HI EAST 15 (Less-advanced)
Czech German Hydrogen Interconnector
(Route including connection to Baltic region)

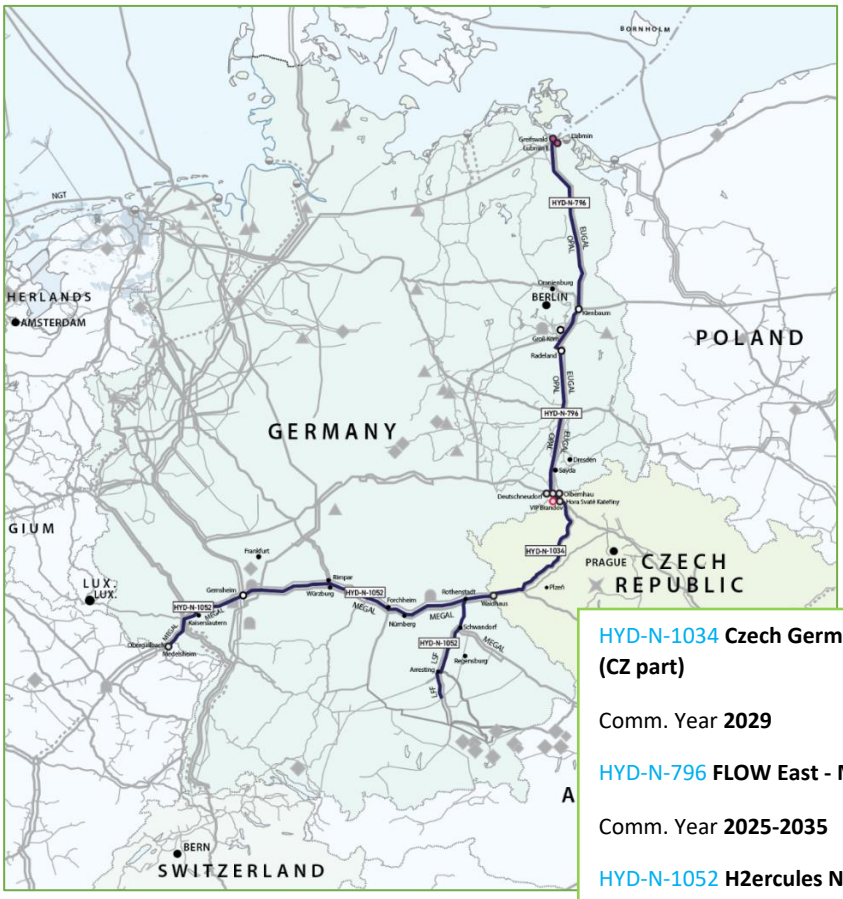
Reasons for grouping [ENTSOG]

The project group aims at interconnecting future hydrogen infrastructure in Czechia and Germany by predominantly repurposing existing natural gas infrastructure.

The group includes investments in Czechia (HYD-N-1034) and East Germany going up to the Baltic Sea (HYD-N-796) and in South Central Germany towards the French Border (HYD-N-1052).

Objective of the group [Promoter]

The Czech German Hydrogen Interconnector (CGHI) aims to create a hydrogen interconnection to enable transport from high potential and cost-efficient future supply areas in Northern Germany and as well as other major production areas in the Baltic Sea with excellent conditions for large-scale, green hydrogen production, with expected high demand clusters in the EU, predominantly in South Germany and North Bohemia. Additionally, it will also enable connection of local suppliers and consumers along the entire corridor.
There is a large natural gas pipeline system that can be repurposed to transport of 100% H2 to the borders of the Czech Republic. A large natural gas pipeline corridor (with several parallel pipes) connecting Northern Germany with demand areas in South Germany is being operated in the Czech Republic. One of the pipes of this system can be repurposed to transport pure hydrogen which will not endanger the security of supply of natural gas and will result to lower cost of transport and much faster implementation than building a new pipeline (in operation by end of 2029).



HYD-N-1034 **Czech German Hydrogen Interconnector (CZ part)**

Comm. Year **2029**

HYD-N-796 **FLOW East - Making Hydrogen Happen**

Comm. Year **2025-2035**

HYD-N-1052 **H2ercules Network South**

Comm. Year **2029**

A. Project group technical information [Promoter/ ENTSOG]

Project technical information [Promoter]

CZ: The subject of the Czech-German Hydrogen Interconnector project, Czech part is the repurposing of part of the infrastructure (gas pipeline DN 1400, approx. 170 km) between the border points VIP Brandov and VIP Waidhaus in the western part of the Czech transmission system to enable to transport pure hydrogen of 144 GWh/d starting in 2029.

DE (OGE): The H2ercules Network South consists of the hydrogen infrastructure across Southern Germany from the French/German border to the border of Germany and the Czech Republic using infrastructure jointly owned and commercially operated by GRTgaz Deutschland and OGE. The estimated total investment costs for the planned repurposing of 561 km of existing pipeline for the transport of hydrogen will be 170 Mio. €, in 2022 prices. Estimated commissioning year is 2029 with an entry capacity of 144 GWh/d from the Czech Republic and 192 GWh/d from France.

DE (GASCADE): The FLOW East - Making Hydrogen Happen consists of repurposed infrastructure from the Baltic sea shore to the Czech-German border. The estimated total investment costs for the planned repurposing of 480 km of existing pipeline for the transport of hydrogen will be 499 Mio. €, in 2022 prices. Estimated commissioning year is 2029 with hydrogen delivered from onshore and offshore electrolysis.

