ETN hydrogen techno-economic study adapted to new market conditions

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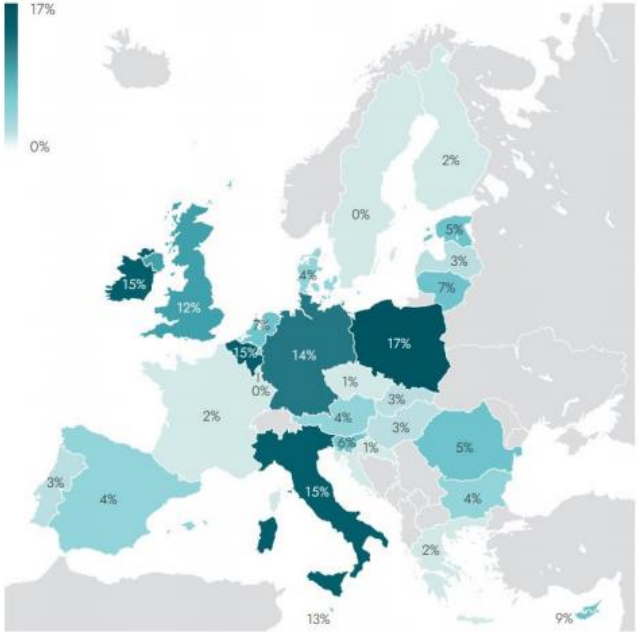
Chair, ETN Young Engineers Committee

Why hydrogen?

According to IEA Net Zero by 2050 report:

- **17%** of global H_2 will be used for power generation
- Requiring **~90 Mt H_2/year**
  - **Equivalent to today's global annual H_2 production!**
  - H_2 needs to be **low-carbon** or **zero-carbon**

→ Aim of the study: Identify the market conditions under which H_2 firing in a GT could become viable.



Fraction of total electricity generation attributed to H_2 generation in 2050
(from European Hydrogen Backbone)

Background

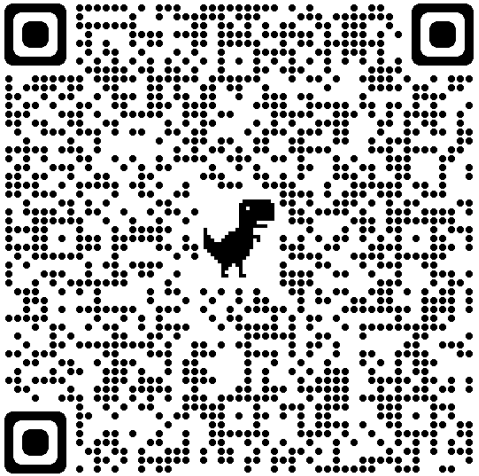
- ETN Young Engineers Committee recently published our first main report:

  “Hydrogen Deployment in Centralised Power Generation – A techno-economic case study”

- Significant market changes during 18 month study (October 2020 – April 2022) – sensitivity analysis included in report.

- Further changes to energy markets since April 2022.

Download now!



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Reference case studies

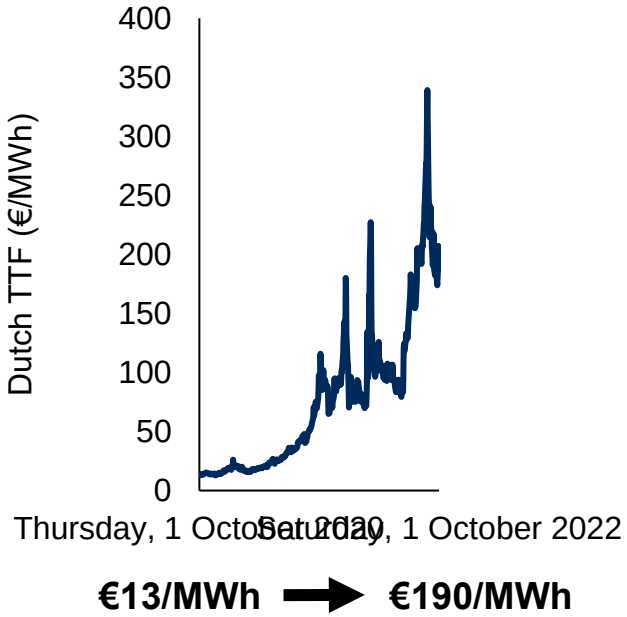
- Open cycle, combined cycle, and combined heat and power GTs
- Cycle output from 20 MW to 650 MW
- Hydrogen blends in natural gas from 0 to 100% (by volume)
- Hydrogen price from €0.50/kg to €4.00/kg
- Carbon price from €50/ton to €325/ton

