Driving δesfa toward energy transition

Dr. Michael Thomadakis

Head of Strategy & Development Division

ΙΕΝΕ 25ο ΣΥΝΕΔΡΙΟ ΕΝΕΡΓΕΙΑ & ΑΝΑΠΤΥΞΗ, 1-2 ΔΕΚΕΜΒΡΙΟΥ 2021

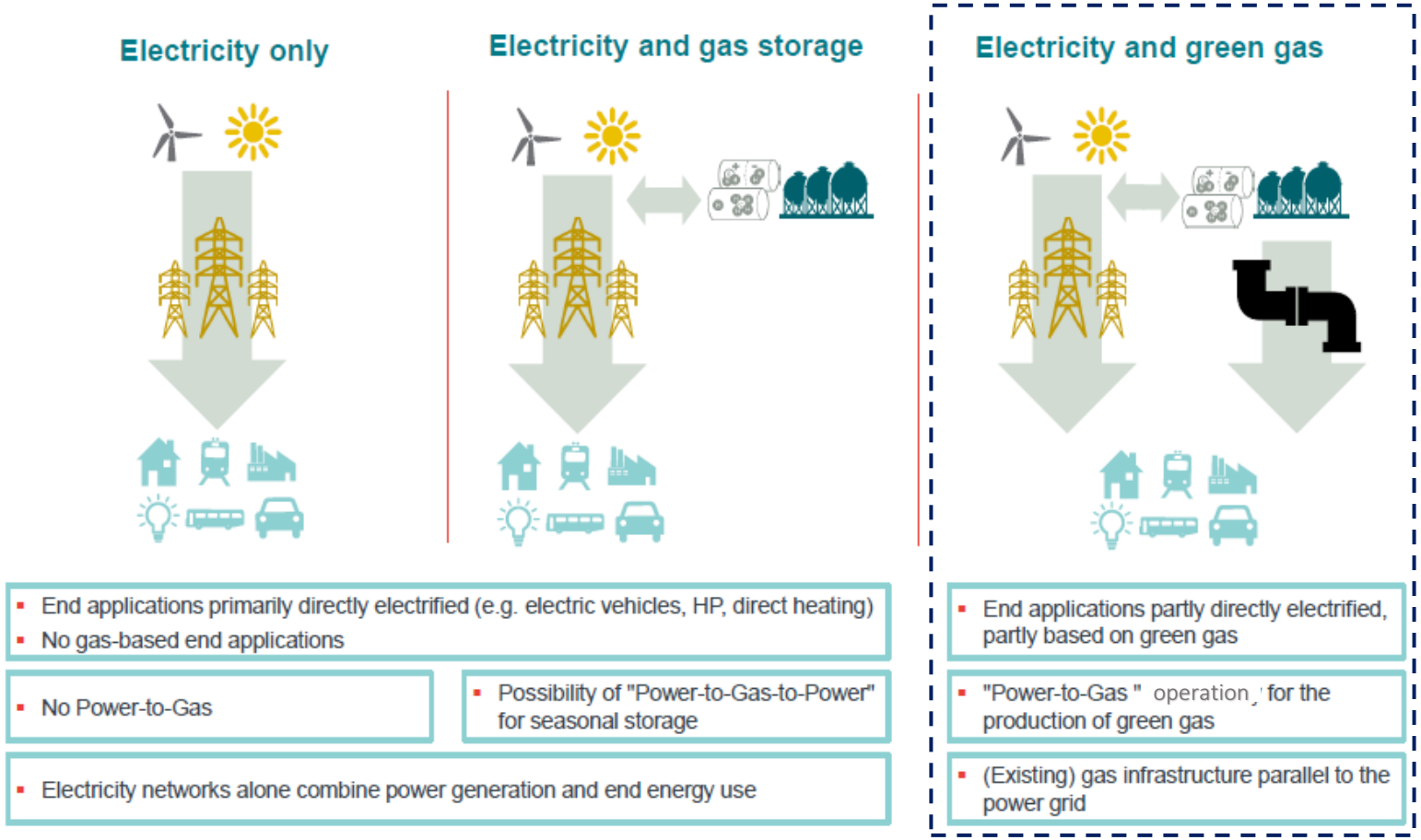
Index

The prospect of renewable gases

Focus on δesfa strategic plan

Different decarbonization pathways are possible…

δesfa supports and promotes a balanced role for gas and electricity in the future



