HI EAST 12 B (Less-advanced)

H2 supply Italy-Austria-Slovakia

Reasons for grouping [ENTSOG]

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

The group includes investments in Slovakia (HYD-N-772), Austria (HYD-N-986) and Italy (HYD-N-1205)

Objective of the group [Promoter]

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

The group is a part of a broader pan-European corridor connecting production areas with demand ones. The objective of the project group is to supply H2 in a reliable and sustainable manner, to potential industrial offtake centers along the project route and for domestic consumption, mainly via repurposed gas infrastructure.

HYD-N-772 **H2 transmission infrastructure in Slovak Republic**

Comm. Year **2029**

HYD-N-986 **H2 Readiness of the TAG pipeline system**

Comm. Year **2029**

Trans Austria Gasleitung

HYD-N-1205 **Italian H2 Backbone**

Comm. Year **2029**

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-772	Infrastructure repurpose for H2	Repurposing	900	85	0
HYD-N-986	H2 Readiness of the TAG pipeline system	Repurposing	From 900 to 1050	380	60 (*)
HYD-N-1205	Italian H2 Backbone	Repurposing	From 750 to 1200	1700	Up to 500 (*)
HYD-N-1205	Italian H2 Backbone	New	From 850 to 1200	640	

(*) depending on the final configuration of the H2 backbone

Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year
HYD-N-772	H2_IP_SK-AT	eustream, a.s.	Transmission Slovakia (SK Hydrogen)	Transmission Austria (AT Hydrogen)	126	2029
HYD-N-772	H2_IP_SK-AT	eustream, a.s.	Transmission Austria (AT Hydrogen)	Transmission Slovakia (SK Hydrogen	142	2029
HYD-N-986	H2_IP_SK-AT	TAG GmbH	Transmission Slovakia (SK Hydrogen)	Transmission Austria (AT Hydrogen)	126	2029
HYD-N-986	H2_IP_SK-AT	TAG GmbH	Transmission Austria (AT Hydrogen)	Transmission Slovakia (SK Hydrogen	142	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-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-1205	DZh2 => ITh2	Snam Rete Gas S.p.A.	Transmission North Africa (DZ Hydrogen)	Transmission Italy (IT Hydrogen)	448	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-772	684	30%	90	30%
HYD-N-986	369	50%	5	50%
HYD-N-1205	3200	30%	58	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 configurations of the H2 backbone.

The following paragraphs are specifically referred to the Slovak project in the group:

SK part – for this group shall be allocated 15 M€ CAPEX (30% range), OPEX 4 M€ (30% range).

SK part is a subsection of the project number HYD-N-772 with the indicated CAPEX and OPEX in the table above which spans from UA border to AT border.

With reference to the overall HYD-N-772 project, a reassessment of the technical solution has already made possible the identification of another line for repurposing with significantly lower CAPEX than reported in the table (estimated amount of 448 M€).

C. Project Benefits [ENTSOG]

C.1 Summary of benefits

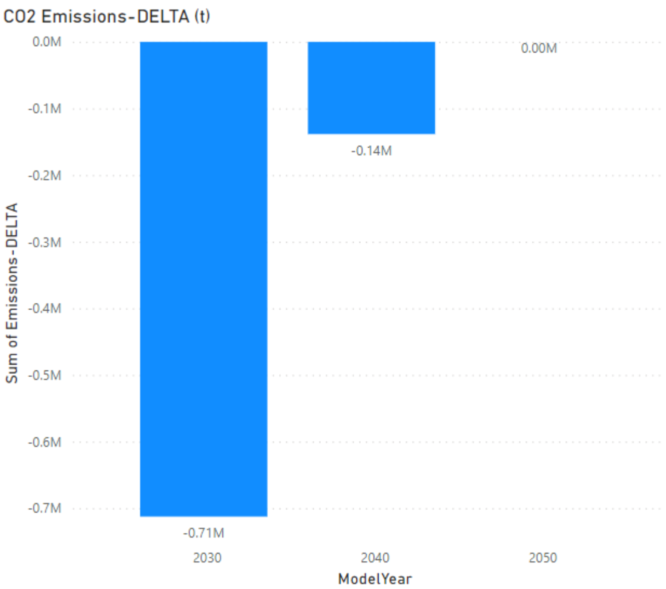
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. PS-CBA analysis of project group EAST 17 was performed following TOOT approach on TYNDP 2022 Hydrogen infrastructure level 1[1]. For more details on the indicators are available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

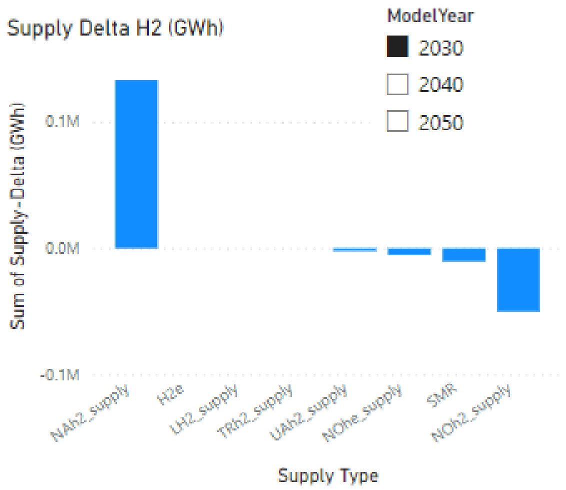
[1] Detail of H2 capacities in TYNDP 2022 Annex C.2 H2 Capacities per country
[2] https://www.entsog.eu/sites/default/files/2023-04/ENTSOG_TYNDP_2022_Annex_D_Methodology_230411.pdf

Distributed Energy

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 710 kt in 2030 and by 140 kt in 2040. The project group enables the transport of green hydrogen from North Africa via Italy and Austria and replaces hydrogen produced by SMR in Europe and hydrogen imports from Norway.

