HI EAST 17 (Less-advanced)

H2 supply Italy-Austria-Germany

Reasons for grouping [ENTSOG]

The project group aims at interconnecting future hydrogen infrastructure between Italy, Austria and Germany, by partially repurposing existing natural gas infrastructure.

The group includes investments in Italy (HYD-N-1205), Austria, (HYD-N-986, HYD-N-757), and Germany (HYD-N-642).

Objective of the group [Promoter]

The project group consists of the construction of an H2 corridor involving Italy, Austria and Germany and the connection with North Africa, enabling the supply of low-cost renewable hydrogen produced in the South to key European clusters of demand.

HYD-N-1205 **Italian H2 Backbone**
Comm. Year **2029**

HYD-N-986 **H2 Readiness of the TAG pipeline system**
Comm. Year **2029**

HYD-N-757 **H2 Backbone WAG + Penta West**
Comm. Year **2030**

HYD-N-642 **HyPipe Bavaria – The Hydrogen Hub**
Comm. Year **2027-2030**

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-1205		Repurposing	From 750 to 1200	1700	Up to 500 (*)
HYD-N-1205	Italian H2 Backbone	New	From 850 to 1200	640	
HYD-N-986	H2 Readiness of the TAG pipeline system	Repurposing	From 900 to 1050	380	60 (*)
HYD-N-757	H2 Backbone WAG + Penta West	Repurposing	1200	140	
HYD-N-757	H2 Backbone WAG + Penta West	New	From 800 to 1200	200	16
HYD-N-642	HyPipe Bavaria - The Hydrogen Hub	Repurposing	From 450 to 700	280	n/a
HYD-N-642	HyPipe Bavaria - The Hydrogen Hub	New	From 700 to 800	14	26

Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year[1]
HYD-N-1205	DZh2 => ITh2	Snam Rete Gas S.p.A.	Transmission North Africa (DZ Hydrogen)	Transmission Italy (IT Hydrogen)	448	2029

[1] *All years should be intended as aligned for a projects commissioning starting from 2030 at the latest.*

HYD-N-1205	H2_IP_IT-AT	Snam Rete Gas S.p.A.	Transmission Italy (IT Hydrogen)	Transmission Austria (AT Hydrogen)	168	2029
HYD-N-1205	H2_IP_IT-AT	Snam Rete Gas S.p.A.	Transmission Austria (AT Hydrogen)	Transmission Italy (IT Hydrogen)	126	2029
HYD-N-986	H2_IP_IT-AT	TAG GmbH	Transmission Italy (IT Hydrogen)	Transmission Austria (AT Hydrogen)	168	2029
HYD-N-986	H2_IP_IT-AT	TAG GmbH	Transmission Austria (AT Hydrogen)	Transmission Italy (IT Hydrogen)	126	2029
HYD-N-757	H2_IP_DE-AT	Gas Connect Austria GmbH	Transmission Austria (AT Hydrogen)	Transmission Germany (DE Hydrogen)	150	2030
HYD-N-757	H2_IP_DE-AT	Gas Connect Austria GmbH	Transmission Germany (DE Hydrogen)	Transmission Austria (AT Hydrogen)	150	2030
HYD-N-642	H2_IP_DE-AT	Bayernets GmbH	Transmission Austria (AT Hydrogen)	Transmission Germany (DE Hydrogen)	150	2027-2030
HYD-N-642	H2_IP_DE-AT	Bayernets GmbH	Transmission Germany (DE Hydrogen)	Transmission Austria (AT Hydrogen)	150	2027-2030

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-1205	3200	30%	58	30%
HYD-N-986	369	50%	5	50%
HYD-N-757	1035	25%	41	50%
HYD-N-642	163	30%	0.761	30%

Description of the cost and range [Promoter]

As indicated above, costs reported represent best estimates available to project promoters at the moment of TYNDP 2022 call for projects (as of December 2022, end of PCI project collection). In particular, the CAPEX and OPEX ranges take into account the maturity of the projects and the cost contingencies. Furthermore, the costs are referred to the projects configuration submitted as PCI candidatures and they could change depending on the final configuration of the H2 backbone.

With specific reference to AT GCA project HYD-D-757: the above-indicated costs were calculated based on the unit prices of the EHB study. The National Development Plan 2022 (approved 05/2023) includes updated figures as follows: CAPEX 921 MEUR, OPEX 37 MEUR.

C. Project Benefits [ENTSOG]

C.1 Summary of benefits

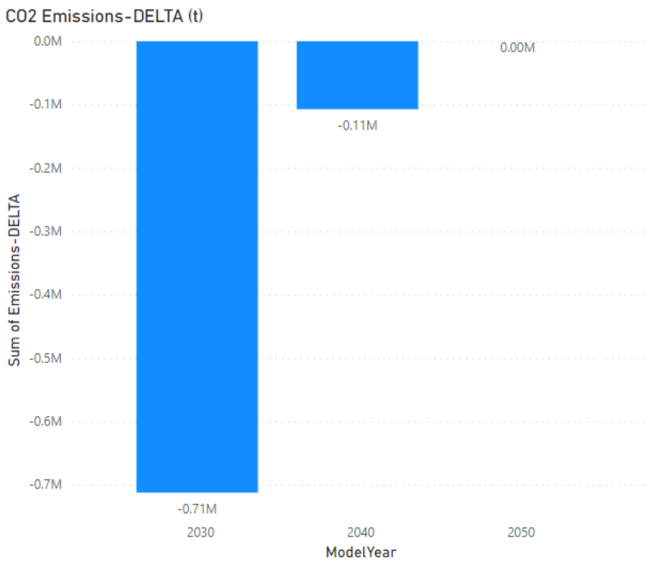
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. PS-CBA analysis of project group EAST 17 was performed following TOOT approach on TYNDP 2022 Hydrogen infrastructure level 1[2]. For more details on the indicators are available in Annex D of TYNDP 2022[3].

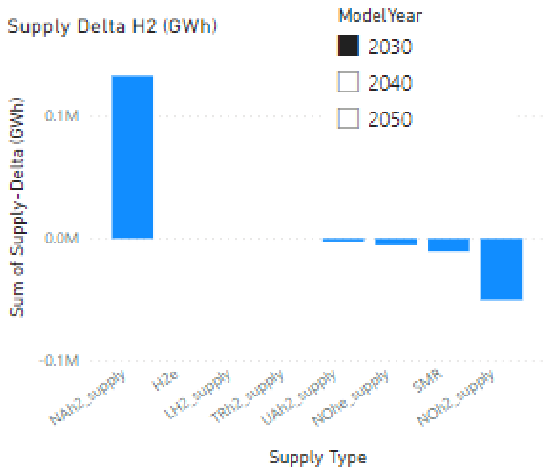
Distributed Energy

Sustainability benefits

Thanks to the projects group, from 2029, the conversion of the interconnections from Italy to Austria and from Austria to Germany in both direction allows higher cooperation between these countries also including Switzerland.

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 CO_2 emissions by 710 kt in 2030. This is explained as the project group will enable replacement of blue hydrogen supplies and, therefore, will reduce natural gas imports, through the access to green hydrogen supply sources.