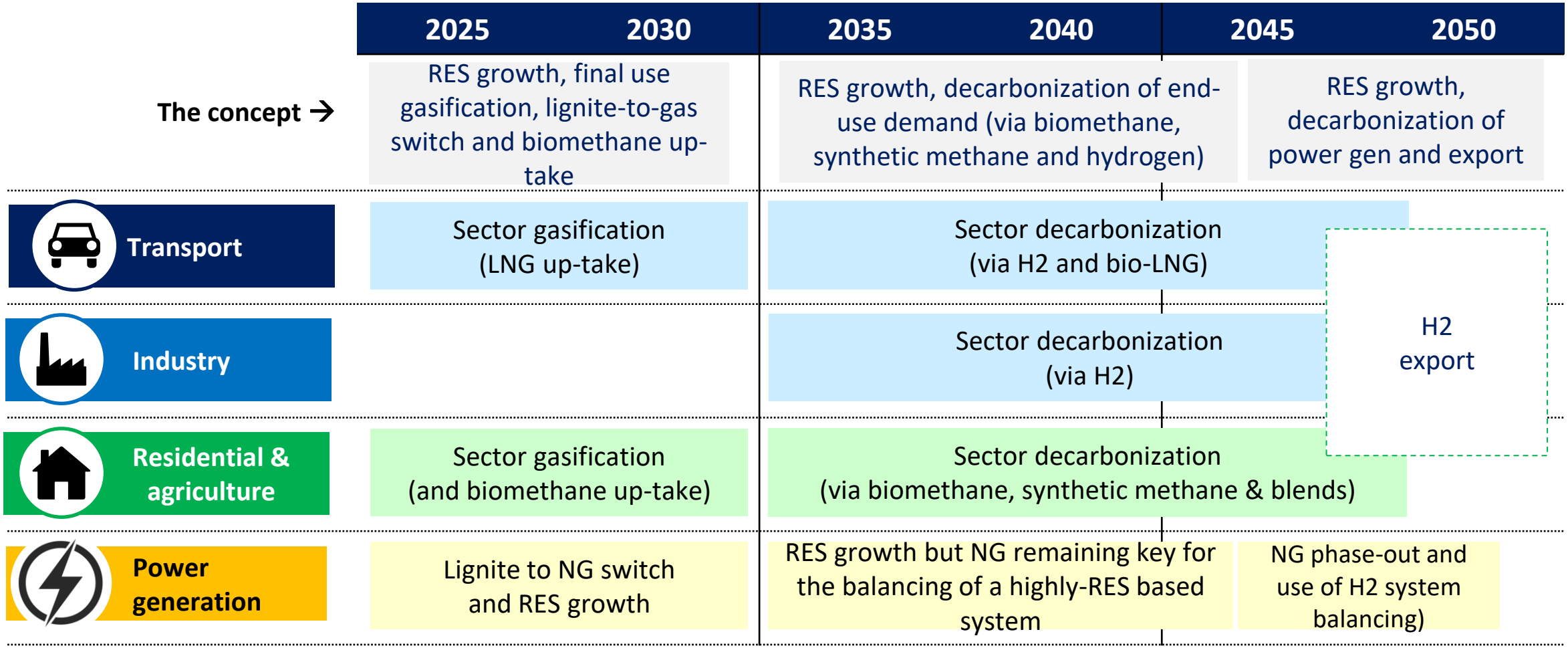
Source: Frontier Economics

δesfa's view and strategic perspective:

- Decarbonization of the electricity supply is a key element towards a carbon-free system
- However, **molecules will still be needed** for different parts of the value chain
- The **gas sector can provide greater energy efficiency** and renewable integration (through the flexibility of storage), delivering on low-carbon technologies such as **hydrogen**, **renewable gas** and –potentially- **carbon capture and storage**
- Continued **usage of existing gas infrastructure is to the benefit of the society**