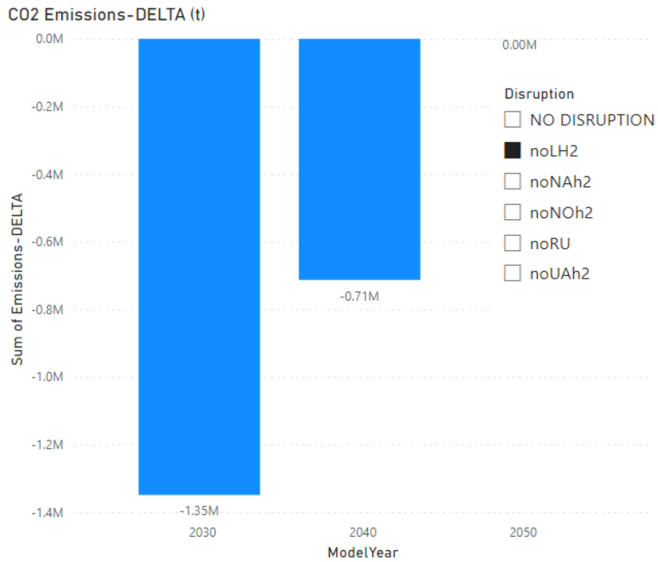


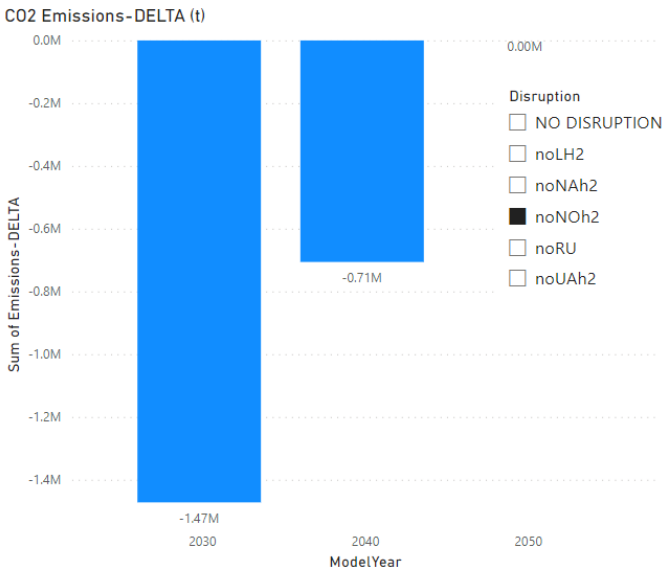


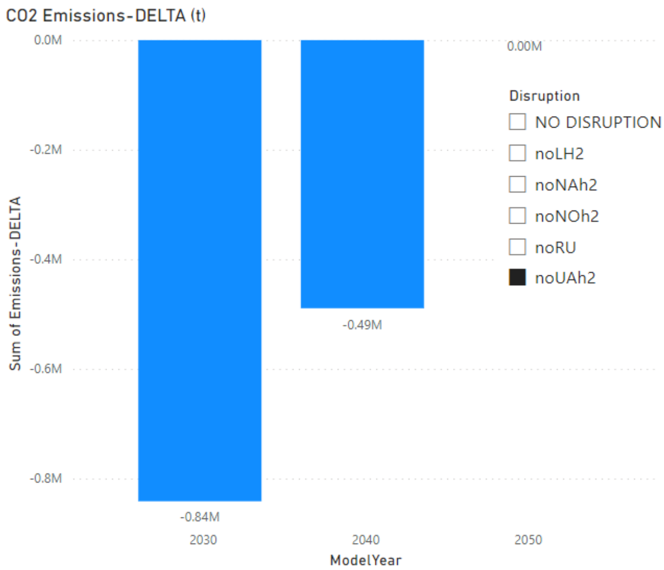
Increased benefits are expected under disruption cases in 2030 and 2040. In case of North Africa disruption, the project group allows cooperation between members states, but the intended purpose of the project group and sustainability benefits are limited.

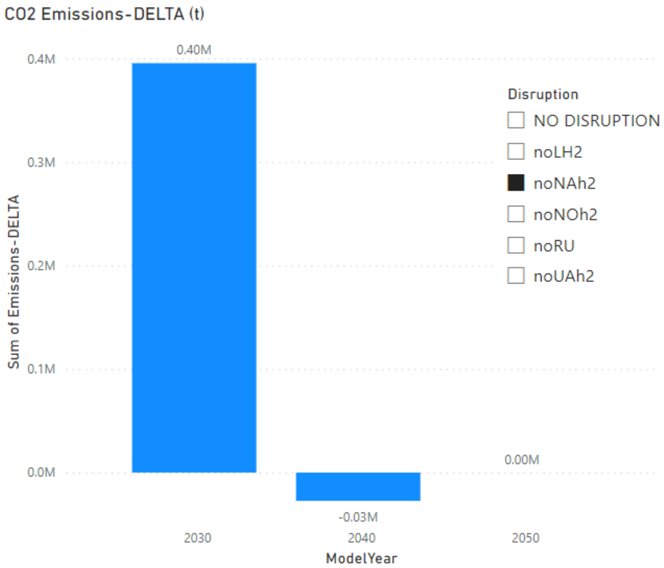
It should be noted that GHG emissions reduction derived in ENTSOG PS-CBA considers DE demand and supply for H2 and NG in all European countries, therefore, sustainability benefits included in section C.1 and C.2 of the project fiche, reflect GHG emissions reduction from the replacement of blue hydrogen 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









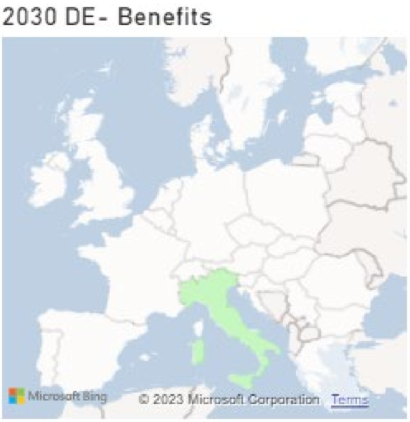
Security of Supply:[3]

