HI WEST 34 (Less-Advanced)

Hystock Opslag H2

gasunie

Reasons for grouping [ENTSOG]

The project group is a stand-alone hydrogen storage in The Netherlands.

This project will enable hydrogen storage in The Netherlands, as well as in neighboring countries.

(Connecting pipeline is not part of this group)

Objective of the group [Promoter]

HyStock is a hydrogen storage project, offering storage services to hydrogen market participants in an open, transparent and non-discriminatory basis. Storage will play a critical role in developing the hydrogen market by ensuring reliability of supply to hydrogen off takers and enabling short and long-term storage of renewable energy. HyStock aims to enable the growth of the hydrogen market and lower the risks for other projects to take FID, both from the supply and demand side.

HYD-A-1279 **Hystock Opslag H2**

Comm. Year **2026**

gasunie

A. Project group technical information [Promoter/ ENTSOG]

Project technical information [Promoter]

Storage

TYNDP Project code	Maximum Injection rate [GWh/d]	Maximum Withdrawal rate [GWh/d]	Working gas volume [GWh]	Geometrical Volume [m3]
HYD-A-1279	4-80 ton/h	1-80 ton/h	1000	T.B.D.

Capacity increment [ENTSOG]

TYNDP Project code	Point name	Operator	From system	To system	Capacity increment [GWh/d]	Comm. year
HYD-A-1279	H2_ST_NL	Gasunie Transport Services B.V.	Transmission Netherlands (NL Hydrogen)	Storage Netherlands (NL Hydrogen)	3,144 MW	2026
HYD-A-1279	H2_ST_NL	Gasunie Transport Services B.V.	Storage Netherlands (NL Hydrogen)	Transmission Netherlands (NL Hydrogen)	3,144 MW	2026

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-A-1279	500	25	20	25

Description of the cost and range [Promoter]

The total investment cost covers the full length of the project (i.e., until the four caverns are operational). This includes development of the above ground facilities (e.g., compressors, drying systems), the connection to the National Hydrogen Grid (HYD-N-468), and the design and development of the four caverns.

OPEX equal roughly € 9 million per year (assuming 2021 prices) and are modelled based on comparable natural gas storage projects (i.e. EnergyStock) and consists of two major categories: (a) Costs of materials / supplies and (b) Personnel / administrative costs incl. overhead.

C. Project Benefits [ENTSOG]

C.1 Summary of benefits

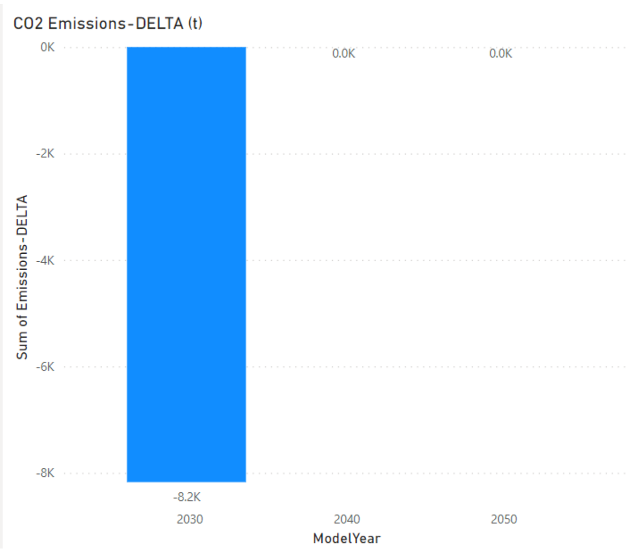
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. More details on the indicators are available in Annex D of TYNDP 2022[1].