Reference case:

Hydrogen: €1.50/kg **Natural gas: 20€/MWh** **CO_2 price: 50 €/ton**

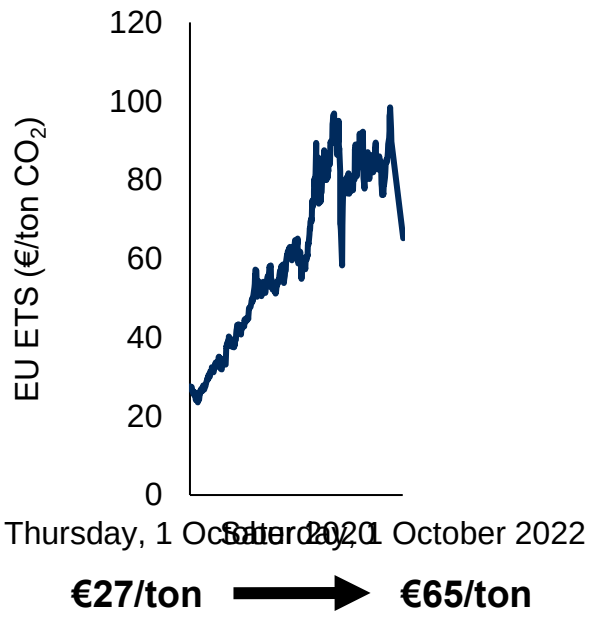
What changed?

- Natural Gas (Dutch TTF)



€13/MWh → €190/MWh

- Carbon (EU ETS)