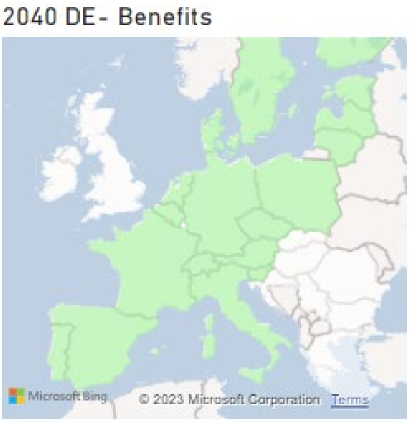
> Reference case:

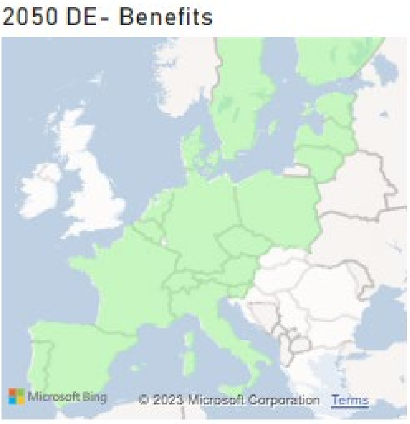
The conversion of the existing natural gas infrastructure doesn't impact the methane demand and will bring positive security of supply benefits for Italy and almost all European countries.

[3] *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.*

The project group mitigates the risk of yearly hydrogen demand curtailment In Italy by 65% in 2030 and by 20-25% in 2040 and 2050. In 2040 and 2050 the project group reduces the risk of hydrogen demand curtail by 2-10% in many European countries.

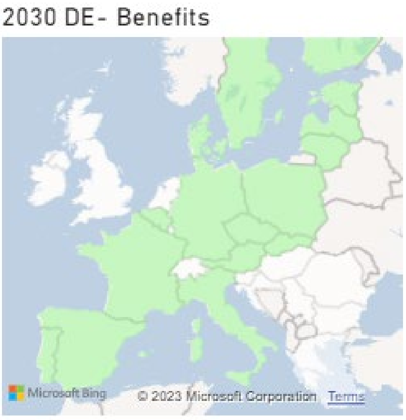


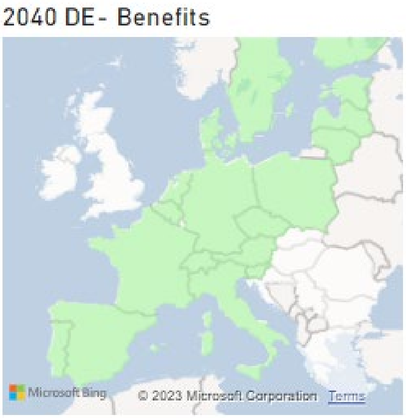


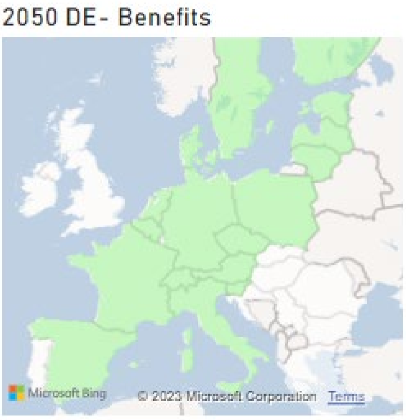


> Climatic stress cases:

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 2-15%. Italy is benefiting the most by mitigating the risk of demand curtailment by 14-15% in 2040 and 2050 and with a maximum of 66% in 2030.







> Disruption cases (S-1):

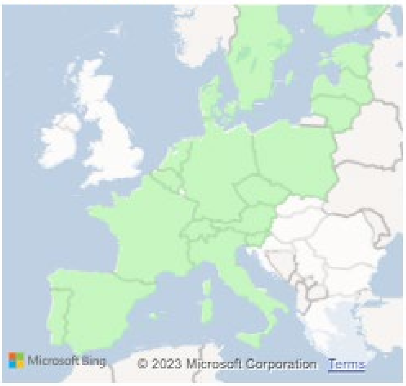
Similarly, under supply disruption cases besides North Africa disruption, the project group shows benefits for mitigating the risk of demand curtailment by 3-23% from 2040 in almost all European countries. In case of north Africa disruption, following the geographical location Italy is mitigating hydrogen demand curtailment in all three time-stamps, with a maximum of 42% in 2030 but also Portugal, Spain and Switzerland can mitigate demand curtailment in this case 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

