HI WEST 8 (Less-Advanced)

Storage GeoH2

Reasons for grouping [ENTSOG]

The project group is a stand-alone underground storage in France. This project will enable storage of hydrogen in France from 2028 (HYD-N-565).

Objective of the group [Promoter]

GeoH2 project is an underground hydrogen storage located in Manosque. This project aims to provide several benefits on hydrogen ecosystem in the area of the industrial port of Fos-sur-Mer, in the vicinity of Marseille in the South of France.
The project will foster the decarbonization of a major CO2-emission hub in France by connecting industrial consumers (refinery, steel-making and petrocheminal sectors) with renewable and low carbon hydrogen.
The first step, planned to be commissioned in 2028, will allow a hydrogen underground storage with a capacity of 6 000 tons in 2 salt caverns currently in brine, hence available. Subsequently, post-2030, capacity can be extended up to 35 000 tons by leaching more new salt caverns.

Interconnection of GeoH2 project with European pipelines will allow to support the advent of a cost-efficient and integrated European hydrogen ecosystem that brings significant benefits to consumers across the Union, driving price convergence and market integration.
GeoH2 project will provide significant benefits to European consumers by ensuring increased hydrogen market integration, energy autonomy and security of supply, as well as helping key European industrial and mobility sectors to future-proof and adapt their activity to a carbon-neutral future. The infrastructure is expected to store 250 GWh of low carbon and renewable hydrogen by 2028.
From our internal assessment, the economic value associated with the corresponding reduction of GHG emissions, estimated at 108 kTons of CO2eq avoided per year, could reach 27 M€/y.

HYD-N-565 **GeoH2**

Comm. Year **2028**

A. Project group technical information [Promoter/ ENTSOG]

Project technical information [Promoter]

GeoH2 project aims to develop, build and operate a hydrogen underground storage facility with an initial capacity of 6 000 tons in 2 salt caverns. These 2 caverns are already built in Manosque and are currently full of brine. The facility in Manosque is owned by the GIE Géométhane (Groupement d'Intérêt Economique) in which Storengy has a 50% share. The other 50% are owned by Géosud (whose shareholders are CNP Assurances for 98% and Géostock for 2%). Start of commercial operation is planned in 2028 for both caverns. Subsequently, capacity can be extended up to 35 000 tons offering significant flexibility potential to hydrogen producers, shippers and ultimately consumers. The project is aligned with commissioning dates for pipeline projects, allowing for an integrated approach to decarbonization in the Fos-Lavera-Marseille area and subsequent interconnection with others European countries.

Storage

TYNDP Project code	Maximum Injection rate [GWh/d]	Maximum Withdrawal rate [GWh/d]	Working gas volume [GWh]	Geometrical Volume [m3]
HYD-N-565	3	3	236	500 000

Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year
HYD-N-565	H2_ST_FR	Storengy	Transmission France (FR Hydrogen)	Storage France (FR Hydrogen)	3	2028
HYD-N-565	H2_ST_FR	Storengy	Storage France (FR Hydrogen)	Transmission France (FR Hydrogen)	3	2028
HYD-N-565	H2_ST_FR	Storengy	Transmission France (FR Hydrogen)	Storage France (FR Hydrogen)	3	2029
HYD-N-565	H2_ST_FR	Storengy	Storage France (FR Hydrogen)	Transmission France (FR Hydrogen)	3	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-565	300	30%	10	50%

Description of the cost and range [Promoter]

This CAPEX was estimated during pre-feasibility study last year (2022). Since 2022, Geomethane launched new studies, some of them are still on-going, but Géométhane can provide lower CAPEX to build this storage. The CAPEX is around **250 M€ +/- 20%**.

