FEBRUARY 2024

SYSTEMIQ

ACHIEVING THE POTENTIAL FOR ELECTROTHERMAL ENERGY STORAGE

AN ACTION PLAN FOR FRANCE

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 FRANCE

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

To reach net-zero greenhouse gas (GHG) emissions by 2050, the French 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 an additional ~50 GW of variable renewable generation by 2030. [1]

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

WHAT IS ELECTROTHERMAL ENERGY STORAGE (ETES)?

ETES technologies 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 FRENCH ECONOMY

INCREASED ENERGY INDEPENDENCE

Large-scale adoption of ETES could help reduce the equivalent of up to 50% of French gas usage today, which translates to a reduction of up to 49 million tonnes CO_2e or 17% of French energy-related GHG emissions. ETES could also help key sectors like food and beverage, chemicals and cement avoid exposure to global gas price fluctuations.

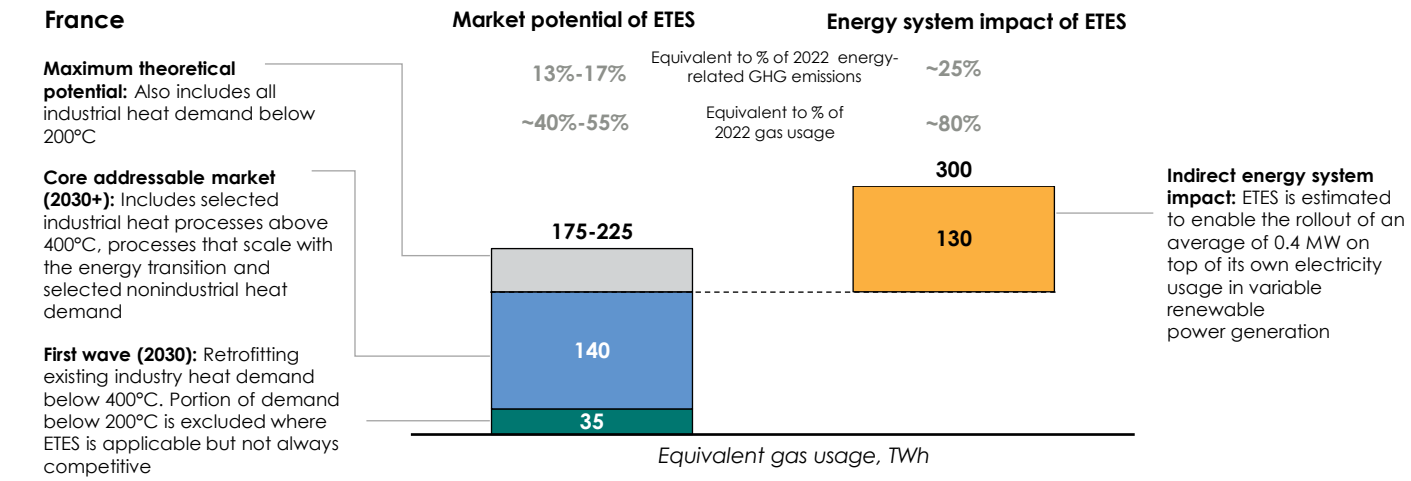
LOWER GRID INVESTMENTS

Peak electricity demand can be up to ~8% lower if industrial heat electrifies with storage. This reduces the grid capacity expansion required compared to electrification without storage. Installation of ETES technologies at French industrial sites could add up to 4 GW of off-peak electricity demand to the French energy system by 2030.

COST-EFFECTIVE AND FLEXIBLE INDUSTRY HEAT DEMAND

ETES are the most efficient technologies today for storing zero-carbon energy for heat usage. They are 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 only 21 MW[3] of ETES projects have been built or taken to final investment decision in France. ETES is an emerging commercial technology and less well known compared with other decarbonisation of industry technologies. As with other energy storage, existing policies, regulations and energy market design can unintentionally disincentivise uptake. **Targeted changes can make ETES more affordable 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: CLEW France fact sheet; 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 France

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
- ETES is **eligible for net-zero subsidies that support** heating and energy storage technologies
- Customers can use **private wires** to directly connect renewables sites with industrial sites, eliminating grid charges
- **Electricity market design** gives the right signals to incentivise flexible assets to come into the system
- ETES can participate in **balancing mechanism, capacity markets** and **ancillary market services**

ATTRACTIVENESS

- **Public procurement** requirements are in place for industrial products with low embedded carbon
- **Industrial users are familiar** with thermal storage technology and applications
- 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** as needed between renewables generation and industrial sites

ACTIONS NEEDED
by stakeholders in France

POLICYMAKERS AND REGULATORS

- **Amend new ARENH nuclear tariff to incentivise flexible industrial loads and demand,** e.g., lower price for interruptible supply compared to baseload.
- **Ensure that support for ETES technology investments is on a similar level** with wind turbines, solar panels, heat pumps, electric batteries and low-carbon hydrogen generation.
- **Consider increasing current gas tax** to help close the gap between gas and power costs and grid fees.
- **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.
- **Amend private wire regulatory requirements in line with the Clean Energy for all Europeans Package, which requires** there should be no disproportionate procedures and costs on such direct wires.
- **Continue ensuring that sustainability criteria are adopted across public procurement policy in line with** the National Plan for Sustainable Purchases, perhaps by considering sustainability criteria adoption as mandatory.