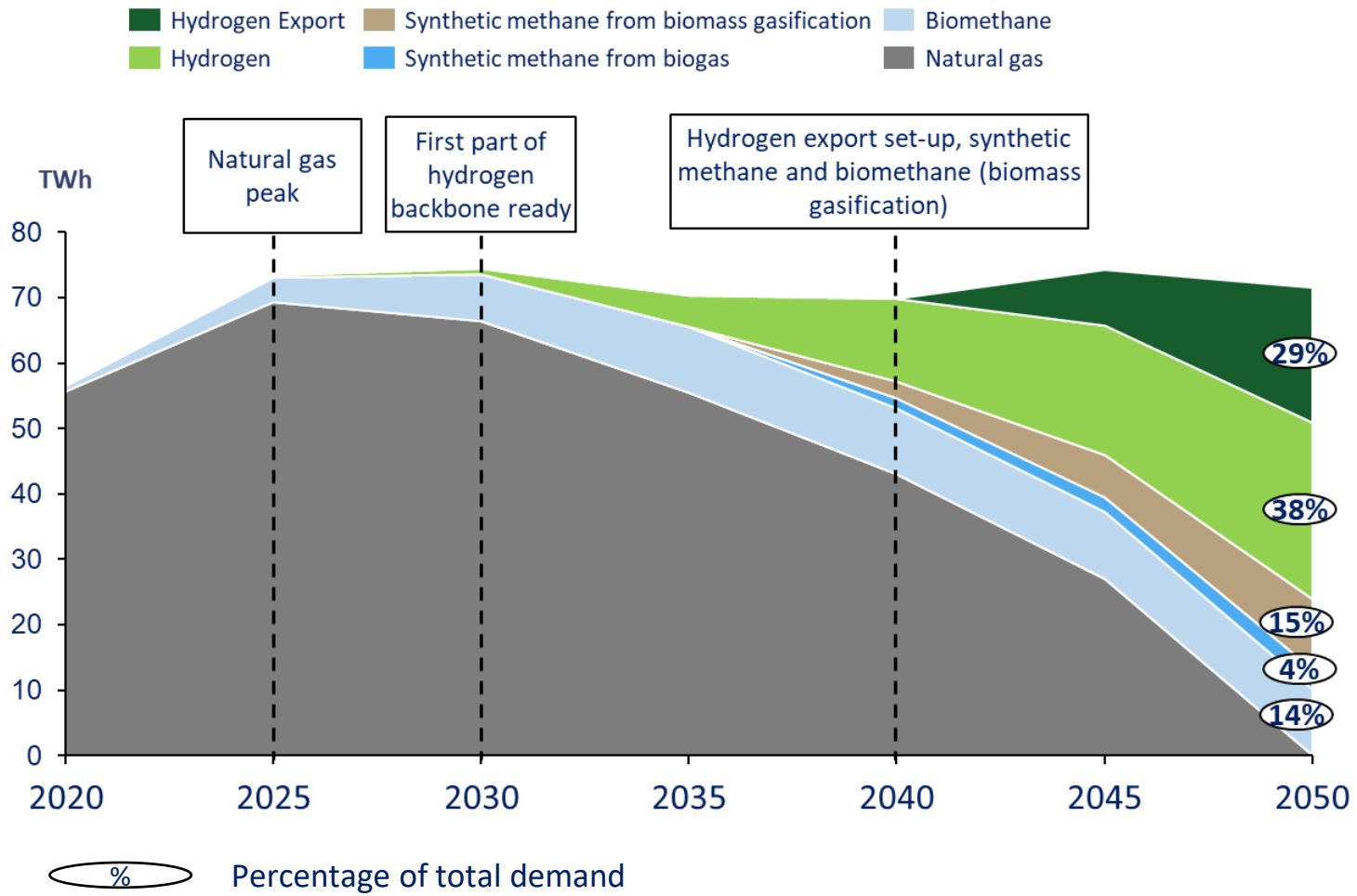
Greece will reach its 2050 goals by first decarbonizing the end-users demand, with the phase-out of NG in power-generation starting only from 2040

DESFA S/D scenario phased approach overview



Overall gas local consumption and export (in energy), is expected to remain stable over time (70TWh) with NG phase-out accelerating from 2040

Gas volume phasing (TWh)