C. Project Benefits [ENTSOG]

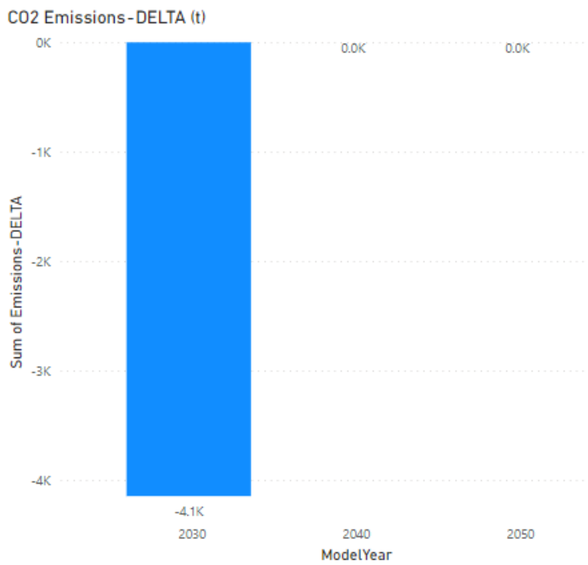
C.1 Summary of benefits

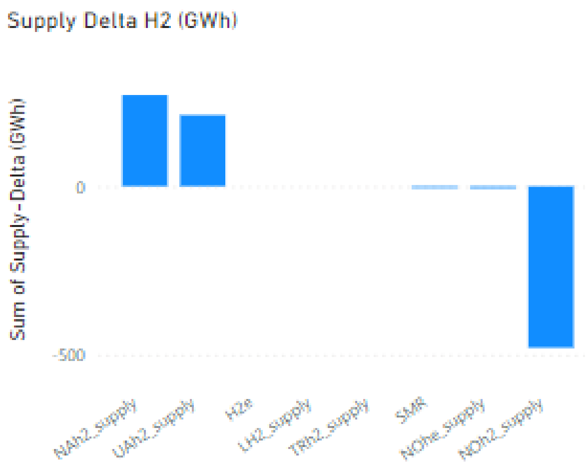
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. More details on the indicators are available in Annex D of TYNDP 2022[1].

Distributed Energy

Sustainability benefits

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 4,1 kt in 2030. The project group enables the transport of green hydrogen and so then replacing use of Norwegian supply which is considered as blue hydrogen in 2030.

