# HI WEST 40 (Less-Advanced)
# H2Sines to Rotterdam

## Reasons for grouping [ENTSOG]

The project group consists of a maritime corridor from Portugal to Rotterdam (liquid hydrogen vessel) together with the liquid hydrogen receiving import terminal in Rotterdam, Netherlands (HYD-N- 543).

This project will enable green hydrogen imports to Netherlands.

*(Export terminal is not part of this group)*

## Objective of the group [Promoter]

The H2Sines.RDAM project will create a marine corridor for renewable liquid hydrogen supply from Portugal to hard-to-abate mobility applications in the Netherlands and establishes an end-to-end supply chain including green hydrogen production, liquefaction, shipping, and import.

The project significantly supports decarbonisation and promotes market integration and security of supply through the establishment of a complementary and flexible supply route to the yet to emerge integrated European hydrogen network.


HYD-N-543 **H2Sines.Rdam LH2 maritime corridor and import terminal**

Comm. Year **2028**

# A. Project group technical information [Promoter/ ENTSOG]

## Project technical information [Promoter]

*Hydrogen Terminal*

| TYNDP Project code | Hydrogen carrier | $H_2$ Import capacity [GWh/d] | Injection capacity [GWh/d] | Storage capacity [$m^3$] |
|---|---|---|---|---|
| HYD-N-543 | Green hydrogen produced in Portugal | 3.36 | 3.36 | Terminal: 25,000 (2x 12,500) |

## Capacity increment [ENTSOG]

| TYNDP Project code | Point name | Operator | From system | To system | Capacity increment [GWh/d] | Comm. year |
|---|---|---|---|---|---|---|
| HYD-N-543 | LH2_Tk_NL | Shell New Energies | Terminal Netherlands (LH2_Tk_NL) | Transmission Netherlands (NL Hydrogen) | 3.36 | 2028 |

## 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-543 | 500 | 50 | 10 | 30 |

**Description of the cost and range [Promoter]**

The project is still in the process of completing the feasibility stages and final project design and associated costs remain subject to further scoping. Estimates for Capex and Opex will be further refined during the tendering process which will be launched during the next phases of detailed engineering.

# C. Project Benefits [ENTSOG]

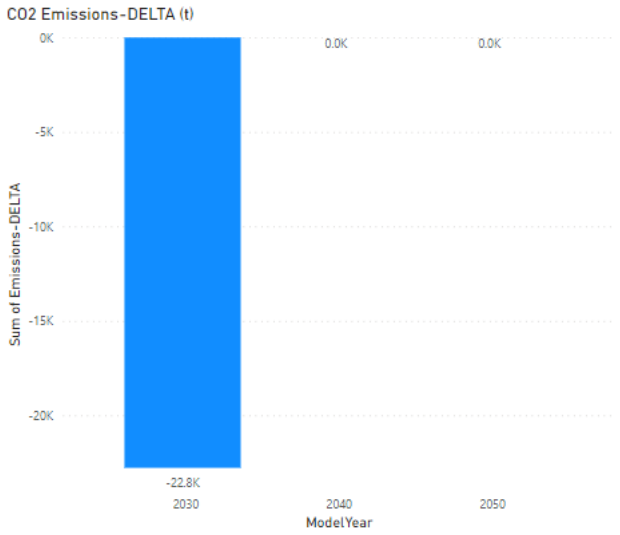
## C.1 Summary of benefits

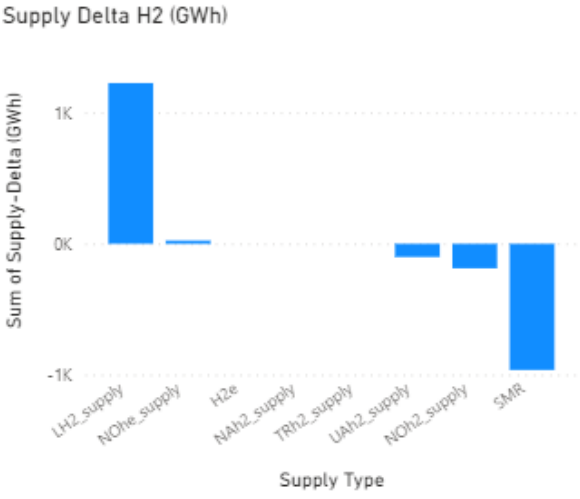
This section provides a summarised analysis by ENTSOG of the main benefits stemming from the realisation of the overall group. More details on the indicators are available in Annex D of TYNDP 2022[1].

