September 2026

Solid oxide fuel cells

Enabling growth in a power-constrained world

centrica

ceres

Disclaimer

This paper is published jointly by Ceres Power Limited ("**Ceres**") and Centrica plc ("**Centrica**") for general information purposes only. It does not constitute investment, legal, regulatory or other professional advice, and should not be relied upon as such. The paper includes statements of opinion and forward-looking statements which are subject to change and may differ materially from actual outcomes. Information has been drawn from a range of publicly available and third-party sources; while Ceres and Centrica have each taken reasonable care in preparing this paper, no representation or warranty (express or implied) is given as to the accuracy or completeness of any information contained in it. To the fullest extent permitted by law, neither Ceres nor Centrica accepts liability for any loss arising from reliance on this paper.

This report was co-authored by Joe Fay.

Contents

FOREWORDS →

Chris O'Shea
Chief Executive Officer, Centrica

The UK faces a real challenge in keeping pace with rising energy demand while ensuring that power remains affordable and low-carbon. A shifting geopolitical landscape has driven up energy prices and delays in grid connections have held back investment at a time when our economy needs it most.

The gap between the electricity we need and the grid capacity available is widening and neither government nor industry can close it alone. To meet growing demand, we need power solutions that can be deployed quickly, operate independently of the grid, and still help accelerate our path to net zero.

Fuel cells can play a vital role here. They are an important component of a resilient, balanced energy system – one that can support the UK's ambitions for clean, secure, domestically produced power. This technology can help us build new energy capacity across a wide range of sectors, from data centres and hospitals to advanced manufacturing. It gives organisations reliable, low-carbon power on-site, delivered at speed.

> Ceres' fuel cell technology represents a meaningful opportunity to address pressing power needs and plug gaps in our existing infrastructure.

Alongside nuclear, battery storage, wind, solar and other technologies, fuel cells can help modernise the UK's energy system and strengthen our long-term security. Investing in solutions like this helps ensure we have a stable, homegrown supply of energy – critical to protecting national interests and supporting British industry.

Ceres' fuel cell technology represents a meaningful opportunity to address pressing power needs and plug gaps in our existing infrastructure. They also offer the chance to deepen UK partnerships and invest in local communities and skills. As we work to meet growing demand and maintain the country's energy security, clean, dependable, and locally produced power will become ever more important.

Phil Caldwell
Chief Executive Officer, Ceres

As electricity demand continues to grow, power is becoming a prerequisite for growth. Access to reliable, sustainable power now shapes investment decisions, industrial competitiveness and economic development. It can determine what gets built, how quickly projects progress, and where capital is deployed. For many industries, the question is no longer when power will be available, but whether it can be secured at all.

This "time-to-power" challenge is what first brought Ceres and Centrica together. While our businesses operate in different parts of the energy system, we reached the same conclusion: the relationship between power and growth is changing, and organisations need new ways to secure the energy certainty that investment and progress now depend on.

This joint paper sets out the role that solid oxide fuel cells play in addressing this challenge. Fuel cells provide reliable, modular and scalable on-site power generation, helping organisations move forward despite growing constraints on grid delivery.

The most forward-thinking companies are acting now. While others wait, industry leaders are turning to fuel cells to secure quicker access to power, enabling growth, reducing risk and gaining a decisive competitive edge.

> While others wait, industry leaders are turning to fuel cells to secure quicker access to power, enabling growth, reducing risk and gaining a decisive competitive edge.

Executive summary

Electricity has become a binding constraint on economic growth. In the UK and across most advanced economies, demand for firm, high-quality power is rising faster than transmission and distribution networks can be reinforced. Ageing infrastructure, congested substations, extended connection queues and deteriorating power quality are lengthening project delivery timelines and eroding investor confidence. The problem is no longer whether sufficient electricity exists in aggregate; it is whether dependable power can be delivered to a specific site on a timescale that matches investment, commissioning and operational requirements.

This delivery gap is a barrier to growth. It shows up most acutely in sectors with large, continuous, quality sensitive loads such as hyperscale and artificial intelligence (AI) data centres, advanced manufacturing, semiconductor fabrication, hospitals, electrified industry, and critical national infrastructure, but its economic footprint is broader. Where sites cannot be commissioned on commercial timelines, capital is redirected, jobs are relocated and productivity growth is deferred.

