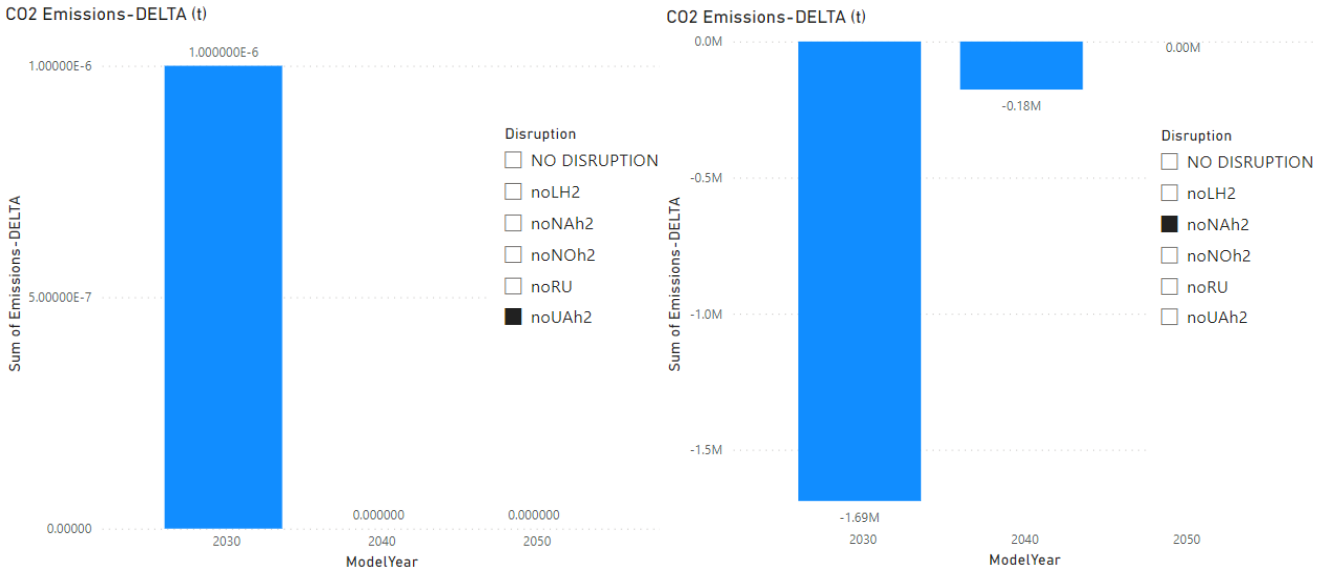


Increased benefits are expected under disruption cases besides of Ukraine disruption in 2030.

1 noLH2 : LH2 disruption / 2 noNOh2 : Norway disruption / 3 noUAh2 : Ukraine disruption/ 4 noNAh2 : North Africa disruption



