Hystories final conference

Panel discussion *Strategies for the deployment of hydrogen storage in Europe*

26th May 2023, 14:15 – 15:45 CEST

Gas Infrastructure Europe

GIE

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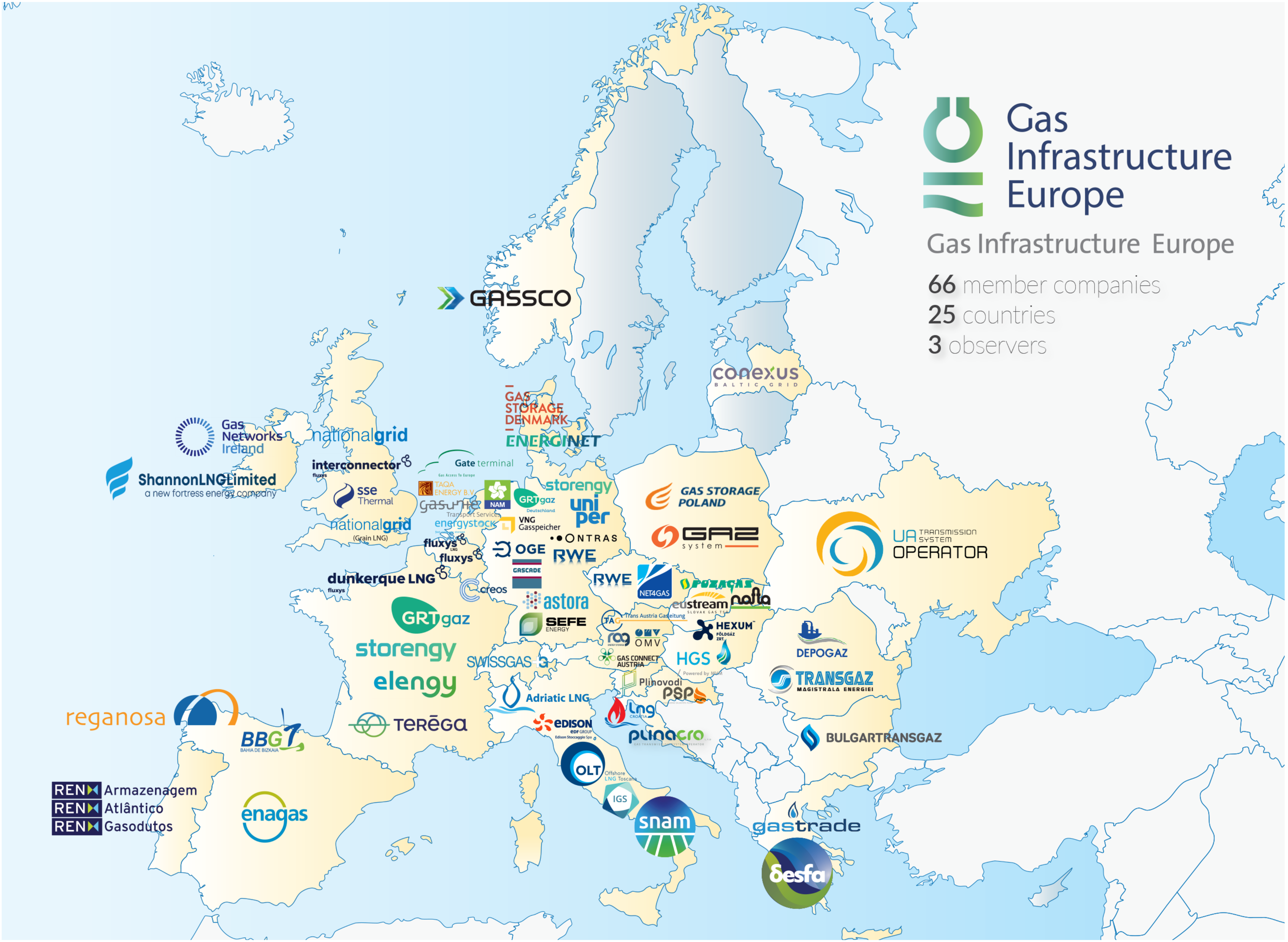
in a nutshell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66 member companies
25 countries
3 observers
GASSCO
conexus BALTIC GRID
GAS STORAGE DENMARK
ENERGINET
