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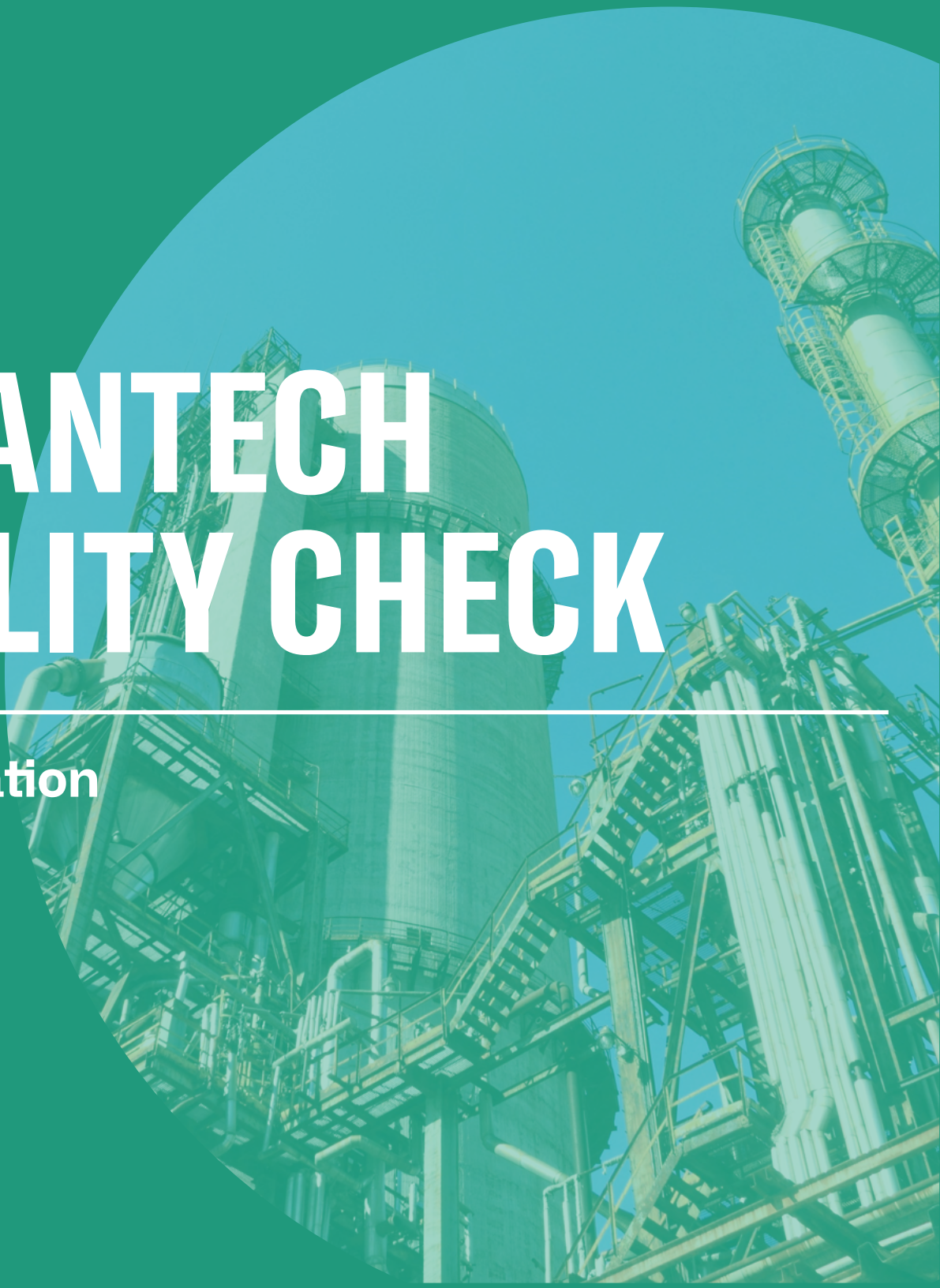
CLEANTECH REALITY CHECK

Electrification



CLEANTECH REALITY CHECK

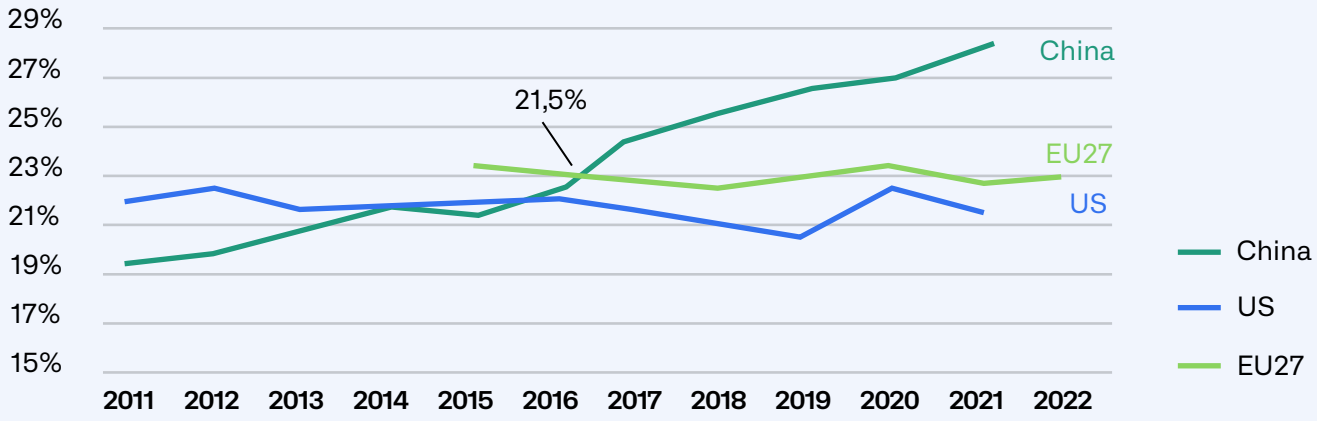
THE ELECTRIFICATION MIRAGE FOR EUROPE?