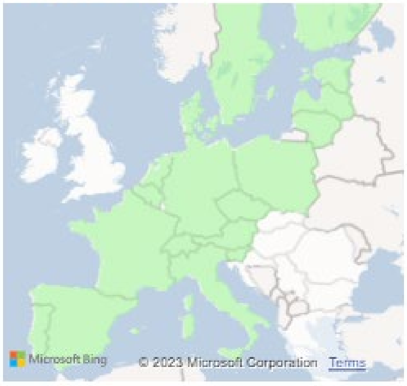
1 noLH2: LH2 disruption

2030 DE- Benefits

2040 DE- Benefits

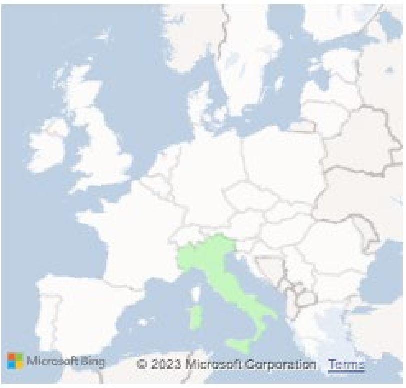


2050 DE- Benefits



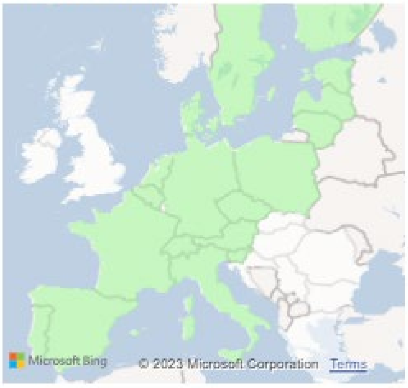
2 noNOh2: Norway disruption

2030 DE- Benefits



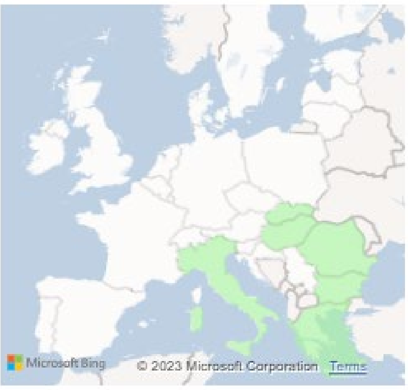
2040 DE- Benefits

2050 DE- Benefits



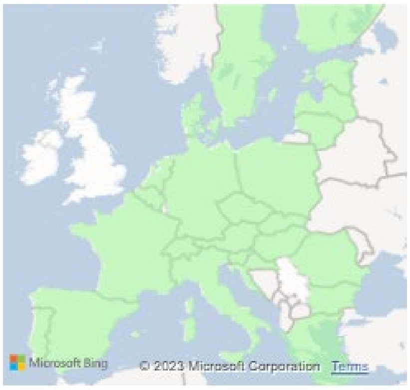
3 noUAh2: Ukraine disruption

2030 DE- Benefits

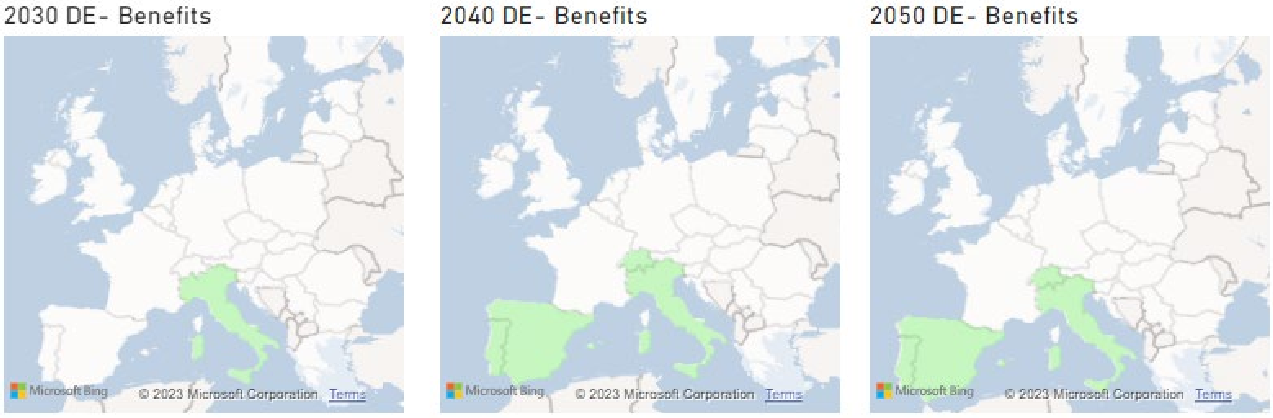


2040 DE- Benefits

2050 DE- Benefits

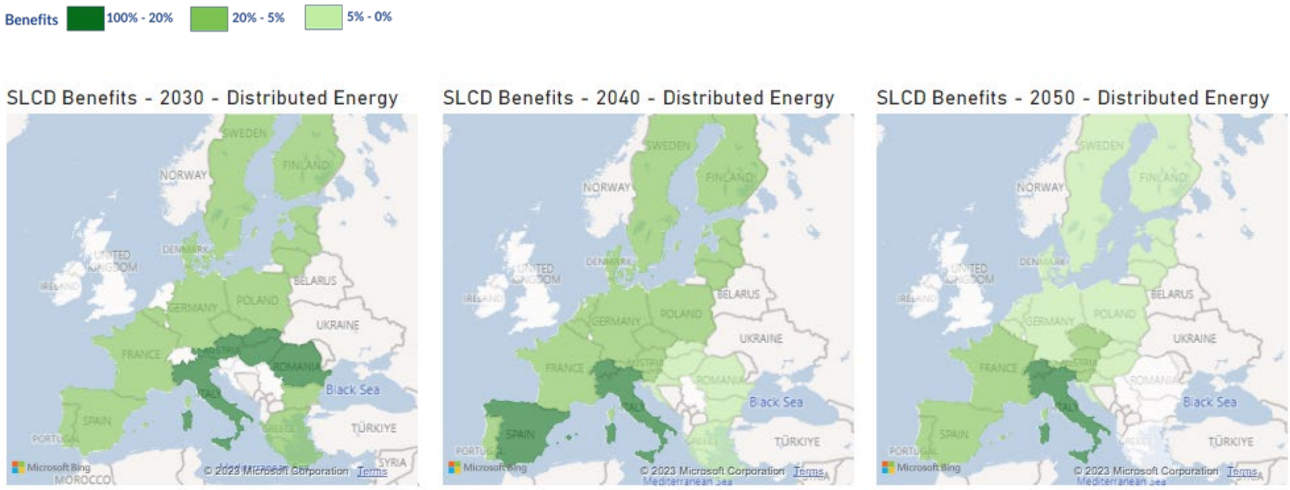


4 noNAh2: North Africa disruption



> Single largest capacity disruption (SLCD):