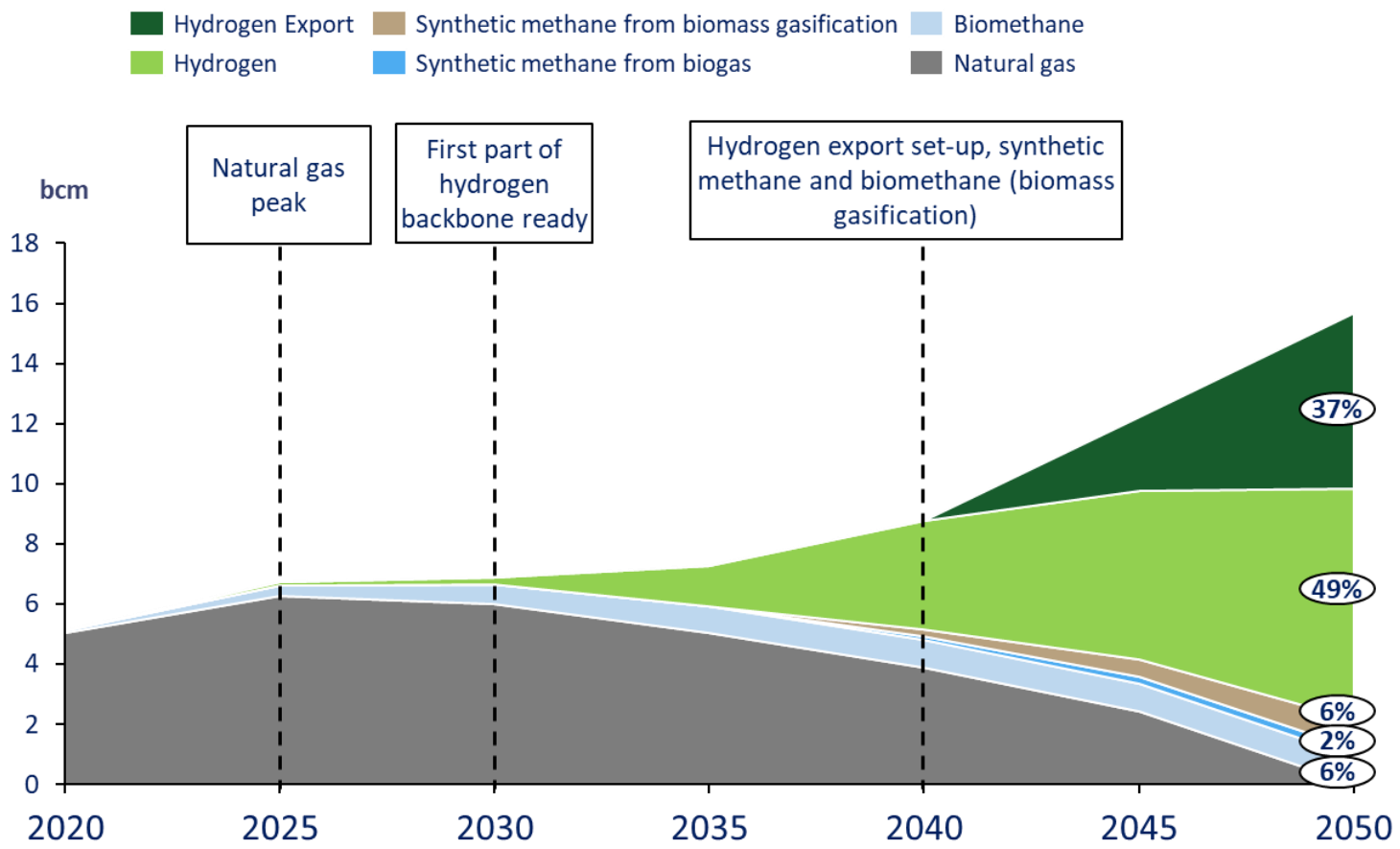


Phased-approach highlights

- **Natural gas peaks in 2025** and is progressively replaced by decarbonised gases
- **Biomethane is the first** decarbonised gas to be used and is expected to grow to 10% by 2030 and reach **full addressable potential by 2035**
- **Synthetic methane and methane from biomass** gasification **start** being used towards **2040** in limited cases where production is cheaper (e.g. curtailed RES, favourable feedstock conditions) and they progressively increase when they become **cheaper than NG (with CO2 price reaching 200€/ton)**
- Relevant volumes of **hydrogen appear from 2035** (when the H2 backbone is up and running) to **decarbonize final consumption** and **from 2040**, when the hydrogen backbone connection to the rest of Europe is in place, Greece is expected to start **exporting Hydrogen to Central Europe**

In terms of volumes, due to the lower calorific value of hydrogen, the required capacity of both NG and H2 pipelines reaches approximately 15 bcm in 2050