[2] Detail of H2 capacities in TYNDP 2022 Annex C.2 H2 Capacities per country
[3] https://www.entsog.eu/sites/default/files/2023-04/ENTSOG_TYNDP_2022_Annex_D_Methodology_230411.pdf

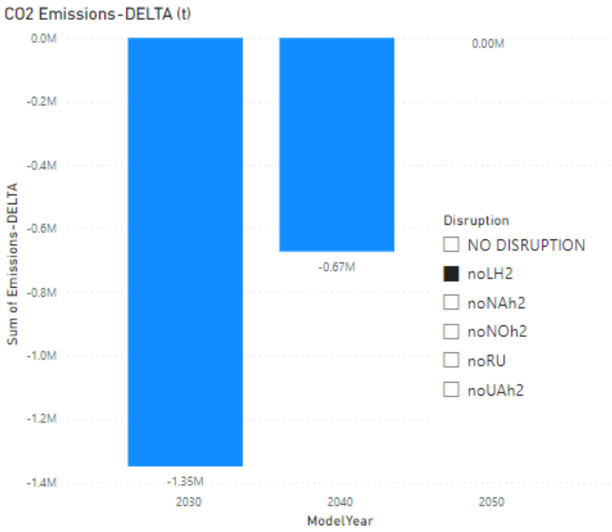
Similarly, when Norwegian, liquid hydrogen imports are disrupted, the project group also contributes to sustainability by reducing overall CO2 emissions in 2030 and also in 2040. In addition sustainability benefits under both disruption cases are considerably higher than in the reference case, as project group capacity is maximized to replace disrupted supplies, and significantly reducing SMR use.

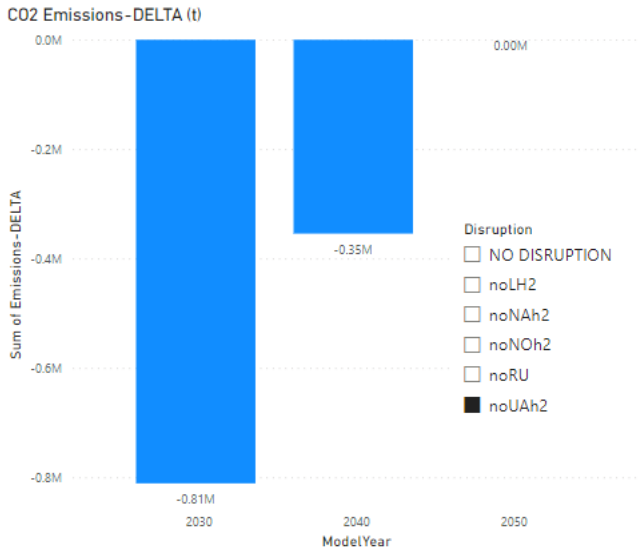
Regarding Ukrainian disruption, sustainability benefits are similar to the reference case, however slightly higher than the reference case due to the lower availability of hydrogen supplies in Eastern Europe.

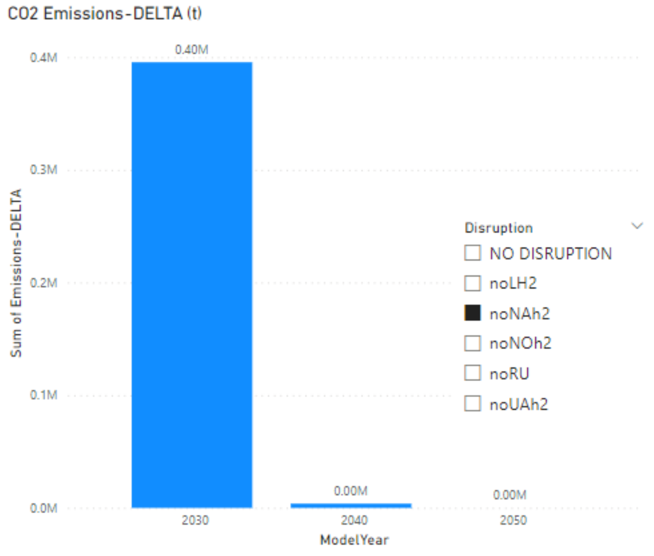
In addition, when North African supplies are disrupted, the project group also contributes to sustainability by enhancing cooperation between countries, and therefore, avoid hydrogen demand curtailment in Italy. As all green hydrogen sources available are already being used at its maximum capacity, SMR will be used to avoid demand curtailment, and subsequently, total CO2 emissions will increase.

It should be noted that GHG emissions reduction derived in ENTSOG PS-CBA considers DE demand and supply for H2 and NG in all European countries, therefore, sustainability benefits included in section C.1 and C.2 of the project fiche, reflect GHG emissions reduction from the replacement of blue hydrogen supplies by green hydrogen supplies enabled by the project group. Nevertheless, additional GHG and non-GHG emissions reduction could stem from the project group implementation from the replacement of other more polluting fuels, as indicated by the project promoter in the section E. Other benefits.

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







Security of Supply:[4]

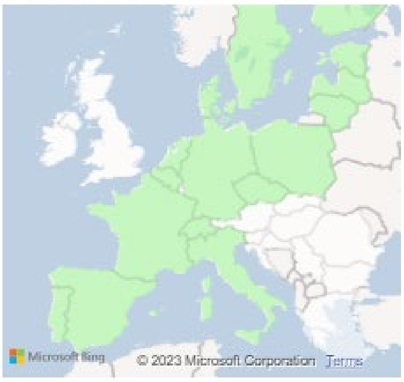
> Reference case:

Thanks to the implementation of the project group, which will enhance cooperation between Italy, Austria and Germany and neighbouring countries, mitigating the risk of demand curtailment in Germany and Baltic states in 2040 and reducing overall risk of demand curtailment in Europe in 2050.

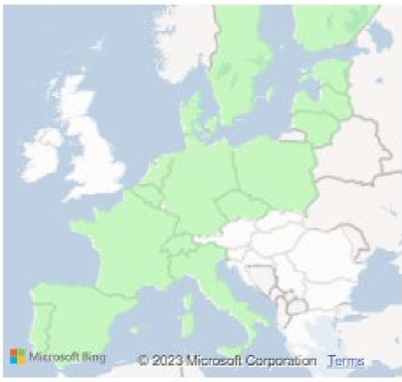
[4] *As for the hydrogen system there is no existing infrastructure level available yet, ENTSOG has identified a possible hydrogen network according to the information provided by promoters in their project submission for the TYNDP/PCI process (i.e., H2 Infrastructure level). Therefore, the System Assessment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

2030 DE- Benefits

2040 DE- Benefits



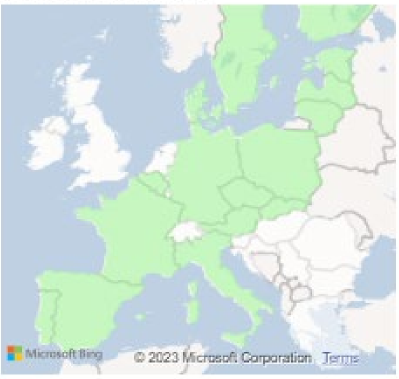
2050 DE- Benefits



> Climatic stress cases:

In addition to the security of supply benefits described for reference cases, additional security of supply benefits are expected under climatic stress cases (2-Week Cold Spell, 2-Week Dunkelflaute and in Peak Day), where due to the higher hydrogen demand the projects group will mitigate risk of demand curtailment in western and central Europe in 2030.