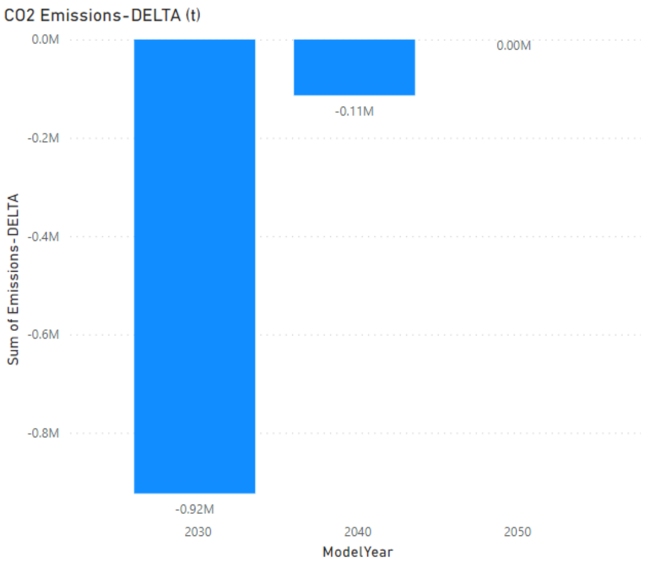
In case of SLCD almost all European countries benefitting from this project group by mitigating the risk of demand curtailment from 2030 onwards. In 2030 highest benefits are recorded, including demand curtailment for Italy by 64% and for Austria, Slovakia, Hungary and Romania by 28-33%. In 2030 the other European countries are benefitting by 6-15%. In 2040 Spain, Switzerland and Spain can reduce the risk demand curtailment by 21-30% and in 2050 Switzerland and Italy by 23%.

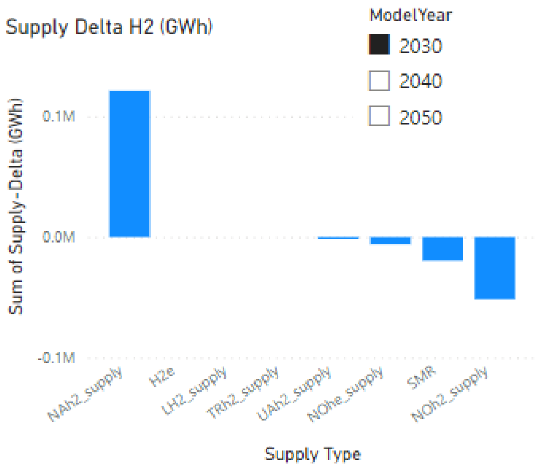


Global Ambition

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 920 kt in 2030 and by 110 kt in 2040. The project group enables the transport of green hydrogen from North Africa via Italy and Austria and replaces blue hydrogen produced by SMR and hydrogen imports from Norway.

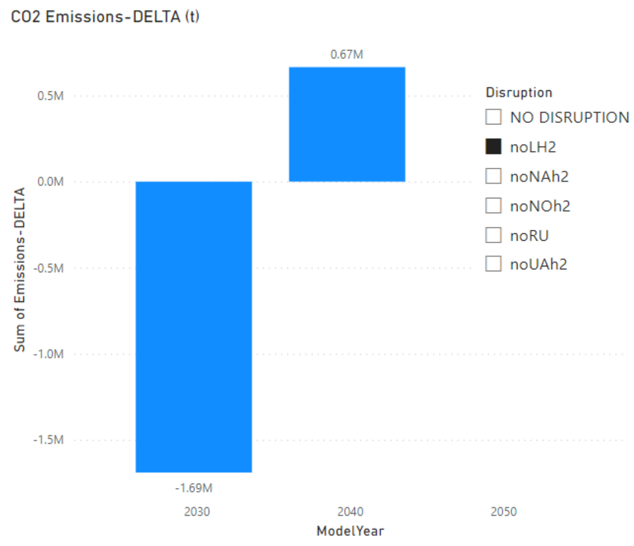


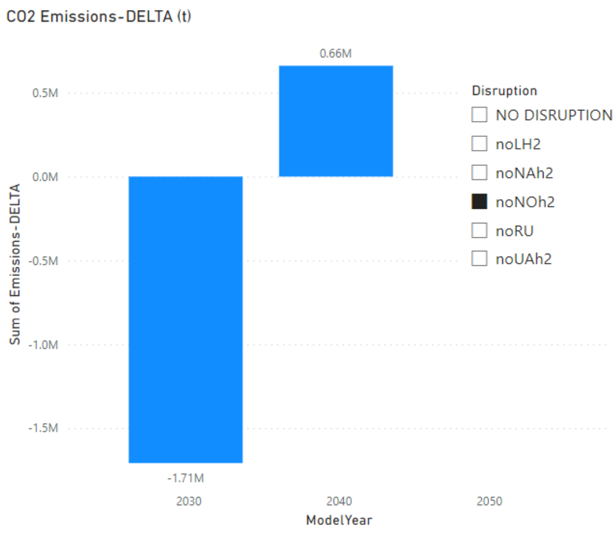


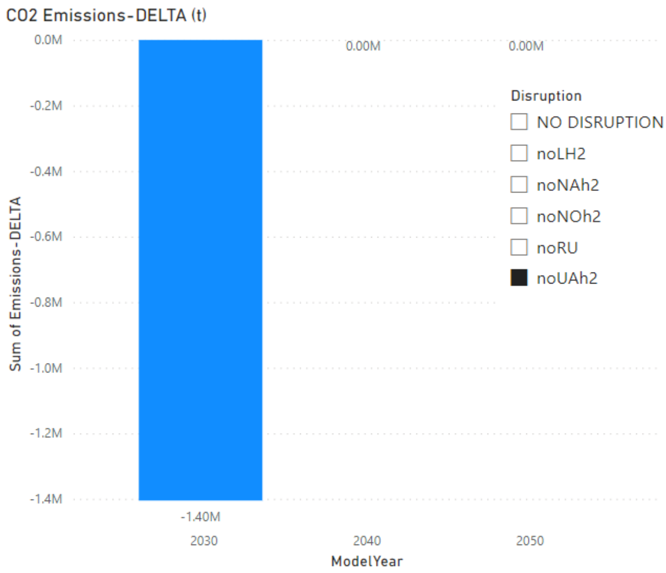
In case of supply disruption, besides North Africa disruption, the project group shows increased sustainability benefits for 2030. In case of North Africa disruption, the project group enables more cooperation and mitigates hydrogen demand curtailment by using more blue hydrogen produced by SMR.