EUROPE NEEDS A JOLT OF ELECTRICITY DEMAND IF IT WANTS THE CLEAN INDUSTRIAL DEAL TO SUCCEED

By **Ann Mettler,** Vice President - Europe and **Julia Reinaud**, Senior Director - Europe, **Breakthrough Energy**

- Europe routinely speaks about 'electrification' as if it is happening. But data tells a different story: demand is flat – and has been for years. In other words: the much-touted electrification revolution in Europe is (so far) failing to materialise.
- Despite ambitious rhetoric and policy initiatives, the stark reality is that Europe is not rising to the occasion and does not currently have the speed and scale required to meet its targets and is nowhere near China's electrification drive. This is yet another example of a divide between assumptions and on-the-ground realities.
- This disconnect has very serious spillover effects: with so little additional demand for electric-based technologies and long queues to connect to the electricity system, there isn't the necessary boost to provide the abundant and affordable clean electrons that industry needs to decarbonise.
- And manufacturing sectors are hurting, too. Despite our supposedly ambitious clean energy transition and renewable targets, our home-grown wind sector is on its knees. Yet another indicator that we need to stress-test the presumably inevitable trajectory towards electrification.
- At the root of this issue is a disjointed policy plan: while going all in on renewables for years, there has only very recently been an accompanying strategy for energy storage and grid modernisation. This is an essential piece of the puzzle because as we all know the sun doesn't always shine and the wind doesn't always blow. The seeming inability to think of – and build towards – a modern energy **system** means that storage and grids are now lagging far behind. Moreover, the rollout of renewables has been uneven with much faster deployment of solar, de-coupled from wind.
- It will be imperative that the EU's (existing) Grid Action Plan and (forthcoming) Electrification Strategy provide an honest stock-take that includes a more holistic approach. They need to connect the dots between a volatile energy system, squeezed industry, and the clean technology enablers that can provide solutions to both – such as Long Duration Energy Storage to absorb and use these clean electrons at all times, and Thermal Energy Storage to electrify Industrial Heat as flexible demand.
- The bottom line is that much of Europe's approach simply doesn't add up and therefore calls for an urgent reality check.

Electrification rate by country



Source: Eurelectric's Power Barometer (2024) based on IEA's Country Energy Profile (2024)

The Cleantech Reality Check is published jointly by Breakthrough Energy and Cleantech for Europe, with analytical support provided by Systemiq.

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THE ELECTRIFICATION MIRAGE FOR EUROPE?

- Electricity demand across the continent has remained stubbornly flat at 22% of final energy demand since 2010, a significant deviation from the EU's renewable energy goals, which target a 37-40% electrification rate by 2030.
- This Cleantech Reality Check highlights three pivotal technologies with the potential to drive electrification across the continent: Long Duration Energy Storage (LDES), industrial heat electrification, and grids extension and modernisation. By examining the progress and challenges associated with these technologies, it reveals that without immediate, coordinated action to accelerate offtake and deployment, Europe's clean energy transition and its broader climate goals are at significant risk.