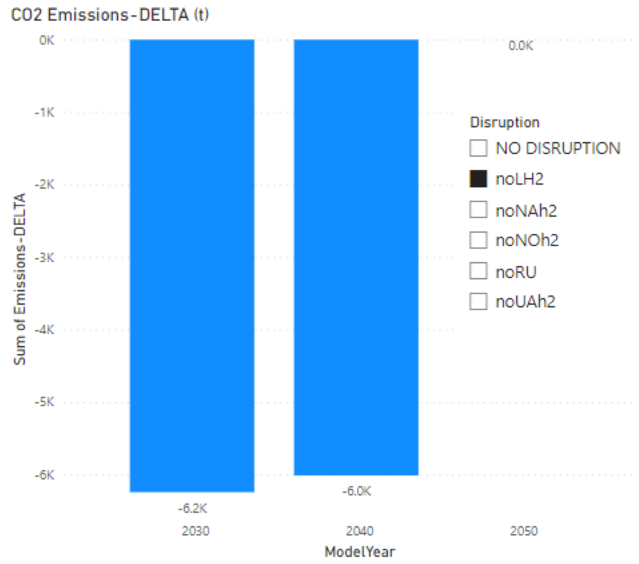


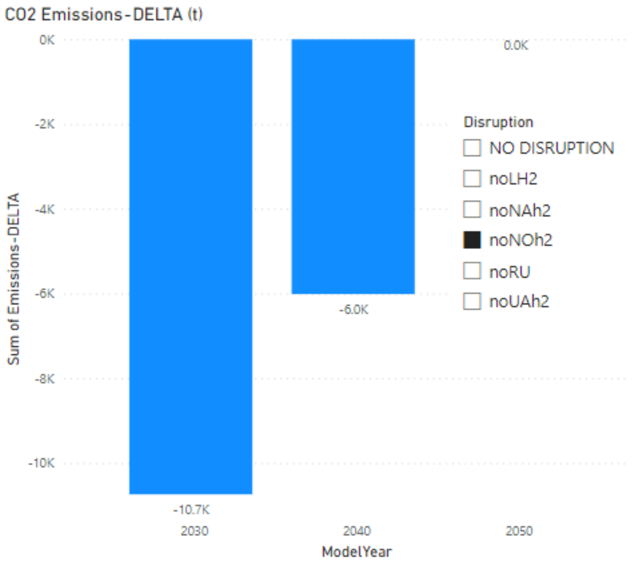


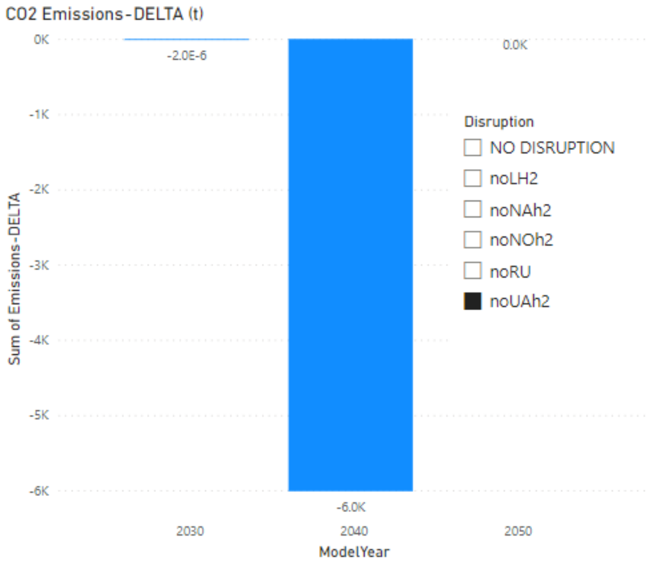
Similar trend is expected under any supply disruption with benefits in 2030 and 2040.

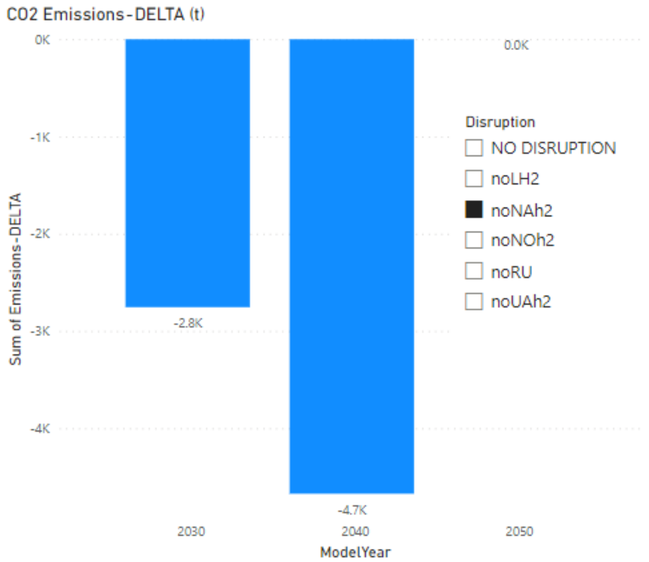
1 noLH2 : LH2 disruption / 2 noNOh2 : Norway disruption / 3 noUAh2 : Ukraine disruption/ 4 noNAh2 : North Africa disruption

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









Security of Supply:[2]

> Reference case

In the reference case, the project is contributing to further mitigation of hydrogen demand curtailment risk in average summer and average winter.