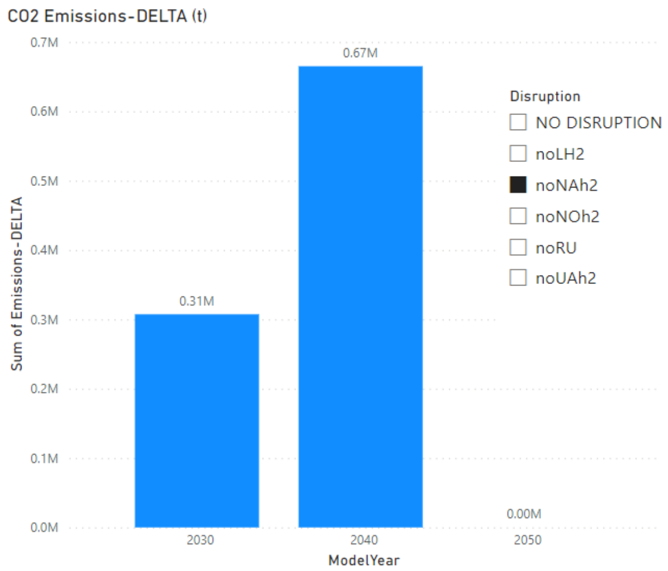
It should be noted that GHG emissions reduction derived in ENTSOG PS-CBA considers GA demand and supply for H2 and NG in all European countries, therefore, sustainability benefits included in section C.1 and C.2 of the project fiche, reflect GHG emissions reduction from the replacement of blue hydrogen 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









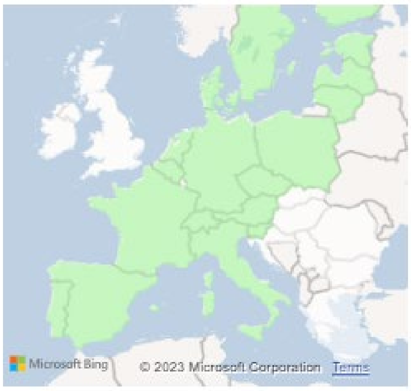
Security of supply:

> Reference case

The conversion of the existing natural gas infrastructure doesn't impact the methane demand and will bring positive security of supply benefits for Italy for all three time-stamps and in 2040 for many European countries in. In 2040 the project group reduces the risk of demand curtailment in Portugal, Spain, Switzerland and Italy by 24-28% and by 6-7% for the other respective Countries in Europa.

2030 GA- Benefits

2040 GA- Benefits

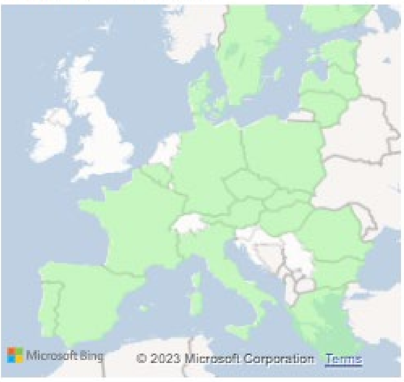


2050 GA- Benefits

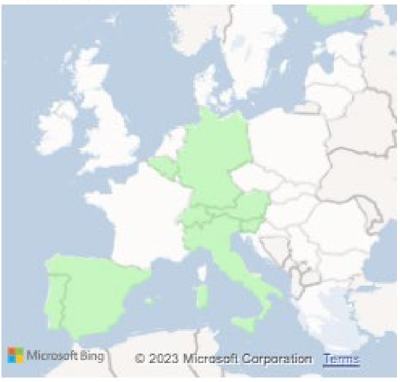
> Climatic stress cases

Under 2 -week and 2-week dunkelflaute climatic stress case, as well as under peak day climatic case the project group shows extended benefits in 2030 by mitigating the risk of hydrogen demand curtailment by 6-7% for many countries in Europe and a maximum of 67% for Italy. In 2040 and 2050 Portugal, Spain, Switzerland and Spain are benefitting by mitigating demand curtailment by 12-18%. Austria, Slovenia, Germany, Belgium and Finland are benefitting by 1-2% in 2040. The reduction in the contribution of the project to avoidance of demand curtailment in 2*040*-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)

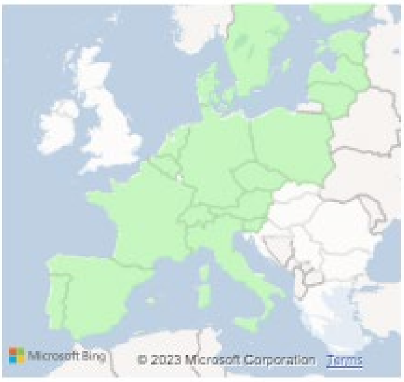
Similarly, under supply disruption cases besides North Africa disruption, the project group shows improved benefits for mitigating the risk of demand curtailment. For example, in 2040 the risk of demand curtailment is reduced by 18-22% for Portugal, Spain, Switzerland and Italy and by 9-11% for other respective countries in Europe. In case of Ukraine Disruption, Slovakia, Hungary, Romania, Bulgaria and Greece are also mitigating their risk of demand curtailment in all three timestamps. In case of North Africa disruption benefits are limited but Italy is benefitting in all three time-stamps and in 2040 the project groups mitigates demand curtailment by 7-9% in Portugal, Spain, Switzerland and Italy