2030 DE- Benefits



2040 DE- Benefits

2050 DE- Benefits

> Disruption cases (S-1):

Under LH2 and Norway supply disruption cases the project group shows increased benefits for mitigating the risk of demand curtailment in western and northern Europe from 2040 onwards (as observed in section C.2. Quantitative benefits).

In case of Ukraine supply disruption south-eastern European countries are benefitting in all three timestamps by reducing the risk of demand curtailment by 30% approximately in Austria, Hungary, Slovakia, Romania, Bulgaria and Greece.

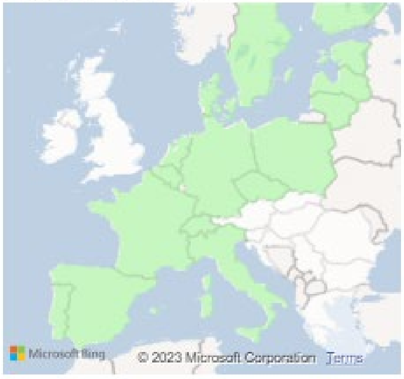
In addition, under North African disruption, project group is significantly reducing the risk of demand curtailment in Italy from 2030 and Iberian Peninsula from 2040.

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

1 noLH2: LH2 disruption

2030 DE- Benefits

2040 DE- Benefits

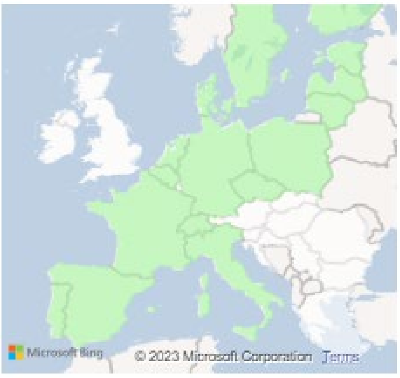


2050 DE- Benefits

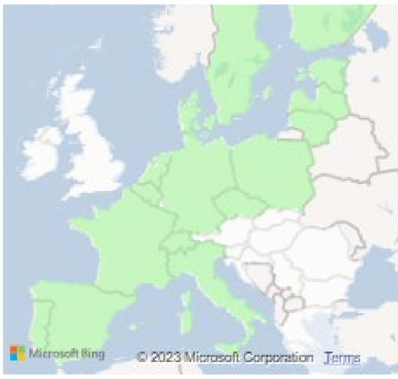
2 noNOh2: Norway disruption

2030 DE- Benefits

2040 DE- Benefits

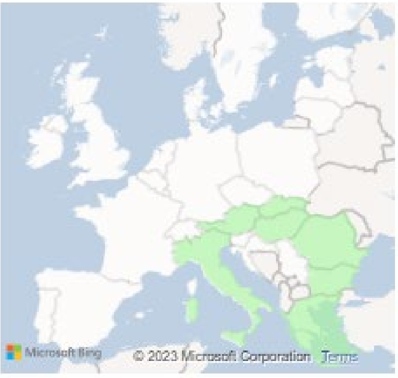


2050 DE- Benefits

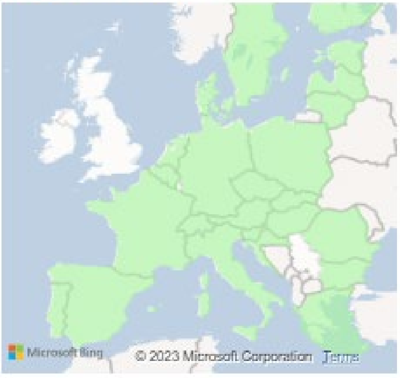


3 noUAh2: Ukraine disruption

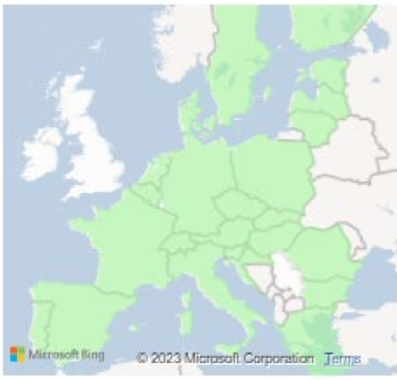
2030 DE- Benefits



2040 DE- Benefits



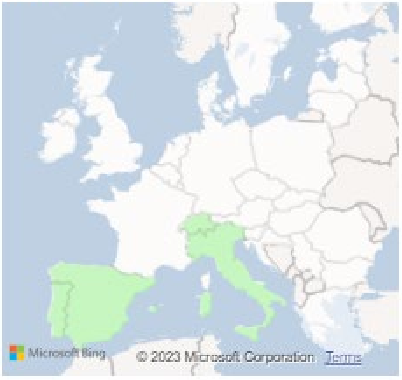
2050 DE- Benefits



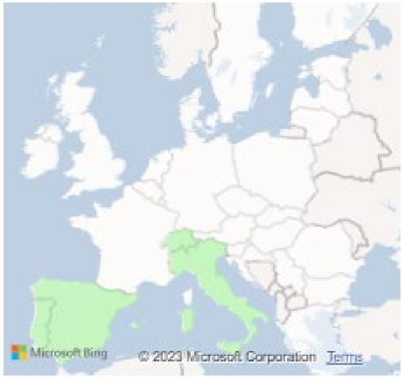
4 noNAh2 : North Africa disruption

2030 DE- Benefits

2040 DE- Benefits



2050 DE- Benefits

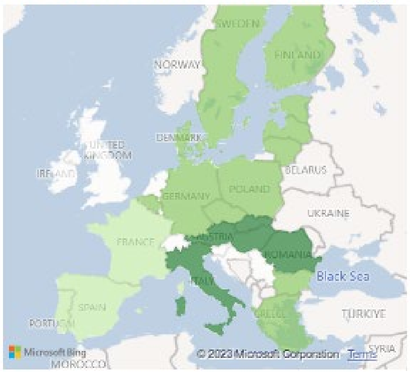


> Single largest capacity disruption (SLCD):

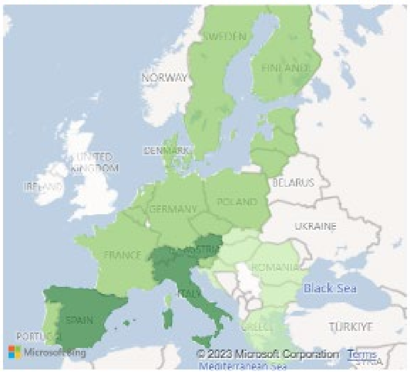
In case of SLCD in 2030, the project group significantly reduces the risk of demand curtailment in Italy by 63% , Austria by 51%, in Hungary, Slovakia and Romania (by 32% approximately) and in Greece and and Bulgaria by 15%. In addition, it also reduces to a lower extent risk of demand curtailment in NorthwestEurope and Baltic region.

Similar trend is observed from 2040 onwards, wherein addition to the benefits already observed in 2030, the project group also helps to mitigate risk of demand curtailment under SLCD in the Iberian Peninsula.