[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.*

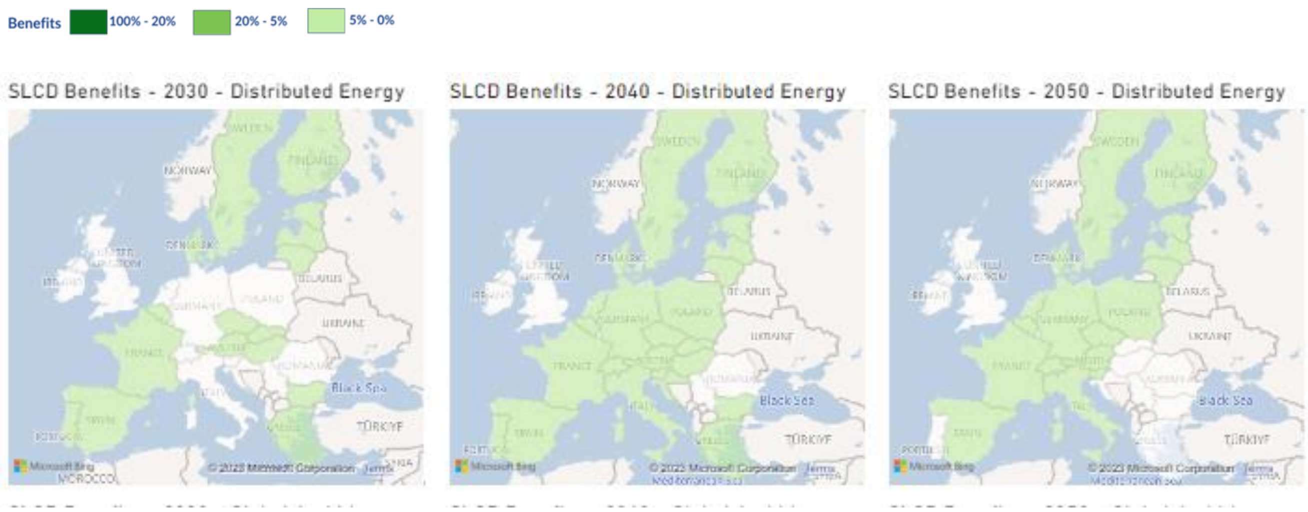
> Climatic stress cases

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

> Disruption cases (S-1):

Similarly, under supply disruption cases, the project group is not further contributing to the mitigation of hydrogen demand curtailment risk.

> Single largest capacity disruption (SLCD):