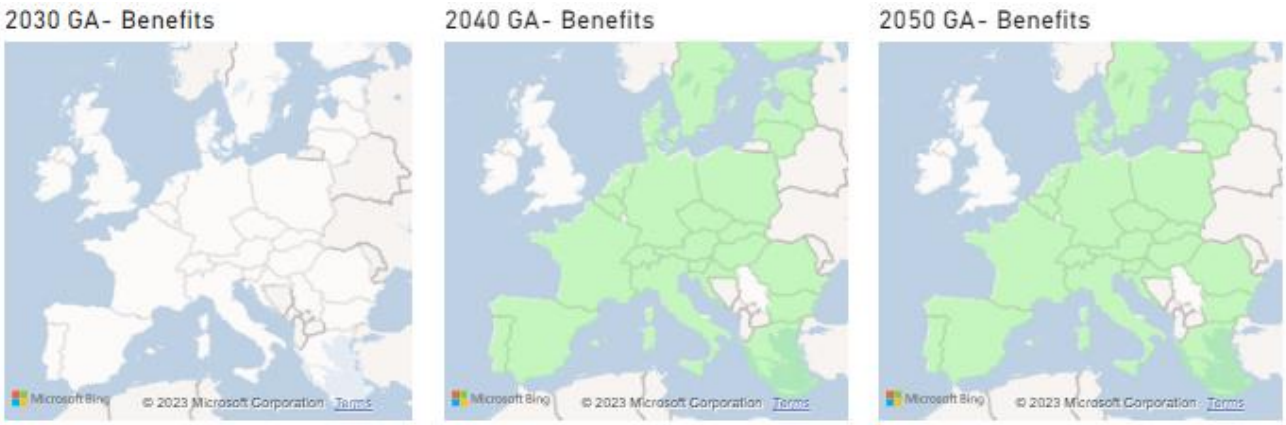




Security of supply:

> Reference case

The conversion of the existing natural gas infrastructure doesn't impact the methane demand and will bring positive security of supply benefits for almost all European countries from 2040 onwards. The project group mitigates the risk of hydrogen demand curtailment in many European countries in 2040 in average winter by 4-6% and by 1-6% in 2050.



> Climatic stress cases

Under 2 -week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group already shows benefits in 2030 by mitigating the risk of hydrogen demand curtailment by 18-19% for many countries. For 2040 and 2050 the project group shows similar results as for the reference case.

> Disruption cases (S-1):

Similarly, under supply disruption cases besides Ukraine disruption, the project group shows improved benefits for mitigating the risk of demand curtailment by 3-11% from 2040 and by 1-5% in 2050. In case of North Africa disruption countries in central south east Europe are already benefitting in 2030 and on a larger extent in 2040 and 2050.

Maps for specifics disruptions: 1 noLH2 : LH2 disruption / 2 noNOh2 : Norway disruption / 3 noUAh2 : Ukraine disruption/ 4 noNAh2 : North Africa disruption

1 noLH2: LH2 disruption

2 noNOh2: Norway disruption

3 noUAh2: Ukraine disruption

4 noNAh2: North Africa disruption

Single largest capacity disruption (SLCD)

In case of SLCD all European countries benefitting from this project group by mitigating the risk of demand curtailment. The highest benefits are recorded in 2030, including 25-30% for Austria, Slovakia, Hungary and Romania and around 8-11% for the other European Countries.

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

SLCD Benefits - 2030 - Global Ambition

SLCD Benefits - 2040 - Global Ambition

SLCD Benefits - 2050 - Global Ambition

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:

GROUP Number	ModelYear	Disruption	Scenario	Unit	Emission Delta	Emission Plus	Emission Minus
HI EAST 8	2030	NO DISRUPTION	DE	tonne	-701.473	538.677.299	539.378.772
HI EAST 8	2030	NO DISRUPTION	GA	tonne	-717.169	592.910.448	593.627.618
HI EAST 8	2030	noLH2	DE	tonne	-1.687.028	540.175.890	541.862.918
HI EAST 8	2030	noLH2	GA	tonne	-1.842.126	594.817.481	596.659.607
HI EAST 8	2030	noNAh2	DE	tonne	-1.110.004	539.785.356	540.895.360
HI EAST 8	2030	noNAh2	GA	tonne	-1.688.367	594.141.433	595.829.800
HI EAST 8	2030	noNOh2	DE	tonne	-1.817.854	538.877.198	540.695.052
HI EAST 8	2030	noNOh2	GA	tonne	-1.860.422	593.310.994	595.171.416
HI EAST 8	2030	noUAh2	DE	tonne	0	539.378.772	539.378.772
HI EAST 8	2030	noUAh2	GA	tonne	0	593.627.618	593.627.618
HI EAST 8	2040	NO DISRUPTION	DE	tonne	-14.284	392.077.044	392.091.328
HI EAST 8	2040	NO DISRUPTION	GA	tonne	-787.400	396.523.252	397.310.651
HI EAST 8	2040	noLH2	DE	tonne	-382.530	392.213.883	392.596.414
HI EAST 8	2040	noLH2	GA	tonne	-23.302	397.455.197	397.478.498
HI EAST 8	2040	noNAh2	DE	tonne	-349.804	392.188.098	392.537.902
HI EAST 8	2040	noNAh2	GA	tonne	-176.522	397.301.977	397.478.498
HI EAST 8	2040	noNOh2	DE	tonne	-426.305	392.144.023	392.570.328
HI EAST 8	2040	noNOh2	GA	tonne	-27.521	397.450.977	397.478.498
HI EAST 8	2040	noUAh2	DE	tonne	0	392.399.183	392.399.183
HI EAST 8	2040	noUAh2	GA	tonne	0	397.478.498	397.478.498
HI EAST 8	2050	NO DISRUPTION	DE	tonne	0	232.557.735	232.557.735
HI EAST 8	2050	NO DISRUPTION	GA	tonne	0	228.306.707	228.306.707
HI EAST 8	2050	noLH2	DE	tonne	0	232.557.735	232.557.735
HI EAST 8	2050	noLH2	GA	tonne	0	228.306.707	228.306.707
HI EAST 8	2050	noNAh2	DE	tonne	0	232.557.735	232.557.735
HI EAST 8	2050	noNAh2	GA	tonne	0	228.306.707	228.306.707
HI EAST 8	2050	noNOh2	DE	tonne	0	232.557.735	232.557.735
HI EAST 8	2050	noNOh2	GA	tonne	0	228.306.707	228.306.707
HI EAST 8	2050	noRU	DE	tonne	0	232.557.735	232.557.735
HI EAST 8	2050	noRU	GA	tonne	0	228.306.707	228.306.707
HI EAST 8	2050	noUAh2	DE	tonne	0	232.557.735	232.557.735
HI EAST 8	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
Romania	-29%	-30%	-16%	-5%	-10%	-6%
Croatia	0%	0%	-16%	-6%	-19%	-7%
Hungary	-29%	-30%	-16%	-5%	-18%	-6%
Slovakia	-30%	-30%	-16%	-5%	-20%	-7%
Bulgaria	-15%	-9%	-8%	-4%	-10%	-7%
Greece	-14%	-9%	-6%	-3%	-9%	-6%
Slovenia	0%	0%	-4%	-3%	-3%	-7%
Czechia	-9%	-9%	-3%	-3%	-3%	-2%
Austria	-25%	-25%	-3%	-3%	-3%	-7%
Belgium	-8%	-8%	-3%	-3%	-2%	-2%
Denmark	-9%	-8%	-3%	-3%	-2%	-2%
Estonia	-9%	-8%	-3%	-3%	-2%	-2%
Finland	-9%	-8%	-3%	-2%	-2%	-2%
France	-9%	-8%	-3%	-3%	-3%	-2%
Germany	-8%	-9%	-3%	-3%	-2%	-2%
Italy	-14%	-11%	-3%	-2%	-3%	-3%
Latvia	-9%	-8%	-3%	-3%	-2%	-2%
Lithuania	-8%	-8%	-3%	-3%	-2%	-2%
Poland	-8%	-9%	-3%	-3%	-2%	-2%
Portugal	-9%	-8%	-3%	-2%	-2%	-3%
Spain	-9%	-8%	-3%	-3%	-3%	-3%
Sweden	-9%	-8%	-3%	-3%	-2%	-2%
Switzerland	0%	0%	-3%	-2%	-3%	-3%
The Netherlands	0%	0%	-3%	-3%	-2%	-2%