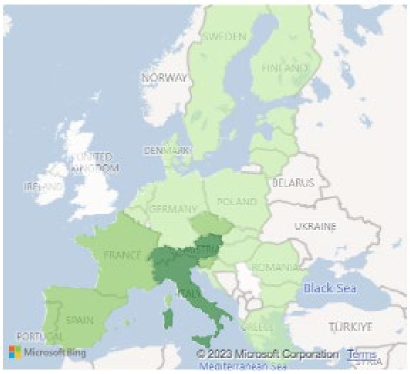
SLCD Benefits - 2030 - Distributed Energy



SLCD Benefits - 2040 - Distributed Energy



SLCD Benefits - 2050 - Distributed Energy

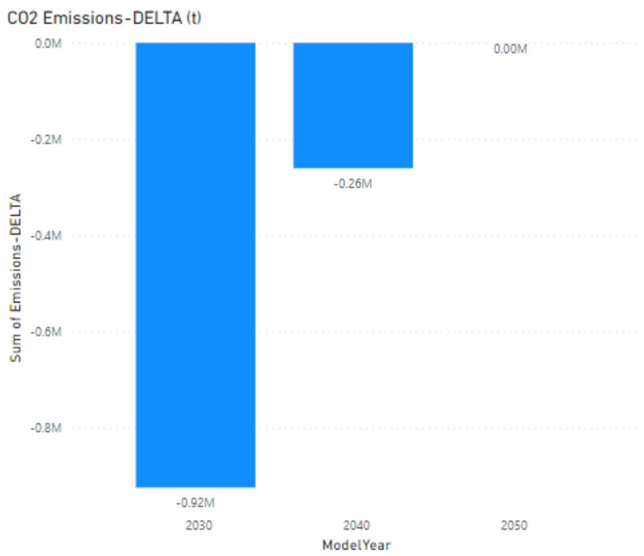


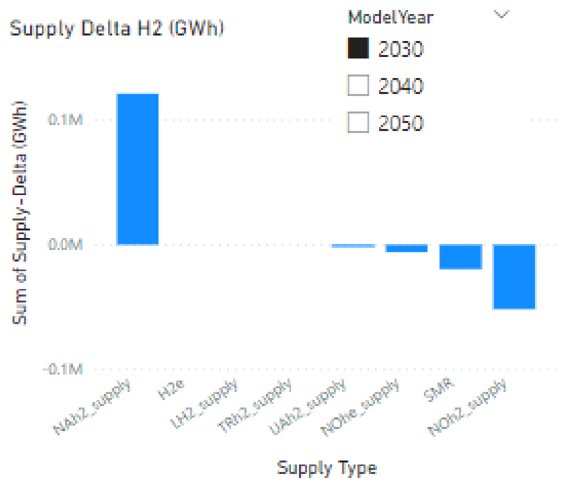
Global Ambition

Sustainability benefits

Thanks to the projects group, from 2029, the conversion of the interconnections from Italy to Austria and from Austria to Germany in both direction allows higher cooperation between these countries also including Switzerland.

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 920 kt in 2030. This is explained as the project group will enable replacement of blue hydrogen supplies and, therefore, will reduce natural gas imports, through the access to green hydrogen supply sources from North Africa.





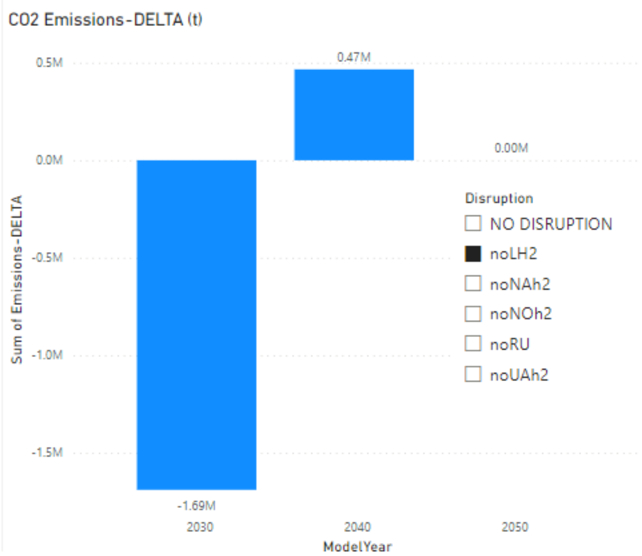
Similarly, when Norwegian, liquid hydrogen imports are disrupted, the project group also contributes to sustainability by reducing overall CO2 emissions in 2030 and also in 2040. In addition sustainability benefits under both disruption cases are considerably higher than in the reference case, as project group capacity is maximized to replace disrupted supplies, and significantly reducing SMR use.

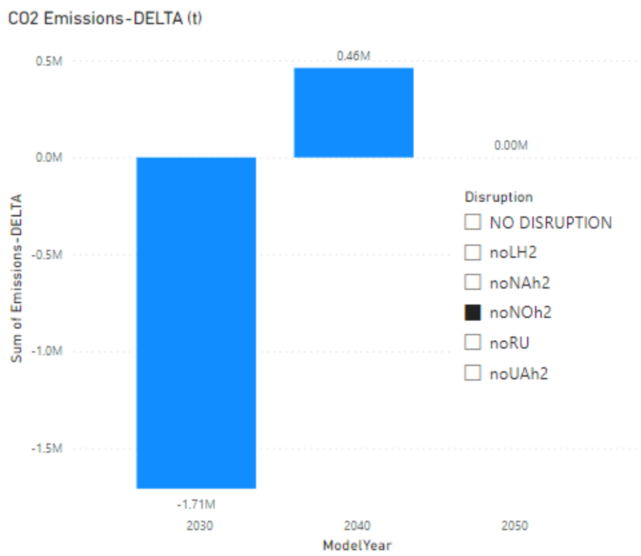
Regarding Ukrainian disruption, sustainability benefits follow the same trend as in the reference case, however, substantially higher than the reference case due to the lower availability of hydrogen supplies in Eastern Europe.

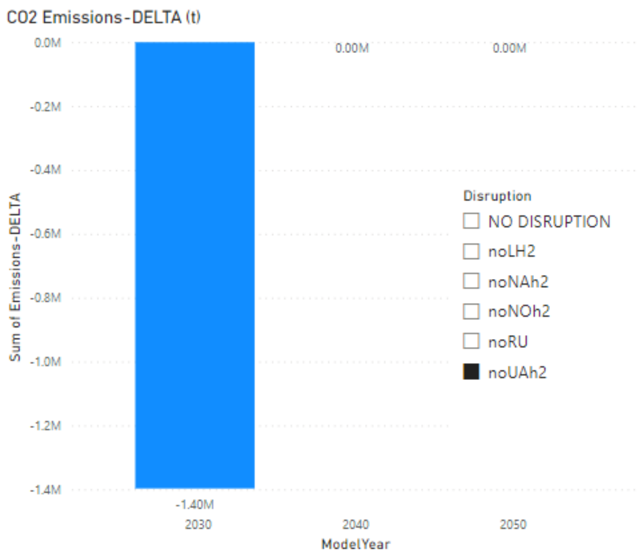
In addition, when North African supplies are disrupted, the project group also contributes to sustainability by enhancing cooperation between countries, and therefore, avoid hydrogen demand curtailment in Italy. As all green hydrogen sources available are already being used at its maximum capacity, SMR will be used to avoid demand curtailment, and subsequently, total CO2 emissions will increase.