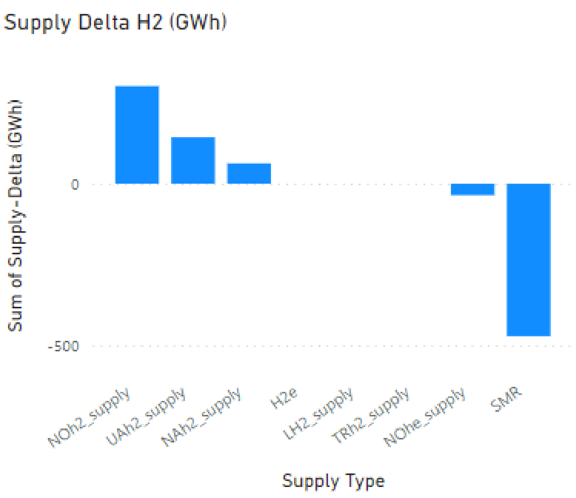
Distributed Energy

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 CO2 emissions by 8,2 kt in 2030. The project group enables the storage and transport of green hydrogen supplies and therefore replaces use blue hydrogen supplies mainly SMR production and to a lesser extent Norwegian imports.

It is important to highlight that however not calculated as part of the reference case and supply disruption cases, higher sustainability benefits might stem from stress cases, such as 2-week dunkleflaute as project group will enable transport of green supplies while coping with high variability of RES sources.

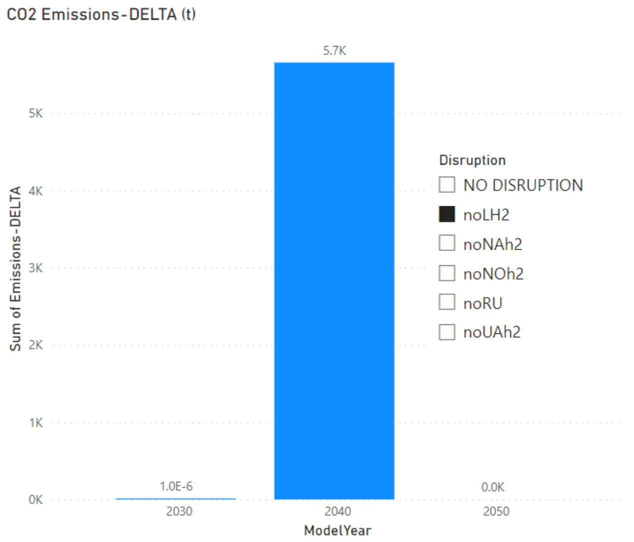


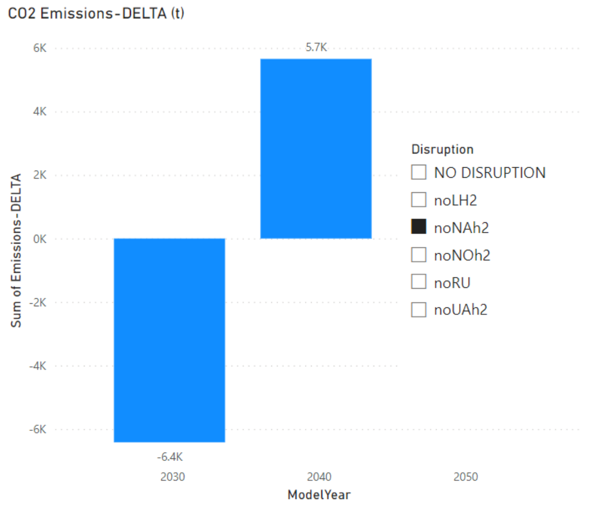


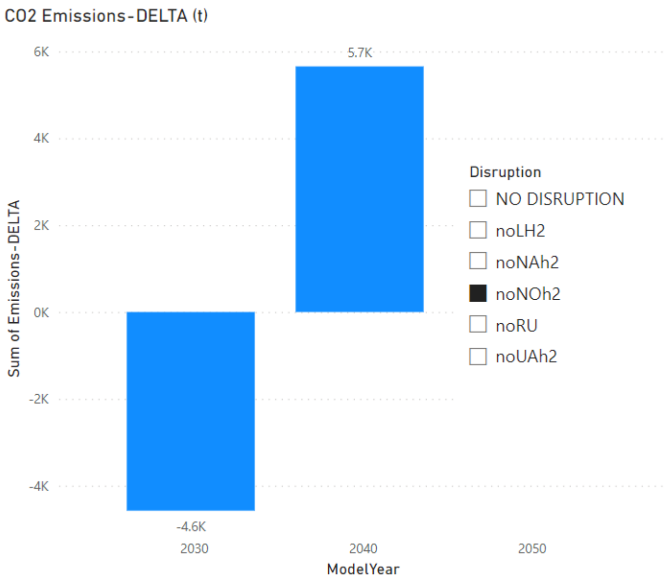
[1] https://www.entsog.eu/sites/default/files/2023-04/ENTSOG_TYNDP_2022_Annex_D_Methodology_230411.pdf