Gas Networks Ireland
nationalgrid
ShannonLNGLimited
a new fortress energy company
interconnector
Gate terminal
sse Thermal
TAQA ENERGY B.V.
gasunie
NAM
GRTgaz Deutschland
storengy
uniper
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energystock
nationalgrid (Grain LNG)
fluxys
ONTRAS
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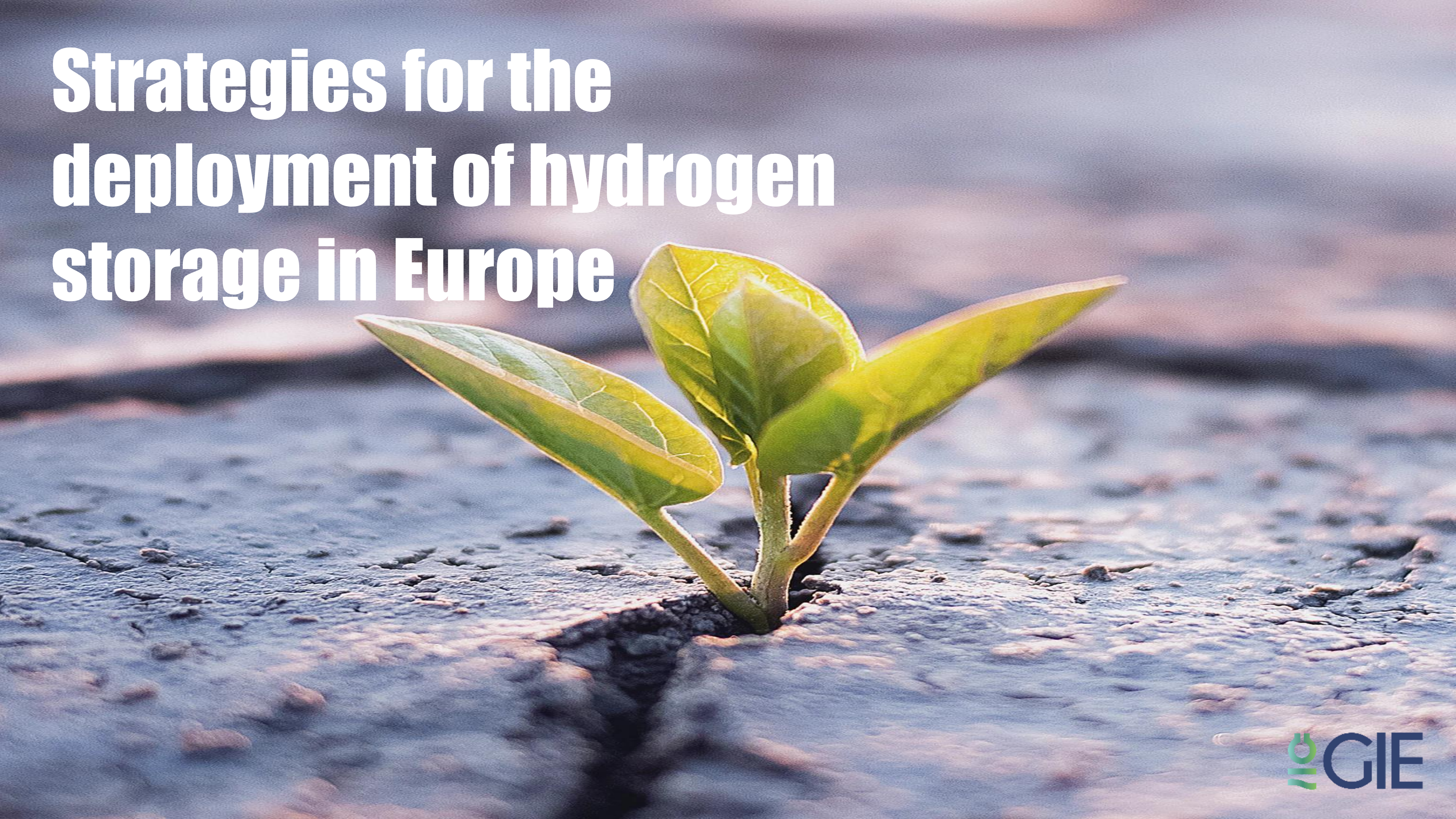
Strategies for the deployment of hydrogen storage in Europe