OFF-TRACK — **ON-TRACK**

	LONG DURATION ENERGY STORAGE	INDUSTRIAL HEAT ELECTRIFICATION	GRID INFRASTRUCTURE
	LDES technologies store and convert energy for longer time periods (8+ hours). LDES becomes critical in regions with >50% of variable renewable electricity sources in their electricity mix, to ensure a reliable electricity supply. Several countries in the EU have reached or are close to reaching this threshold. - Electrochemical (power-to-power): e.g., flow battery, metal air - Mechanical (power-to-power): Pumped-Hydro Storage PH or other less traditional technologies such as compressed or liquid air - Thermal (power-to-heat): heat storage e.g., molten salt or heat storage bricks - Chemical (power-to-x): Storage of e.g., hydrogen or ammonia before they are used as fuel or chemical feedstock Thermal LDES presents advantages: simplicity of technology (compared to PHS that are harder to build), near-term cost competitiveness vs. fossil-based heat, especially in regions with lower renewables cost or curtailed renewable energy.	Industry represents 10-15% of EU final energy demand (1,800 TWh). Industrial heat is categorised into three ranges of temperature : low (<100°C) at 15-25% of demand, medium (100-400°C) at 30-40%, high (>400°C) at 45-55%. For low-temperature range, industrial heat pumps and thermal energy storage (Power-to-Heat) and e-boilers are the preferred solution, with heat pumps offering the highest efficiency. Medium temperature heat range is currently not feasible for heat pumps. Therefore, it will need to rely on other technology such as Thermal Energy Storage. High temperature heat electrification solutions are process-specific (e.g., electric furnaces) and still nascent, therefore shifting the near-term focus on <400°C range.	Grids connect power generators to power consumers via high-voltage transmission lines, substations, and distribution systems. They play a crucial part in a net-zero economy where electricity is likely to supply up to 70% of final energy demand. Two complementary type of actions are required for grids: buildouts, which can take up to 10 years of development in Europe; and modernisation of existing assets, representing an opportunity to deploy new technologies to enhance existing grid framework in a shorter timeframe. All in all, the grid system requires significant action to not only meet EU's climate goals, but also powering Europe's energy system and maintain stability with increasing variable renewables in the grid.
Required in place or pace by 2030 Breakdown of requirement	**~130 GW** **Pumped-Hydro Storage:** ~65 GW **Novel LDES technology:** ~65 GW *Novel LDES includes Thermal, Chemical, or Electrochemical (non-Li-ion) Energy Storage*	**~425 TWh** **Low range (<100°C):**): ~175 TWh **Med range (100-400°C):** ~200 TWh	Distribution **17M km** **250k km/year** of buildout pace to reach target Transmission **0.8M km** **10k km/year** of buildout pace to reach target
Progress	**0.8 GW of novel LDES** is operational today **3.7 GW of novel LDES** under development	**50-100 TWh** in low-to-medium range	**Current build out pace [required increase]** **80k km/yr** [x3] **0.5k km/yr** [x200]
What is working well	• Power market reform gives signals for energy storage development • Flexibility assessments methodology finalisation • Countries starting LDES auctions	• Successful use cases for some deployed projects • Power market designs going in right direction • Access to wholesale prices with renewable electricity source	• Highly reliable and functional grid • Leading European grid cable manufacturing supply • Increased policy awareness of importance of grid
What is not working well	• Lack of clear revenue model for LDES • Lack of targets and action plan on flexibility and storage • Lack of level playing field with other technologies	• Lack of financing options and fiscal incentives • Issues of technology awareness and scalability • Unsupportive grid connection processes and fees	• Lack of forward-looking planning and legislated targets • Lack of financing structures and incentive schemes for innovation and infrastructure development • Permitting and compliance processes resulting in backlog and limited pace of expansion • Cable industry is under pressure and fully booked production lines

Notes: All sources for data points are provided in the three sectoral briefs for Series 2.

CLEANTECH REALITY CHECK

THE ELECTRIFICATION MIRAGE FOR EUROPE?

ARE THE ENABLING CONDITIONS FOR RAPID SCALE UP IN PLACE?

- In place and sufficient
- In place and insufficient
- Missing
- No applicable

DEMAND ENVIRONMENT ENCOURAGES EARLY OFFTAKE

- Legislated targets set an ambitious horizon for technology adoption
- Sufficient coordination between relevant sectors and government bodies
- Permitting and approval processes matching pace of required uptake

SUPPLY ENVIRONMENT ENABLES ECONOMIES OF SCALE

- Revenue mechanisms aligned with uptake of required solutions
- Subsidies and incentives targeted to de-risk innovation
- Initiation of demand via government-backed market mechanism

MARKET IS FACILITATED AND COORDINATED

- Technology awareness across key stakeholders
- Technology and/or enabling infrastructure are mature
- Pace of innovation adoption meets sectoral needs

ACTION AGENDA

Key actions and interventions areas to develop the EU electrification system

	LONG-DURATION ENERGY STORAGE	INDUSTRIAL HEAT ELECTRIFICATION	GRID INFRASTRUCTURE
1	• Develop storage targets and action plan, including LDES targets in Nationally Determined Contributions (NDCs) and National Energy & Climate Plans (NECPs)	• Increase awareness of technology, to decrease perceived risk and enable access to funds	• Implement an integral strategic vision and targets for coordinated EU network buildout and modernisation
2	• Provide incentive mechanism that is aligned with positive externalities to improve business case	• Provide supportive ecosystem for novel technologies, starting from sectoral mandates up to novel technology inclusion	• Reform investment paradigm and financing structures to stimulate investment in a future-proof grid
3	• Introduce innovative financing facilities and structures focused on project de-risking for novel LDES technologies	• Introduce de-risking mechanisms for novel technologies, focused on demand-side (industry)	• Address slow permitting and approvals that limits pace of capacity expansion
4	• Introduce a fit for purpose power grid regulation to streamline solicitation process and adjust fees accordingly	• Provide clarity on prices and taxes related to fossil fuels moving forward	• Provide financial incentives to de-risk and speed up adoption of new technologies by system operators