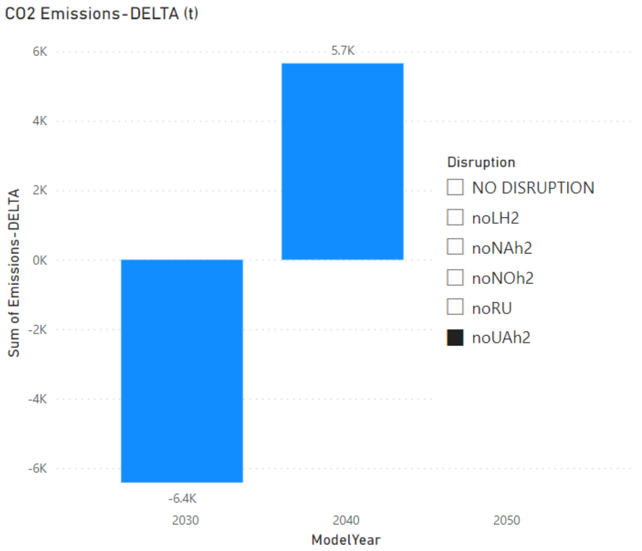
Similar trend is expected under yearly supply disruption in 2030 (with exception of liquid hydrogen imports), nevertheless to a lower extent due to the lower supply availability. In 2040, triggered by the higher hydrogen demand, project group will increase overall CO2 emissions by using more SMRs and hence reduce demand curtailment.

1. *NoLH2: Liquid imports disruption/ 2. noNOh2 : Norway disruption / 3. noUAh2 : Ukraine disruption/ 4. noNAh2 : North Africa disruption*









Security of Supply:[2]

> Reference case:

No security of supply benefits were observed under reference case (summer/winter average demand).

> Climatic stress cases:

Under 2 -week and 2-week dunkelflaute and peak climatic stress cases, project groups contributes to the reduction of demand curtailment in The Netherlands in 2030.

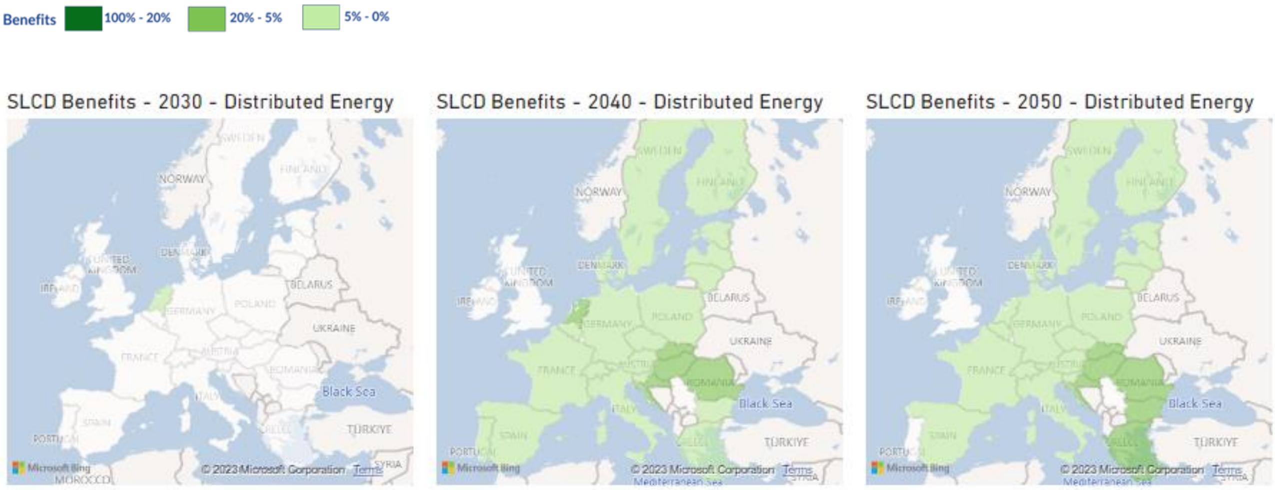
[2] *As for the hydrogen system there is no existing infrastructure level available yet, ENTSOG has identified a possible hydrogen network according to the information provided by promoters in their project submission for the TYNDP/PCI process (i.e., H2 Infrastructure level). Therefore, the System Assessment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