### Distributed Energy

#### Sustainability benefits

Thanks to the project group, from 2028, the newly built terminal improves and diversifies hydrogen supply in the Netherlands. 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 22,8 kt in 2030. This can be explained as in 2030 the project group will enable the replacement of blue hydrogen locally produced (i.e SMR) with green hydrogen imports through the maritime corridor Sines to Rotterdam.

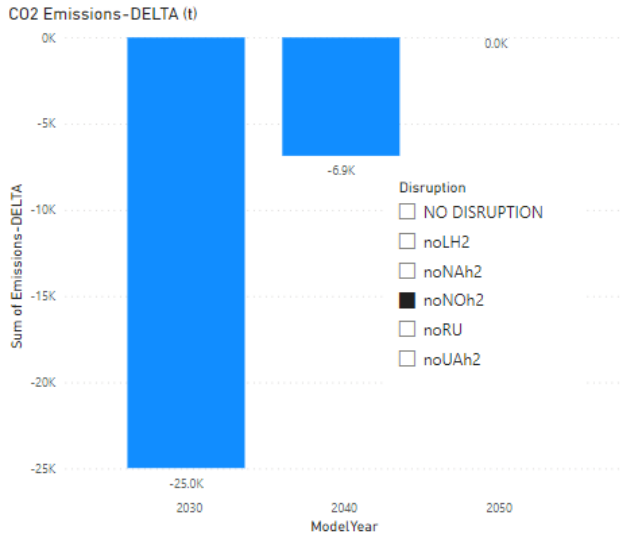


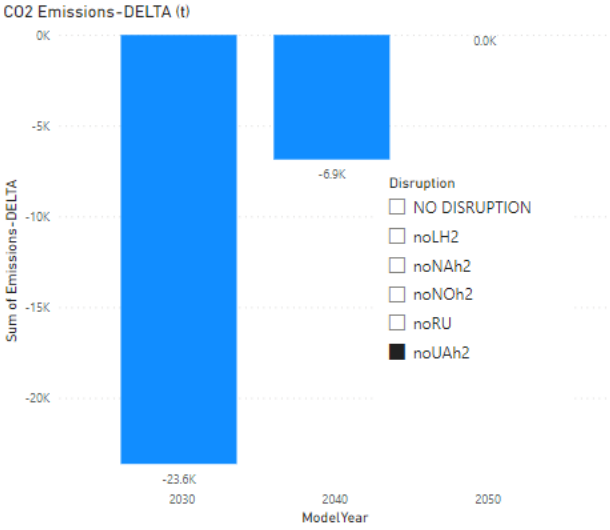



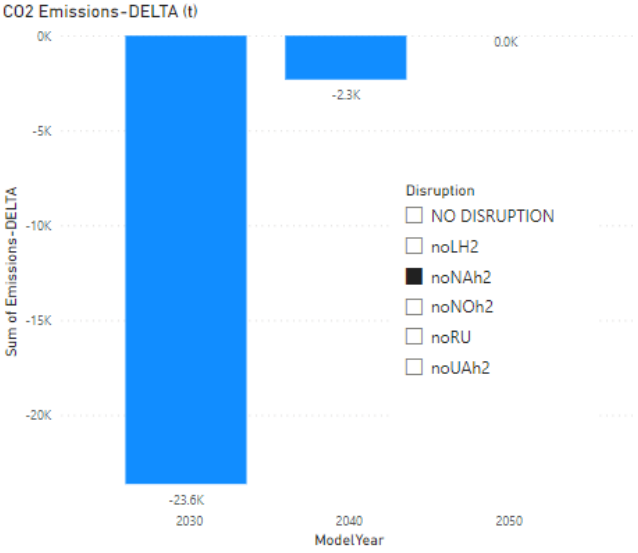

Similar benefits are expected in 2030 under disruption cases (liquid imports disruption is not included as this disruption case will result in disruption of the maritime corridor Sines to Rotterdam). In addition, higher sustainability benefits are expected for 2040 under disruption cases, as due to the lower availability of supply the project group will reduce blue hydrogen supplies avoiding hydrogen demand curtailment.