Long-term grid reinforcement and continued investment in renewables and nuclear remain essential to a decarbonising, electrifying economy. However, none of these completely solve power-quality and reliability needs, nor the near-term time-to-power problem. Programmes measured in years to decades cannot underwrite investment decisions that must be closed in months. Behind-the-meter generation, sited close to load and independent of the connection queue, is emerging as the mechanism through which growth can proceed while system level infrastructure catches up.

Solid oxide fuel cell (SOFC) technology is uniquely suited to this role. SOFCs are high-temperature electrochemical devices that oxidise a fuel (typically natural gas, biogas or hydrogen) to produce electricity directly. Since the electrochemical process does not involve combustion, SOFCs can achieve electrical efficiencies of approximately 60 to 65% LHV (Lower Heating Value) on natural gas, rising to over 90% efficiency in some cases where waste heat is recovered. Because they generate stable, high voltage direct current (DC) in modular units, they align with the electrical architecture of modern data centres and industrial loads without the mechanical, noise and emissions penalties of rotating combustion machinery.

The strategic value of solid oxide is not confined to the near-term. The same electrochemical platform can be reversed to function as a solid oxide electrolysis cell (SOEC) to produce hydrogen, integrated with high temperature heat sources such as advanced modular reactors, coupled to carbon capture using its concentrated CO_2 stream, and configured as part of hybrid systems with renewables and batteries. This creates genuine optionality: an asset closing the delivery gap today, while expanding its role alongside the decarbonised energy system that follows.

Execution capability matters as much as the technology. The Ceres and Centrica collaboration links a scalable, steel-supported stack platform and a licensed global manufacturing base with UK energy supply, project delivery and long-term operation and maintenance. This is the combination required to move solid oxide from bespoke installation to infrastructure grade deployment.

The implication for decision makers is direct. Where growth is being constrained by grid delivery, SOFCs offer a technically credible, commercially deployable and strategically durable route to firm power at the point of use. It is a no regrets asset in an environment where regret over stranded time is now the dominant cost.

> Where growth is being constrained by grid delivery, SOFCs offer a technically credible, commercially deployable and strategically durable route to firm power at the point of use.

1: Power as a delivery constraint

1.1. The demand curve has shifted

Global electricity demand is rising because the economy is electrifying. Transport, heat, industry, digital infrastructure and, most recently, AI compute are all growing and converting from fuel-based to electron-based operation. The IEA (International Energy Agency) identifies a structural shift: global electricity demand is growing much faster than overall energy demand and is now expected to outpace global economic growth through 2030.[1,2]

Much of this growth is concentrated in loads that require dependable, high-quality power on shorter timescales than incumbent infrastructure can deliver. CBRE Investment Management projects global data centre supply to expand from approximately 76 GW in 2026 to 182 GW by 2030, a compound growth rate that the grid was not planned to accommodate. They also estimate that global power demand from AI workloads alone will rise from around 14 GW in 2025 to over 120 GW by 2030, with inference (rather than training) accounting for most of the increment.[3]

Electricty demand (thousand TWh)

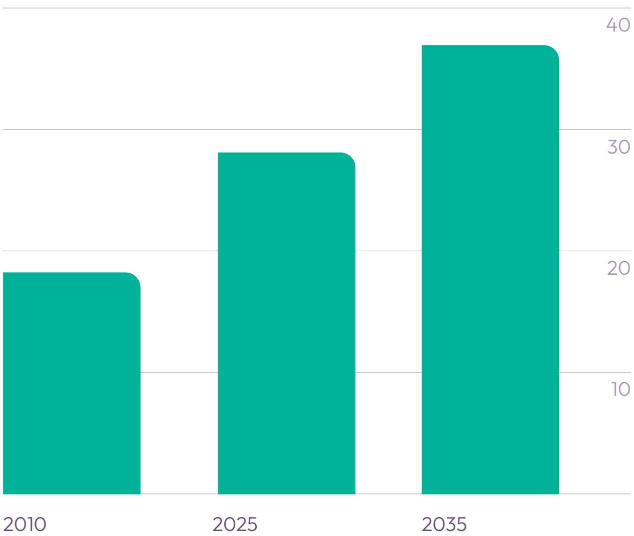


Figure 1: Global historical and forecast electricity demand (2010–2035). The 2035 value is projected based on the Stated Policies Scenario (STEPS). Source: Created using raw datasets from the IEA World Energy Outlook 2025 and the IEA Electricity Mid-Year Update 2026.