> Disruption cases (S-1):

Similarly to the reference case, under yearly disruption cases, project group does not show additional SoS benefits.

> Single largest capacity disruption (SLCD):

In case of single largest capacity disruption, the project group mitigates the risk of demand curtailment in 2030 in The Netherlands and in 2040 and 2050 the project group mitigates the risk of demand curtailment in overall Europe, including Eastern countries.

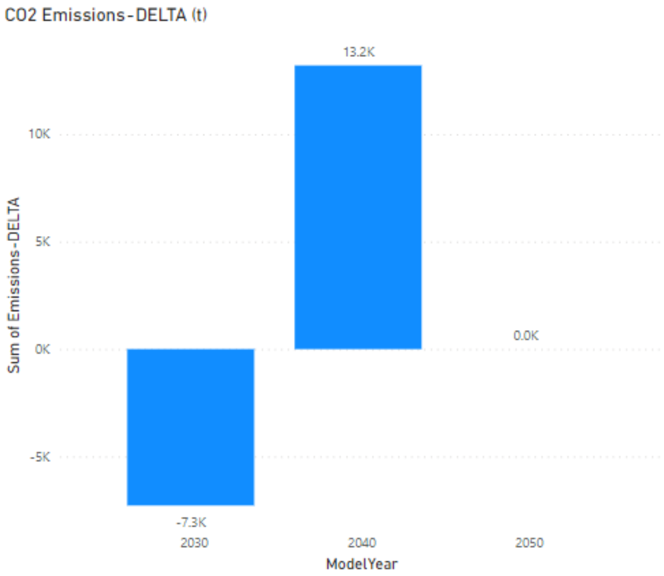


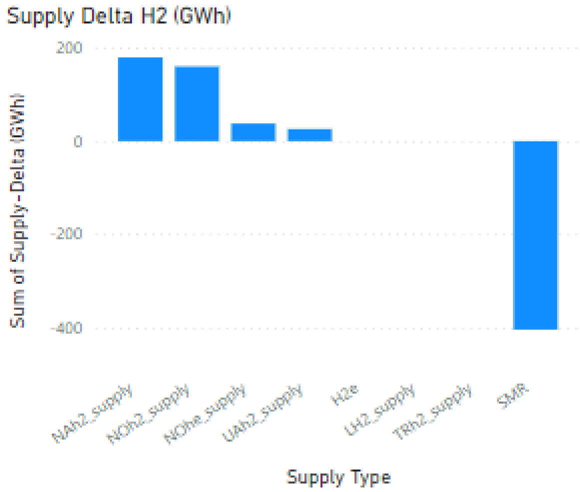
Global Ambition

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 7,3 kt in 2030. The project group enables the storage and transport of green hydrogen supplies and therefore replaces use blue hydrogen supplies produced via SMR.