*1 noNOh2 : Norway disruption / 2 noUAh2 : Ukraine disruption/ 3 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:

The projects group did not show additional security of supply benefits under the reference case (summer/winter average demand). **It is important to highlight that security of supply benefits of this group might be underestimated due to the inclusion of competing projects enabling hydrogen supply in this area**.

[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:

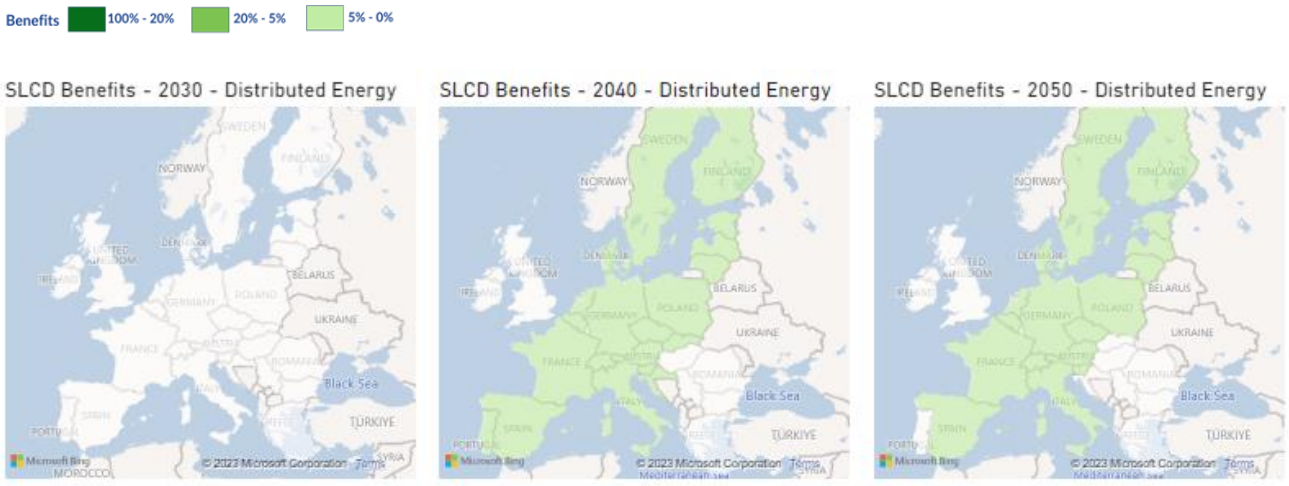
The project group did not show additional security of supply benefits under climatic stress cases (peak, 2-weeks and 2-weeks Dunkelflaute).

> Disruption cases (S-1):

The project group did not show additional security of supply benefits under yearly disruption cases.

> Single largest capacity disruption (SLCD):

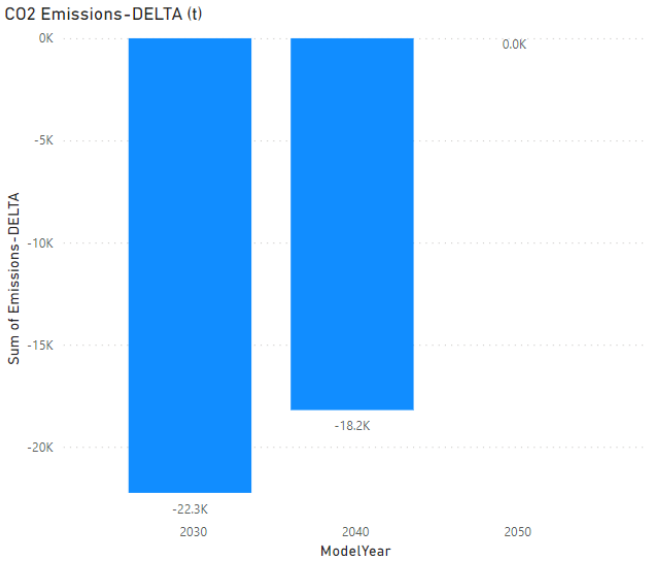
In case of SLCD many European countries benefit from this project group by mitigating the risk of demand curtailment from 2030 onwards.