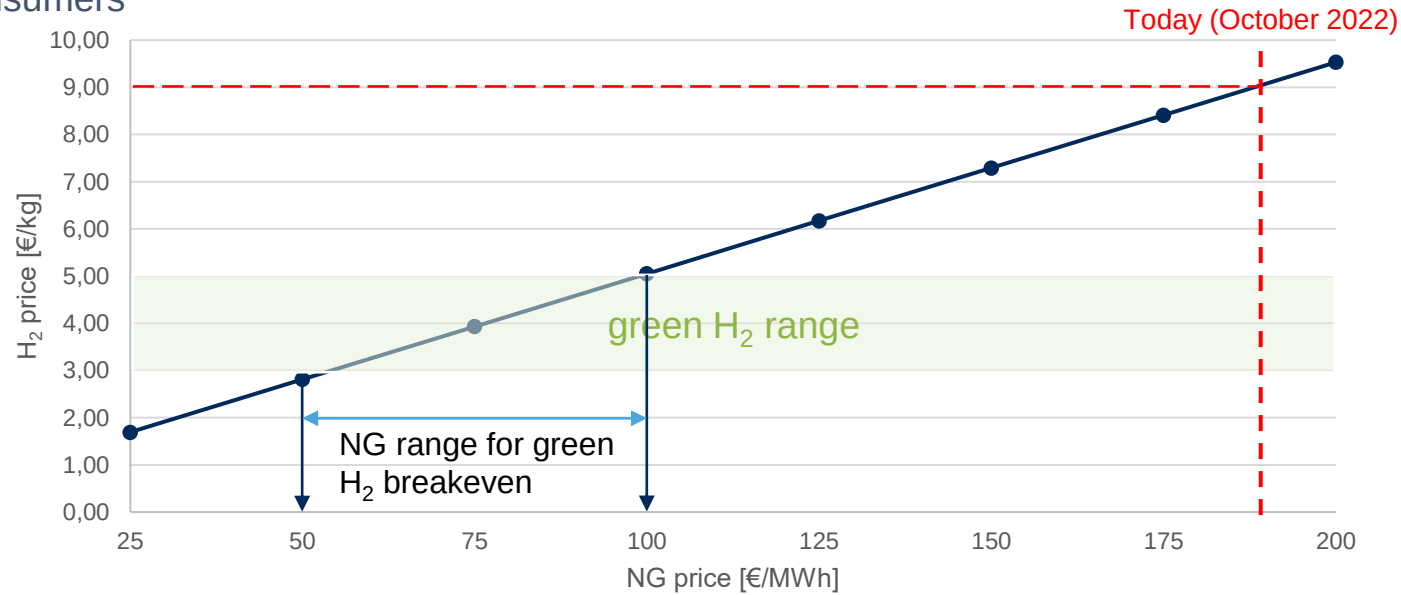


€27/ton → €65/ton

Impact of natural gas price on H_2 price

For NG price above 100 €/MWh → **blue H_2** price reaches > 5€/kg and **green H_2** could become **competitive with blue**

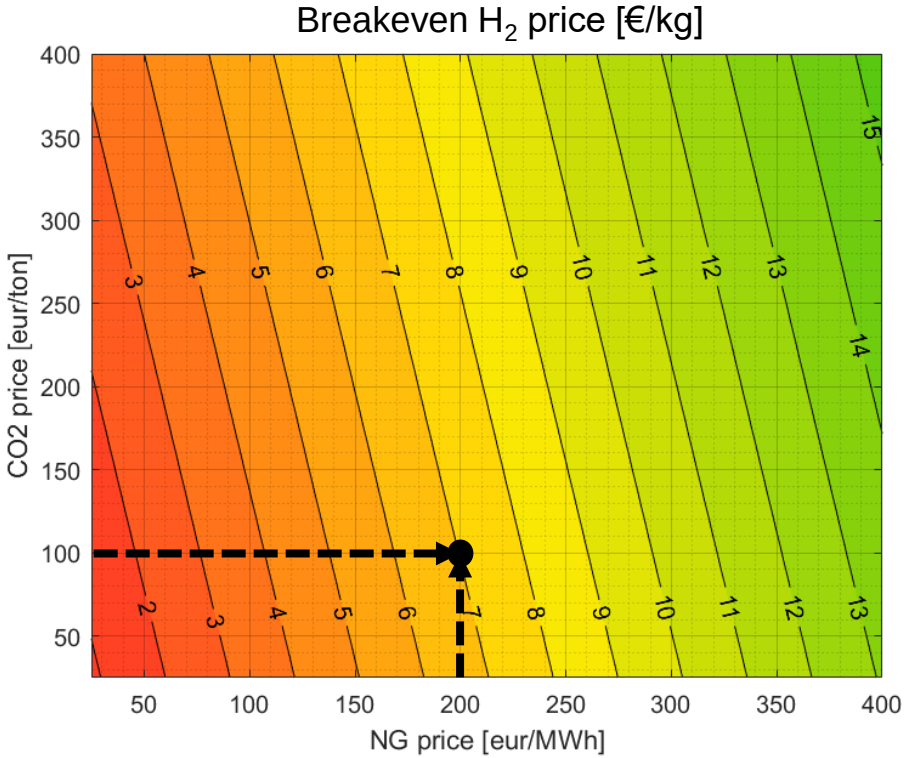
However, with these fuel cost overall generation price will increase, meaning an additional burden for consumers



*assuming FTR technology operating for 8760 h @ 75% constant conversion efficiency (LHV basis) with a CCR of 80%