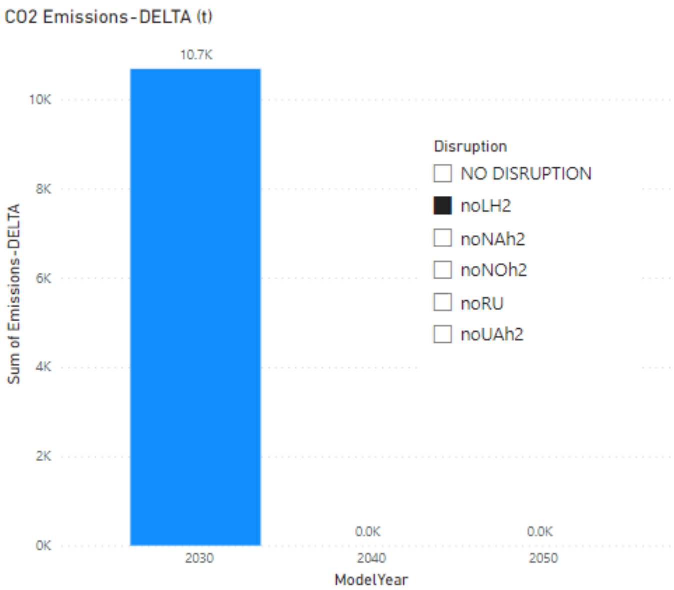
It is important to highlight that however not calculated as part of the reference case and supply disruption cases, higher sustainability benefits might stem from stress cases, such as 2-week dunkleflaute as project group will enable transport of green supplies while coping with high variability of RES sources.

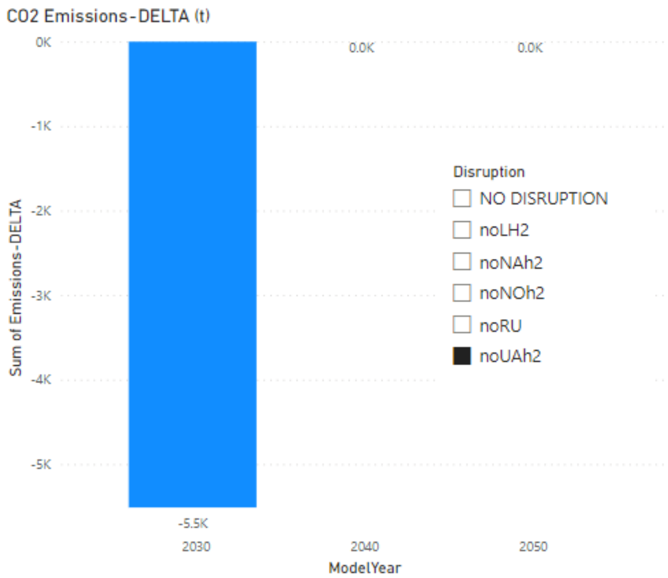


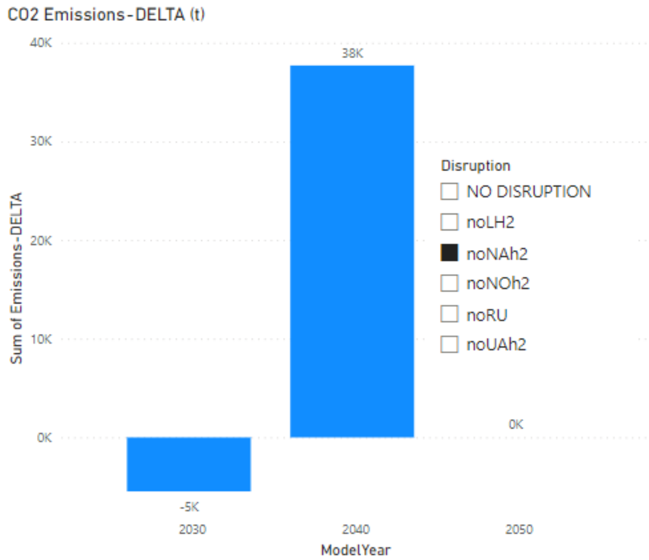


Similar trend is expected under yearly supply disruption in 2030 (with exception of liquid hydrogen imports), nevertheless to a lower extent due to the lower supply availability. In 2040, triggered by the higher hydrogen demand, project group will increase overall CO2 emissions by using more SMRs and hence reduce demand curtailment.