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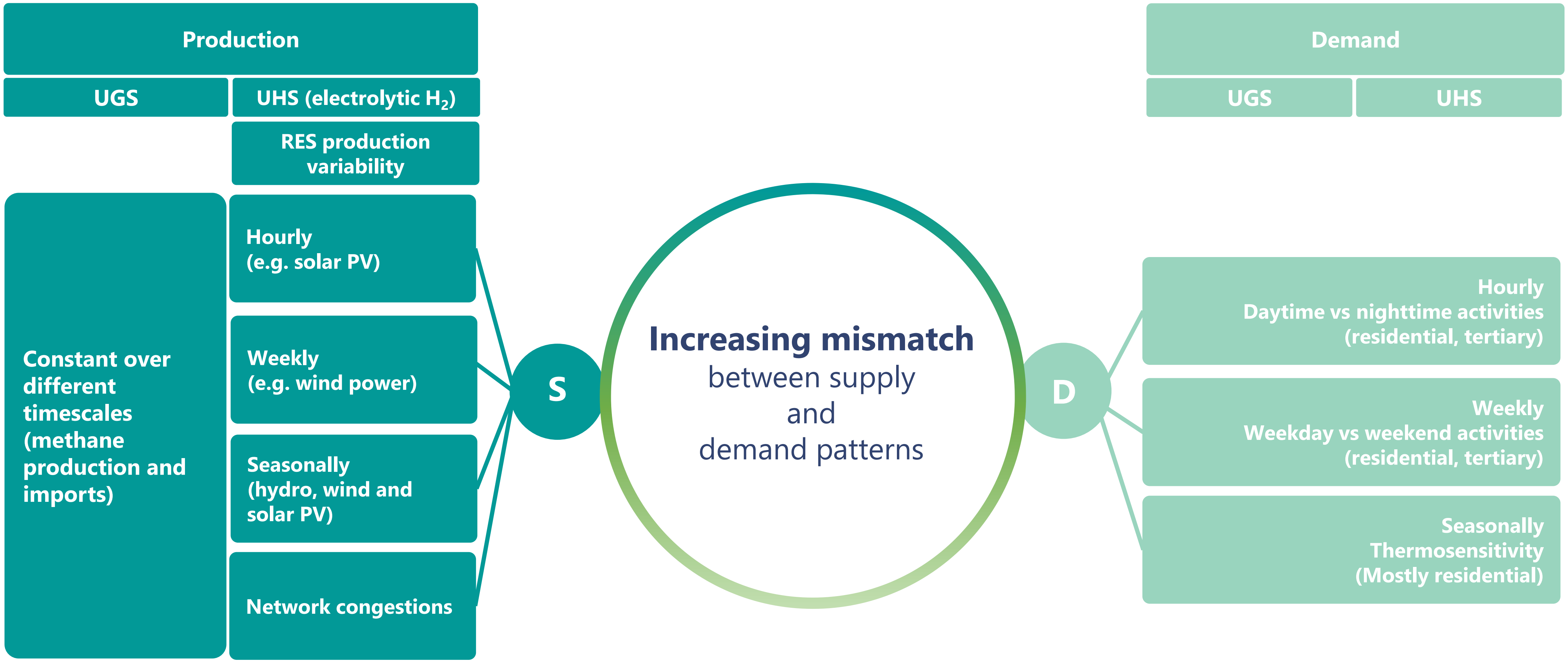
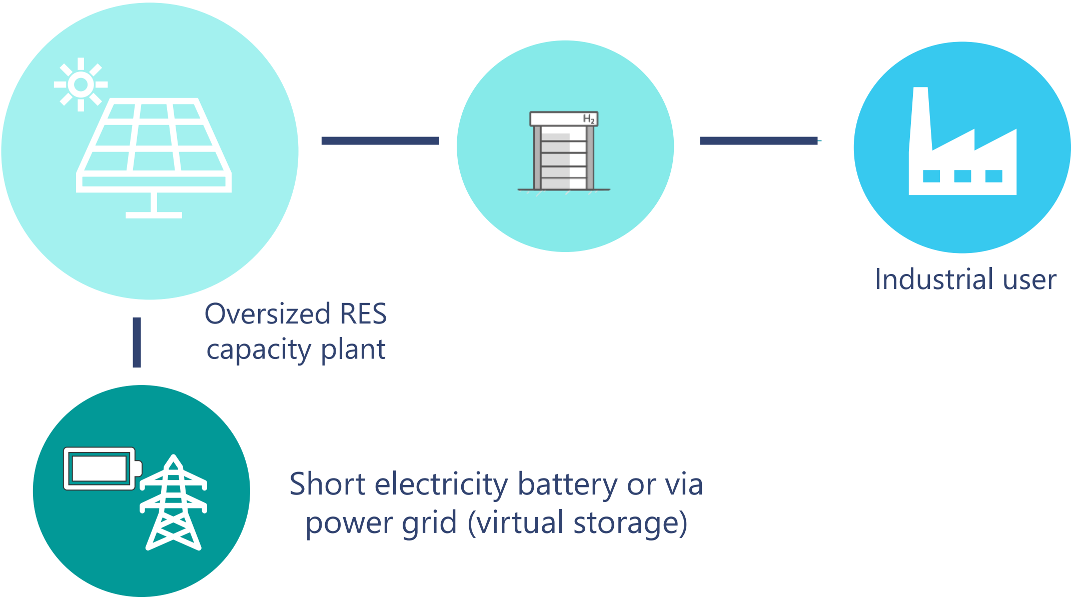
Evolving role of UHS as power mix changes