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

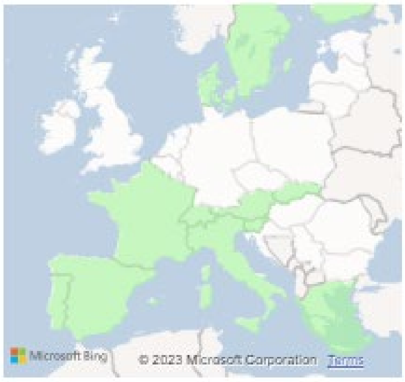
1 noLH2: LH2 disruption

2030 GA- Benefits

2040 GA- Benefits



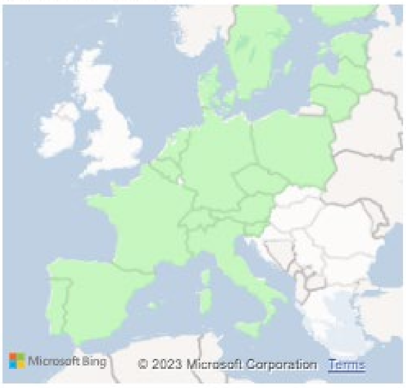
2050 GA- Benefits



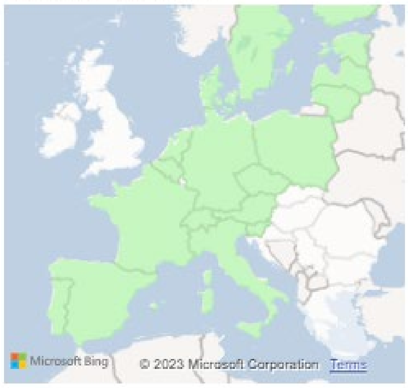
2 noNOh2: Norway disruption

2030 GA- Benefits

2040 GA- Benefits



2050 GA- Benefits

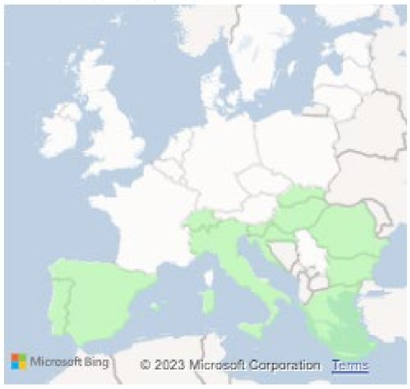


3 noUAh2: Ukraine disruption

2030 GA- Benefits

2040 GA- Benefits

2050 GA- Benefits



4 noNAh2: North Africa disruption

2030 GA- Benefits

2040 GA- Benefits

2050 GA- Benefits

> 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, 41% for Austria and 29-30% for Slovakia, Hungary and Romania. Other respective countries are mitigating risk of demand curtailment by 5-7% in 2030. In 2040 and 2050 countries in South West Europe including Portugal, Spain, Switzerland, Italy, Austria and Slovenia are benefitting the most.

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:

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	-841429,12	539378771,9	540220201,1
2030	NO DISRUPTION	GA	tonne	-923595,77	592910448,4	593834044,2
2030	noLH2	GA	tonne	-1689986,39	594817481,2	596507467,6
2030	noNAh2	GA	tonne	307388,96	594141433,2	593834044,2
2030	noNOh2	GA	tonne	-1708282,42	593310994,3	595019276,7
2030	noUAh2	GA	tonne	-1404907,80	593627617,9	595032525,7
2040	NO DISRUPTION	DE	tonne	-138386,32	392077044	392215430,3
2040	noLH2	DE	tonne	-713147,23	392213883,4	392927030,6
2040	noNAh2	DE	tonne	-27332,64	392188097,7	392215430,3
2040	noNOh2	DE	tonne	-705975,52	392144022,6	392849998,1
2040	noUAh2	DE	tonne	-489233,11	392399182,9	392888416
2040	NO DISRUPTION	GA	tonne	-113656,77	396523251,6	396636908,4
2040	noLH2	GA	tonne	665068,26	397455196,7	396790128,5
2040	noNAh2	GA	tonne	665068,26	397301976,6	396636908,4
2040	noNOh2	GA	tonne	660848,65	397450977,1	396790128,5
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%
Spain	-6%	-7%	-21%	-18%	-12%	-9%
Austria	-33%	-41%	-15%	-13%	-18%	-14%
Slovenia	0%	0%	-15%	-13%	-14%	-14%
Portugal	-6%	-7%	-13%	-18%	-12%	-9%
Czechia	-7%	-7%	-8%	-5%	-6%	-1%
Latvia	-7%	-8%	-8%	-4%	-4%	-1%
Lithuania	-7%	-8%	-8%	-4%	-5%	-1%
Poland	-6%	-7%	-8%	-4%	-5%	0%
France	-6%	-7%	-8%	-5%	-7%	-6%
Germany	-7%	-7%	-7%	-4%	-4%	-1%
Belgium	-6%	-8%	-7%	-4%	-5%	0%
Denmark	-6%	-8%	-7%	-4%	-5%	0%
Estonia	-7%	-8%	-7%	-4%	-5%	-1%
Finland	-7%	-8%	-7%	-4%	-5%	0%
Sweden	-7%	-8%	-7%	-4%	-5%	-1%
The Netherlands	0%	0%	-7%	-4%	-5%	0%
Croatia	0%	0%	-5%	-2%	-3%	-1%
Bulgaria	-15%	-6%	-4%	-1%	-1%	-2%
Hungary	-29%	-29%	-4%	-1%	-1%	-1%
Romania	-28%	-29%	-4%	-1%	0%	-2%
Slovakia	-29%	-30%	-4%	-2%	-1%	-2%
Greece	-14%	-5%	-3%	-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	-7%	-7%	-7%	-2%	-5%	0%
Average2W	Belgium	-6%	-6%	-6%	-2%	-4%	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%	-6%	-1%	-4%	0%
Average2W	Denmark	-6%	-7%	-6%	-2%	-4%	0%
Average2W	Estonia	-6%	-6%	-5%	-1%	-4%	0%
Average2W	Finland	-6%	-6%	-6%	-1%	-4%	0%
Average2W	France	-6%	-7%	-6%	-2%	-4%	0%
Average2W	Germany	-7%	-7%	-5%	-1%	-3%	0%
Average2W	Greece	-1%	-7%	0%	0%	0%	0%
Average2W	Hungary	0%	-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%	-6%	-1%	-3%	0%