Hydrogen Transmission

TYNDP Project code	Section name	New / Repurposing	Nominal Diameter [mm]	Section Length [km]	Compressor power [MW]
HYD-N-1034	CGHI – CZ part	Repurposing	1400	170	0
HYD-N-796	Flow East	Repurposing	1400	480	22
HYD-N-1052	H2ercules Network South	Repurposing	1100	458	0
HYD-N-1052	H2ercules Network South	Repurposing	1000	103	0

Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year
HYD-N-1034	H2_IP_CZ-DE	NET4GAS, s.r.o.	Transmission Germany (DE Hydrogen)	Transmission Czechia (CZ Hydrogen)	144	2029
HYD-N-1034	H2_IP_CZ-DE	NET4GAS, s.r.o.	Transmission Czechia (CZ Hydrogen)	Transmission Germany (DE Hydrogen)	144	2029

HYD-N-796	H2_IP_CZ-DE	GASCADE Gastransport GmbH	Transmission Germany (DE Hydrogen)	Transmission Czechia (CZ Hydrogen)	144	2029
HYD-N-1052	H2_IP_CZ-DE	Open Grid Europe GmbH	Transmission Czechia (CZ Hydrogen)	Transmission Germany (DE Hydrogen)	144	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 [%]
HYD-N-1034	50	50%	2	50%
HYD-N-796	499	30%	6	30%
HYD-N-1052	170	30%	21	30%

Description of the cost and range [Promoter]

CZ: The cost estimation is based on combination of the top-down benchmark (using the European Hydrogen Backbone) numbers and detailed technical analysis of the existing pipeline. The main investment cost items include: Replacement of valves & resealing of the flanges, Repair of parts of the pipeline with higher WT reduction, Separation of the corridor from the NG network, Upgrade of commercial metering at BTS, Cleaning & nitrogen purging, replacement of maintenance equipment and replacement of electrical equipment not in ATEX IIC class. Range determined based on difference between benchmark and detailed analysis (detailed analysis indicating lower required investment).

DE: CAPEX and OPEX are based on best estimates at the time of project submission in December 2022 and might be subject to changes, e.g. due to supplier price adjustments or concretization of project scope. Cost deviations are already considered in both CAPEX and OPEX cost ranges.

C. Project Benefits [ENTSOG]

C.1 Summary of benefits

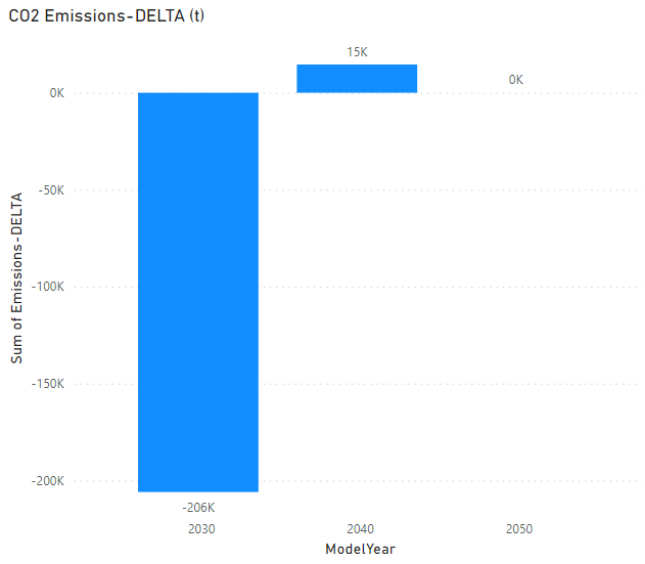
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. More details on the indicators are available in Annex D of TYNDP 2022[1].

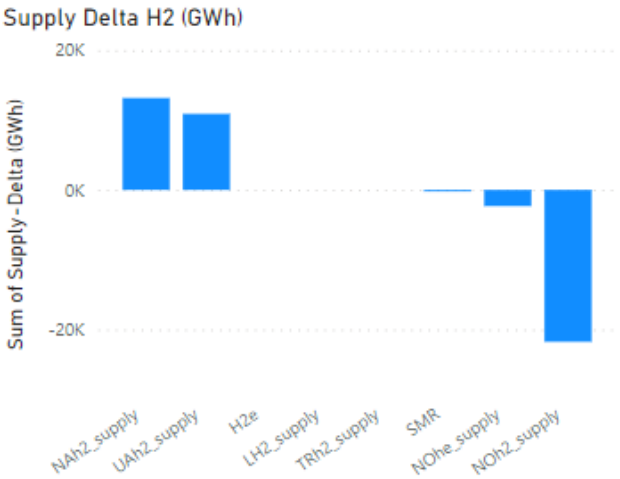
Distributed Energy

Sustainability benefits

Thanks to the projects group, from 2029, the repurposed infrastructure between Germany and Czech Republic allows more hydrogen flows between the two countries and improves cooperation for most 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 206 kt in 2030. In 2030 the project group is enabling the replacement of Imports from Norway and is enabling more supply of green hydrogen from North Africa and Ukraine. In 2040 the project group increases cooperation between countries and as all green hydrogen supply sources (both locally produced and imported) are already used at their maximum capacity, an increase in blue hydrogen (i.e. SMR) is needed to satisfy the hydrogen demand in 2040 and reduces demand curtailment.



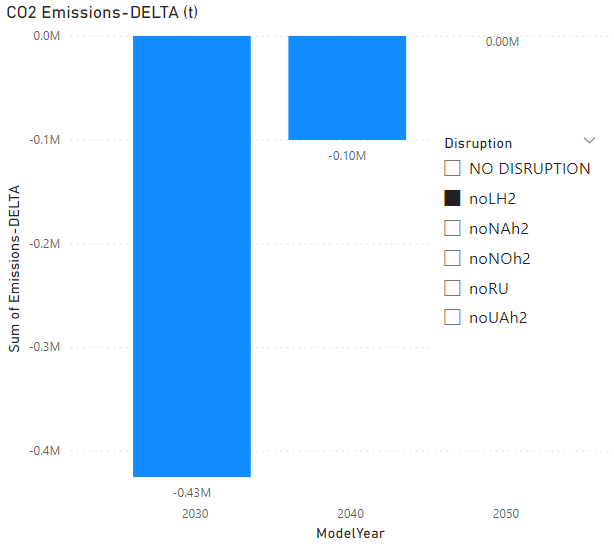


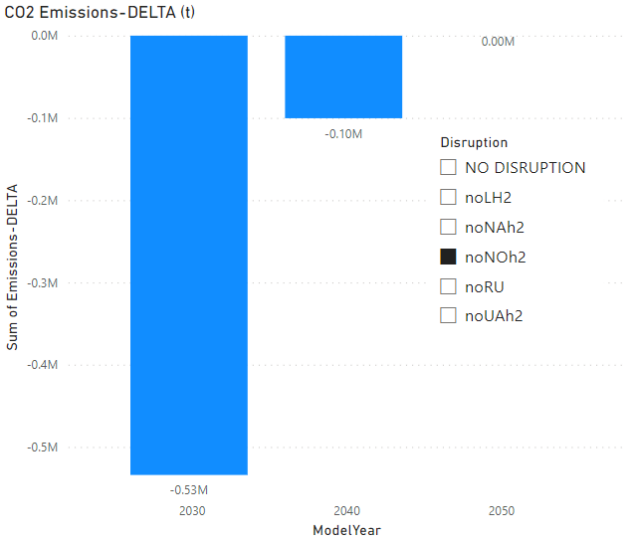
[1] https://www.entsog.eu/sites/default/files/2023-04/ENTSOG_TYNDP_2022_Annex_D_Methodology_230411.pdf