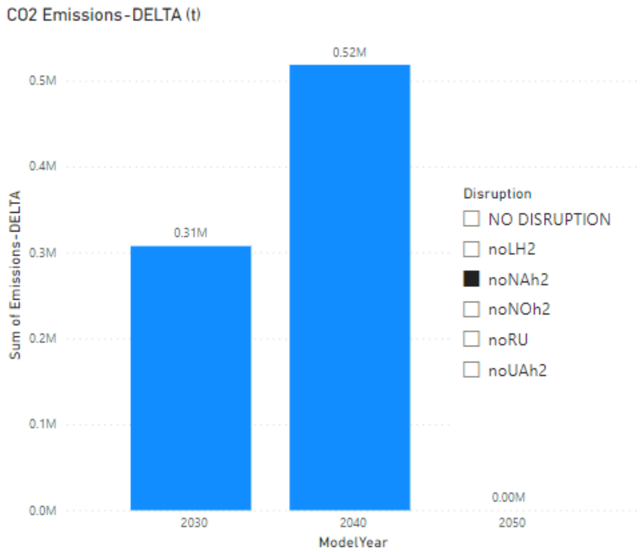
It should be noted that GHG emissions reduction derived in ENTSOG PS-CBA considers DE demand and supply for H2 and NG in all European countries, therefore, sustainability benefits included in section C.1 and C.2 of the project fiche, reflect GHG emissions reduction from the replacement of blue hydrogen supplies by green hydrogen supplies enabled by the project group. Nevertheless, additional GHG and non-GHG emissions reduction could stem from the project group implementation from the replacement of other more polluting fuels, as indicated by the project promoter in the section E. Other benefits.

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









Security of supply:

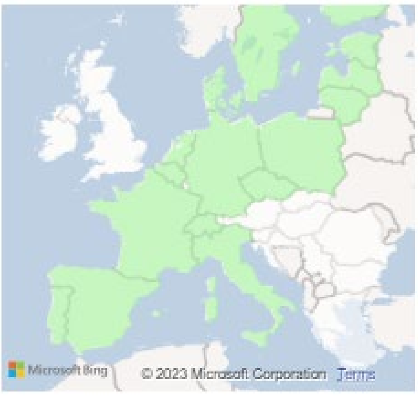
> Reference case

In 2030, the project group reduces the risk of demand curtailment in Italy. In addition, in 2040, by enabling cooperation between Italy, Austria and Germany the project group reduces the risk of demand curtailment in the newly connected countries and to a lower extent in Northern Europe and Iberian Peninsula through complementary infrastructure included in the infrastructure level.

The reduction in the contribution of the project to avoidance of demand curtailment in 2050 is linked to the saturation of the infrastructure capacity, while further potential supply to cover increased demand can be made available through additional projects.

2030 GA- Benefits

2040 GA- Benefits



2050 GA- Benefits

> Climatic stress cases

In addition to the security of supply benefits described for reference cases, additional security of supply benefits are expected under climatic stress cases (2-Week Cold Spell, 2-Week Dunkelflaute and in Peak Day), where due to the higher hydrogen demand the projects group will mitigate risk of demand curtailment in overall Europe in 2030.

The reduction in the contribution of the project to avoidance of demand curtailment in 2050 is linked to the saturation of the infrastructure capacity, while further potential supply to cover increased demand can be made available through additional projects.

2030 GA- Benefits

2040 GA- Benefits

2050 GA- Benefits

> Disruption cases (S-1)

Under LH2 and Norway supply disruption, the project group shows higher security of supply benefits for mitigating the risk of demand curtailment due to the lower availability of supplies (as observed in section C.2 Quantitative benefits) .

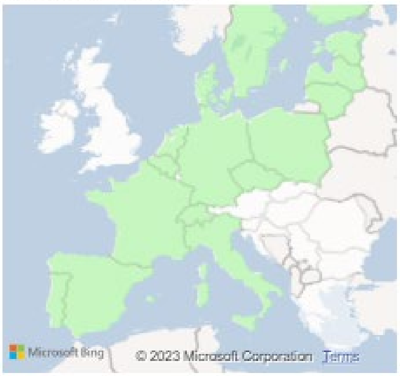
In case of Ukraine supply disruption south-eastern European countries are benefitting in all three timestamps by reducing the risk of demand curtailment by 20% in 2030, 32% in 2040 and 24%in 2050. The reduction in the contribution of the project to avoidance of demand curtailment in 2050 is linked to the saturation of the infrastructure capacity, while further potential supply to cover increased demand can be made available through additional projects.