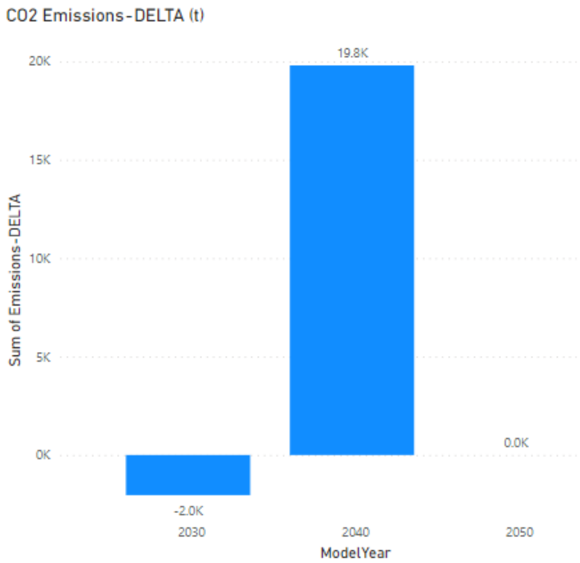


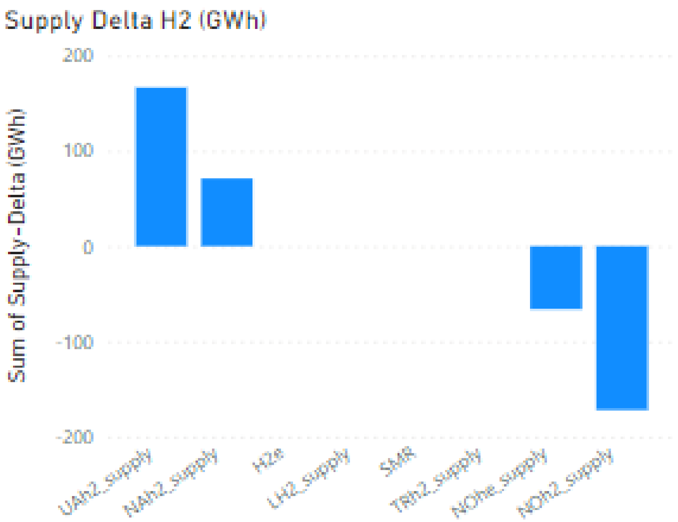
In case of single largest capacity disruption (SLCD), the project group reduces the risk of demand curtailment in some countries from 2030, by 1%. In addition, from 2040, the project group helps to mitigate the risk of demand curtailment due to the increase of storage capacity in Europe by 1-3%.

Global Ambition

Sustainability benefits

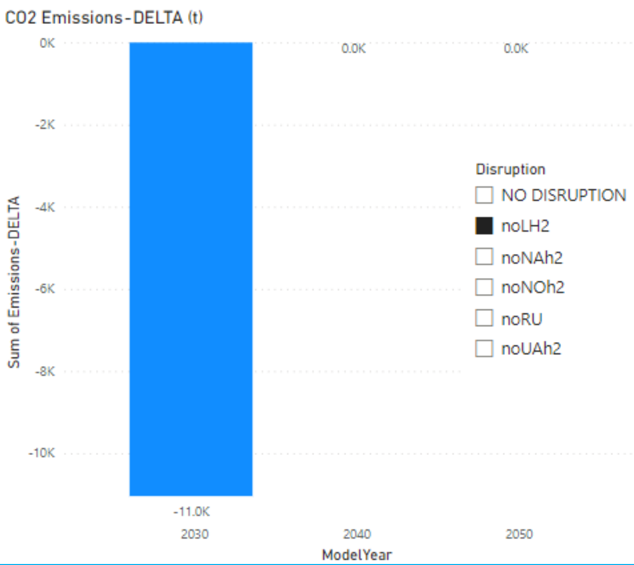
In the reference case, which analyses yearly demand in two periods (average winter and average summer), the project group will contribute to sustainability by reducing overall CO2 emissions by 2 kt in 2030. The project group enables the transport of green hydrogen and so then replacing use of Norwegian supply which is considered as blue hydrogen in 2030. However, in 2040, triggered by the higher hydrogen demand project group will increase overall CO2 emissions by using more SMRs to reduce demand curtailment.