The grid cannot keep pace with this profile. In the UK, some transmission connection offers now sit in queues extending to 2035 and beyond, with multi-year wait times reported for large connections in the most constrained zones.[4] The National Energy System Operator (NESO) and Ofgem have both acknowledged that queue management is the immediate binding constraint.[5]

The economic consequence is measurable. Ofgem has reported that grid delays are deferring projects, raising delivered cost of capital and, in some cases, causing project cancellation. Individual data centre developments have quoted delivery cost increases of up to 200% where capital remains locked up awaiting energisation.[6] This is a growth story turned into a queue story, and the queue is now long enough to be a barrier to national economic growth.

Government has begun to respond. The UK is prioritising strategic connections and removing so called "zombie" projects from the queue to make room for data centres, AI Growth Zones, electric vehicle charging hubs and industrial sites.[7] These reforms are necessary but not sufficient. Reprioritising a queue does not create additional grid capacity; it reallocates scarcity.

Beyond volume, the quality of grid power is deteriorating in ways that matter for the most electrically demanding loads. As electricity systems incorporate higher shares of renewable generation, maintaining grid stability becomes more complex, making the system more sensitive to disruption. The 2025 Iberian blackout underlined the fragility of highly interconnected, low inertia systems which are less able to absorb sudden shocks to the network: the loss of a limited number of generation assets triggered a cascade of generation disconnections across a substantial fraction of the peninsula before controllable resources could arrest the frequency excursion.[8,9] For operators of critical loads, the practical implication is that grid electricity is becoming a less deterministic input than it was a decade ago.

Power demand (GW)

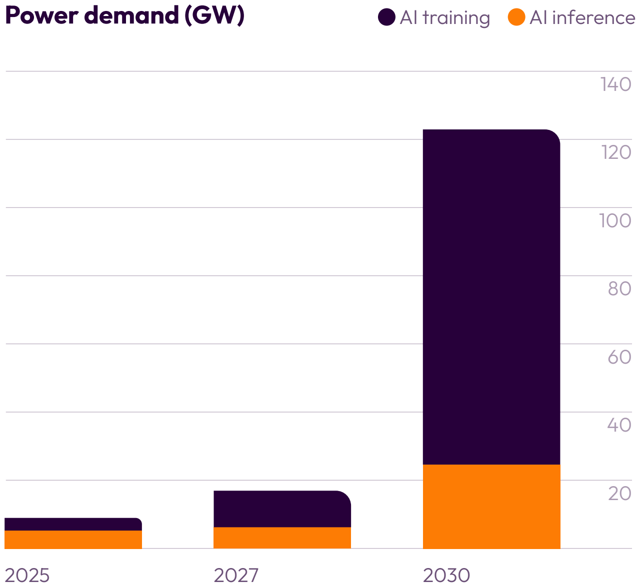


Figure 2: Global power demand for AI training vs. AI inference, gigawatts (GW). Source: Adapted from Global Commercial Real Estate Services Investment Management.[3] Original data from RBC Imagine, 2026 Generative AI Update (January 2026); AI inference vs. training estimates based on Structure Research (November 2025).

Taken together, these signals point to a structural, not cyclical, shift. Electricity demand is outgrowing the scale, pace and, in places, the reliability of the traditional grid-only response. The cost of that shift is falling on developers, operators and end users.

> System level investment operates on timescales incompatible with the delivery cadence of the loads currently driving economic growth. This is the gap that behind-the-meter generation exists to close.

1.2. Why system transition does not resolve near-term delivery risk

The pipeline of low-carbon build is real. Renewables have overtaken coal globally on an installed capacity basis. Nuclear output is at its highest recorded level. Both trends are expected to continue and remain indispensable.[1] Neither addresses the near-term problem this paper is concerned with.