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

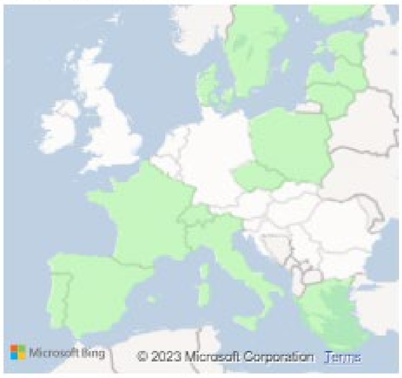
1 noLH2: LH2 disruption

2030 GA- Benefits

2040 GA- Benefits



2050 GA- Benefits



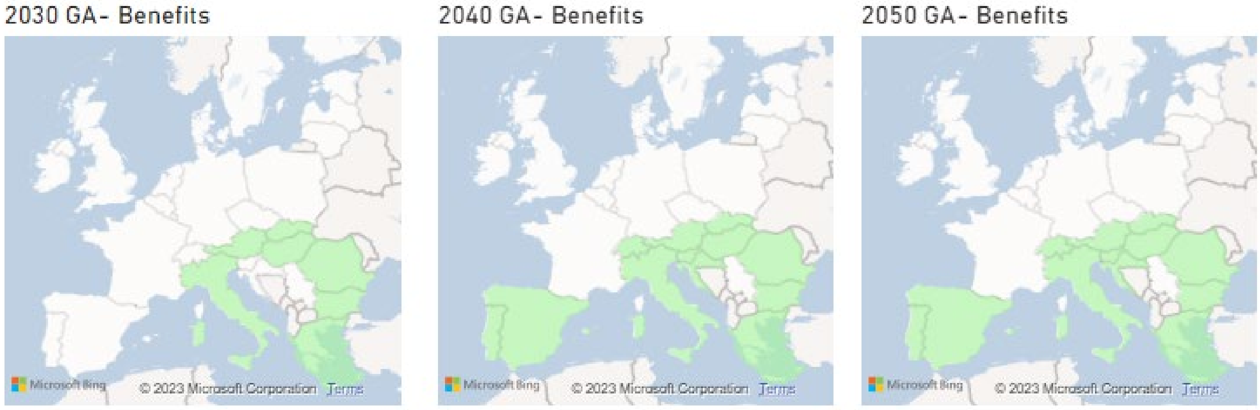
2 noNOh2: Norway disruption

2030 GA- Benefits

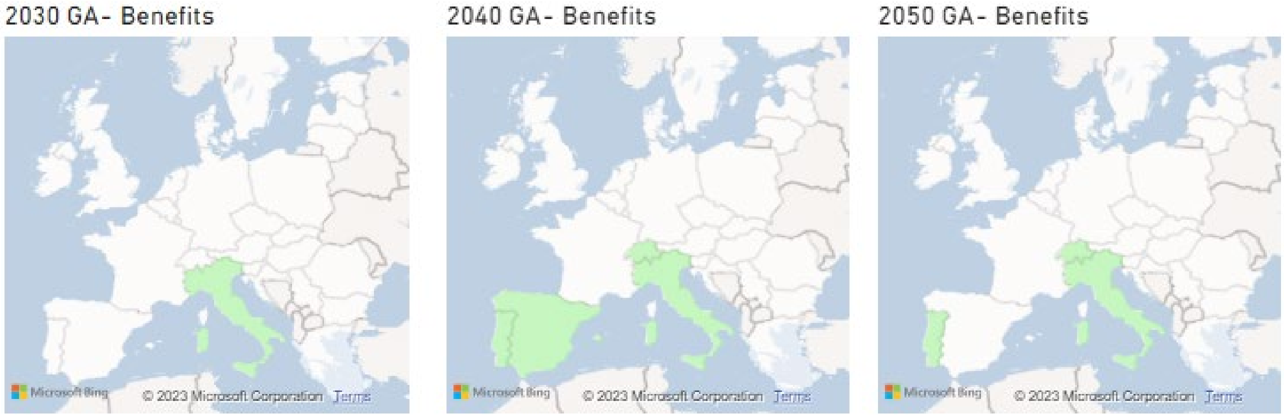
2040 GA- Benefits

2050 GA- Benefits

3 noUAh2: Ukraine disruption



4 noNAh2 : North Africa disruption

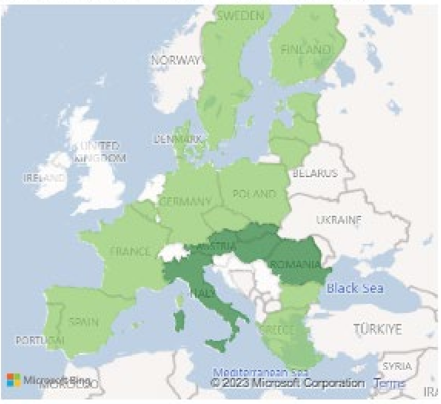


> Single largest capacity disruption (SLCD):

In case of SLCD almost all European countries benefitting from this project group by mitigating the risk of demand curtailment. The highest benefits are recorded in 2030, including 68% for Italy, *56%* for Austria and 35% for Slovakia, Hungary and Romania. Other respective countries are mitigating risk of demand curtailment by 6% in 2030. In 2040 and 2050 countries in South West Europe including Portugal, Spain, Switzerland, Italy, Austria and Slovenia are benefitting the most.

The reduction in the contribution of the project to avoidance of demand curtailment in 2050 is linked to the saturation of the infrastructure capacity, while further potential supply to cover increased demand can be made available through additional projects.

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:

ModelYear	Disruption	Scenario	Unit	Emissions-DELTA	Emissions-PLUS	Emissions-MINUS
2030	NO DISRUPTION	DE	tonne	-712494,39	538677299	539389793,4
2030	noLH2	DE	tonne	-1349328,21	540175890,2	541525218,4
2030	noNAh2	DE	tonne	395562,68	539785356,1	539389793,4
2030	noNOh2	DE	tonne	-1472101,73	538877197,8	540349299,5
2030	noUAh2	DE	tonne	-810904,50	539378771,9	540189676,4
2030	NO DISRUPTION	GA	tonne	-923595,77	592910448,4	593834044,2
2030	noLH2	GA	tonne	-1690059,75	594817481,2	596507540,9
2030	noNAh2	GA	tonne	307388,96	594141433,2	593834044,2
2030	noNOh2	GA	tonne	-1708282,42	593310994,3	595019276,7
2030	noUAh2	GA	tonne	-1396899,08	593627617,9	595024517
2040	NO DISRUPTION	DE	tonne	-107258,38	392077044	392184302,4
2040	noLH2	DE	tonne	-672723,25	392213883,4	392886606,6
2040	noNAh2	DE	tonne	3795,30	392188097,7	392184302,4
2040	noNOh2	DE	tonne	-665551,53	392144022,6	392809574,1
2040	noUAh2	DE	tonne	-354365,89	392399182,9	392753548,8
2040	NO DISRUPTION	GA	tonne	-260464,48	396523251,6	396783716,1
2040	noLH2	GA	tonne	465995,59	397455196,7	396989201,1
2040	noNAh2	GA	tonne	518260,55	397301976,6	396783716,1
2040	noNOh2	GA	tonne	461775,98	397450977,1	396989201,1
2040	noUAh2	GA	tonne	0,00	397478498,3	397478498,3
2050	NO DISRUPTION	DE	tonne	0,00	232557734,8	232557734,8
2050	noLH2	DE	tonne	0,00	232557734,8	232557734,8
2050	noNAh2	DE	tonne	0,00	232557734,8	232557734,8
2050	noNOh2	DE	tonne	0,00	232557734,8	232557734,8
2050	noRU	DE	tonne	0,00	232557734,8	232557734,8
2050	noUAh2	DE	tonne	0,00	232557734,8	232557734,8
2050	NO DISRUPTION	GA	tonne	0,00	228306706,5	228306706,5
2050	noLH2	GA	tonne	0,00	228306706,5	228306706,5
2050	noNAh2	GA	tonne	0,00	228306706,5	228306706,5
2050	noNOh2	GA	tonne	0,00	228306706,5	228306706,5
2050	noRU	GA	tonne	0,00	228306706,5	228306706,5
2050	noUAh2	GA	tonne	0,00	228306706,5	228306706,5

Curtailment Rate (SLCD):

Country	2030-DE-DELTA	2030-GA-DELTA	2040-DE-DELTA	2040-GA-DELTA	2050-DE-DELTA	2050-GA-DELTA
Switzerland	0%	0%	-30%	-19%	-23%	-15%
Italy	-64%	-68%	-30%	-19%	-23%	-14%
Austria	-51%	-56%	-25%	-20%	-26%	-20%
Spain	-5%	-6%	-21%	-18%	-12%	-9%
Slovenia	0%	0%	-15%	-13%	-14%	-14%
Portugal	-5%	-6%	-13%	-18%	-12%	-9%
Poland	-6%	-6%	-8%	-3%	-4%	0%
France	-5%	-6%	-8%	-4%	-7%	-6%
Czechia	-6%	-6%	-8%	-4%	-6%	0%
Belgium	-6%	-6%	-7%	-4%	-4%	0%
Denmark	-6%	-6%	-7%	-4%	-5%	0%
Estonia	-6%	-6%	-7%	-4%	-5%	0%
Finland	-6%	-6%	-7%	-3%	-5%	0%
Germany	-6%	-6%	-7%	-4%	-4%	0%
Latvia	-6%	-6%	-7%	-4%	-4%	0%
Lithuania	-6%	-6%	-7%	-3%	-4%	0%
Sweden	-6%	-6%	-7%	-3%	-5%	0%
The Netherlands	0%	0%	-7%	-4%	-5%	0%
Bulgaria	-15%	-6%	-4%	-2%	-1%	-7%
Croatia	0%	0%	-4%	-2%	-1%	-7%
Greece	-14%	-6%	-4%	-1%	-1%	-7%
Hungary	-32%	-35%	-4%	-1%	-1%	-7%
Romania	-32%	-35%	-4%	-1%	-1%	-6%
Slovakia	-33%	-35%	-4%	-2%	-2%	-7%