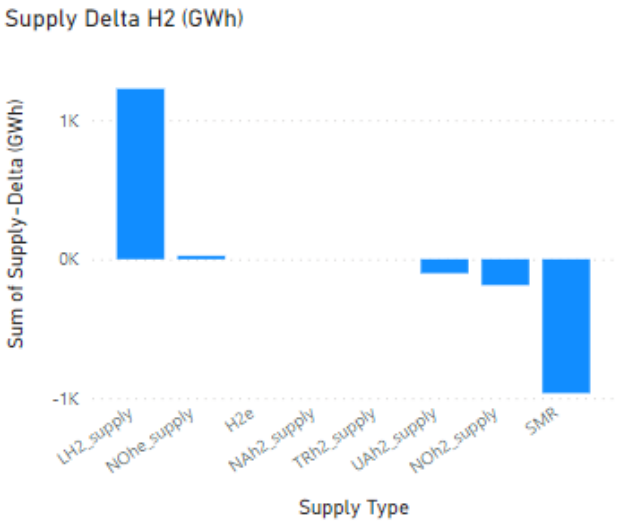


## Global Ambition

### Sustainability benefits

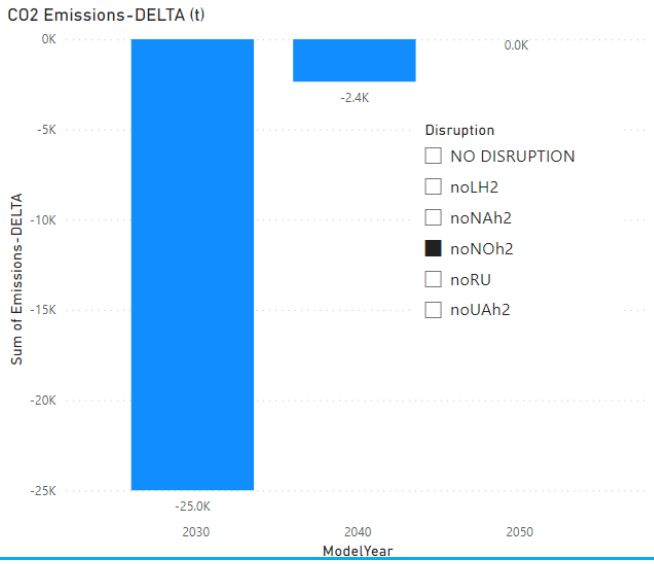
Thanks to the project group, from 2028, the newly built terminal improves and diversifies hydrogen supply in the Netherlands. In the reference case, which analyses yearly demand in two periods (average winter and average summer), the project group will contribute to sustainability by reducing overall CO2 emissions by 22,3 kt in 2030. This can be explained as in 2030 the project group will enable the replacement of blue hydrogen locally produced (i.e SMR) with green hydrogen imports through the maritime corridor Sines to Rotterdam.