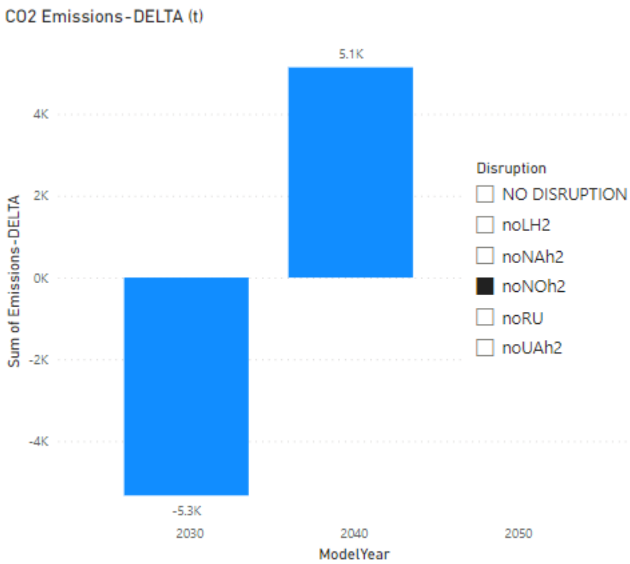


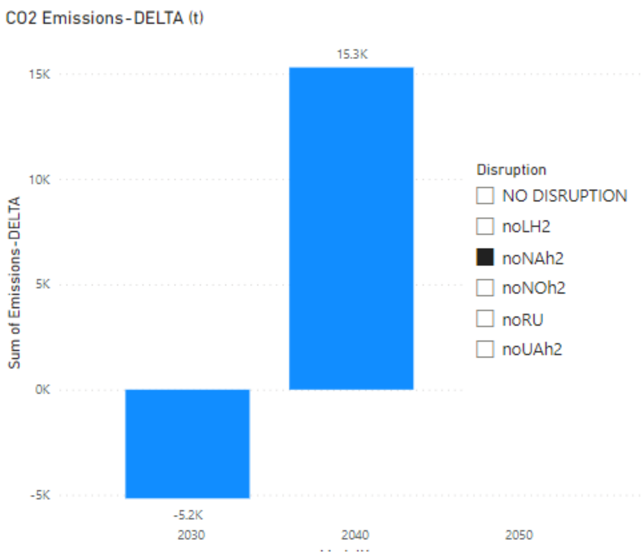


Similar trend is expected under supply disruptions.

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







Security of supply benefits

> Reference case

In the reference case, the project is contributing to further mitigation of hydrogen demand curtailment risk in average summer and average winter a little in 2040, that cannot be displayed on the map.

> Climatic stress cases

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

> Disruption cases (S-1):

Similarly, under supply disruption cases, the project group is not further contributing to the mitigation of hydrogen demand curtailment risk.

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

SLCD Benefits - 2030 - Global Ambition

SLCD Benefits - 2040 - Global Ambition

SLCD Benefits - 2050 - Global Ambition

In case of single largest capacity disruption (SLCD), the project group reduces the risk of demand curtailment in most countries from 2030, by 1%. In addition, in 2040, the project group helps to mitigate the risk of demand curtailment due to the increase of storage capacity in Europe by 1-2%.

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	-4145,82	538677299	538681444,9
2030	noLH2	DE	tonne	-6242,33	540175890,2	540182132,6
2030	noNAh2	DE	tonne	-2754,50	539785356,1	539788110,6
2030	noNOh2	DE	tonne	-10738,48	538877197,8	538887936,3
2030	noUAh2	DE	tonne	0,00	539378771,9	539378771,9
2030	NO DISRUPTION	GA	tonne	-2038,05	592910448,4	592912486,5
2030	noLH2	GA	tonne	-11042,26	594817481,2	594828523,4
2030	noNAh2	GA	tonne	-5168,19	594141433,2	594146601,4
2030	noNOh2	GA	tonne	-5328,81	593310994,3	593316323,1
2030	noUAh2	GA	tonne	0,00	593627617,9	593627617,9
2040	NO DISRUPTION	DE	tonne	0,00	392077044	392077044
2040	noLH2	DE	tonne	-6011,14	392213883,4	392219894,5
2040	noNAh2	DE	tonne	-4671,94	392188097,7	392192769,6
2040	noNOh2	DE	tonne	-6011,14	392144022,6	392150033,8
2040	noUAh2	DE	tonne	-6011,14	392399182,9	392405194
2040	NO DISRUPTION	GA	tonne	19798,43	396523251,6	396503453,2
2040	noLH2	GA	tonne	0,00	397455196,7	397455196,7
2040	noNAh2	GA	tonne	15298,07	397301976,6	397286678,6
2040	noNOh2	GA	tonne	5139,65	397450977,1	397445837,5
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
Belgium	-1%	-1%	-2%	-1%	-1%	0%
Czechia	-1%	-1%	-2%	-2%	-2%	-1%
Estonia	-1%	-1%	-2%	-1%	-2%	0%
Finland	-1%	-1%	-2%	-1%	-2%	-1%
Germany	0%	-1%	-2%	-1%	-1%	0%
Latvia	-1%	-1%	-2%	-1%	-1%	-1%
Lithuania	-1%	-1%	-2%	-1%	-1%	-1%
Poland	-1%	-1%	-2%	-1%	-1%	0%
Portugal	-1%	-1%	-2%	-1%	0%	-1%
Slovenia	0%	0%	-2%	-1%	-1%	0%
Sweden	-1%	-1%	-2%	-1%	-2%	-1%
Switzerland	0%	0%	-2%	-1%	-1%	-1%
The Netherlands	0%	0%	-2%	-1%	-2%	0%
France	-1%	-1%	-2%	-1%	-1%	0%
Austria	-1%	-1%	-1%	-1%	-2%	0%
Italy	-1%	-1%	-1%	-1%	-2%	0%
Bulgaria	-1%	0%	-1%	0%	0%	0%
Croatia	0%	0%	-1%	-1%	0%	-1%
Denmark	-1%	-1%	-1%	-1%	-1%	0%
Greece	-1%	0%	-1%	0%	0%	0%
Hungary	-1%	-1%	-1%	-1%	0%	-1%
Slovakia	-1%	-1%	-1%	-1%	0%	-1%
Spain	-1%	-1%	-1%	-1%	-2%	0%
Romania	0%	-1%	-1%	0%	0%	0%