Renewables

Wind and solar are variable resources, and their output can often fall short of the load profiles of industrial and digital consumers. Their integration requires substantial additional investment in grid reinforcement, system stability measures, excess generation management and long duration storage. Even where generation capacity is nominally sufficient, renewable output is not always available when and where demand occurs, meaning that additional firm capacity, or a firm capacity equivalent (storage plus flexibility), is required to maintain security of supply at high electrification levels. New renewables infrastructure can also be slowed by planning constraints and local opposition, particularly when developments materially affect land use or visual impact.

Nuclear

Large light water reactors, today's dominant nuclear technology globally, deliver firm zero carbon baseload but on 10-to-15-year project timescales.[10,11] Small modular reactors (SMRs) and advanced modular reactors (AMRs), including the high temperature gas cooled reactors of most relevance to industrial heat and hydrogen, will not deliver first electrons at scale in the UK until the early to mid-2030s.[12] In Ireland, the country's 27-year ban remains in force and legislative reform is unresolved.[13] While nuclear is a compelling long horizon answer; it is not the solution for a data centre that needs to be commissioned in 2027.

This does not diminish the importance of system-level investment. Rather, it is that system level investment operates on timescales incompatible with the delivery cadence of the loads currently driving economic growth. This is the gap that behind-the-meter generation exists to close.

2: Moving behind-the-meter

Energy users are responding rationally. Rather than waiting on a queue whose cost of delay can exceed the cost of on-site generation, they are installing dependable capacity close to load. In Ireland, this has been codified: EirGrid's connection policy now requires new large data centres to provide their own generation and storage as a condition of connection. In the UK, government reform of connections is proceeding in parallel with a growing appetite among developers to underwrite delivery certainty through on-site power.[14]

Historically, behind-the-meter generation was contingency infrastructure. Diesel gensets and standby combined heat and power (CHP) plants were designed to cover short outages of a reliable grid. The change is that it is becoming primary infrastructure, sized for continuous operation, engineered for high availability and increasingly financed as a strategic asset rather than a compliance overhead. Analysts expect sustained growth in on-site generation through the coming decade, with a rising share provided by gas fired and fuel cell capacity.[15]

Legacy behind-the-meter technologies have limits. Combustion turbines in the 30 to 400 MW class are subject to long original engine manufacturer (OEM) lead times, currently up to seven years for large sizes, and face permitting friction on emissions, noise and cooling water. Reciprocating gas engines are more available but can be constrained by NO_x, particulate matter and noise in populated locations. Neither map cleanly to the operating profile of modern digital loads, which combine high load factor with sensitivity to voltage transients and harmonics.

The market is therefore looking for an on-site power technology that is:

- Deployable in months rather than years.
- Modular and scalable at the site level.
- Able to deliver high-quality, high availability power.
- Compatible with a decarbonising fuel and heat system over the asset life.

Solid oxide fuel cells satisfy all four criteria.

Minimum–maximum grid connection wait times (years)