Case study update – Large CCGT

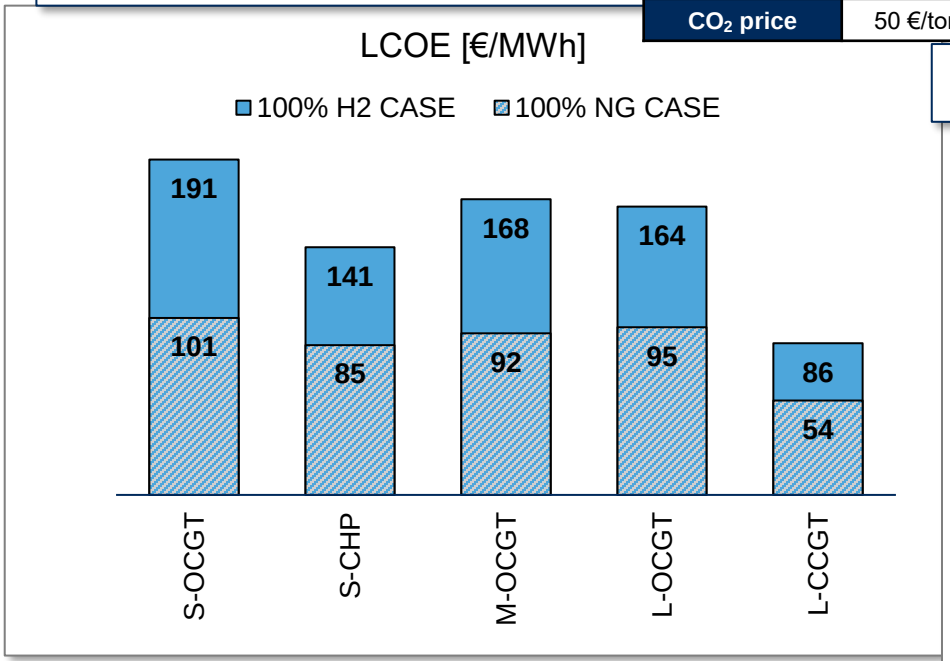
- 650 MW output
- 64% efficiency
- Example:
  - Natural gas = 200 €/MWh
  - CO_2 = 100 €/ton
  - H_2 < 7 €/kg to justify use in large CCGT (i.e., lower LCOE than 100% natural gas)



