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SYSTEMIQ

ACHIEVING THE POTENTIAL FOR ELECTROTHERMAL ENERGY STORAGE

AN ACTION PLAN FOR SPAIN

Country-specific memo to

CATALYSING THE GLOBAL OPPORTUNITY FOR ELECTROTHERMAL ENERGY STORAGE: PROMISING NEW TECHNOLOGIES FOR BUILDING LOW-CARBON, COMPETITIVE AND RESILIENT ENERGY SYSTEMS

With the support of Breakthrough Energy

ETES IS A PROMISING ENABLER OF NET-ZERO INDUSTRY IN SPAIN

Electrifying industrial heat is critical for decarbonisation and can increase energy security. ETES is a new, commercially available technologies to electrify heat in industry and other sectors.

To reach net-zero greenhouse gas (GHG) emissions by 2050, the Spanish energy system will see mass electrification in all sectors. Integration and balancing of large volumes of variable renewable energy will be required for the target of ~81% renewable electricity by 2030.[1]

ETES is a promising new technology for building low-carbon, competitive and resilient energy systems in Spain

WHAT IS ELECTROTHERMAL ENERGY STORAGE (ETES)?

ETES are technologies to electrify (industrial) heat. The asset can convert electricity into heat at chosen times, such as when the electricity price is low. The heat can be stored for days in the asset and can be discharged to provide continuous heat, for example, to use in industrial processes.

ETES is available at commercial scale through 40+ technology providers. Models that are commercially available today can reach up to 400°C, with higher temperatures in development.

ETES is currently the only technology for electrification of heat that can store energy. Other technologies that electrify heat – heat pumps, electric boilers and electric furnaces – do not have integrated energy storage.

BENEFITS OF ETES FOR THE SPANISH ECONOMY

INCREASED ENERGY INDEPENDENCE

Large-scale adoption of ETES could help reduce the equivalent of up to 50% of Spanish gas usage today, which translates to a reduction of 38 million tonnes CO_2e or 18% of Spanish energy-related GHG emissions. ETES could also help key sectors like food and beverage, pulp and paper, chemicals and cement avoid price fluctuations.

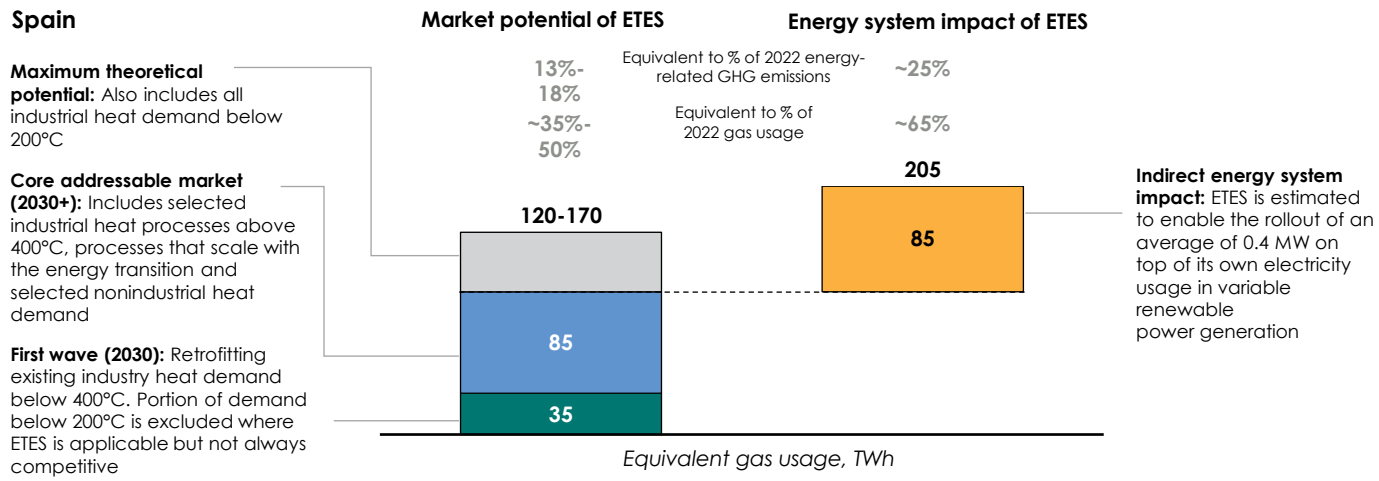
LOWER GRID INVESTMENTS

Peak electricity demand can be up to ~12% lower if industrial heat electrifies with storage. This reduces the grid capacity expansion required compared to electrification without storage. Installation of the ETES technologies on Spanish industrial sites could add up to ~4 GW of off-peak electricity demand to the Spanish energy system by 2030.