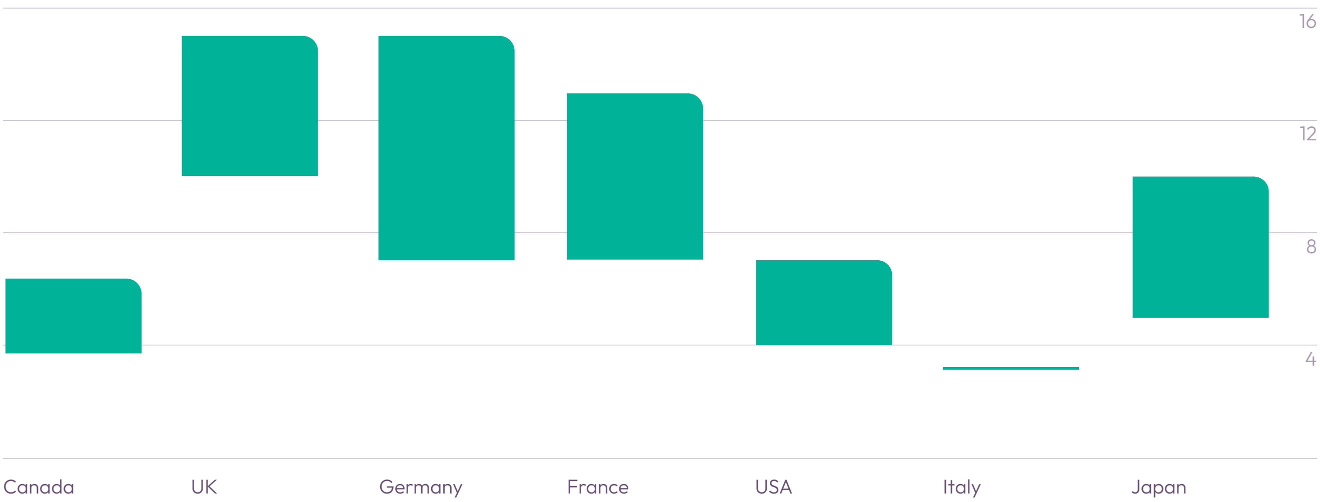


Figure 3: Typical minimum and maximum grid connection timelines for new data centre developments across G7 countries.[16-25]

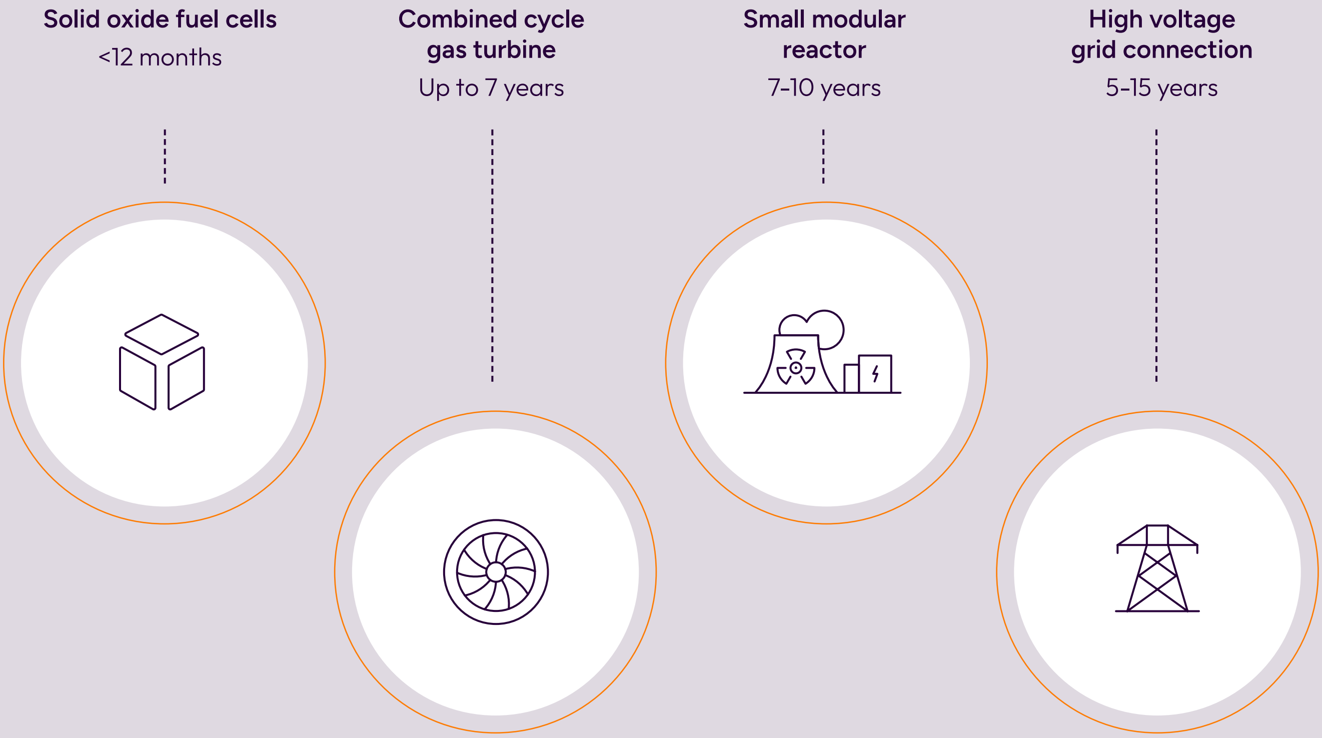


Figure 4: Time-to-power comparison across selected power generation solutions. Deployment timelines are estimated and based on publicly available industry sources.[26-28]