Curtailment Rate (Climatic Stress):

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

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

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

D. Environmental Impact [Promoter]

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

TYNDP Code	Type of infrastructure	Surface of impact	Environmentally sensitive area
HYD-N-565	Storage	n.a	n.a

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs

Environmental Impact explained [Promoter]

Géométhane has a strong track record in reducing any environmental or climate risks of its storage activities and will proactively monitor the good operation of the system and ensure that any risks are mitigated.

To mitigate these risks, Géométhane will carry out public consultation during the engineering phase to ensure that project benefits and characteristics are well-understood by the public. We will also ensure to clarify any project risks (in particular in relation to the environment and biodiversity) and how these are mitigated specifically. Finally, the ability to exploit existing storage capacities will further reduce any new incremental impact on the local community.

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 proposed methodology will significantly undervalue the benefits provided by storage projects. The benefits should include:

- Impact on operational costs
- Impact on the hydrogen supply mix (renewable vs low-carbon vs other supply sources; cross-border trade)
- Impact on GHG and non-GHG emissions
- Impact on RES curtailment
- Impact on security of supply (demand curtailment and/or avoided investments in alternative technologies (e.g. SMR/ATR, pipelines, etc.))

Flexibility and security of supply are key criteria of the revised TEN-E regulation and the REPowerEU plan for a successful transformation of the European energy system. Storage (across all vectors) has been identified as a key lever to achieve this. Existing experience of storage facilities for natural gas and electricity confirms and underlines the need for storage in a well-functioning energy system, working synergistically with other flexibility solutions such as demand-response and networks.

<u>Internal assessment</u> :

In addition to the benefits identified in this project fiche, the GeoH2 project is likely to provide significant flexibility services to the European energy system. These benefits will notably take the form of a reduced curtailment of renewable sources as well as generation cost savings in electricity markets. Independent evaluations conducted by Artelys show that the development of the GeoH2 project could help decrease renewable curtailment by 12.4 gigawatt-hours while saving 14 million euros in operation costs over the year 2030.

According to this same assessment, the implementation of the GeoH2 project could also foster a more efficient use of local renewable resources, resulting in the integration of 3 additional kilotons of renewable hydrogen in the system each year. Artelys results also suggest that the project could be useful in concentrating the consumption of local electrolysers within hours of low-carbon power generation. Nine additional kilotons of low-carbon hydrogen could therefore be produced each year within hours where thermal power generation resources do not contribute to the French electricity supply, which meets both security of supply and low-carbon hydrogen integration objectives.

Finally, the project will be included in an extensive hydrogen value chain that is likely to supply 15% of the French demand by 2030, with a direct connection to hard-to-abate activities – notably steel-making, refineries and heavy transportation.

F. Useful links [Promoter]

Useful links:

https://www.geomethane.fr/stockage-dhydrogene-a-manosque/