COST-EFFECTIVE AND FLEXIBLE INDUSTRY HEAT DEMAND

ETES is the most efficient technology today for storing zero-carbon energy for heat usage. It is also a relatively low investment compared with equivalent systems. Other technologies to electrify heat require additional storage (such as batteries) to align with variable renewable energy. These have lower energy storage efficiency (~80%) and 0.3–4 times higher capital costs by 2040.[2]

So far 1 GW[3] of ETES projects have been built or taken to final investment decision in Spain. This is despite Spain being a region where ETES is already financially competitive with gas boilers. This may be because ETES is an emerging commercial technology and less well known compared with other decarbonisation of industry technologies and long grid connection queues. **Targeted changes can make ETES more attractive and accessible, and support the piloting and advancement of lower technology readiness level ETES technologies.**



Please see Figure 5 of the main report or the Technical Appendix for full details on assumptions and sources

1: Spain draft NECP revision 2023; 2: *Driving to Net Zero Industry*, LDES Council; 3: Database of the European energy storage technologies and facilities

CRITICAL ENABLERS
to accelerate ETES uptake in Spain

Enabler in place | Enabler in progress | Enabler not in place

AFFORDABILITY

- **Grid costs charging structure** reflects congestion alleviation and off-peak utilisation benefits of flexible demand
- **Electricity market design** gives right signals to incentive flexible assets to come into the system
- ETES can participate in **balancing mechanism, capacity markets** and **ancillary market services**
- ETES is eligible for **net-zero subsidies** supporting heating and energy storage technologies
- Customers can use **private wires** to directly connect renewables sites with industrial sites, eliminating grid charges

ATTRACTIVENESS

- Industrial users are **familiar with thermal storage** technology and applications
- **Public procurement** requirements are in place for products with low embedded carbon
- Industrial users have the access and capability to **optimise in the wholesale price market**

ACCESSIBILITY

- Companies are readily **able to connect and access grid** capacity required
- Companies are able to deploy **private wires** between renewables generation and industrial sites

ACTIONS NEEDED
by stakeholders in Spain

POLICYMAKERS AND REGULATORS

Launch storage-specific tenders for Spain to hit target of 22 GW by 2030. Both the UK and Italy have specific storage tenders with either a capacity renumeration or grant. Capacity auctions have not proven successful for procuring long-duration storage.

Amend the subsidy requirement to consume 75% of colocated renewable power into a requirement for green power purchase agreements to widen applicability to ETES projects.

Introduce regulatory sandbox for small-scale pilots and introduce grants and guarantees for first-of-a-kind commercial projects for nascent ETES technologies at lower technology readiness level.

Include decarbonisation of industrial heat explicitly in Spain decarbonisation targets with electrification of industrial heat processes and associated fossil fuel reduction/GHG emissions reductions as a key metric.

Amend transmission grid connection auctions to ensure right level of priority is given to flexible demand in the new grid connection auctions. New auction does not currently cover ETES, which is defined as demand.

GRID OPERATORS

Reform the grid tariff structure to reduce charges in P4/P5 periods to align incentives with consumption of peak solar power production.

Simplify long and complex processes for industrial customers to upgrade grid capacity that will be needed as industry electrifies.

INDUSTRIAL END USERS

Assess market appetite, and if possible introduce green premium price products to help fund the cost gap between ETES and boilers. There is increasing demand from sectors across the board for Scope 2 and Scope 3 decarbonisation.

Execute business case comparisons for a cost-effective electrification plan for sites. Applicable industries of food and beverage, chemicals, pulp and paper and cement can invest the time to work with technology companies to assess whether ETES would be a cost-effective solution for electrifying processes.

Collaborate with technology companies and other value chain stakeholders to rapidly improve technology towards commercial deployment.

TECHNOLOGY PROVIDERS

Identify and focus commercial activities and product design on locations and sectors where ETES technologies are competitive today. This will sustain technology providers whilst technology continues to mature and market conditions improve further.

Work with policymakers, grid operators and industry to raise awareness of ETES applications and benefits and to drive forward the implementation. This is especially important because there will be a much wider variety of applications in the future.

Establish relationships with grid operators and utilities to provide a turnkey solution for customers that removes the complexity of permitting, grid connection and charging pattern optimisation.