Case study update for 100% Hydrogen GTs

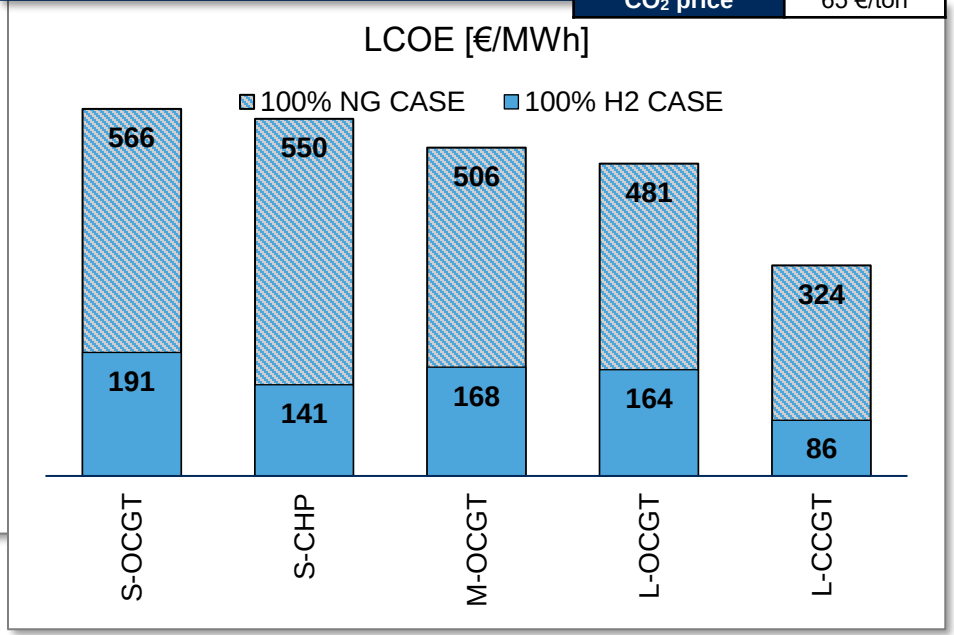
Reference Scenario

Hydrogen cost	**1.5 €/kg**
Natural gas cost	20 €/MWh
CO_2 price	50 €/ton



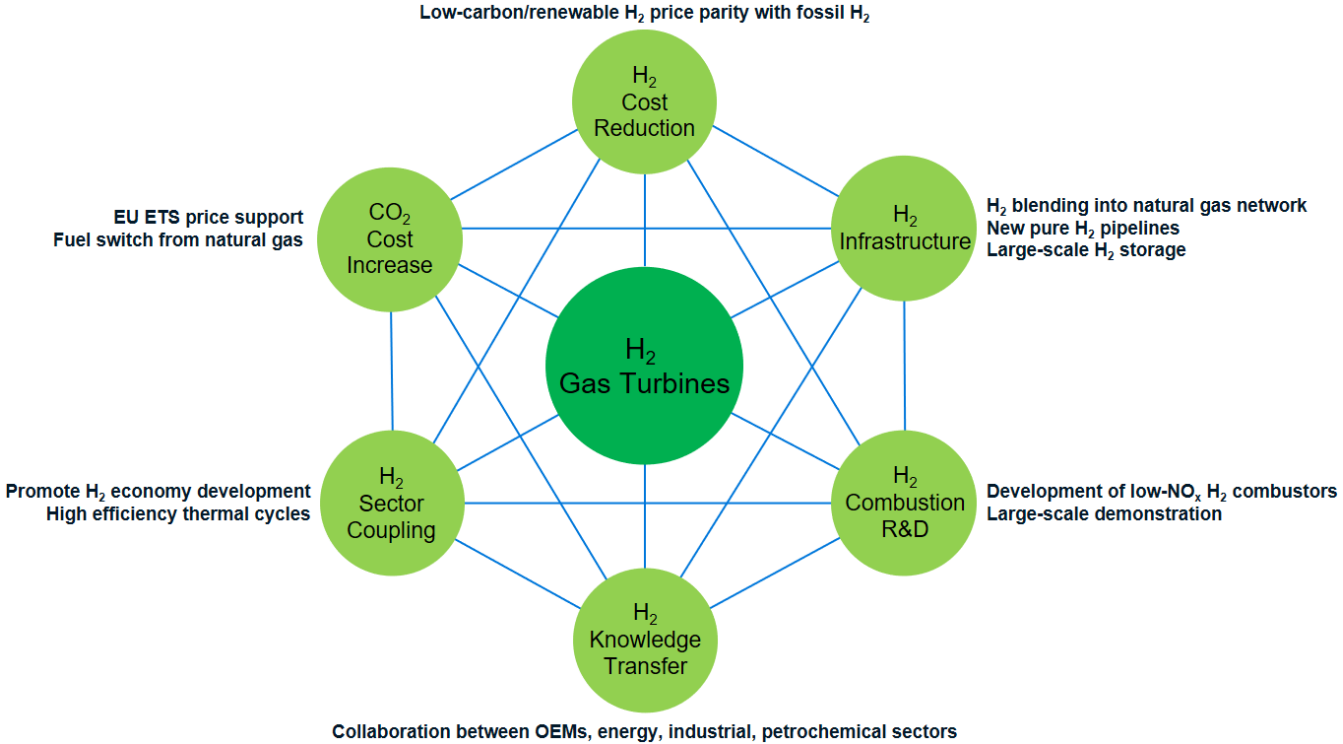
Updated scenario

Hydrogen cost	**1.5 €/kg**
Natural gas cost	190 €/MWh
CO_2 price	65 €/ton



LCOE: Levelised Cost of Electricity

Hydrogen GT roadmap still applies!