As behind-the-meter generation moves from contingency to primary infrastructure, the specification tightens. The pressures described in Section 1 translate into a defined set of engineering and commercial requirements that any credible on-site power technology must meet:

1. Modularity and scalability

Load growth is rarely linear. Data centre halls are commissioned in stages, industrial expansions are phased against demand, and hospital campuses grow by wing. A modular architecture allows capacity to be added in increments matched to demand, avoiding early over build and preserving the option to expand or contract as customer requirements evolve. Modularity also reshapes redundancy (the provision of back-up capacity). Instead of full duplication of entire systems (referred to as “2N”), operators can achieve equivalent availability with incremental overcapacity by adding one additional component (referred to as “N+1”), taking individual modules offline for maintenance without loss of service. This supports capital efficiency and utilisation.

2. Deployment speed and predictability

The economic case for on-site power collapses if the on-site solution replicates the timeline of the grid connection it is meant to substitute for. Factory manufacture, standardised balance of plant, pre-engineered enclosures and repeatable planning submissions all matter. So does supply chain depth: a technology that can be manufactured in multiple facilities across multiple geographies is more delivery robust than one concentrated in a single line.

3. Power quality and operational reliability

Modern IT and process loads are intolerant of voltage sags, frequency excursions, harmonics and momentary interruptions. A power source that meets nameplate capacity but fails on power quality is not fit for purpose. This is why the industry has migrated towards tiered availability standards, with Tier IV data centres targeting 99.995% uptime (approximately 26 minutes of permitted downtime per year).

4. Responsiveness and load-following

Real loads are not constant. Compute loads fluctuate with workload allocation, cooling loads follow ambient conditions and industrial processes ramp with production. On-site power must load follow while preserving efficiency and life. The technology's operating envelope (minimum stable load, ramp rate, cycling tolerance) is a critical specification.

5. Future optionality and system compatibility

Assets financed on 15-to-20-year horizons must remain economic across the same window. This favours technologies that can accept multiple fuels (natural gas today, hydrogen or biomethane later), integrate with heat recovery and carbon capture, and interoperate with future generations of grid architecture and system services.

6. Cost transparency and capital efficiency

Users increasingly prefer service-based delivery through Energy as a Service (EaaS) or Power Purchase Agreements (PPAs), rather than on balance sheet capital expenditure. According to the IEA, many regions, including Europe and the US, saw wholesale electricity prices rise year on year in 2025.[29] The UK is a particularly acute example, with electricity prices significantly higher than competing markets. (see Figure 5). Predictable unit costs, transparent operating and maintenance profiles, and clear allocation of fuel and market risk are decisive to bankability.

Electricity price (p/kWh)