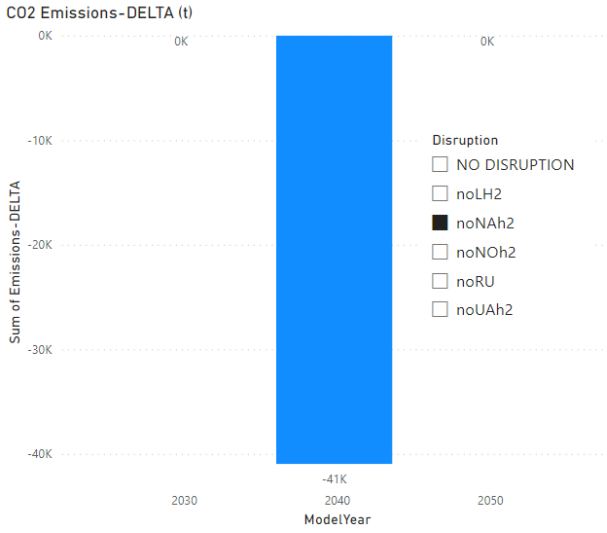
Sustainability benefits are increased under Norway and LH2 supply disruption cases. For example in case of LH2 disruption the project group is contributing to sustainability by reducing overall CO2 emissions by 430 kt in 2030 and 100 kt in 2040.

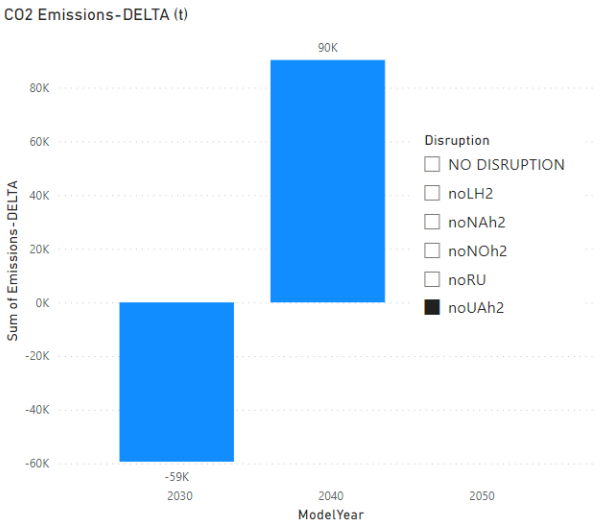
In case of Ukraine and North Africa disruption sustainability benefits decrease in 2030, however under North Africa disruption the project is contributing to sustainability in 2040.

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









Security of Supply:[2]

> Reference case:

In the reference case, the project is not contributing to further mitigation of hydrogen demand curtailment risk in average summer and average winter. The benefits could be limited based on the composition of the hydrogen reference infrastructure level.

2030 DE- Benefits

2040 DE- Benefits

2050 DE- Benefits

> Climatic stress cases:

Under 2 -week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group the project group is not further mitigating the risk of demand curtailment. Similar to the reference case, the benefits could be limited based on the composition of the hydrogen reference infrastructure level.

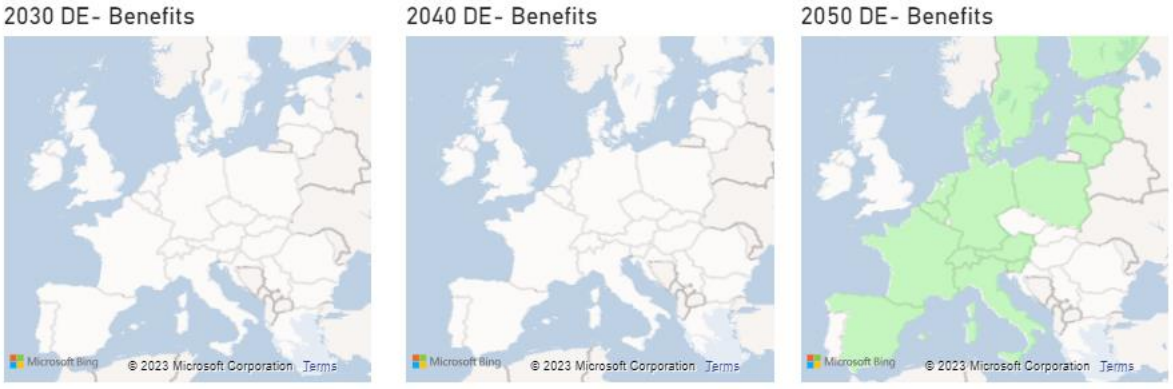
> Disruption cases (S-1):

Under all supply disruption cases and refence yearly demand, the project group mitigates the risk of demand curtailment in 2050 for many European countries by 1-2%. In case of Ukraine supply disruption the project group mitigates the risk of demand curtailment from 2040 onwards, including the mitigation of demand curtailment in south eastern European countries by 8-11%.

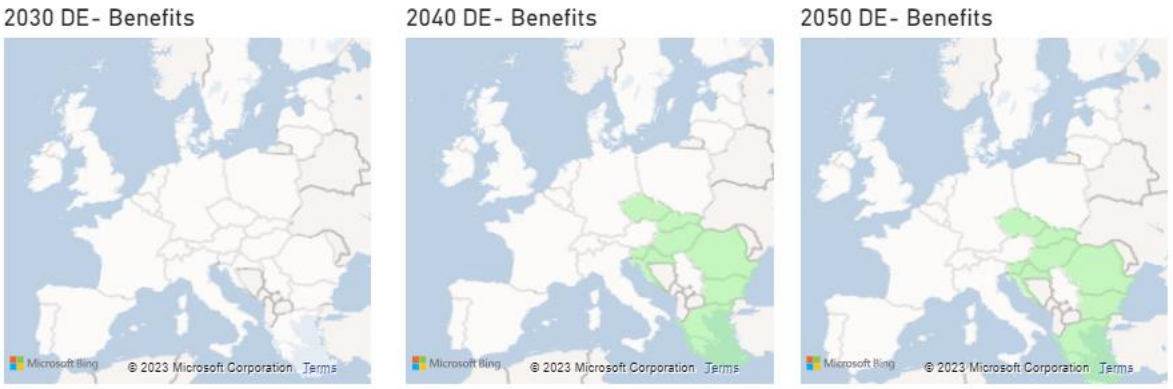
[2] *As for the hydrogen system there is no existing infrastructure level available yet, ENTSOG has identified a possible hydrogen network according to the information provided by promoters in their project submission for the TYNDP/PCI process (i.e., H2 Infrastructure level). Therefore, the System Assessment 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) 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.*