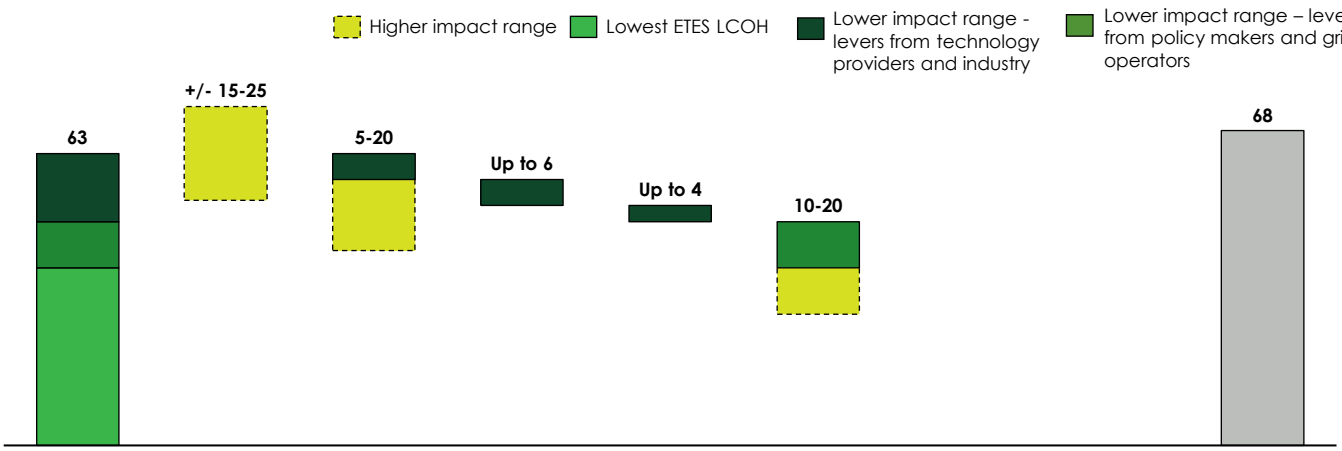
LEVERS TO CLOSE THE ETES AFFORDABILITY GAP

The immediate use case of ETES is anticipated to be replacement of industrial gas boilers in the food and beverage, pulp and papers and chemicals sectors. To serve this market, ETES technologies need to achieve cost parity with gas boilers, and this is already the case in Spain. However, there is potential for ETES to be even more competitive. The figure below illustrates the levers to further reduce ETES LCOH by 2030, an important moment because ETES assets being considered now will be operational before 2030.

Almost all levers can be actioned now by the relevant parties, except the technology progression (which requires production scale).

It is important that technology providers, industrial end users, policymakers and grid operators act now to realise the impact of these levers. If all levers materialise, **ETES will be even more competitive in Spain.**

Levers to improve affordability in Spain, levelised cost of heat (LCOH) in EUR/MWh thermal 2030



Parties involved	**Market participants**	**Industry, tech providers**	**Tech providers**	**Industry**	**Regulators, grid operators**	**Regulators, grid operators**	**Policymakers and regulators**
Examples	•Change in power purchasing agreement cost •Change in wholesale power prices •Change in discount for off-peak power	•Optimised charging •On-site power supply •Gas boiler as backup •Combined heat and power setup	•Further capital expenditure reductions	•Green premium •Other environmental opportunity costs	•Payment for services to balance electricity grid *(discounted at 50% for market risk)*	•N/A	•N/A

Please note that the LCOH for a specific case can be different from the generic numbers represented in this graph. See the Technical Appendix for details on the assumptions.

Sources: Technology provider interviews, P2H Cost Calculator (2022) - Agora, IRENA Remap 2030, TNO Technology fact sheet (2015), Thermal Energy Storage (2023) - RTC, Industrial Thermal Batteries (2023) - LDES, Prospects for LDES in Germany (2022) – Aurora, expert interviews, TSO And DSO websites; Capturing the green-premium value from sustainable materials (McKinsey, 2022); Scaling textile recycling in Europe–turning waste into value (McKinsey, 2022); The Promising Effect of a Green Food Label in the New Online Market (Jiang Y, Wang HH, Jin S, Delgado MS, 2019); Historical gas TTF futures and day-ahead spot market power (investing.com); ERCOT; Thermal Batteries: Opportunities To Accelerate Decarbonization of Industrial Heat (Renewable Thermal Collective, 2023)

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