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	-9%	-9%	-4%	-3%	-2%	-3%
Average2W	Belgium	-8%	-9%	-3%	-3%	-1%	-1%
Average2W	Bulgaria	-3%	-10%	-3%	-3%	-11%	-3%
Average2W	Croatia	0%	0%	-3%	-3%	-12%	-3%
Average2W	Cyprus	0%	0%	0%	0%	0%	0%
Average2W	Czechia	-10%	-10%	-4%	-3%	-2%	-1%
Average2W	Denmark	-8%	-10%	-3%	-3%	-1%	-1%
Average2W	Estonia	-9%	-9%	-3%	-3%	-2%	-1%
Average2W	Finland	-9%	-9%	-3%	-3%	-2%	-1%
Average2W	France	-8%	-10%	-3%	-3%	-1%	-1%
Average2W	Germany	-9%	-9%	-3%	-2%	-1%	-1%
Average2W	Greece	-3%	-10%	-4%	-3%	-11%	0%
Average2W	Hungary	-4%	-10%	-3%	-3%	-12%	-3%
Average2W	Ireland	0%	0%	0%	0%	0%	0%
Average2W	Italy	-5%	0%	-3%	-3%	-1%	-2%
Average2W	Latvia	-9%	-9%	-3%	-3%	-1%	-1%

Average2W	Lithuania	-9%	-9%	-3%	-3%	-1%	-1%
Average2W	Luxembourg	0%	0%	0%	0%	0%	0%
Average2W	Malta	0%	0%	0%	0%	0%	0%
Average2W	Poland	-9%	-9%	-3%	-3%	-1%	-1%
Average2W	Portugal	-8%	-9%	-3%	-3%	0%	-3%
Average2W	Romania	-4%	-9%	-3%	-3%	-11%	-3%
Average2W	Serbia	0%	0%	0%	0%	0%	0%
Average2W	Slovakia	-10%	-10%	-4%	-3%	-12%	-3%
Average2W	Slovenia	0%	0%	-4%	-4%	-2%	-3%
Average2W	Spain	-8%	-9%	-3%	-2%	-2%	-3%
Average2W	Sweden	-9%	-10%	-3%	-2%	-2%	-1%
Average2W	Switzerland	0%	0%	-4%	-3%	-1%	-2%
Average2W	The Netherlands	0%	0%	-3%	-3%	-2%	-1%
Average2W	United Kingdom	0%	0%	0%	0%	0%	0%
Average2WDF	Austria	-9%	-9%	-4%	-3%	-2%	-3%
Average2WDF	Belgium	-9%	-9%	-3%	-3%	-1%	-1%
Average2WDF	Bulgaria	-3%	-10%	-4%	-3%	-11%	-3%
Average2WDF	Croatia	0%	0%	-3%	-3%	-11%	-4%
Average2WDF	Cyprus	0%	0%	0%	0%	0%	0%
Average2WDF	Czechia	-10%	-10%	-4%	-3%	-2%	-1%
Average2WDF	Denmark	-8%	-10%	-3%	-3%	-1%	-1%
Average2WDF	Estonia	-9%	-9%	-3%	-2%	-2%	-1%
Average2WDF	Finland	-9%	-9%	-3%	-3%	-2%	-1%
Average2WDF	France	-8%	-10%	-3%	-2%	-1%	-1%
Average2WDF	Germany	-9%	-9%	-3%	-3%	-1%	-1%
Average2WDF	Greece	-3%	-10%	-4%	-3%	-11%	0%
Average2WDF	Hungary	-4%	-10%	-3%	-3%	-11%	-4%
Average2WDF	Ireland	0%	0%	0%	0%	0%	0%
Average2WDF	Italy	-5%	0%	-3%	-2%	-1%	-3%
Average2WDF	Latvia	-9%	-9%	-3%	-2%	-1%	-1%
Average2WDF	Lithuania	-9%	-9%	-3%	-2%	-1%	-1%
Average2WDF	Luxembourg	0%	0%	0%	0%	0%	0%
Average2WDF	Malta	0%	0%	0%	0%	0%	0%
Average2WDF	Poland	-9%	-9%	-3%	-2%	-1%	-1%
Average2WDF	Portugal	-8%	-9%	-3%	-3%	0%	-2%
Average2WDF	Romania	-4%	-9%	-3%	-3%	-11%	-4%
Average2WDF	Serbia	0%	0%	0%	0%	0%	0%
Average2WDF	Slovakia	-10%	-10%	-4%	-3%	-12%	-4%
Average2WDF	Slovenia	0%	0%	-4%	-3%	-2%	-4%
Average2WDF	Spain	-8%	-9%	-3%	-3%	-2%	-2%
Average2WDF	Sweden	-9%	-10%	-3%	-3%	-2%	-1%
Average2WDF	Switzerland	0%	0%	-4%	-2%	-1%	-3%
Average2WDF	The Netherlands	0%	0%	-3%	-3%	-2%	-1%
Average2WDF	United Kingdom	0%	0%	0%	0%	0%	0%
DC	Austria	-7%	-8%	-3%	-3%	-2%	-2%
DC	Belgium	-7%	-7%	-2%	-2%	-1%	-1%