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	-6%	-7%	0%	0%	0%	0%
Average2W	Belgium	-6%	-6%	-6%	-1%	-3%	0%
Average2W	Bulgaria	-1%	-7%	0%	0%	0%	0%
Average2W	Croatia	0%	0%	0%	0%	0%	0%
Average2W	Cyprus	0%	0%	0%	0%	0%	0%
Average2W	Czechia	-6%	-7%	-5%	-1%	-3%	0%
Average2W	Denmark	-6%	-7%	-5%	-1%	-3%	0%
Average2W	Estonia	-6%	-6%	-4%	-1%	-3%	0%
Average2W	Finland	-6%	-6%	-5%	-1%	-3%	0%
Average2W	France	-6%	-7%	-5%	-1%	-3%	0%
Average2W	Germany	-7%	-7%	-5%	0%	-3%	0%
Average2W	Greece	-1%	-7%	0%	0%	0%	0%
Average2W	Hungary	-1%	-7%	0%	0%	0%	0%
Average2W	Ireland	0%	0%	0%	0%	0%	0%
Average2W	Italy	-66%	-67%	-15%	-18%	-14%	-14%

Average2W	Latvia	-6%	-6%	-5%	-1%	-3%	0%
Average2W	Lithuania	-6%	-6%	-5%	-1%	-3%	0%
Average2W	Luxembourg	0%	0%	0%	0%	0%	0%
Average2W	Malta	0%	0%	0%	0%	0%	0%
Average2W	Poland	-6%	-7%	-5%	-1%	-3%	0%
Average2W	Portugal	-6%	-6%	-14%	-18%	0%	-13%
Average2W	Romania	-1%	-6%	0%	0%	0%	0%
Average2W	Serbia	0%	0%	0%	0%	0%	0%
Average2W	Slovakia	-6%	-7%	0%	0%	0%	0%
Average2W	Slovenia	0%	0%	0%	0%	0%	0%
Average2W	Spain	-6%	-6%	-15%	-17%	-10%	-13%
Average2W	Sweden	-6%	-7%	-5%	-1%	-3%	0%
Average2W	Switzerland	0%	0%	-16%	-18%	-15%	-14%
Average2W	The Netherlands	0%	0%	-5%	-1%	-3%	0%
Average2W	United Kingdom	0%	0%	0%	0%	0%	0%
Average2WDF	Austria	-6%	-7%	0%	0%	0%	0%
Average2WDF	Belgium	-7%	-6%	-5%	-1%	-3%	0%
Average2WDF	Bulgaria	-1%	-7%	0%	0%	0%	0%
Average2WDF	Croatia	0%	0%	0%	0%	0%	0%
Average2WDF	Cyprus	0%	0%	0%	0%	0%	0%
Average2WDF	Czechia	-6%	-7%	-5%	0%	-3%	0%
Average2WDF	Denmark	-6%	-7%	-5%	-1%	-3%	0%
Average2WDF	Estonia	-6%	-6%	-5%	0%	-3%	0%
Average2WDF	Finland	-6%	-6%	-5%	-1%	-3%	0%
Average2WDF	France	-6%	-7%	-5%	-1%	-3%	0%
Average2WDF	Germany	-7%	-7%	-5%	-1%	-3%	0%
Average2WDF	Greece	-1%	-7%	0%	0%	0%	0%
Average2WDF	Hungary	-1%	-7%	0%	0%	0%	0%
Average2WDF	Ireland	0%	0%	0%	0%	0%	0%
Average2WDF	Italy	-66%	-67%	-15%	-17%	-14%	-14%
Average2WDF	Latvia	-6%	-6%	-5%	0%	-3%	0%
Average2WDF	Lithuania	-6%	-6%	-5%	0%	-3%	0%
Average2WDF	Luxembourg	0%	0%	0%	0%	0%	0%
Average2WDF	Malta	0%	0%	0%	0%	0%	0%
Average2WDF	Poland	-6%	-7%	-5%	0%	-3%	0%
Average2WDF	Portugal	-6%	-6%	-14%	-18%	0%	-12%
Average2WDF	Romania	-1%	-6%	0%	0%	0%	0%
Average2WDF	Serbia	0%	0%	0%	0%	0%	0%
Average2WDF	Slovakia	-6%	-7%	0%	0%	0%	0%
Average2WDF	Slovenia	0%	0%	0%	0%	0%	0%
Average2WDF	Spain	-6%	-6%	-15%	-18%	-10%	-12%
Average2WDF	Sweden	-6%	-7%	-5%	-1%	-3%	0%
Average2WDF	Switzerland	0%	0%	-16%	-18%	-15%	-15%
Average2WDF	The Netherlands	0%	0%	-5%	-1%	-3%	0%
Average2WDF	United Kingdom	0%	0%	0%	0%	0%	0%

DC	Austria	-5%	-6%	0%	0%	0%	0%
DC	Belgium	-5%	-5%	-5%	-2%	-3%	0%
DC	Bulgaria	0%	-5%	0%	0%	0%	0%
DC	Croatia	0%	0%	0%	0%	0%	0%
DC	Cyprus	0%	0%	0%	0%	0%	0%
DC	Czechia	-5%	-5%	-4%	-1%	-3%	0%
DC	Denmark	-5%	-5%	-4%	-2%	-3%	0%
DC	Estonia	-4%	-5%	-5%	-1%	-3%	0%
DC	Finland	-4%	-5%	-5%	-1%	-3%	0%
DC	France	-5%	-5%	-6%	-1%	-3%	0%
DC	Germany	-5%	-5%	-5%	-2%	-2%	0%
DC	Greece	0%	-5%	0%	0%	0%	0%
DC	Hungary	0%	-5%	0%	0%	0%	0%
DC	Ireland	0%	0%	0%	0%	0%	0%
DC	Italy	-57%	-58%	-14%	-13%	-13%	-14%
DC	Latvia	-4%	-5%	-5%	-1%	-3%	0%
DC	Lithuania	-4%	-5%	-5%	-1%	-3%	0%
DC	Luxembourg	0%	0%	0%	0%	0%	0%
DC	Malta	0%	0%	0%	0%	0%	0%
DC	Poland	-4%	-5%	-5%	-1%	-3%	0%
DC	Portugal	-4%	-5%	-6%	-10%	0%	-4%
DC	Romania	0%	-5%	0%	0%	0%	0%
DC	Serbia	0%	0%	0%	0%	0%	0%
DC	Slovakia	-5%	-6%	0%	0%	0%	0%
DC	Slovenia	0%	0%	0%	0%	0%	0%
DC	Spain	-5%	-6%	-5%	-11%	-4%	-5%
DC	Sweden	-4%	-5%	-5%	-1%	-3%	0%
DC	Switzerland	0%	0%	-14%	-13%	-14%	-14%
DC	The Netherlands	0%	0%	-4%	-2%	-3%	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-1205	Pipelines and compressor stations	As the project foresees a high level of repurposing and for new built pipelines the same routes of existing pipelines are expected to be exploited (parallel assets), there will be no or minimal impacted surface as well as other environmental impacts.	The project is in feasibility study, but it is foreseen to use 73% of repurposed pipeline: thus, no additional use of land will be necessary, and all environmental impacts will be very minimal since the remaining new pipes are expected to exploit the same routes of existing pipelines. However, in order to tackle even the residual environmental impacts, appropriate restoration activities will be planned, according to best practices developed and applied thanks to competences gained over more than 80 years in building gas pipelines.
HYD-N-986	Pipelines and compressor stations	The project is based on the repurposing of existing infrastructure, thus surface and the environment won't be affected by pipeline routing. Compressor stations are expected to be built at locations of existing ones, leading to no or very limited impact either.	The project will utilize existing pipelines, hence no additional pipelines have to be installed and no new routes developed. The required compressor stations are expected to be built within already developed areas of existing ones, limiting the potential reclamation of additional land and environmental impacts to a minimum. The project implementation will follow best practice, comply with EU and national regulations, and all necessary measures will be taken to mitigate potential impacts on land and environment.
HYD-N-757	Pipelines and compressor stations	To minimise the environmental impact, existing pipelines are used or, where new construction is necessary, laid in the same route as an existing pipeline system (parallel). Compressor stations are integrated into existing stations in	The project implementation will follow best practice, comply with EU and national regulations, and all necessary measures will be taken to mitigate potential impacts on land and environment. State-of-the-art technologies such as fibre sensing, EMAT pigging or laser detection measurements reflect the highest standard of environmentally friendly work management.