Gas volume phasing (bcm)

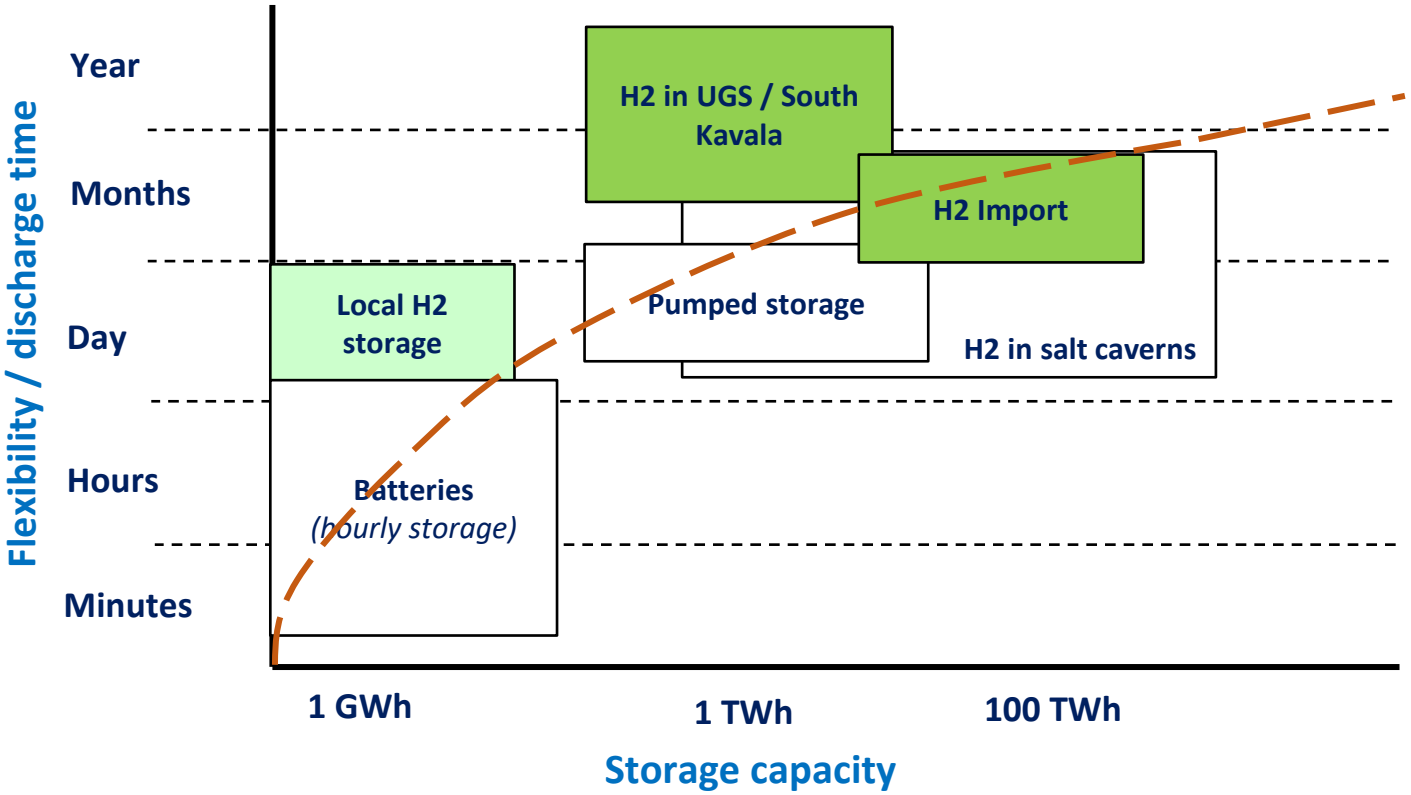


% Percentage of total demand

Phased-approach highlights

- **The growth of biomethane (in 2025) and synthetic methane from biomass gasification and biogas (in 2040) has similar impact in the increase of the volumes** compared to the energy demand (previous slide), since both have the same energy content with fossil natural gas
- **Regarding hydrogen**, although that in terms of energy it becomes relevant after 2035, **its volumes become significant after 2030**, due to its considerably lower calorific value (approximately 3 times lower than methane). The dedicated H2 pipeline is expected by 2035, so prior to this, these volumes are expected to be accommodated within the natural gas pipelines as blends
- **The total decarbonized landscape of 2050, along with H2 exports starting 2040, lead to significantly higher volumes transported through the system** (both existing and dedicated H2 pipelines), **although in terms of energy the demand is at the same level with 2025.**

Gas storage: the only way to provide seasonal flexibility, also for renewable gases
This makes South Kavala a "must have" gas facility, but even more is needed!