DC	Bulgaria	-1%	-8%	-3%	-2%	-9%	-1%
DC	Croatia	0%	0%	-3%	-2%	-9%	-2%
DC	Cyprus	0%	0%	0%	0%	0%	0%
DC	Czechia	-8%	-8%	-3%	-3%	-2%	-2%
DC	Denmark	-7%	-7%	-2%	-2%	-1%	-1%
DC	Estonia	-7%	-8%	-3%	-2%	-1%	-2%
DC	Finland	-7%	-7%	-2%	-2%	-1%	-1%
DC	France	-7%	-7%	-3%	-2%	-1%	-1%
DC	Germany	-7%	-7%	-3%	-2%	-1%	-1%
DC	Greece	-1%	-8%	-4%	-3%	-9%	0%
DC	Hungary	-1%	-8%	-3%	-2%	-9%	-2%
DC	Ireland	0%	0%	0%	0%	0%	0%
DC	Italy	-6%	-1%	-2%	-2%	-2%	-1%
DC	Latvia	-7%	-8%	-3%	-2%	-1%	-2%
DC	Lithuania	-7%	-8%	-3%	-2%	-1%	-1%
DC	Luxembourg	0%	0%	0%	0%	0%	0%
DC	Malta	0%	0%	0%	0%	0%	0%
DC	Poland	-7%	-8%	-3%	-2%	-1%	-1%
DC	Portugal	-7%	-7%	-3%	-2%	0%	-1%
DC	Romania	-1%	-8%	-3%	-2%	-9%	-2%
DC	Serbia	0%	0%	0%	0%	0%	0%
DC	Slovakia	-8%	-9%	-4%	-2%	-9%	-2%
DC	Slovenia	0%	0%	-4%	-2%	-1%	-2%
DC	Spain	-7%	-8%	-2%	-2%	-1%	-2%
DC	Sweden	-7%	-7%	-2%	-1%	-1%	-1%
DC	Switzerland	0%	0%	-3%	-2%	-2%	-1%
DC	The Netherlands	0%	0%	-2%	-2%	-1%	-1%
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-1137	Hydrogen pipelines	Repurpose of existing above-ground objects	Minimal impact is expected on the topsoil.
HYD-N-1264	Hydrogen pipelines	Repurpose of existing above-ground objects	Neutral impact on land and protected areas

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs
HYD-N-1137	A minimal impact on the environment is expected, as the implementation of the first and second stages of the project involves the repurposing of existing gas pipelines without the construction of additional large facilities such as a compressor station.	detailed calculation not available yet	detailed calculation not available yet
HYD-N-1264	Please see “Environmental impact explained”	Detailed calculation not available yet	Detailed calculation not available yet

Environmental Impact explained [Promoter]

- SK part : Basis of the project is repurpose of existing methane infrastructure to hydrogen with the neutral impact on the land and protected areas, as there will be no further demands resulting from routing of the project. Existing pipeline has been accepted by the nature, as the pipeline corridor has already existed there for more than 45 years. Mitigation measures in place prove positive impact on the environment.
- We expect positive impacts on the CO2 emissions, as project foresees two electricity powered compression units on SK territory, which could replace methane powered installed compression power.

- UA part: The first and second stages of the project implementation involve the reconstruction of the existing main gas pipelines, without the construction of a compressor station, which can serve as an additional source of emissions. Currently, Gas TSO of Ukraine expects minimal impact on the environment from the works on the modification of the main gas pipeline. However, the exact impact on the environment will be based on the results of the Environmental Impact Assessment and Biodiversity Assessment (if necessary).