GRID OPERATORS

- **Amend grid fees structure to incentivise more off-peak/flexible consumption compared to baseload** by (1) increasing the differential between super peak and high-season peak/off-peak fees and (2) amending the grid discount rates that currently disincentivise concentrating consumption in off-peak periods versus baseload.
- **Continue piloting and scaling up demand-side response market trials** to enable future demand side response auctions from industrial sites.
- **Reassess connection backlog and develop prioritisation scheme for zero carbon power and flexible demand** to enable industrial customers to connect in a reasonable time. Connection queues can be up to eight years.

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 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 turnkey solutions for customers** that removes the complexity of permitting, grid connection and charging pattern optimisation.

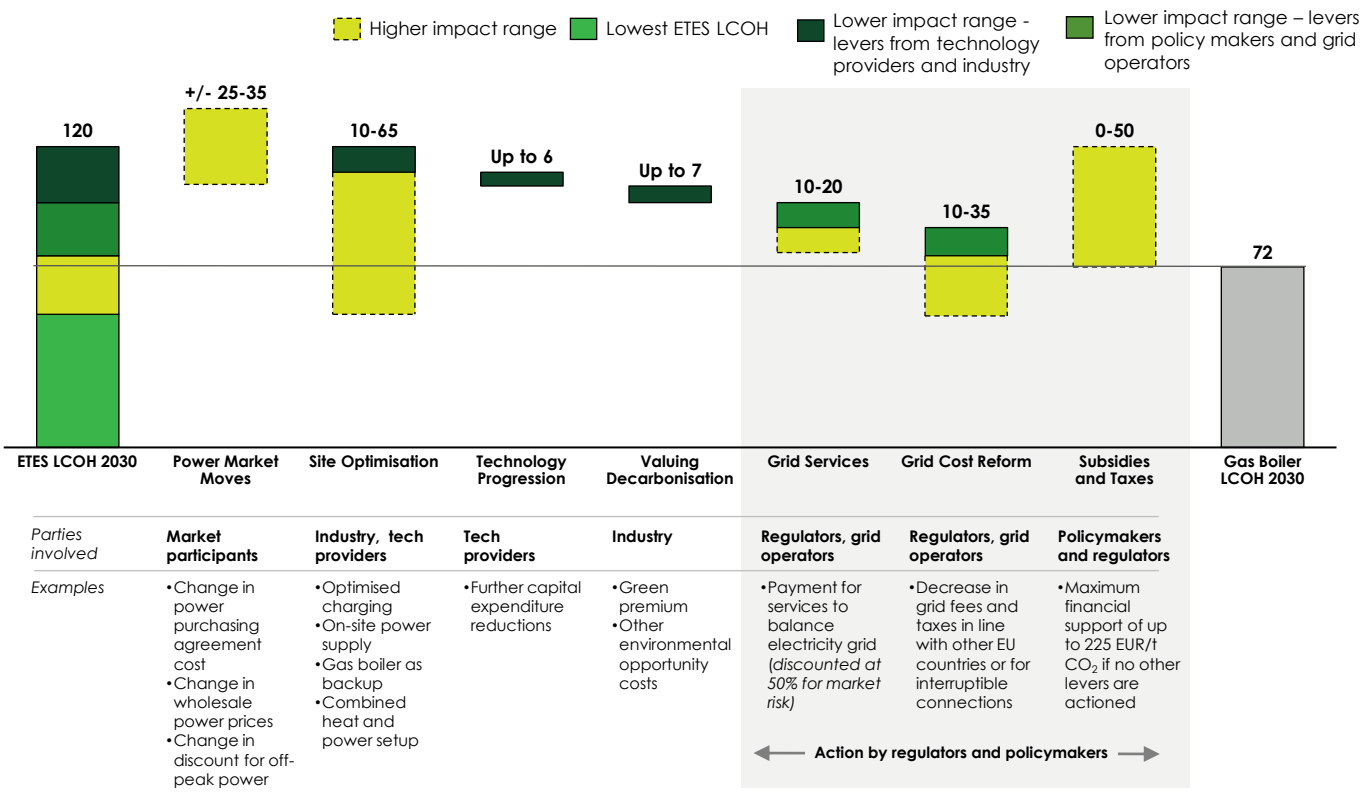
LEVERS TO CLOSE THE ETES AFFORDABILITY GAP

The immediate use case of ETES is anticipated to be replacement of industrial gas boilers in the food and beverage, chemicals and cement sectors. To serve this market, ETES technologies need to achieve cost parity with gas boilers. The Figure below illustrates the levers to close the affordability gap 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). In the absence of all other levers, a moderate subsidy of at most ~50 EUR/MWh thermal (~225 EUR/t CO_2) will be required for ETES to reach cost parity with gas boilers.

It is important that technology providers, industrial end users, policymakers and grid operators act now to realise the impact these levers. If all levers materialise, **the affordability gap in France can be closed without subsidies.**

Levers to bridge the affordability gap in France, levelised cost of heat (LCOH) in EUR/MWh thermal 2030



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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