1 noLH2: LH2 disruption

2 noNOh2: Norway disruption



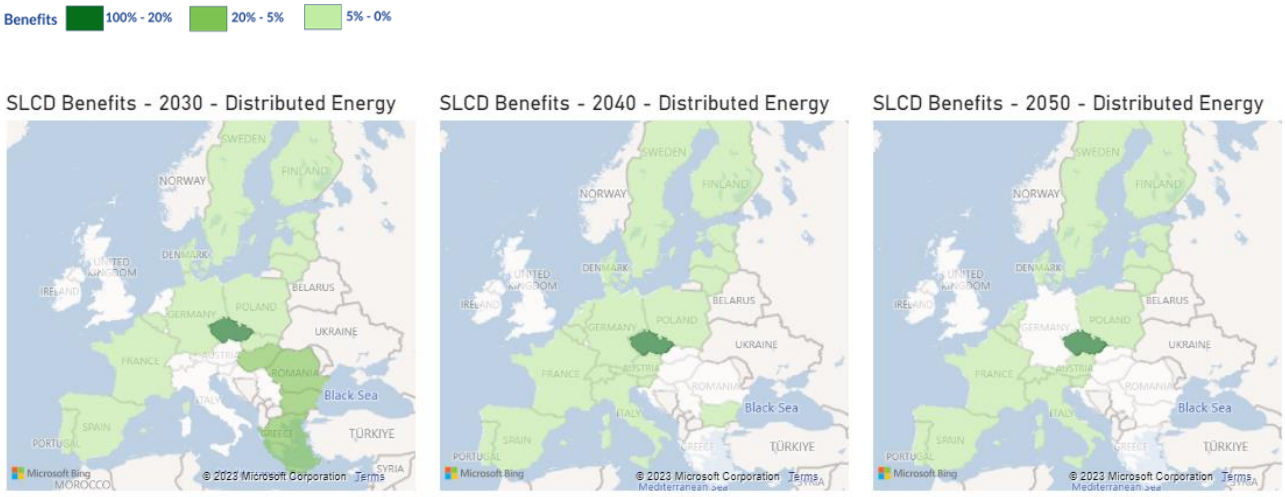
3 noUAh2: Ukraine disruption



4 noNAh2: North Africa disruption

> Single largest capacity disruption (SLCD):

In case of SLCD many European countries benefitting from this project group by mitigating the risk of demand curtailment from 2030 onwards. Under SLCD Czech Republic is benefiting the most including 61% in 2030, 41% in 2040 and 36% in 2030. Furthermore Hungary, Romania, Bulgaria and Greece are mitigating their risk of demand curtailment under SLCD by 5-6% in 2030.

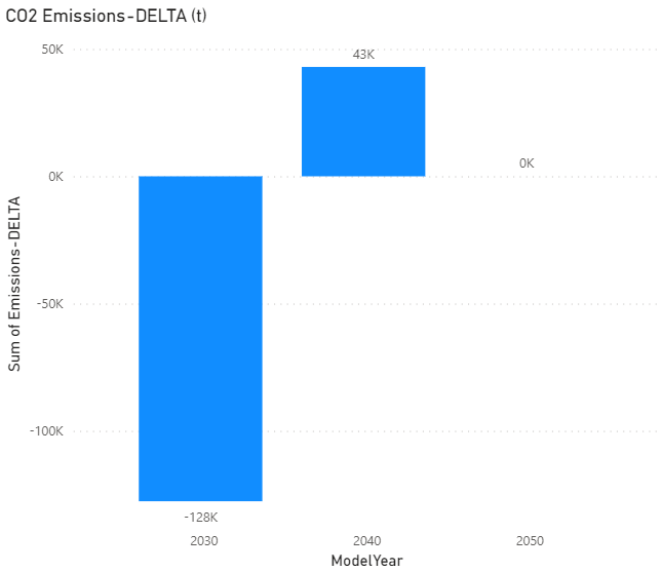


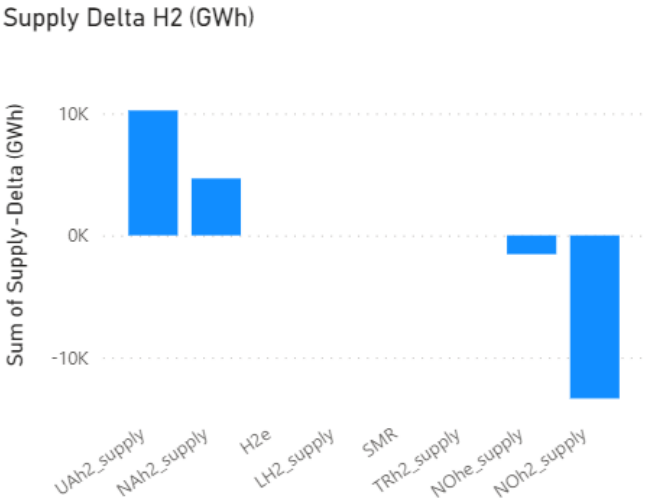
Global Ambition

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 128 kt in 2030. In 2030 the project group is enabling the replacement of Imports from Norway and is enabling more supply of green hydrogen from North Africa and Ukraine. In 2040 the project group increases cooperation between countries and as all green hydrogen supply sources (both locally produced and imported) are already used at their maximum capacity, an