1 noLH2: No liquid imports/ 2. NOh2 : Norway disruption / 3. noUAh2 : Ukraine disruption/ 4. noNAh2 : North Africa disruption







Security of supply benefits

> Reference case

No security of supply benefits were observed under reference case (summer/winter average demand).

> Climatic stress cases

Under 2 -week and 2-week dunkelflaute and peak climatic stress cases, project groups contributes to the reduction of demand curtailment in The Netherlands in 2030.

> Disruption cases (S-1)

Similarly to the reference case, under yearly disruption cases, project group does not show additional SoS benefits.

> Single largest capacity disruption (SLCD):

In case of single largest capacity disruption, the project group mitigates the risk of demand curtailment in 2030 in The Netherlands and in 2040 and 2050 the project group mitigates the risk of demand curtailment in overall Europe, including Eastern countries.

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

SLCD Benefits - 2030 - Global Ambition

SLCD Benefits - 2040 - Global Ambition

SLCD Benefits - 2050 - Global Ambition

C.2 Quantitative benefits [ENTSOG]

The following tables display all the benefits quantified by ENTSOG through specific indicators and stemming from the realisation of the considered project group.

CO2 Emissions:

GROUP Number	ModelYear	Disruption	Scenario	Unit	Emissions-DELTA	Emissions-PLUS	Emissions-MINUS
HI WEST 34	2030	NO DISRUPTION	DE	tonne	-8173,73	538669125,3	538677299
HI WEST 34	2030	noLH2	DE	tonne	0,00	540175890,2	540175890,2
HI WEST 34	2030	noNAh2	DE	tonne	-6416,68	539778939,4	539785356,1
HI WEST 34	2030	noNOh2	DE	tonne	-4573,90	538872623,9	538877197,8
HI WEST 34	2030	noUAh2	DE	tonne	-6416,68	539372355,2	539378771,9
HI WEST 34	2030	NO DISRUPTION	GA	tonne	-7274,40	592903174	592910448,4
HI WEST 34	2030	noLH2	GA	tonne	10681,19	594828162,4	594817481,2
HI WEST 34	2030	noNAh2	GA	tonne	-5468,68	594135964,5	594141433,2
HI WEST 34	2030	noNOh2	GA	tonne	-4573,90	593306420,4	593310994,3
HI WEST 34	2030	noUAh2	GA	tonne	-5512,07	593622105,9	593627617,9
HI WEST 34	2040	NO DISRUPTION	DE	tonne	0,00	392077044	392077044
HI WEST 34	2040	noLH2	DE	tonne	5655,20	392219538,6	392213883,4
HI WEST 34	2040	noNAh2	DE	tonne	5655,20	392193752,9	392188097,7
HI WEST 34	2040	noNOh2	DE	tonne	5655,20	392149677,8	392144022,6
HI WEST 34	2040	noUAh2	DE	tonne	5655,20	392404838,1	392399182,9
HI WEST 34	2040	NO DISRUPTION	GA	tonne	13195,48	396536447,1	396523251,6
HI WEST 34	2040	noLH2	GA	tonne	0,00	397455196,7	397455196,7
HI WEST 34	2040	noNAh2	GA	tonne	37701,36	397339678	397301976,6
HI WEST 34	2040	noNOh2	GA	tonne	4219,61	397455196,7	397450977,1
HI WEST 34	2040	noUAh2	GA	tonne	0,00	397478498,3	397478498,3
HI WEST 34	2050	NO DISRUPTION	DE	tonne	0,00	232557734,8	232557734,8
HI WEST 34	2050	noLH2	DE	tonne	0,00	232557734,8	232557734,8
HI WEST 34	2050	noNAh2	DE	tonne	0,00	232557734,8	232557734,8
HI WEST 34	2050	noNOh2	DE	tonne	0,00	232557734,8	232557734,8
HI WEST 34	2050	noRU	DE	tonne	0,00	232557734,8	232557734,8
HI WEST 34	2050	noUAh2	DE	tonne	0,00	232557734,8	232557734,8
HI WEST 34	2050	NO DISRUPTION	GA	tonne	0,00	228306706,5	228306706,5
HI WEST 34	2050	noLH2	GA	tonne	0,00	228306706,5	228306706,5
HI WEST 34	2050	noNAh2	GA	tonne	0,00	228306706,5	228306706,5
HI WEST 34	2050	noNOh2	GA	tonne	0,00	228306706,5	228306706,5
HI WEST 34	2050	noRU	GA	tonne	0,00	228306706,5	228306706,5
HI WEST 34	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
Hungary	0%	0%	-20%	-10%	-16%	-1%
Slovakia	0%	0%	-20%	-10%	-16%	-1%
Romania	0%	0%	-19%	-10%	-15%	-1%
Croatia	0%	0%	-19%	-10%	-15%	-1%
The Netherlands	-2%	-2%	-8%	-4%	-5%	-2%
Bulgaria	0%	0%	-4%	-9%	-6%	-1%
Greece	0%	0%	-3%	-9%	-5%	0%
Austria	0%	0%	-1%	-1%	-1%	-1%
Belgium	0%	0%	-1%	-1%	-1%	-1%
Czechia	0%	0%	-1%	-1%	-1%	-1%
Denmark	0%	0%	-1%	-1%	-1%	-1%
Estonia	0%	0%	-1%	-1%	-1%	-1%
Finland	0%	0%	-1%	-1%	-1%	-1%
France	0%	0%	-1%	-1%	-1%	-1%
Germany	0%	0%	-1%	-1%	-1%	-1%
Italy	0%	0%	-1%	-1%	-1%	-1%
Latvia	0%	0%	-1%	-1%	-1%	-1%
Lithuania	0%	0%	-1%	-1%	-1%	-1%
Poland	0%	0%	-1%	-1%	-1%	-1%
Portugal	0%	-1%	-1%	-1%	0%	-1%
Slovenia	0%	0%	-1%	-1%	-1%	-1%
Spain	0%	0%	-1%	-1%	-1%	-1%
Sweden	0%	0%	-1%	-1%	-1%	-1%
Switzerland	0%	0%	-1%	-1%	-1%	-1%