Available flexibility solution technologies

Localized flexibility	Centralized flexibility

- The Underground Gas Storage (UGS) facility in South Kavala is a "must have" facility for the system (and even more capacity may be required)
- DESFA is actively pursuing its incorporation in the National Natural Gas System through the respective tender launched by the Hellenic Republic Asset Management Fund
- However, **more gas storage will be needed to meet net-zero**

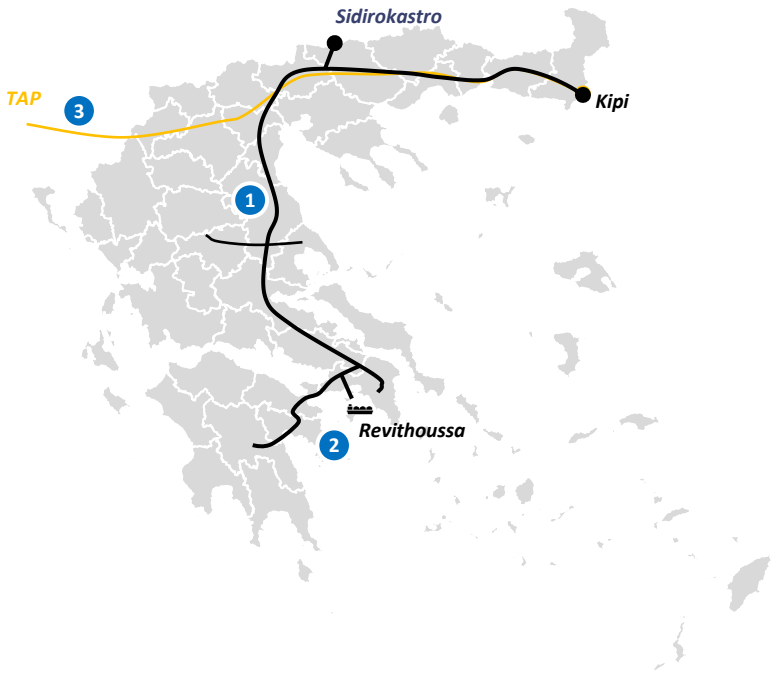
Source: Study for δesfa's long term strategy towards the 2050 decarbonization goals, Strategy&

δesfa's hydrogen network is expected to expand in parallel to the current methane network proving a complete dual system

Gas network phased expansion

2020 state: dedicated to Natural Gas

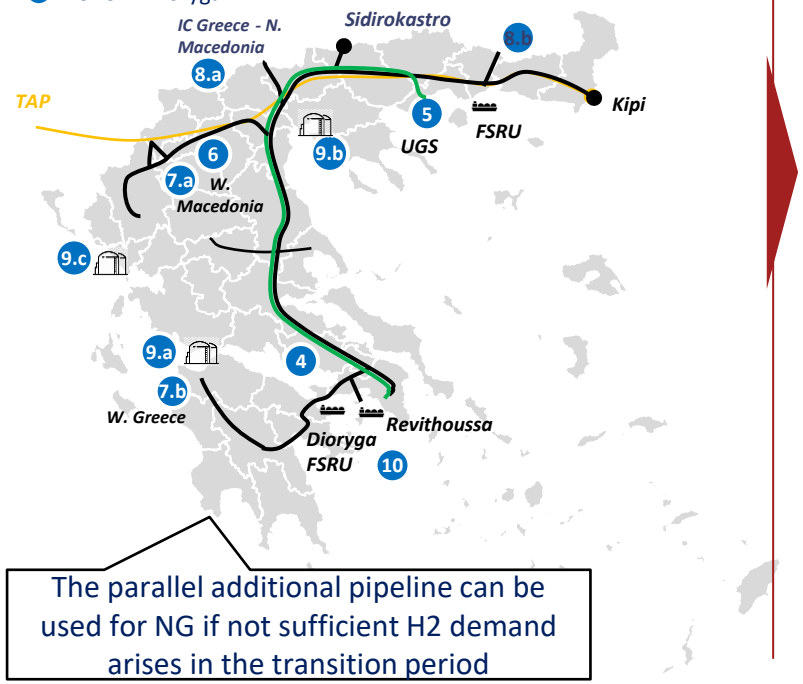
1. NG pipeline to serve power gen. and final consumption
2. LNG terminal active in Revithoussa
3. TAP connection for NG with other European networks