Want to learn more?

- Attend our virtual panel session and Q&A, hosted by the Young Engineers Committee report authors
- 28th October 2022, 12:00 – 13:00 CEST
- Official side event of European Hydrogen Week 2022!

European Hydrogen Week Side Event

Register now!

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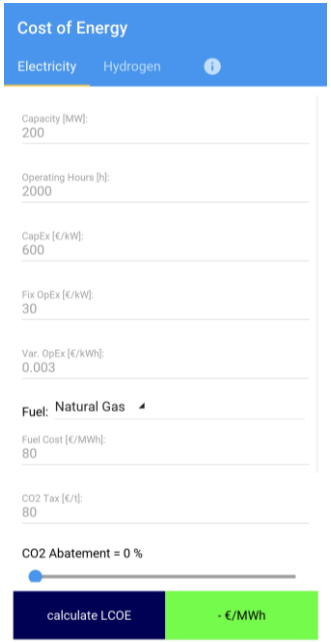
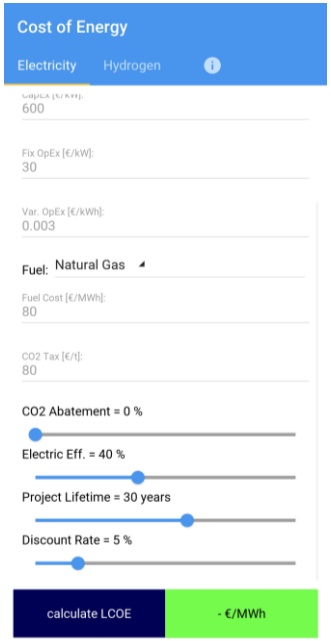
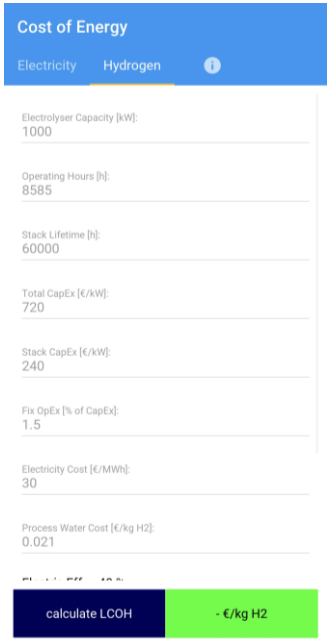
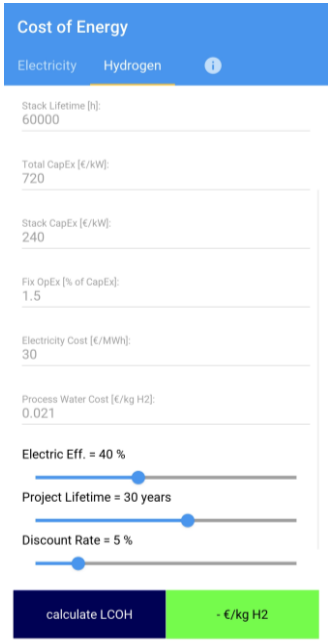
Respond to changing market conditions

- The YEC (led by Antonio Escamilla) released an Android app for calculating LCOE and LCOH