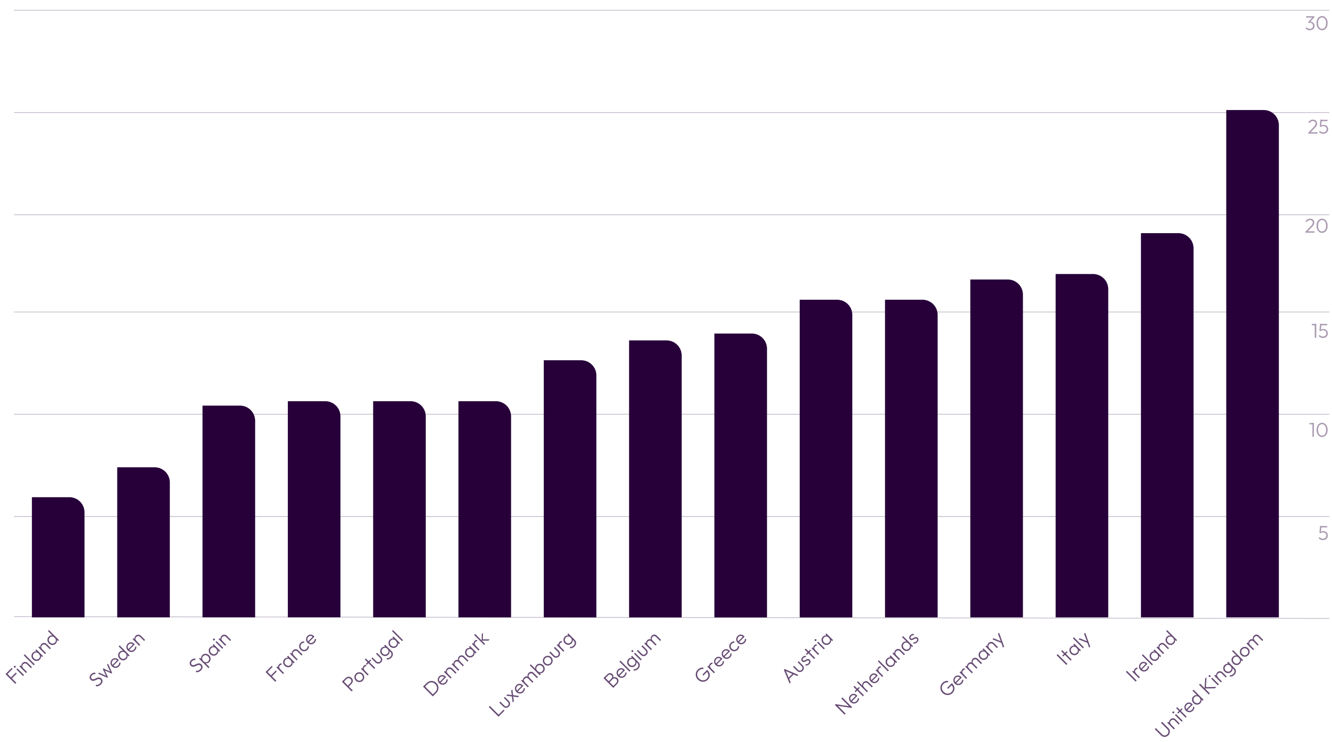


Figure 5: Comparison of non-domestic electricity prices for medium consumers in the UK and EU14, July to December 2025 (excluding VAT and other recoverable taxes and levies).[30]

Planning and community acceptance
Local air quality, noise, water use and visual impact determine whether a project secures planning approval, and how quickly. Technologies with lower local impact profiles clear planning faster and encounter less community opposition, a hard-won lesson from recent large gas turbine deployments in the US.

Figure 6 sets out sector specific requirement patterns. These are indicative and must be validated site by site, but they illustrate the direction in which the market is moving: away from a single specification (installed MW) and toward a multi-dimensional specification in which reliability, quality, flexibility and lifecycle compatibility carry equal weight with headline capacity.

Data centres

- Ultra-high reliability: capable of achieving Tier IV uptime (99.995%).
- Modular redundancy (N+1 preferred over full duplication where feasible).
- High-voltage for high power and sensitive IT equipment.
- Rapid response to step changes in computing and cooling loads.
- Integration with cooling systems and power conditioning infrastructure.
- Capability for grid independence and site-level resilience (including islanding and black start).
- Integration with grid and other on-site generation and storage technologies.

Hospitals

- Life-critical reliability with zero tolerance for interruption.
- Tiered resilience architecture (instantaneous UPS (Uninterruptible Power Supply) with sustained on-site generation).
- High power quality to protect medical equipment.
- Segregation and prioritisation of critical and non-critical loads.
- Compliance with healthcare infrastructure standards and testing requirements.
- Continuous operation during maintenance and system testing.

Commercial

- High availability aligned to business continuity requirements.
- Configurable redundancy based on operational risk.
- Modularity to support phased occupancy and demand growth.
- Integration with on-site renewables, storage and EV charging infrastructure.
- Adaptability to changing load profiles and building use.
- Compliance with emission requirements and consideration of applicable carbon pricing mechanisms and regulatory requirements.

Industrial

- Continuous, high-capacity power for energy-intensive operations.
- High load density and dynamic load handling, including rapid ramp-up and ramp-down.
- High power quality (including stable voltage and minimising electrical distortion that can affect sensitive equipment).
- Integration with process heat and combined heat and power (CHP) systems.
- Fuel flexibility (e.g. natural gas today with transition to low-carbon fuels).
- Minimal tolerance for downtime due to production and safety impacts.