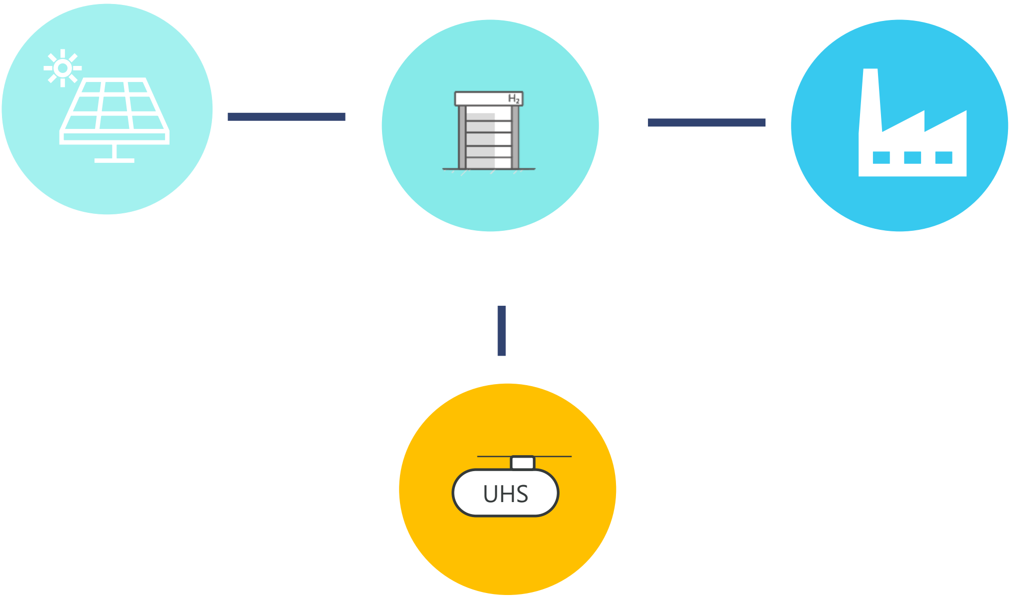
Scalability of UHS

Renewable electrolysis system using electricity storage to store



- Batteries in the electricity system enabling to store any excess of RES, resulting in lower LCOH compared to a case without batteries (higher utilization of the electrolyser)
- Savings eroding over time as deeper penetration of RES further increases storage costs as electricity storage are not scalable

