FEBRUARY 2024

SYSTEMIQ

ACHIEVING THE POTENTIAL FOR ELECTROTHERMAL ENERGY STORAGE

AN ACTION PLAN FOR THE NETHERLANDS

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 THE NETHERLANDS

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 Dutch 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 ~100% clean electricity by 2035.[1]

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

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 DUTCH ECONOMY

INCREASED ENERGY INDEPENDENCE

Large-scale adoption of ETES could help reduce the equivalent of up to 30% of Dutch gas usage today, which translates to a reduction of up to 23 million tonnes CO_2e or 17% of Dutch energy-related GHG emissions. ETES could also help key sectors like food and beverage and chemicals avoid exposure to global gas price fluctuations.

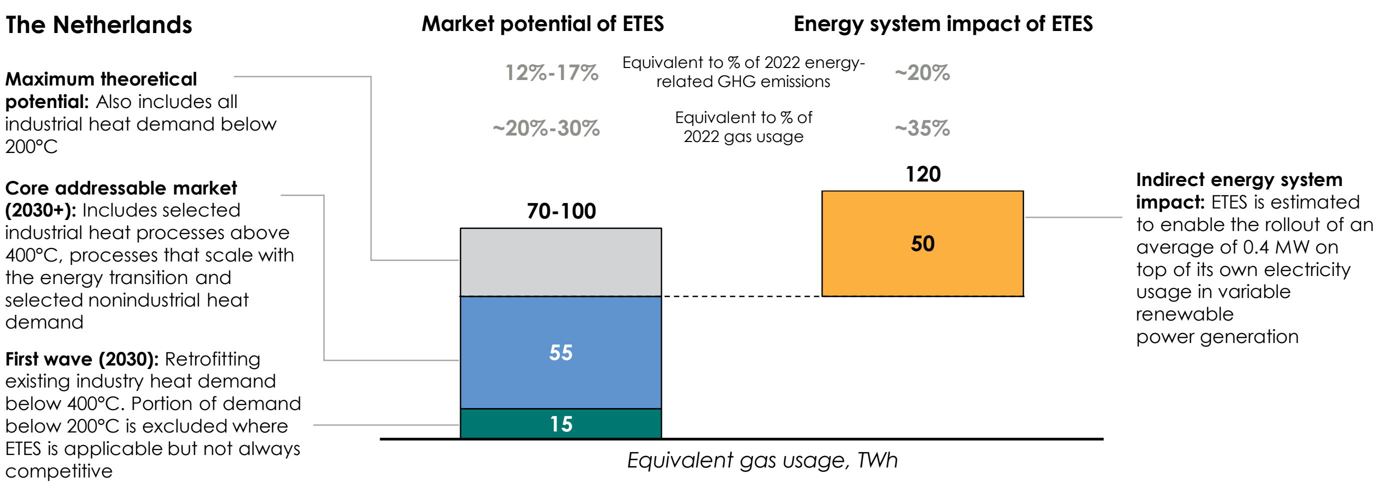
LOWER GRID INVESTMENTS

Peak electricity demand can be up to ~30% lower if industrial heat electrifies with storage. This reduces the grid capacity expansion required compared to electrification without storage. Installation of ETES technology at Dutch industrial sites could add up to 2 GW of off-peak electricity demand to the Dutch 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 25 MW[3] of ETES projects have been built or taken to final investment decision in the Netherlands. 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 commercially available 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: Netherlands draft NECP revision 2023; 2: *Driving to Net Zero Industry*, LDES Council; 3: Reuters

CRITICAL ENABLERS
to accelerate ETES uptake in the Netherlands

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

AFFORDABILITY

- ETES is eligible for **net-zero subsidies** supporting heating and energy storage technologies
- **Grid costs charging structure** reflects congestion alleviation and off-peak utilisation benefits of flexible demand
- **Electricity market design** gives right signals to incentivise flexible assets to come into the system
- ETES can participate in **balancing mechanism, capacity markets** and **ancillary market services**
- 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 the Netherlands

POLICYMAKERS AND REGULATORS

Add dedicated SDE++ subsidy for ETES. Adjust subsidies for ETES capital costs. This is justified by benefits of ETES (charging flexibility and full decarbonisation compared to common setup of 40% use electric boilers)

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.