E. Other benefits [Promoter]

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

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

Description of Other benefits [Promoter]

CEHC initiative (hereinafter as "Corridor") aims to develop infrastructure for supply of renewable or low carbon H2 to high demand clusters in the EU. This is essential for meeting EU's decarbonization targets, especially in heavy industries in which H2 represents the only way to achieve it as well as countries that heavily rely on industry and usage of coal such as Czechia. In the long term, the use of hydrogen will replace fossil energy sources.

Sustainability benefits:

Supply of the hydrogen to the Europe via this Corridor will contribute to reaching the EU's decarbonization goal as it has the potential to selectively replace fossil fuels as well as help to decarbonize hard to abate heavy industrial processes. Using the assumptions stated in the European Hydrogen Backbone publications, we estimate the project can contribute to CO2 emission savings of up to 15-20 Mt/y based on the end-users' technology.

Market Integration benefits:

The project aims to interconnect H2 networks of multiple Member States (Germany, Czechia, Slovakia, Hungary, Poland) with major H2 supply sources in Ukraine, North Africa and South-East Europe

Security of Supply and flexibility benefits:

The project significantly contributes to Europe's security and flexibility of H2 supply by connecting the EU to a supply region outside the EU and thus enhancing the EU's energy diversification. More specifically, both Czechia and Germany are expected to be H2 deficit countries in 2030 and as such they will not be able to meet expected demand without import of H2 from high potential supply areas such as Ukraine, North Africa and South-East Europe. Additionally, thanks to the network topology along the Corridor (multiple existing pipelines in parallel), repurposing of one of lines will allow to maintain dual (NG and H2) transport system and without impacting SoS of natural gas.

Competition benefits:

Developing the Corridor will enable means for connecting multiple H2 producers from various supply regions along the route and thus increasing the competition in the region of Central and Western Europe. Moreover, the cost of transport is expected to be much lower than that of corridors based on newly built pipelines. The competition will be further enhanced by faster implementation of repurposed infrastructure in comparison with building a new one. Last but not least, the high capacity of the CEHC project will enable development of hydrogen economy along the entire route providing sufficient capacity for demand areas and as well as for production facilities.

- 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.

Ukraine:

1. This project creates an additional opportunity for producers of renewable energy in Ukraine, expanding their sales market. Ukraine has significant potential for the production of electricity from solar and wind energy. However, unfortunately, a significant part of the generated electricity cannot be supplied to the power grid

due to technical limitations. However, this electricity can be used for the production of "green hydrogen" with the aim of its further export to the EU.

2. CEHC can become one of the key projects for the development of alternative energy as part of the post-war reconstruction of Ukraine. The Ukrainian energy industry was significantly affected by the terrorist attacks of Russia. Accordingly, its recovery will take place taking into account new technologies and approaches with significant attention to renewable energy. The reconstruction of Ukraine's energy sector will require significant investments. However, the possibility of hydrogen production with subsequent export to the more liquid EU market will increase investors' interest in the restoration of Ukraine's energy sector.
3. The development of this Corridor in Ukraine will allow connecting the hydrogen infrastructures of Poland, Slovakia, Hungary, and Romania through Ukraine.

Slovakia :

In Slovakia, the project is supported by the Ministry of Economy of the Slovak Republic; Slovak DSO – SPP-distribúcia, a.s.; the Slovak SSO – NAFTA, a.s. and the Slovak National Hydrogen Association – Cluster – an interest association of legal entities which creates activities to support emerging hydrogen ecosystem in Slovakia. All these entities support CEHC initiative as they believe that it offers a promising, sustainable perspective for the development of the hydrogen market in Slovakia. Moreover, eustream, a.s. as the Slovak TSO is in discussion with potential H2 off-takers.

F. Useful links [Promoter]

Useful links:

Central European Hydrogen Corridor (cehc.eu)