		order to use access routes and the existing infrastructure.	
HYD-N-642	Pipelines and compressor station	The environmental impact can be reduced to a minimum by mainly using an existing pipeline system. In order to reduce the impact on the environment and nature as much as possible the principle of pipeline bundling for additional new constructions will be applied.	The project will be mainly centred are the usage of the existing pipeline system (95%). All appropriate technical safety precautions necessary to ensure safe operation at all times are taken. Mitigation measures and environmental works will follow best practice and will comply with national and EU-regulations.

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs
HYD-N-1205: The environmental impacts will be minimized by a careful evaluation and choice of the possible routes for the projects' layouts. Additionally, mitigation measures and environmental restoration works will ensure that the realization of the projects respects the crossed areas, further minimising potential impacts.	The project foreseen to use 73% of repurposed pipeline: no additional mitigation measure will be required The new pipelines will be built very close to the existing natural gas pipelines with low impacts on sensitive areas already assessed in the past. Furthermore, the building of new pipelines will foresee, appropriate restoration activities according to best practices, such as the reintroduction of species of flora and fauna through conservation and naturalization methods and construction works performed outside of the nesting period of the animal species.	The additional costs have been already taken into consideration in the relevant cost estimations (CAPEX & OPEX already reported in the previous sections)	N/A
HYD-N-986 will not impact on additional land and the environment by development of new pipeline routes; compressor stations are	The project implementation will follow best practice, comply with EU and national regulations, and all	Related costs have been considered in CAPEX & OPEX estimations (CAPEX &	N/A

expected to be built at locations of existing ones.	necessary measures will be taken to mitigate potential impacts on land and environment.	OPEX already reported in the previous sections)	
HYD-N-757 will not substantially and irreversibly affect the environment.	In order to ensure that environmental assessments are correct, environmental monitoring will be carried out before, during and after the construction of the infrastructure.	Related costs have been considered in CAPEX & OPEX estimations	N/A
HYD-N-642: The environmental impact will be reduced to a minimum by using existing pipeline routes. Additionally, compressor stations are expected to be built at locations of existing ones.	Mitigation measures and environmental works will follow best practice and will comply with national and EU-regulations.	Related costs have been considered in CAPEX & OPEX estimations	N/A

Environmental Impact explained [Promoter]

The infrastructure along the corridor will be mostly constituted of repurposed pipelines, so no additional use of land will be caused for the most part.

Compressor stations are in general expected to be built within the already developed areas of existing compressor stations, avoiding reclamation of new land and environmental impacts.

The implementation and completion of the minority new pipelines in the group will follow the best practices and all environmental laws and prescriptions. The environmental impacts will be minimized by a careful evaluation and choice of the possible routes for the projects' layouts. Additionally, mitigation measures and environmental restoration works will ensure that the realization of the projects respects the crossed areas, further minimising potential impacts

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]

As detailed in sections C.1 and C.2, ENTSOG PS-CBA analysis considers only direct GHG emissions reduction from the replacement of blue hydrogen supplies with green hydrogen supplies. Considering the above-mentioned assumption, higher sustainability benefits could materialize with the implementation of the project group, as it follows:

Sustainability: all hydrogen supplies (both blue and green H2) enabled by the project group could further reduce GHG emissions due to the replacement of more pollutant fuels, such as grey hydrogen, natural gas, diesel or coal. Moreover, once covered by alternative fuels, also the emissions related to the H2 unserved demand should be taken into account. Both aspects are already under assessment for improvements of CBA Methodology.

The project group will also enable the **reduction of other non-CO2 negative** pollutants (e.g. NOx, SOx, PMx, etc.) with associated benefits stemming from the project, that should be monetised according to their social cost (specific parameters allowing for the monetization of such non-CO2 emissions already exists, e.g. included in the JRC consultation on energy storage as well as in several other CBA methodologies).

Considering all the above reasons, the sustainability benefits reported in this PS-CBA should be intended as conservative, having the proposed projects much higher positive environmental impacts.

Infrastructure Flexibility: H2 projects contribute to improve the flexibility of the system. More in detail:

- Delta Line-Pack: as for natural gas, pipelines themselves can act as temporary storage providing balancing solutions and ensuring flexibility and security of supply to the system.
- Transport and subsequent storage of hydrogen in dedicated underground hydrogen storage would increase flexibility as well security of supply of hydrogen systems, by allowing seasonal modulation with the storage of renewable and low carbon hydrogen, according to the hydrogen production and consumption profiles.

Avoided cost for the energy system: the projects produce additional benefits on other energy systems (e.g. avoided costs on other energy infrastructure, flexibility services, etc.).

Improvement of market integration: A monetization of the indicator assessing, for example, the positive effects in terms of H2 prices alignment across EU, thanks to interconnections across Members States with cost-competitive H2 supplies, such as the renewable sources produced in North Africa and the South.

Competition: it will be important to include indicators that value H2 supply competition developments, facilitating production and demand scaling up as well as H2 diffusion.

F. Useful links [Promoter]

Useful links:

Initiative SoutH2 Corridor

https://www.south2corridor.net/

SNAM

https://www.snam.it/export/sites/snam-rp/repository-srg/file/it/business-servizi/Processi_Online/Allacciamenti/informazioni/piano-decennale/pd_2022_2031/consultazione/Piano-Decennale-22-31-Documento.pdf#page=94

Trans Austria Gasleitung

https://h2-readiness-tag.at/en/

Austrian Coordinated Network Development Plan 2022

Gas Connect Austria

H2 Backbone WAG+PW (h2backbone-wag-pw.at)

https://www.gasconnect.at/fileadmin/Fachabteilungen/ST/NEP/02-CNPD_2022-_EN.pdf

bayernets

HyPipe Bavaria: The Hydrogen Hub (hypipe-bavaria.com)

EU initiatives / Maps including the projects

European Hydrogen Backbone Maps | EHB European Hydrogen Backbone

H2 Infrastructure Map Europe (h2inframap.eu)