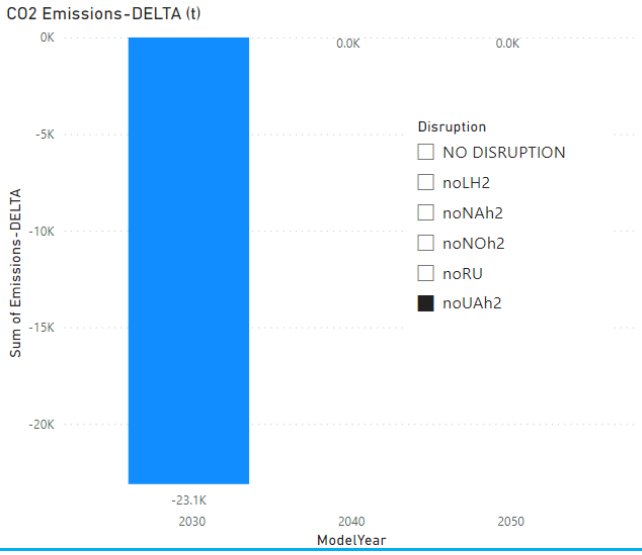


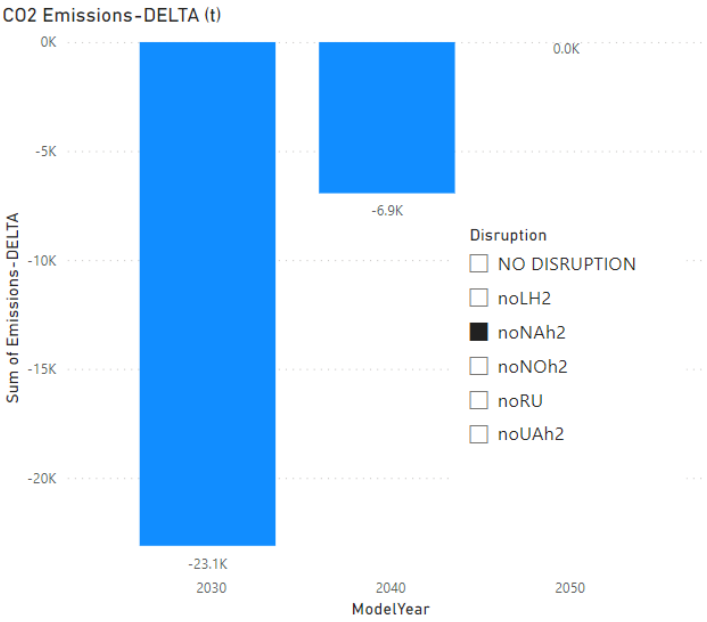




Similar benefits are expected in 2030 under disruption cases (liquid imports disruption is not include as this disruption case will result in disruption of the maritime corridor Sines to Rotterdam). In addition, higher sustainability benefits are expected for 2040 under disruption cases, as due to the lower availability of supply the project group will reduce blue hydrogen supplies avoiding hydrogen demand curtailment.

*1 noNOh2 : Norway disruption / 2 noUAh2 : Ukraine disruption/ 3 noNAh2 : North Africa disruption*






### Security of supply benefits

#### > Reference case

The project group did not show additional security of supply benefits under the reference case (summer/winter average demand). **It is important to highlight that security of supply benefits of this group might be underestimated due to the inclusion of competing projects enabling hydrogen supplies in this area.**




#### > Climatic stress cases

The Project group did not show additional security of supply benefits under climatic stress cases (peak, 2-weeks and 2-weeks dunkleflaute).




### > Disruption cases (S-1)

The Project group did not show additional security of supply benefits under yearly disruption cases.

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

In case of SLCD many European countries benefitting from this project group by mitigating the risk of demand curtailment mainly in 2040, however to a limited extent (between 1 and 3%).