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%	-1%	0%	0%
Average2W	Belgium	0%	0%	0%	-1%	-1%	-1%
Average2W	Bulgaria	0%	0%	0%	0%	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%	0%	0%	0%	0%	0%
Average2W	Estonia	0%	0%	-1%	0%	-1%	0%
Average2W	Finland	0%	0%	0%	0%	0%	-1%
Average2W	France	0%	0%	0%	0%	0%	0%
Average2W	Germany	0%	0%	-1%	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%	-1%	0%	-1%	0%
Average2W	Lithuania	0%	0%	-1%	0%	-1%	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%	0%	0%	0%
Average2W	Slovenia	0%	0%	0%	0%	0%	0%
Average2W	Spain	0%	0%	0%	-1%	0%	0%
Average2W	Sweden	0%	0%	-1%	-1%	0%	-1%
Average2W	Switzerland	0%	0%	0%	0%	-1%	0%
Average2W	The Netherlands	-1%	-1%	0%	0%	0%	-1%
Average2W	United Kingdom	0%	0%	0%	0%	0%	0%
Average2WDF	Austria	0%	0%	0%	0%	0%	0%
Average2WDF	Belgium	0%	0%	-1%	0%	-1%	-1%
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	-1%	0%	-1%	0%	0%	0%
Average2WDF	Denmark	0%	0%	0%	0%	0%	0%
Average2WDF	Estonia	0%	0%	0%	0%	-1%	0%
Average2WDF	Finland	0%	0%	-1%	0%	0%	-1%
Average2WDF	France	0%	0%	0%	0%	0%	0%
Average2WDF	Germany	0%	0%	0%	0%	0%	0%
Average2WDF	Greece	0%	0%	0%	-1%	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%	-1%	0%
Average2WDF	Lithuania	0%	0%	0%	0%	-1%	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	0%	0%	0%	0%	0%	0%
Average2WDF	Slovenia	0%	0%	0%	0%	0%	0%
Average2WDF	Spain	0%	0%	-1%	-1%	0%	0%
Average2WDF	Sweden	0%	0%	-1%	-1%	0%	-1%
Average2WDF	Switzerland	0%	0%	0%	0%	-1%	0%
Average2WDF	The Netherlands	-1%	-1%	0%	0%	0%	-1%