Hydrogen Pipeline: 0km

2030 state: expansion of NG + H2 line

4. Dedicated H2 pipeline for industrial sites and final consumers
5. UGS for Methane potentially convertible to H2
6. Injection of H2 from White Dragon in dedicated pipeline
7. W. Macedonia (a) and W. Greece (b) NG branch (H2 ready)
8. NG exit points in N. Macedonia (a) and IGB (b)
9. LNG Depot in Patras (a), Thessaloniki (b) and Igoumenitsa (c)
10. FSRU in Dioryga

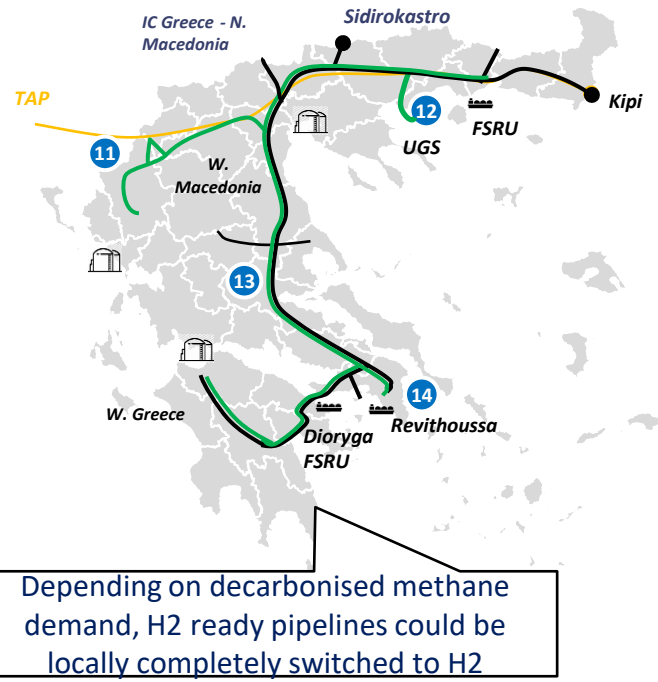


The parallel additional pipeline can be used for NG if not sufficient H2 demand arises in the transition period

Hydrogen Pipeline: 600km

2050 Final state: dual system parallel

11. Connection for Hydrogen Export through TAP repurposing
12. Connection to UGS for H2 seasonal system balance
13. Completion of parallel Hydrogen network
14. Revithoussa switched from gasification to liquefaction plant



Depending on decarbonised methane demand, H2 ready pipelines could be locally completely switched to H2

Hydrogen Pipeline: 2000km

Integration of new gases into δesfa's regulated business will be vital

Preparing for our future through a number of activities…

- Moving to hydrogen ready infrastructure
- Long term strategy study for renewable gases (part of our Development Study)
- Participation in the national hydrogen strategy committee
- Participation in all the relevant discussions for EU legislative amendments
- Participation in the White Dragon project (IPCEI candidate)
- Cooperation with relevant EU associations

Through these initiatives, δesfa aims to:

1. Contribute to the design of national H2 strategy and engage in the discussion regarding the ongoing developments on an EU level
2. Define and promote δesfa's role in the context of the European and Greek Hydrogen strategy
3. Prepare our current and future network to be H2-ready
4. Identify and prioritize business opportunities over the next years, including hydrogen and biomethane pilot projects
5. Cooperate with the main energy companies for H2 projects and participate in R&D studies

Regulatory Framework will undergo radical changes in Greece and EU

Regulation should:

- be **flexible** to allow the emergence of new gases/technologies
- be updated to **cope with cross-cutting aspects** (e.g. infrastructure planning)
- be **coherent across multiple sectors** (e.g. integration of P2G and energy management services for all sectors)
- **facilitate decarbonisation**, improve market functioning and **maximise the opportunities arising from sector coupling**