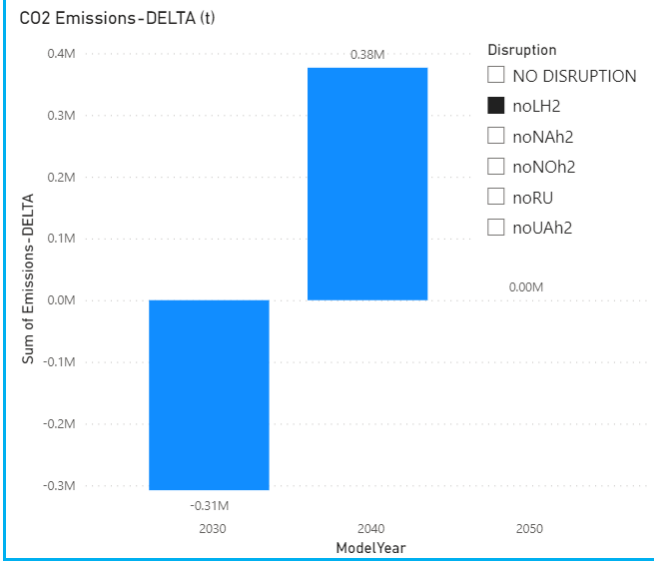
increase in blue hydrogen (i.e. SMR) is needed to satisfy the hydrogen demand in 2040 and reduces demand curtailment.

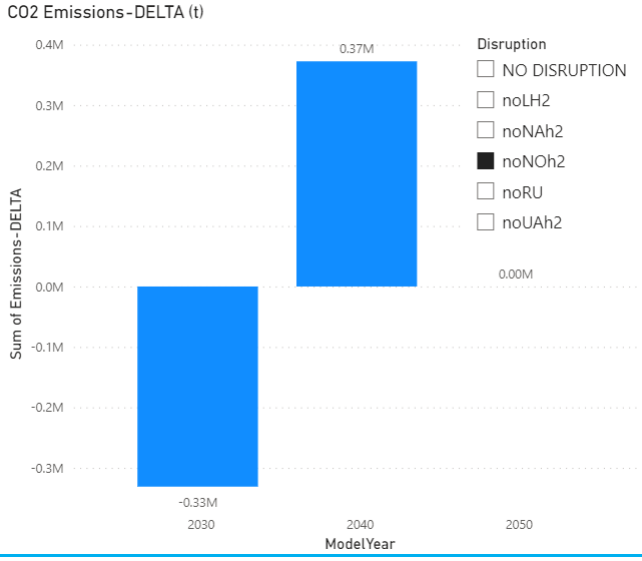


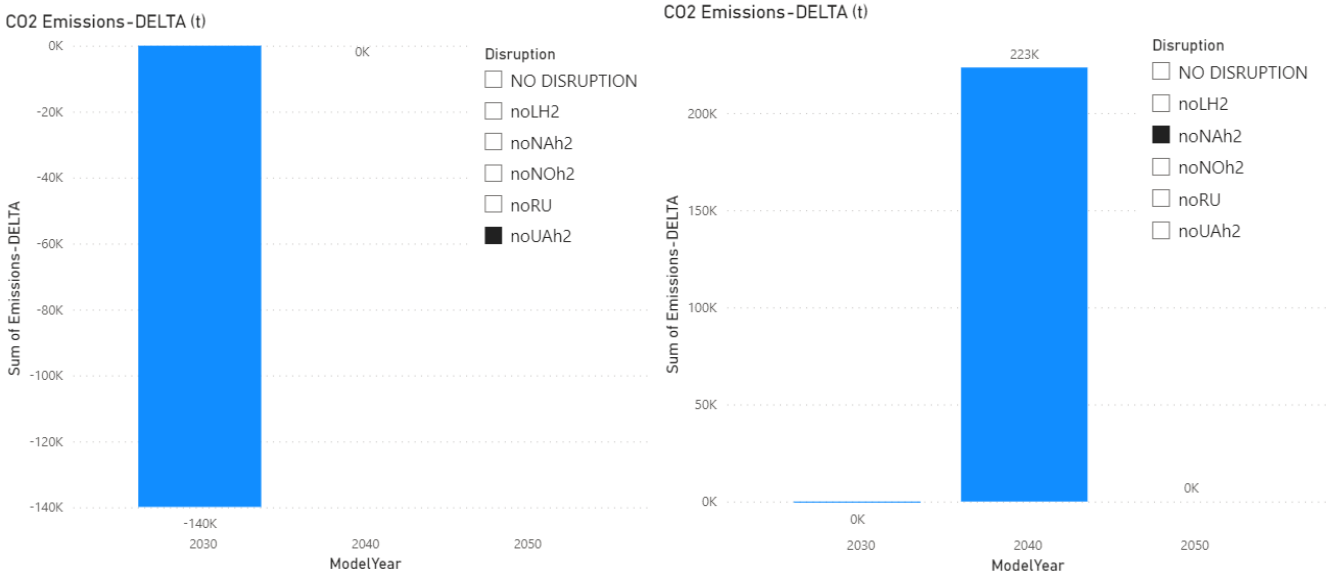


In case of disruption cases, besides North Africa disruption, sustainability benefits are increased in 2030. For example, in case of LH2 disruption the project group is contributing to sustainability by reducing overall CO2 emissions by 430 kt in 2030 and 100 kt in 2040. However, in 2040 sustainability benefits are limited as an increase in blue hydrogen (i.e. SMR) is needed to satisfy the hydrogen demand under the respective disruption case in 2040. In case of Ukraine disruption in 2040 with or without the project group, SMR is already used at the maximum in this region and therefore there is no Delta in CO2 Emissions.

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







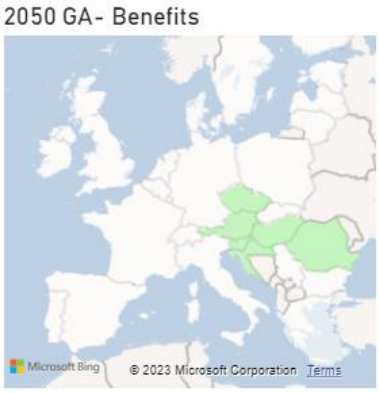
Security of supply:

> Reference case

The conversion of the existing natural gas infrastructure doesn't impact the methane demand and in the reference case. In Reference Case, the projects group mitigates risk of demand curtailment in Eastern European countries (Czech Republic, Austria, Slovakia, Slovenia, Croatia, Hungary and Romania) by 1-2% in 2050. The benefits could be limited based on the composition of the hydrogen reference infrastructure level.