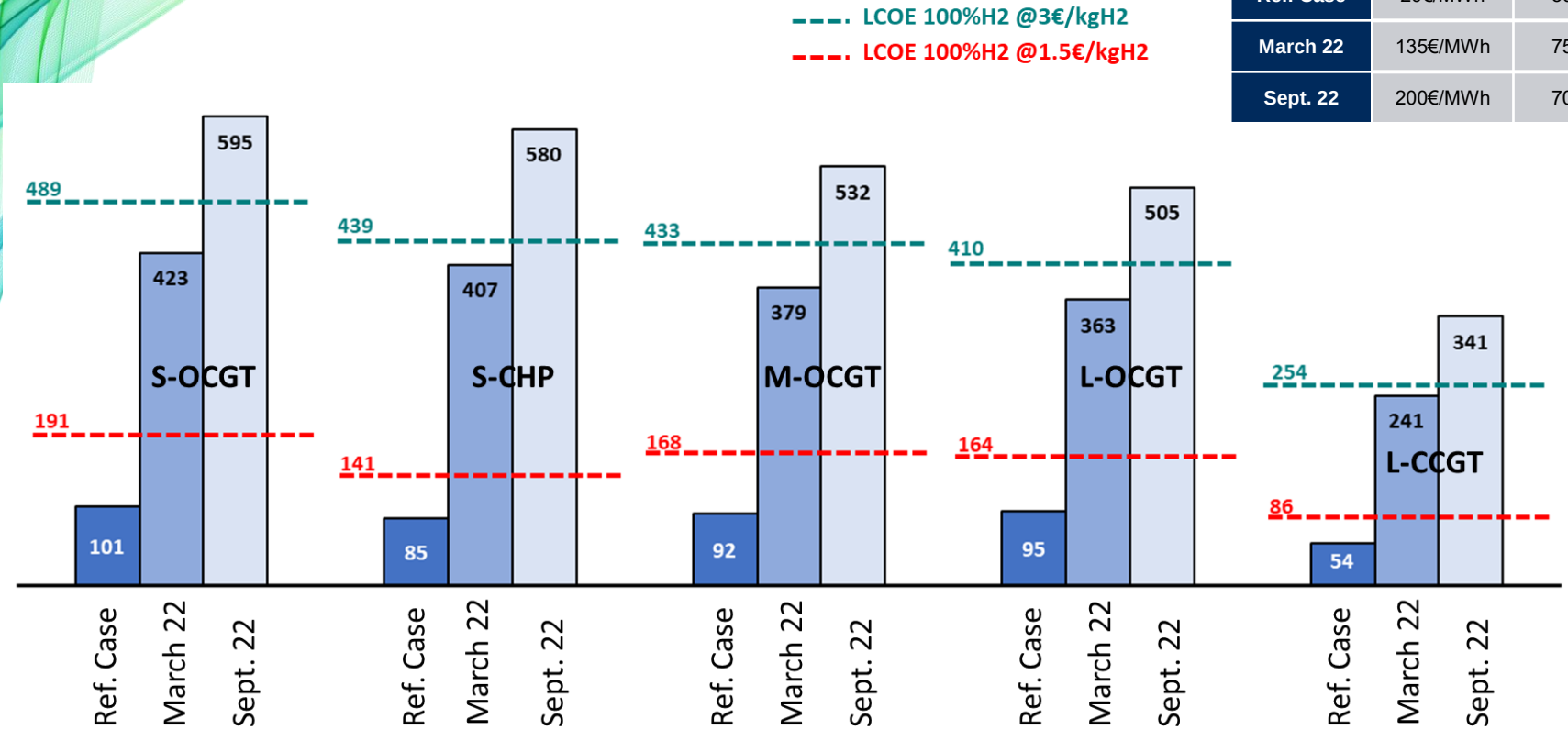
And finally…

- “Thank you!” to study co-authors and supporters:
  - Daria Bellotti, Serena Gabriele, Lorenzo Pilotti, Alessandro Castelli, Alireza Kalantari
  - ETN Hydrogen Working Group

Questions?

LCOE of 100% Hydrogen GTs vs 100%NG GTs

	Natural gas cost	CO_2 price
Ref. Case	20€/MWh	50€/ton
March 22	135€/MWh	75€/ton
Sept. 22	200€/MWh	70€/ton



Case study update – Small OCGT

- 20 MW output
- 36.5% efficiency
- Increase in natural gas and carbon price reduces the hydrogen cost (diagonal) required to achieve LCOE parity with unabated natural gas.
- For example:
  - NG = 200 €/MWh
  - CO_2 = 100 €/ton
  - H_2 < 7 €/kg to justify use