Reform volume-based tax per energy carrier to avoid the disincentive of higher energy taxes for industrials switching unintentionally switching consumption bands when electrifying processes.

Acknowledge energy storage systems as distinct (non-end user) for grid charges, aligning with EU Regulation 2019/943 and EU Directive 2019/944.

Include decarbonisation of heat as a critical goal on relevant websites (Dashboard Klimaatbeleid), include thermal energy storage in publications (Klimaatnota, Klimaat- en energieverkenning, Nationaal Programma Verduurzaming Industrie) and in net-zero discussions.

GRID OPERATORS

Approve the proposal for Non-Firm Transport Agreement, which has a 50% grid fee discount for a grid connection that is used only 85% of the time.

Accelerate all grid connection timelines. The Dutch government has several plans (increased investments, accelerated permitting) for this. Longer term, investment in grid workforce may be required.

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 pulp and paper 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.

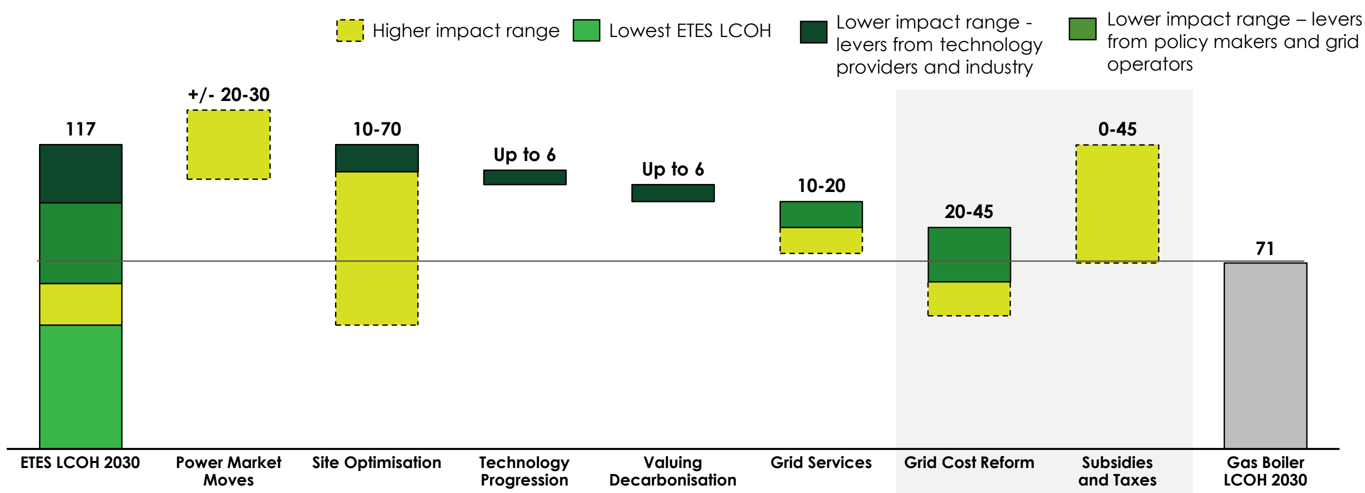
LEVERS TO CLOSE THE ETES AFFORDABILITY GAP

The immediate use case of ETES is anticipated to be replacement of industrial gas boilers in the food and beverage and chemicals 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 ~45 EUR/MWh thermal (~215 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 of these levers. If all levers materialise, **the affordability gap in the Netherlands can be closed without subsidies.**

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



	Power Market Moves	Site Optimisation	Technology Progression	Valuing Decarbonisation	Grid Services	Grid Cost Reform	Subsidies and Taxes
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)*	• Further decrease in grid fees and taxes in line with other EU countries	• Maximum financial support of up to 215 EUR/t CO_2 if no other levers are actioned

← **Action by regulators and policymakers** →

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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