Average2W	Lithuania	-6%	-6%	-6%	-1%	-4%	0%
Average2W	Luxembourg	0%	0%	0%	0%	0%	0%
Average2W	Malta	0%	0%	0%	0%	0%	0%
Average2W	Poland	-6%	-7%	-6%	-1%	-4%	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%	-7%	-2%	-5%	0%
Average2W	Spain	-6%	-6%	-15%	-17%	-10%	-13%
Average2W	Sweden	-6%	-7%	-6%	-1%	-4%	0%
Average2W	Switzerland	0%	0%	-16%	-18%	-15%	-14%
Average2W	The Netherlands	0%	0%	-6%	-2%	-4%	0%
Average2W	United Kingdom	0%	0%	0%	0%	0%	0%
Average2WDF	Austria	-7%	-7%	-7%	-2%	-5%	0%
Average2WDF	Belgium	-6%	-6%	-6%	-1%	-4%	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%	-6%	-1%	-4%	0%
Average2WDF	Denmark	-6%	-7%	-6%	-1%	-4%	0%
Average2WDF	Estonia	-6%	-6%	-5%	-1%	-4%	0%
Average2WDF	Finland	-6%	-6%	-6%	-2%	-4%	0%
Average2WDF	France	-6%	-7%	-6%	-1%	-4%	0%
Average2WDF	Germany	-7%	-7%	-5%	-1%	-3%	0%
Average2WDF	Greece	-1%	-7%	0%	0%	0%	0%
Average2WDF	Hungary	0%	-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%	-6%	-1%	-3%	0%
Average2WDF	Lithuania	-6%	-6%	-6%	-1%	-4%	0%
Average2WDF	Luxembourg	0%	0%	0%	0%	0%	0%
Average2WDF	Malta	0%	0%	0%	0%	0%	0%
Average2WDF	Poland	-6%	-7%	-6%	-1%	-4%	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%	-7%	-2%	-5%	0%
Average2WDF	Spain	-6%	-6%	-15%	-18%	-10%	-12%
Average2WDF	Sweden	-6%	-7%	-6%	-1%	-4%	0%
Average2WDF	Switzerland	0%	0%	-16%	-18%	-15%	-15%
Average2WDF	The Netherlands	0%	0%	-6%	-1%	-4%	0%
Average2WDF	United Kingdom	0%	0%	0%	0%	0%	0%
DC	Austria	-5%	-6%	-6%	-3%	-4%	0%
DC	Belgium	-5%	-5%	-6%	-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%	-5%	-2%	-4%	0%
DC	Denmark	-5%	-5%	-5%	-2%	-3%	0%
DC	Estonia	-4%	-5%	-5%	-2%	-4%	0%
DC	Finland	-4%	-5%	-5%	-2%	-3%	0%
DC	France	-5%	-5%	-6%	-2%	-4%	0%
DC	Germany	-5%	-5%	-5%	-2%	-3%	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%	-6%	-2%	-3%	0%
DC	Lithuania	-4%	-5%	-6%	-2%	-3%	0%
DC	Luxembourg	0%	0%	0%	0%	0%	0%
DC	Malta	0%	0%	0%	0%	0%	0%
DC	Poland	-4%	-5%	-6%	-2%	-3%	0%
DC	Portugal	-5%	-5%	-6%	-10%	0%	-4%
DC	Romania	0%	-5%	0%	0%	0%	0%
DC	Serbia	0%	0%	0%	0%	0%	0%
DC	Slovakia	-4%	-6%	0%	0%	0%	0%
DC	Slovenia	0%	0%	-7%	-2%	-4%	0%
DC	Spain	-5%	-6%	-6%	-11%	-4%	-5%
DC	Sweden	-4%	-5%	-5%	-2%	-4%	0%
DC	Switzerland	0%	0%	-14%	-13%	-14%	-14%
DC	The Netherlands	0%	0%	-5%	-2%	-4%	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-772	Pipelines	The project is based on repurpose of existing above-ground objects.	Neutral impact on land and protected areas as existing pipelines will be used with no additional compressor station.
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-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.

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs
HYD-N-772:	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. This project will use the same corridor and pipelines that are currently used to transport natural gas with no need for a compressor station producing noise emissions. Neither investments in anti-flooding measures considering a country relief nor landslide remediation measures are going to be taken.	Related costs have been considered in CAPEX & OPEX 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 expected to be built at locations of existing ones.	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.	Related costs have been considered in CAPEX & OPEX estimations (CAPEX & OPEX already reported in the previous sections)	N/A
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 foresees 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

Environmental Impact explained [Promoter]

The infrastructure will be mostly constituted of repurposed pipelines, so no additional use of land will be caused.

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:

- <u>Delta Line-Pack</u>: as for natural gas, pipelines themselves can act as temporary storage providing balancing solutions and ensuring flexibility and security of supply to the system.
- <u>Transport and subsequent storage of hydrogen in dedicated underground hydrogen storage</u> 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.).

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

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

- Projects will give positive signals to the future H2 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, inter alia hydrogen storage facility, connection of the distribution systems with the full consumption structure – industry, households, mobility.

F. Useful links [Promoter]

Useful links:

European Hydrogen Backbone Maps | EHB European Hydrogen Backbone

https://www.sunshynecorridor.eu/

https://www.south2corridor.net/

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

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

Austrian Coordinated Network Development Plan 2022

https://www.eustream.sk/files/sk/transparency/rozvoj-siete/plany-rozvoja-siete/eus_tyndp_2023_2032.pdf