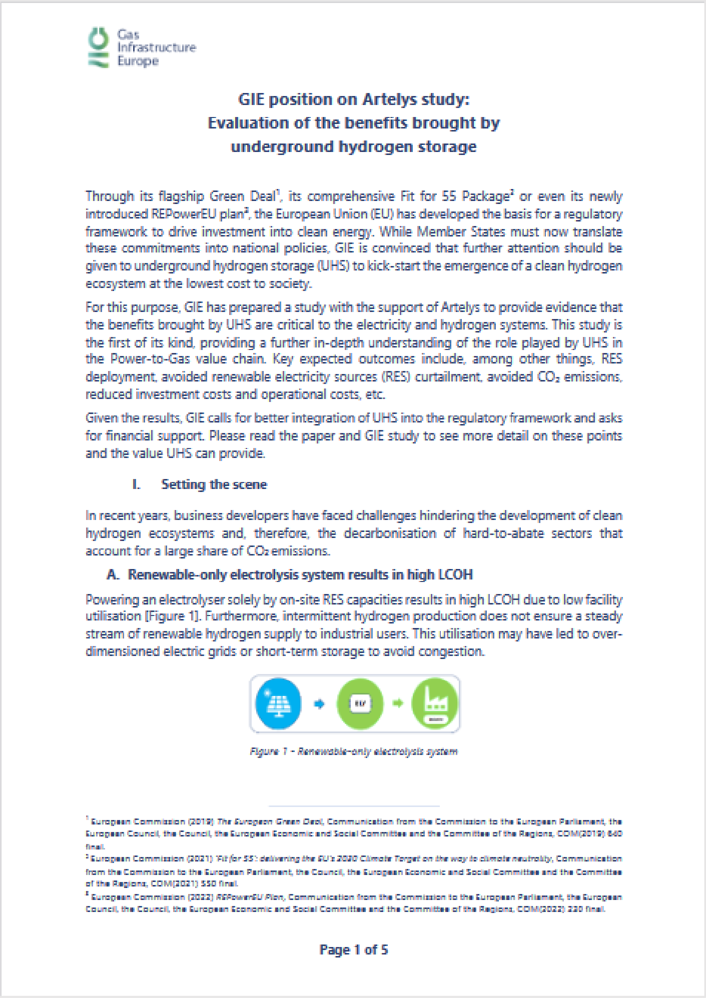
Renewable electrolysis system using UHS to better use RES-deployment



- UHS enabling to store at large scale - Benefits increasing with RES deployment & electricity grid constraints
- Resulting in lower LCOH than in the case with batteries (higher-scalability of storage)

Showcasing the pathways & values of underground hydrogen storage

GIE, supported by Artelys, quantified the value of UHS for the 1st time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GIE position on Artelys study:
Evaluation of the benefits brought by underground hydrogen storage

Through its flagship Green Deal[1], its comprehensive Fit for 55 Package[2] or even its newly introduced REPowerEU plan[3], the European Union (EU) has developed the basis for a regulatory framework to drive investment into clean energy. While Member States must now translate these commitments into national policies, GIE is convinced that further attention should be given to underground hydrogen storage (UHS) to kick-start the emergence of a clean hydrogen ecosystem at the lowest cost to society.

For this purpose, GIE has prepared a study with the support of Artelys to provide evidence that the benefits brought by UHS are critical to the electricity and hydrogen systems. This study is the first of its kind, providing a further in-depth understanding of the role played by UHS in the Power-to-Gas value chain. Key expected outcomes include, among other things, RES deployment, avoided renewable electricity sources (RES) curtailment, avoided CO_2 emissions, reduced investment costs and operational costs, etc.

Given the results, GIE calls for better integration of UHS into the regulatory framework and asks for financial support. Please read the paper and GIE study to see more detail on these points and the value UHS can provide.