> Climatic stress cases

Under 2 -week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group s*hows similar sustainability benefits with the same magnitude as in the reference case for all three time-stamps*. Similar to the reference case the benefits could be limited based on the composition of the hydrogen reference infrastructure level.

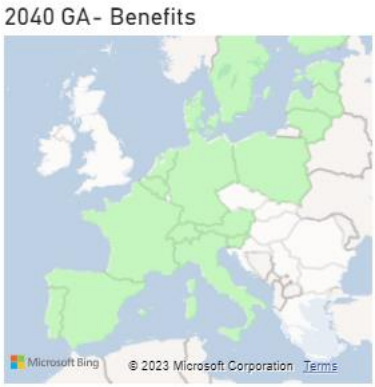


> Disruption cases (S-1)

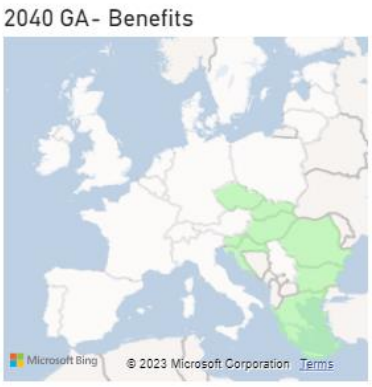
Under all hydrogen supply disruption cases and refence yearly demand, the project group mitigates the risk of demand curtailment in 2040 for many European countries by 1-2%. In 2050 the project group mitigates the risk of demand curtailment for south-eastern European countries by 8-27% and by 1-4%in case of North African disruption

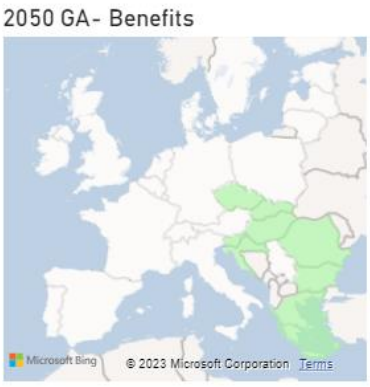
1 noLH2: LH2 disruption

2 noNOh2: Norway disruption

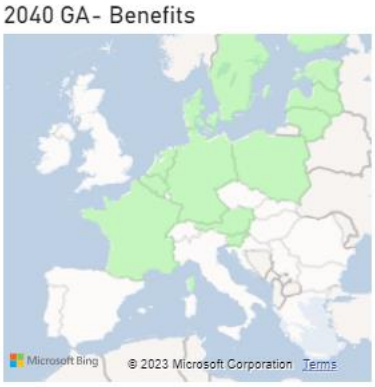


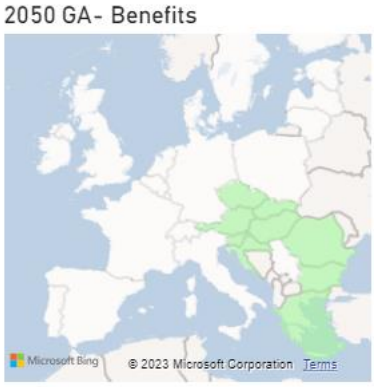
3 noUAh2: Ukraine disruption





4 noNAh2: North Africa disruption





> Single largest capacity disruption (SLCD):

In case of SLCD many European countries benefitting from this project group by mitigating the risk of demand curtailment from 2030 onwards. Under SLCD Czech Republic is benefiting the most including 62% in 2030, 27% in 2040 and 28% in 2030. Romania can mitigate their risk of demand curtailment under SLCD by 6% in 2030. The other respective European countries can mitigate the risk of demand curtailment by 1-2 in all three time-stamps.

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	-205.888	538.677.299	538.883.187
2030	NO DISRUPTION	GA	tonne	-127.624	592.910.448	593.038.073
2030	noLH2	DE	tonne	-425.520	540.175.890	540.601.410
2030	noLH2	GA	tonne	-307.881	594.817.481	595.125.362
2030	noNAh2	DE	tonne	0	539.785.356	539.785.356
2030	noNAh2	GA	tonne	-43	594.141.433	594.141.477
2030	noNOh2	DE	tonne	-534.047	538.877.198	539.411.245
2030	noNOh2	GA	tonne	-331.092	593.310.994	593.642.086
2030	noUAh2	DE	tonne	-59.354	539.378.772	539.438.126
2030	noUAh2	GA	tonne	-139.875	593.627.618	593.767.493
2040	NO DISRUPTION	DE	tonne	14.565	392.077.044	392.062.479
2040	NO DISRUPTION	GA	tonne	42.968	396.523.252	396.480.283
2040	noLH2	DE	tonne	-100.385	392.213.883	392.314.268
2040	noLH2	GA	tonne	376.672	397.455.197	397.078.524
2040	noNAh2	DE	tonne	-40.956	392.188.098	392.229.054
2040	noNAh2	GA	tonne	223.452	397.301.977	397.078.524
2040	noNOh2	DE	tonne	-100.385	392.144.023	392.244.407
2040	noNOh2	GA	tonne	372.453	397.450.977	397.078.524
2040	noUAh2	DE	tonne	90.329	392.399.183	392.308.854
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
Czechia	-61%	-62%	-41%	-27%	-36%	-28%
Austria	0%	0%	-1%	-1%	-1%	-2%
Belgium	-2%	-2%	-1%	-1%	-1%	0%
Bulgaria	-6%	-5%	-1%	0%	0%	-3%
Denmark	-2%	-2%	-1%	-1%	-1%	0%
Estonia	-2%	-2%	-1%	-1%	-1%	0%
Finland	-2%	-2%	-1%	-1%	-1%	0%
France	-2%	-2%	-1%	-1%	-1%	0%
Germany	-2%	-2%	-1%	-1%	-1%	0%
Italy	0%	0%	-1%	-1%	-1%	-1%
Latvia	-2%	-2%	-1%	-1%	-1%	0%
Lithuania	-2%	-2%	-1%	-1%	-1%	0%
Poland	-2%	-1%	-1%	-1%	-1%	0%
Portugal	-2%	-1%	-1%	-1%	-1%	-2%
Slovenia	0%	0%	-1%	-1%	-1%	-3%
Spain	-2%	-1%	-1%	-1%	-1%	-1%
Sweden	-2%	-2%	-1%	-1%	-1%	0%
Switzerland	0%	0%	-1%	-1%	-1%	-2%
The Netherlands	0%	0%	-1%	-1%	-1%	0%
Croatia	0%	0%	0%	0%	0%	-2%
Greece	-5%	-5%	0%	0%	0%	-2%
Hungary	-6%	-5%	0%	0%	0%	-2%
Romania	-6%	-6%	0%	0%	0%	-2%
Slovakia	-5%	-5%	0%	-1%	0%	-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	0%	0%	-1%	0%	-1%	-1%
Average2W	Belgium	0%	0%	-1%	0%	0%	0%
Average2W	Bulgaria	0%	0%	0%	0%	0%	-1%
Average2W	Croatia	0%	0%	0%	0%	0%	-1%
Average2W	Cyprus	0%	0%	0%	0%	0%	0%
Average2W	Czechia	0%	0%	0%	0%	0%	-1%
Average2W	Denmark	0%	0%	-1%	-1%	-1%	0%
Average2W	Estonia	0%	0%	0%	0%	-1%	0%
Average2W	Finland	0%	0%	-1%	0%	-1%	0%
Average2W	France	0%	0%	-1%	0%	-1%	0%
Average2W	Germany	0%	0%	0%	0%	0%	0%
Average2W	Greece	0%	0%	0%	0%	0%	0%
Average2W	Hungary	0%	0%	0%	0%	0%	-1%
Average2W	Ireland	0%	0%	0%	0%	0%	0%
Average2W	Italy	0%	0%	-1%	0%	0%	-1%