## 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 | -22775,65 | 538677299 | 538700074,7 |
| 2030 | noLH2 | DE | tonne | -117,45 | 540175890,2 | 540176007,7 |
| 2030 | noNAh2 | DE | tonne | -23638,43 | 539785356,1 | 539808994,5 |
| 2030 | noNOh2 | DE | tonne | -24976,12 | 538877197,8 | 538902173,9 |
| 2030 | noUAh2 | DE | tonne | -23638,43 | 539378771,9 | 539402410,4 |
| 2030 | NO DISRUPTION | GA | tonne | -22255,72 | 592910448,4 | 592932704,2 |
| 2030 | noLH2 | GA | tonne | -51,90 | 594817481,2 | 594817533,1 |
| 2030 | noNAh2 | GA | tonne | -23117,61 | 594141433,2 | 594164550,8 |
| 2030 | noNOh2 | GA | tonne | -24992,14 | 593310994,3 | 593335986,4 |
| 2030 | noUAh2 | GA | tonne | -23117,61 | 593627617,9 | 593650735,5 |
| 2040 | NO DISRUPTION | DE | tonne | 0,00 | 392077044 | 392077044 |
| 2040 | noLH2 | DE | tonne | 0,00 | 392213883,4 | 392213883,4 |
| 2040 | noNAh2 | DE | tonne | -2312,71 | 392188097,7 | 392190410,4 |
| 2040 | noNOh2 | DE | tonne | -6863,51 | 392144022,6 | 392150886,1 |
| 2040 | noUAh2 | DE | tonne | -6863,51 | 392399182,9 | 392406046,4 |
| 2040 | NO DISRUPTION | GA | tonne | -18203,23 | 396523251,6 | 396541454,8 |
| 2040 | noLH2 | GA | tonne | 0,00 | 397455196,7 | 397455196,7 |
| 2040 | noNAh2 | GA | tonne | -6938,12 | 397301976,6 | 397308914,8 |
| 2040 | noNOh2 | GA | tonne | -2351,64 | 397450977,1 | 397453328,8 |
| 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 | 0% | 0% | -2% | -1% | -1% | 0% |
| Czechia | 0% | 0% | -2% | -2% | -2% | 0% |
| Estonia | 0% | 0% | -2% | -1% | -2% | 0% |
| Finland | 0% | 0% | -2% | -1% | -2% | 0% |
| Germany | 0% | 0% | -2% | -1% | -1% | 0% |
| Latvia | 0% | 0% | -2% | -1% | -1% | 0% |
| Lithuania | 0% | 0% | -2% | -1% | -1% | -1% |
| Poland | 0% | 0% | -2% | -1% | -1% | 0% |
| Portugal | 0% | 0% | -2% | -1% | 0% | -1% |
| Slovenia | 0% | 0% | -2% | -1% | -1% | 0% |
| Sweden | 0% | 0% | -2% | -1% | -2% | 0% |
| Switzerland | 0% | 0% | -2% | -1% | -1% | -1% |
| France | 0% | 0% | -2% | -1% | -1% | 0% |
| The Netherlands | -1% | -1% | -2% | -1% | -2% | 0% |
| Austria | 0% | 0% | -1% | -1% | -2% | 0% |
| Croatia | 0% | 0% | -1% | -1% | 0% | -1% |
| Denmark | 0% | 0% | -1% | -1% | -1% | 0% |
| Italy | 0% | 0% | -1% | -1% | -2% | 0% |
| Slovakia | 0% | 0% | -1% | -1% | 0% | -1% |
| Spain | 0% | 0% | -1% | -1% | -1% | 0% |
| Greece | 0% | 0% | -1% | 0% | 0% | 0% |
| Hungary | 0% | 0% | -1% | -1% | 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% | 0% | 0% |
| Average2W | Belgium | 0% | 0% | 0% | 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% | 0% | 0% | -1% | 0% | 0% |
| Average2W | Estonia | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2W | Finland | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2W | France | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2W | Germany | 0% | 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% | 0% | 0% | 0% |
| Average2W | Slovenia | 0% | 0% | 0% | -1% | 0% | 0% |
| Average2W | Spain | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2W | Sweden | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2W | Switzerland | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2W | The Netherlands | -1% | -1% | 0% | -1% | 0% | 0% |
| Average2W | United Kingdom | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2WDF | Austria | 0% | 0% | 0% | -1% | 0% | 0% |
| Average2WDF | Belgium | 0% | 0% | 0% | -1% | 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% | -1% | 0% | 0% |
| Average2WDF | Denmark | 0% | 0% | 0% | -1% | 0% | 0% |
| Average2WDF | Estonia | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2WDF | Finland | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2WDF | France | 0% | 0% | 0% | 0% | 0% | 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 | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2WDF | Slovenia | 0% | 0% | 0% | -1% | 0% | 0% |
| Average2WDF | Spain | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2WDF | Sweden | 0% | 0% | 0% | 0% | 0% | 0% |
| Average2WDF | Switzerland | 0% | 0% | 0% | 0% | 0% | -1% |
| Average2WDF | The Netherlands | -1% | -1% | 0% | 0% | 0% | 0% |
| Average2WDF | United Kingdom | 0% | 0% | 0% | 0% | 0% | 0% |
| DC | Austria | 0% | 0% | 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% | 0% | 0% | 0% | 0% |
| DC | Hungary | 0% | 0% | 0% | 0% | 0% | 0% |
| DC | Ireland | 0% | 0% | 0% | 0% | 0% | 0% |
| DC | Italy | 0% | 0% | 0% | 0% | 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% | 0% | 0% | 0% | 0% | 0% |
| DC | Slovenia | 0% | 0% | 0% | 0% | 0% | 0% |
| DC | Spain | 0% | 0% | 0% | 0% | 0% | 0% |
| DC | Sweden | 0% | 0% | 0% | 0% | 0% | 0% |
| DC | Switzerland | 0% | 0% | 0% | 0% | -1% | 0% |
| DC | The Netherlands | -1% | -1% | 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-543 | Maritime corridor and import terminal | TBC | TBC |

| Potential impact | Mitigation measures | Related costs included in project CAPEX and OPEX | Additional expected costs |
|---|---|---|---|
| To be confirmed and refined in next project phase, see below | | | |