I. Setting the scene

In recent years, business developers have faced challenges hindering the development of clean hydrogen ecosystems and, therefore, the decarbonisation of hard-to-abate sectors that account for a large share of CO_2 emissions.

A. Renewable-only electrolysis system results in high LCOH

Powering an electrolyser solely by on-site RES capacities results in high LCOH due to low facility utilisation [Figure 1]. Furthermore, intermittent hydrogen production does not ensure a steady stream of renewable hydrogen supply to industrial users. This utilisation may have led to over-dimensioned electric grids or short-term storage to avoid congestion.

Figure 1 - Renewable-only electrolysis system

[1] European Commission (2019) *The European Green Deal*, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2019) 640 final.
[2] European Commission (2021) *'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality*, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2021) 550 final.
[3] European Commission (2022) *REPowerEU Plan*, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2022) 230 final.

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Objective & approach

Values of hydrogen storage

SYSTEM VALUE
KPI: total annualized costs

INSURANCE VALUE
KPsI: storage, flexibility, installed capacity

ARBITRAGE VALUE
KPIs: production cost, H_2 supply routes

KICK-START VALUE
KPIs: investments in renewable and

ENVIRONMENTAL VALUE
KPIs: avoided CO_2 emissions and RES

Impact analysis of hydrogen storage

- System dynamics (production, storage)
- Generation/demand mix
- Cost metrics (total, levelized, etc.)
- Carbon emissions

Showcasing the values of hydrogen storage

- Quantitative evolution of the benefits brought by hydrogen storage
- Key messages on the values

Territorial use case

#1	On-site green hydrogen production for industrial consumer
#2	Hydrogen production from grid-connected electrolysis for thermosensitive consumer backed-up by an alternative supply option
#3	Hydrogen production from grid-connected electrolysis for industrial consumer backed-up by an alternative supply option
#4	On-site renewables for green hydrogen production and power injection/consumption into/from the grid

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Values generated by UHS in an integrated energy system

System

Avoid over-investment in infrastructure elements across the entire energy system

Arbitrage

Allow better use of the cheapest hydrogen sources in competitive markets

Insurance

Ensure sufficient volumes and injection rates are available to end-uses subject to uncertain demand levels

Environmental

Allow withdrawal of decarbonised electricity for H_2 production and limit RES curtailment

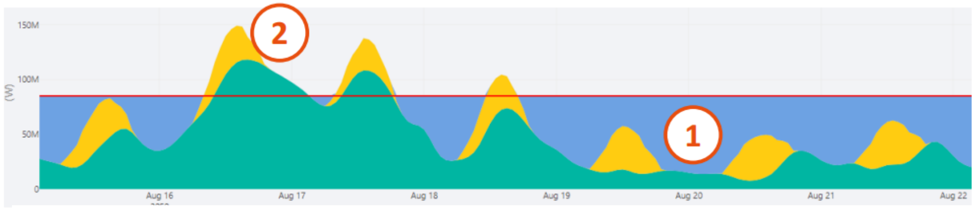
Kick-start

Allow to optimally size investments in RES capacity to comply with transition targets