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%	-1%	0%
Average2W	Portugal	0%	0%	0%	0%	0%	-1%
Average2W	Romania	0%	0%	0%	0%	0%	-1%
Average2W	Serbia	0%	0%	0%	0%	0%	0%
Average2W	Slovakia	0%	0%	0%	0%	0%	-1%
Average2W	Slovenia	0%	0%	0%	-1%	-1%	-1%
Average2W	Spain	0%	0%	-1%	0%	-1%	-1%
Average2W	Sweden	0%	0%	-1%	0%	-1%	0%
Average2W	Switzerland	0%	0%	-1%	0%	0%	-1%
Average2W	The Netherlands	0%	0%	-1%	-1%	-1%	0%
Average2W	United Kingdom	0%	0%	0%	0%	0%	0%
Average2WDF	Austria	0%	0%	-1%	0%	-1%	-2%
Average2WDF	Belgium	-1%	0%	0%	0%	0%	0%
Average2WDF	Bulgaria	0%	0%	0%	0%	0%	-1%
Average2WDF	Croatia	0%	0%	0%	0%	0%	-2%
Average2WDF	Cyprus	0%	0%	0%	0%	0%	0%
Average2WDF	Czechia	0%	0%	0%	0%	0%	-2%
Average2WDF	Denmark	0%	0%	-1%	0%	-1%	0%
Average2WDF	Estonia	0%	0%	0%	0%	-1%	0%
Average2WDF	Finland	0%	0%	-1%	0%	-1%	0%
Average2WDF	France	0%	0%	-1%	0%	-1%	0%
Average2WDF	Germany	0%	0%	0%	0%	0%	0%
Average2WDF	Greece	0%	0%	0%	0%	0%	0%
Average2WDF	Hungary	0%	0%	0%	0%	0%	-1%
Average2WDF	Ireland	0%	0%	0%	0%	0%	0%
Average2WDF	Italy	0%	0%	-1%	0%	0%	-1%
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%	-1%	0%
Average2WDF	Portugal	0%	0%	-1%	0%	0%	-1%
Average2WDF	Romania	0%	0%	0%	0%	0%	-2%
Average2WDF	Serbia	0%	0%	0%	0%	0%	0%
Average2WDF	Slovakia	0%	0%	0%	0%	0%	-1%
Average2WDF	Slovenia	0%	0%	-1%	0%	-1%	-2%
Average2WDF	Spain	0%	0%	-1%	0%	-1%	-1%
Average2WDF	Sweden	0%	0%	-1%	0%	-1%	0%
Average2WDF	Switzerland	0%	0%	-1%	0%	0%	-1%
Average2WDF	The Netherlands	0%	0%	-1%	0%	-1%	0%
Average2WDF	United Kingdom	0%	0%	0%	0%	0%	0%

DC	Austria	0%	0%	0%	0%	-1%	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%	-1%	0%	-1%	0%
DC	Finland	0%	0%	0%	0%	-1%	0%
DC	France	0%	0%	-1%	0%	0%	0%
DC	Germany	0%	0%	-1%	-1%	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%	-1%	0%
DC	Latvia	0%	0%	-1%	0%	0%	0%
DC	Lithuania	0%	0%	-1%	0%	0%	0%
DC	Luxembourg	0%	0%	0%	0%	0%	0%
DC	Malta	0%	0%	0%	0%	0%	0%
DC	Poland	0%	0%	-1%	0%	0%	0%
DC	Portugal	0%	0%	-1%	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%	-1%	0%	0%	0%
DC	Spain	0%	0%	0%	0%	-1%	0%
DC	Sweden	0%	0%	0%	0%	-1%	0%
DC	Switzerland	0%	0%	0%	0%	-1%	0%
DC	The Netherlands	0%	0%	0%	0%	-1%	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-1034	Hydrogen pipelines	Reconstruction of existing above-ground objects	All existing above-ground objects that will be reconstructed are not located in any environmentally sensitive area.
HYD-N-796	Hydrogen pipelines	Reconstruction of existing above-ground objects	All existing above-ground objects that will be reconstructed are not located in any environmentally sensitive area.
HYD-N-1052	Hydrogen pipelines	Reconstruction of existing above-ground objects or locally limited interferences	Minimal environmental impacts expected due to repurposing of pipeline or locally limited interferences.