**Environmental Impact explained** [Promoter]

The promoters have engaged in proactive work on minimising and mitigating the risk of negative impacts on the environment. The members of the consortium have a long track record on working on large-scale energy and industrial projects and in managing their environmental and social impacts. Engagements with local communities are also planned to coordinate and cooperate on risk mitigation measures in both Portugal and the Netherlands.

For instance, environmental criteria have been considered in the site selection exercise and will continue to play a crucial role in project design and decision-making. A full environmental and safety risk assessment is expected to be completed during the next stage of the project to this effect. This will further allow to identify any potential impacts and proactively define appropriate and effective risk mitigation measures, which may fully be known today given the early stage of the project advancement.

## E. Other benefits [Promoter]

Missing benefits are all benefits of a project which may be not captured by ENTSOG analysis.

As a necessary condition a missing benefit cannot have discrepancies with the benefits already covered by the assessment run by ENTSOG and this condition needs to be proved and justified.

### Description of Other benefits [Promoter]

The project will be an early enabler of decarbonisation of hard-to-abate mobility sectors by establishing the first complete and end-to-end supply chain for green and renewable liquefied hydrogen harnessing the full potential of renewable and clean energy production in Portugal and supplying it to important demand centres for hydrogen in the Netherlands and beyond. As such,

- The project **significantly contributes to national and European energy policy objectives around sustainability** and **reinforces diversification and security of supply** by complementing (yet to be established) hydrogen pipeline infrastructure. Notably, the project will deliver up to 100t of renewable and RED2-compliant liquefied hydrogen per day to contribute to Fit-for-55 targets in relation to the decarbonisation of transport (and RFNBOs in particular) – providing GHG emission savings of up to 568 kt CO2eq per year in hard-to-abate sectors that are crucial for the European economy.
- This will ultimately **reduce dependence on non-EU supply** (by reducing the reliance on fossil energy vectors) **and foster market integration** and competition across the continent.
  The import terminal in Rotterdam will also be able to **accommodate additional hydrogen supply** (i.e. beyond volumes supplied from Sines), which furthermore allows to support European energy policy objectives around hydrogen imports as established by the RePowerEU plan.
  As a result, H2Sines.RDAM **significantly contributes to rapidly-changing European energy policy imperatives**, in particular in the context of a new geopolitical order since Russia's invasion of Ukraine (not reflected in ENTSOG's current modelling assumption) that reinforces the need for energy autonomy and security of supply across the Union.
- In addition, the project will support the development of the wider hydrogen economy across
  - job creation, both directly-linked to the project and additional indirect job creation and wider spill-overs into the general economy
  - build-up of R&D capabilities around green hydrogen production, liquification, shipping and regasification, as well as
  - dissemination of technological advancements and learning from its status as a first-of-its-kind commercial demonstrator for an LH2 maritime corridor and complete supply chain.
- Finally, the project will **support the development of new digital solutions**, by putting in place an Energy Management System that aims to (i) dispatch and "operate" the H2 plant accounting for external factors such as the forecast of RE production, the H2 demand from the liquefaction unit and other end users of the gaseous hydrogen (industries or mobility end users in Portugal), and power market dynamic and internal constraints (characteristics of the H2 plant equipment, safe operation, state of the plant) and (ii) focus on flexibility valorisation and value optimization, optimizing the LCOH in real-time dispatch.

## F. Useful links [Promoter]

**Useful links:**

https://www.engie.com/en/news/H2Sines-Project

https://www.shell.nl/media/nieuwsberichten/2022/renewable-liquid-hydrogen-supply-chain.html