Illustration with territorial use case 1

A SYSTEM WITHOUT UHS

Hourly supply-demand balance over 1 week **without** H2 storage

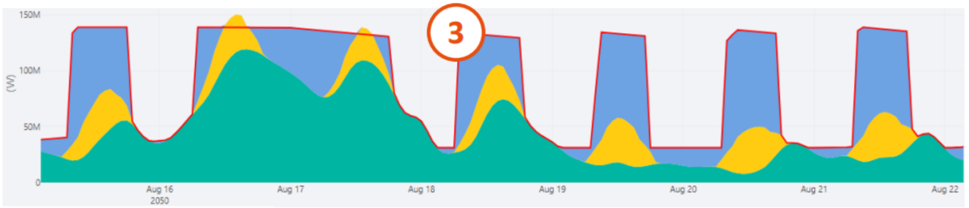


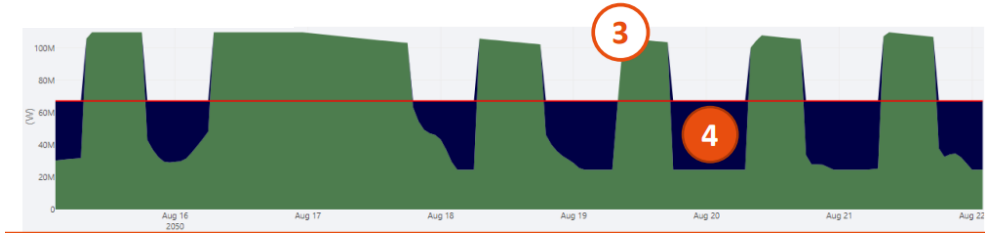
Electricity supply

Hydrogen supply

A SYSTEM WITH UHS

Hourly supply-demand balance over 1 week **with** H2 storage





1. The power generated by RES on site
   - not sufficient to power the electrolyser in order to meet the hydrogen demand (flat demand)

2. Surplus renewable generation curtailed

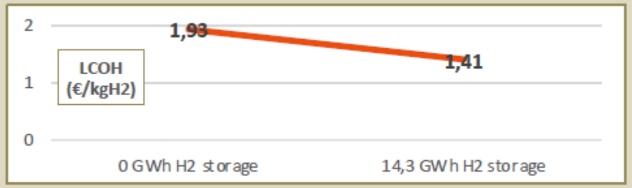
3. During low electricity price periods (high RES)
   - UHS enables to increase the electrolysis capacity and to produce more H2 than the instantaneous demand

4. During high electricity price periods (Low RES)
   - UHS discharges to meet the demand, enabling electrolysis to reduce its operation

Results of territorial use case 1

System value

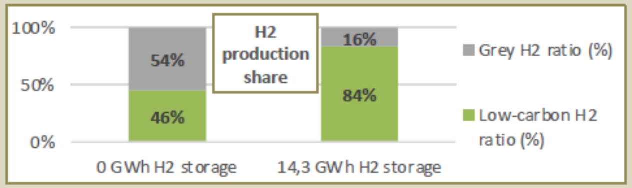
Hydrogen storage enables to better use the cheapest hydrogen sources and to decrease full cost of hydrogen production.



UHS **reduces the hydrogen costs** by **25%**

Arbitrage value

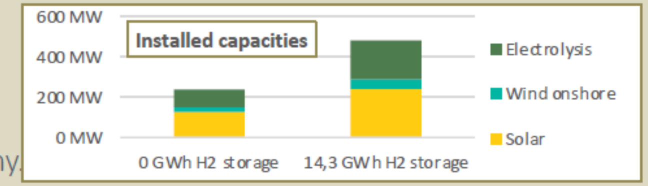
Hydrogen storage fosters renewable hydrogen production by allowing a better use of local RES resources.



UHS results in up to **38%** more renewable H_2 in the mix

Kick-start value

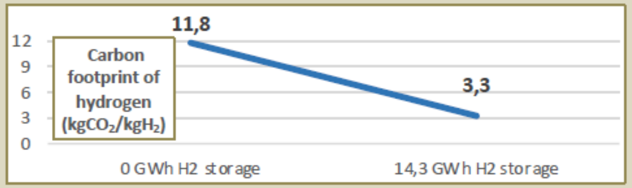
Hydrogen storage allows for a system-level optimization of electrolysis and RES sources, facilitating the emergence of a hydrogen economy.



UHS is key to meeting **compliance with transition targets** and facilitating the emergence of hydrogen ecosystem

Environmental value

Hydrogen storage allows the system to withdraw decarbonised electricity for hydrogen production, thereby reducing carbon emissions.