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs
HYD-N-1034: Negligible as adjustments will take place mostly in the existing above-ground objects.	Minimization of crossings of construction machinery between individual workplaces and trips of empty means of transport. To prevent the leakage of oil or other harmful substances in the affected areas, it will be forbidden to carry out their maintenance, refuelling, replenishment of operating fluids and repairs at construction sites. Prevention of dripping of oil substances from construction mechanisms and means of transport by ensuring their good	Detailed calculation not available yet	Not expected

	technical condition. Limit construction sites to the smallest extent possible, cleaning of vehicles and roads, covering of transported bulk materials and limiting their free storage, not carrying out earthworks in unfavourable seasons, scraping of the construction site surface.		
HYD-N-796	Any measures necessary are taken by the project promoter in order to reduce or to fully avoid environmental damage caused by construction work.	Detailed calculation is not available yet	Not expected
HYD-N-1052	Minimal environmental impacts expected due to repurposing of pipeline or locally limited interferences.	Detailed calculation is not available yet	Not expected

Environmental Impact explained [Promoter]

No serious environmental threats have been identified as the repurposing will take place mostly in the existing above-ground objects or locally limited interferences. The impact of works will be reduced with the maximum effort by selecting the most suitable technology during the implementation of the project. In order to avoid air and water pollution, respective measures will be taken during the construction phase. The construction sites will be equipped with technical means for the possible remediation of leakage of fuel or other harmful substances that may endanger the quality of surface or underground water. All produced waste will be collected, disposed of, or recycled in accordance with applicable regulation. Waste collection containers will be placed in designated places and marked accordingly. Further detailed measures will be described in the building permit design and agreed with the concerned environmental authority.

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]

The project 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 the Czech Republic. In the long term, the use of hydrogen will replace fossil energy sources. The H2ercules Network South and the FLOW East projects contribute to this as they largely cover future hydrogen demand for Germany and enable bidirectional transition to the Czech Republic. Further, multiple areas of Germany as the North, the West and the East are interconnected into one integrated network.

Sustainability benefits:

Using the assumptions stated in the European Hydrogen Backbone (EHB) initiative, we estimate the project can contribute to emission savings of up to 10-20 Mt/y* based on the end-users' technology. Additionally, re-purposing of the existing infrastructure has a much lower impact on the environment during construction phase than the construction of a new pipeline.

Market Integration benefits:

The project aims to interconnect H2 networks of two member states with considerable H2 demand (Germany, the Czech Republic) and major H2 supply regions (Northern Germany and Baltics).

Security of Supply and flexibility benefits:

The project significantly contributes to Europe's security and flexibility of H2 supply by offering a North-South supply axis for expected high demand clusters in the EU and enhances EU energy diversification. More specifically, both the Czech Republic 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 Baltic. Additionally, thanks to the network topology along the corridor (multiple existing pipelines in parallel), repurposing of one of the pipelines 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 CGHI project of 144 GWh/d will enable development of hydrogen economy along the entire route providing sufficient capacity for demand areas and as well as for production facilities.

Project supporters:

The project has already received official support from a number of local partners from the hydrogen value chain.

In the Czech Republic these are: the Czech Ministry of Industry and Trade, the Czech NRA ERÚ, GasNet (largest gas DSO in the Czech Republic), Czech Hydrogen Technology Platform (HYTEP), Ústecký kraj (regional platform to develop hydrogen production and consumption hub in Northern part of the Czech Republic), ČEZ (largest energy utility in the region), ČEPS (transmission system operator in electricity) and MND (gas storage operator) and others.

H2ercules Network South:

Sustainability benefits:

A faster ramp-up of the hydrogen economy in Germany is more important than ever in order to drive forward the decarbonization program, put the German energy system on a more robust footing, and thus contribute towards a decarbonized security of supply. This is where the H2ercules can make a significant contribution, as it overcomes many challenges on a large scale. The ramp-up of the hydrogen market can thus reduce the use of conventional energy sources. This helps to reduce GHG emissions and to use more and more decarbonized energy. This project enables the transmission of hydrogen across the borders of the Member States Germany, France and the Czech Republic. Since no hydrogen is transported on this route via pipeline today, this will be a significant increase compared to the situation prior to the commissioning of the project. The majority of the network can be repurposed which makes it cost efficient and sustainable.

Competition, market integration, security of supply and flexibility benefits:

The project's main impact is to create new hydrogen capacities at cross-border points. H2ercules Network South establishes a cross-border transport of hydrogen from the French/German and Czech/German border to demand centres in southern Germany. By exchanging with the adjacent TSOs and projects, interoperability is ensured. This linkage has a positive impact on system flexibility and security of supply as well. A non-discriminatory network is established which impacts competition between market participants.

The overall H2ercules establishes direct cross-border connections to five European countries (Norway, the Netherlands, Belgium, France and the Czech Republic). In addition, the import corridors also indirectly impact the countries not directly bordering with Germany but being part of the same supply corridors. H2ercules Network South enables the hydrogen import to Germany from regions with the biggest potential for renewable hydrogen production as Ukraine, Southern Europe and Northern Africa as well as the Baltic region.

The H2ercules Network contributes to the connection of different value chains (production, storage, demand centres). The H2ercules pipeline network will enable the connection of domestic green hydrogen production and thus connects new sources to the existing pipeline network. The H2ercules network reaches demand centres in Germany with a total demand of about 90 TWh in 2030 - that is nearly 2/3 of Germany's hydrogen demand. Furthermore, several storage facilities in the north of Germany can be connected. The H2ercules network thus makes a significant contribution to European supply security and facilitates development of a European Hydrogen Backbone.

The H2ercules project received several Letters of Support from partners / consortia from the hydrogen value chain:

- The Ministry for the Environment, Energy and Climate Protection of the State of Lower Saxony
- Ministry of Economic Affairs, Industry, Climate Action and Energy of the State of North Rhine-Westphalia
- Ministry of the Environment, Climate Protection and the Energy Sector, Baden-Württemberg
- Bavarian Ministry of Economic Affairs, Regional Development and Energy
- Federal Ministry for Economic Affairs and Climate Action
- NET4GAS s.r.o., Eustream a.s., Gas Transmission Operator of Ukraine LLC, GRTgaz Deutschland
- NET4GAS s.r.o., Eustream a.s., Trans Austria Gasleitung GmbH, SNAM S.p.A.
- NET4GAS s.r.o, GASCADE Gastransport GmbH
- BASF SE, Shell Chemicals and Products
- GRTgaz SA, Terega SA, REN – Gasodutos, S.A.,Enagas Transporte S.A.U., GRTgaz Deutschland
- Bayernets GmbH
- HNS Hydrogen Network
- Fluxys Belgium
- Uniper Hydrogen GmbH

* The calculation was made on EHB assumptions.

F. Useful links [Promoter]

Useful links:

Project's website:

CGHI: https://www.cghi.eu/

H2ercules: H_2ercules (h2ercules.com)

FLOW: https://www.flow-hydrogen.com/en/home-en/