Average2WDF	United Kingdom	0%	0%	0%	0%	0%	0%
DC	Austria	0%	0%	-1%	0%	0%	0%
DC	Belgium	0%	0%	-1%	0%	0%	0%
DC	Bulgaria	0%	0%	0%	-1%	0%	-1%
DC	Croatia	0%	0%	0%	-1%	0%	0%
DC	Cyprus	0%	0%	0%	0%	0%	0%
DC	Czechia	0%	0%	-1%	0%	0%	0%
DC	Denmark	0%	0%	-1%	0%	0%	0%
DC	Estonia	0%	0%	0%	-1%	0%	0%
DC	Finland	0%	0%	-1%	-1%	0%	0%
DC	France	0%	0%	0%	0%	0%	-1%
DC	Germany	0%	0%	0%	0%	-1%	0%
DC	Greece	0%	0%	0%	0%	0%	0%
DC	Hungary	0%	0%	0%	-1%	0%	0%
DC	Ireland	0%	0%	0%	0%	0%	0%
DC	Italy	0%	0%	-1%	-1%	0%	-1%
DC	Latvia	0%	0%	0%	-1%	0%	0%
DC	Lithuania	0%	0%	0%	-1%	0%	-1%
DC	Luxembourg	0%	0%	0%	0%	0%	0%
DC	Malta	0%	0%	0%	0%	0%	0%
DC	Poland	0%	0%	0%	-1%	0%	-1%
DC	Portugal	0%	0%	0%	0%	0%	0%
DC	Romania	0%	0%	0%	-1%	0%	0%
DC	Serbia	0%	0%	0%	0%	0%	0%
DC	Slovakia	0%	0%	0%	-1%	0%	0%
DC	Slovenia	0%	0%	0%	0%	0%	0%
DC	Spain	0%	0%	-1%	0%	0%	0%
DC	Sweden	0%	0%	-1%	-1%	0%	0%
DC	Switzerland	0%	0%	-1%	-1%	0%	-1%
DC	The Netherlands	-2%	-2%	-1%	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-A-1279	Storage	Above and underground	No

Potential impact	Mitigation measures	Related costs included in project CAPEX and OPEX	Additional expected costs
T.B.D.	T.B.D.	T.B.D.	T.B.D.

Environmental Impact explained [Promoter]
The project relates to the construction of new salt caverns for the storage of (clean) hydrogen. The project life cycle analysis (LCA) and climate change impact study will be assessed as part of the environmental permitting process required for HyStock. In this study, the questions that are part of the IPCEI application will be answered (projects must comply with the principle of 'do no significant harm' (DNSH)). These questions consider the following; climate change and adaption, sustainable use and protection of water and marine resources, transition to a circular economy (including waste prevention and recycling), pollution prevention and control and protection and restoration of biodiversity and ecosystems. A preliminary review showed that HyStock is not expected to lead to an increased adverse impact on any of these subjects. More details can be given when the LCA impact study has been completed.

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]

Developing a hydrogen storage infrastructure can stimulate the growth of the hydrogen economy, leading to regional development and creating new employment opportunities in a region that disproportionally benefits from improved economic activities due to unfavorable demographics (declining population and lowering incomes). Further, the knowledge and technology developed through this project can benefit other companies, researchers, and stakeholders involved in the development of hydrogen technologies and renewable energy.

F. Useful links [Promoter]

Useful links:
https://www.hystock.nl/