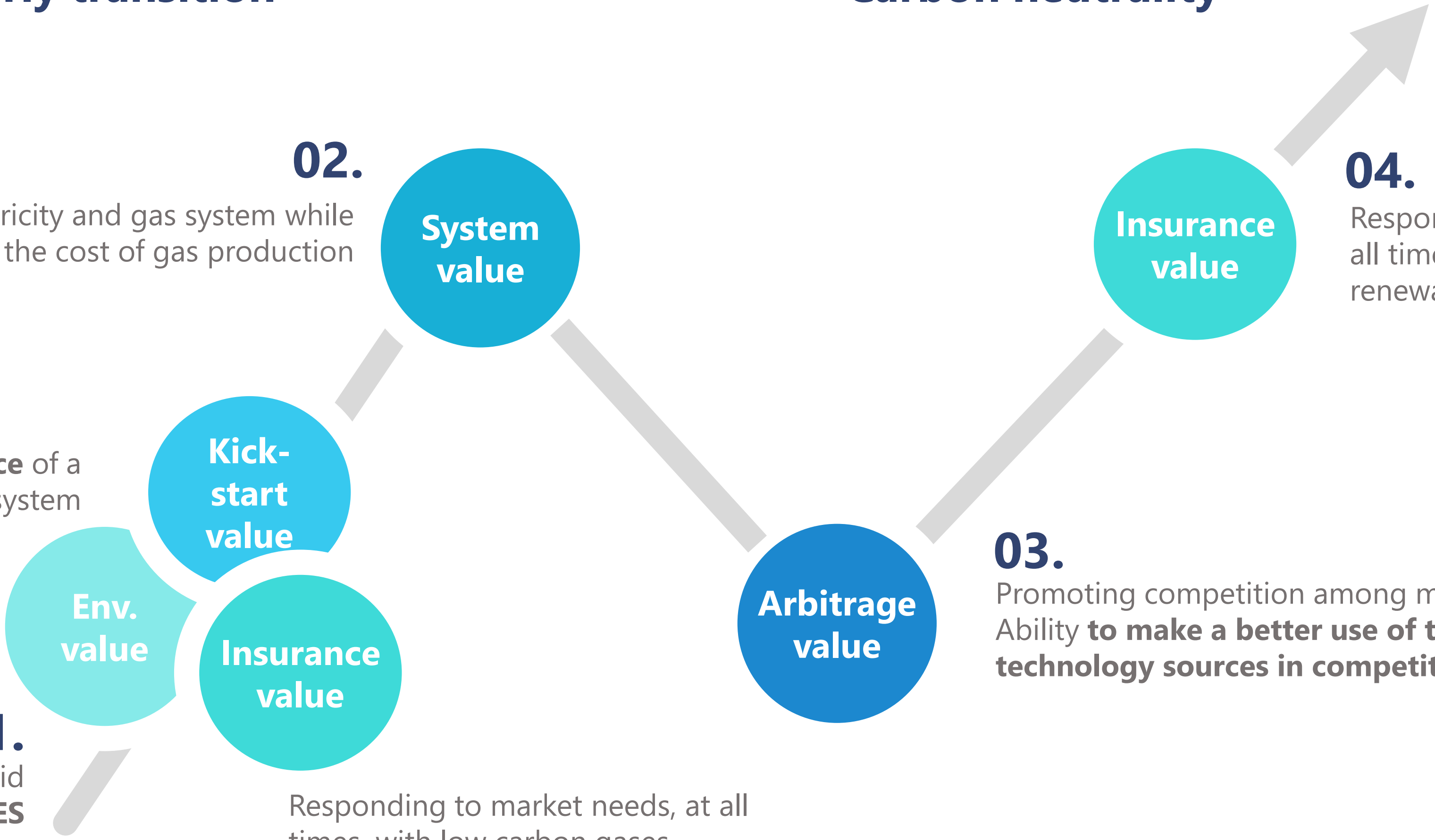


UHS **reduces the average carbon emissions of H_2** by **70%**

An appropriate vision for the role of large-scale storage

Long-term storage vital across all stages of the market development and the energy system as a whole

Early transition → **Carbon neutrality**



01.

Mitigating the stress on the power grid while ensuring **a better use of RES**
Key elements to accommodate electrification

Facilitating the emergence of a decarbonized ecosystem

Responding to market needs, at all times, with low carbon gases

02.

Optimisation of the **entire** electricity and gas system while lowering the cost of gas production

03.

Promoting competition among market participants
Ability **to make a better use of the cheapest energy technology sources in competitive markets**

04.

Responding to market needs, at all times, with low and mostly renewable sources

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