Figure 6: An overview of select power supply needs by sector and application, with indicative requirements reflecting typical operational priorities. Requirements may vary based on-site conditions, load profile and regulatory context.

3: Solid oxide fuel cell technology and deployment

3.1. How solid oxide fuel cells work

A solid oxide fuel cell is a high temperature, solid-state electrochemical device that converts the chemical energy of a fuel directly into electricity. Unlike a combustion engine, which generates power by burning fuel, a fuel cell converts the energy through an electrochemical reaction. It is the absence of a combustion step that results in fuel cell technology having high efficiencies and a low local emissions profile.

SOFCs are distinct because they use a solid ceramic electrolyte, whereas other fuel cell technologies use liquid or polymer-based electrolytes. They are well suited to stationary applications such as data centres and industrial processes, where continuous, high-availability power is critical. Their high electrical efficiency, ability to operate at significant load and suitability for critical applications make them particularly relevant where power quality and uptime matter.

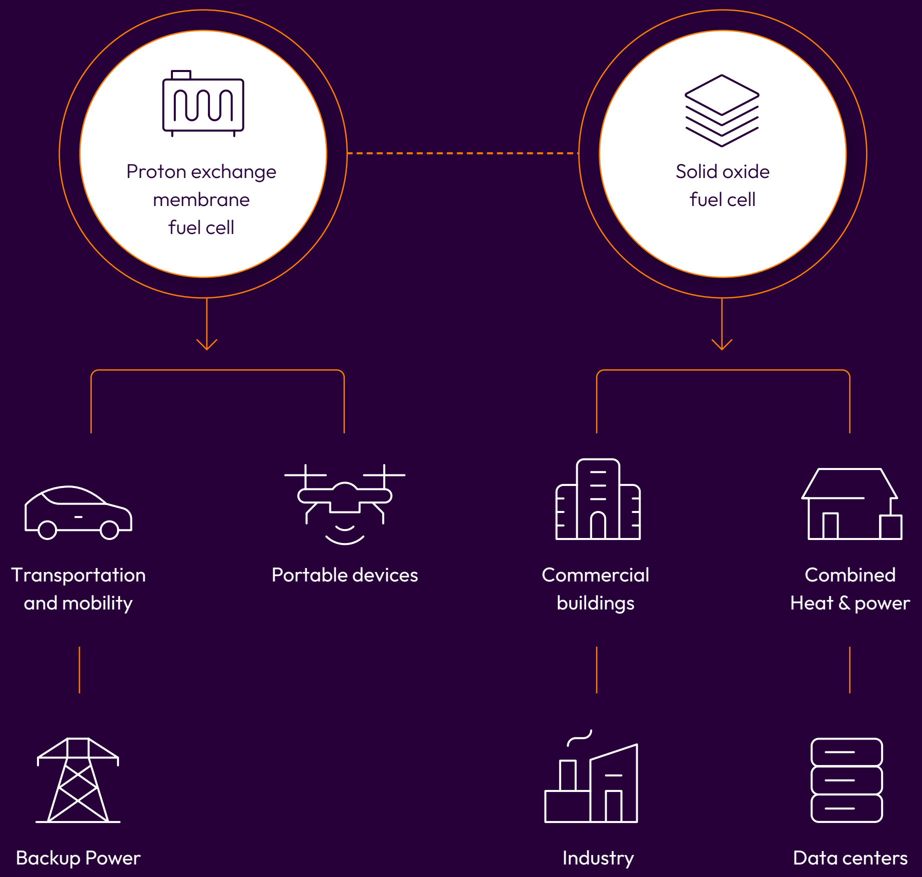


Figure 7: Example applications of major fuel cell technologies, including proton exchange membrane (PEM) and solid oxide fuel cells.

SOFCs can operate on a range of fuels, including natural gas, biomethane and hydrogen, depending on system design. In natural gas systems, methane is reformed within the cell to produce hydrogen and carbon monoxide, both of which are then electrochemically oxidised. Because this process uses heat generated within the fuel cell, it supports efficient thermal management, improves overall system efficiency and can reduce the need for a separate external reformer for separate external fuel processing.

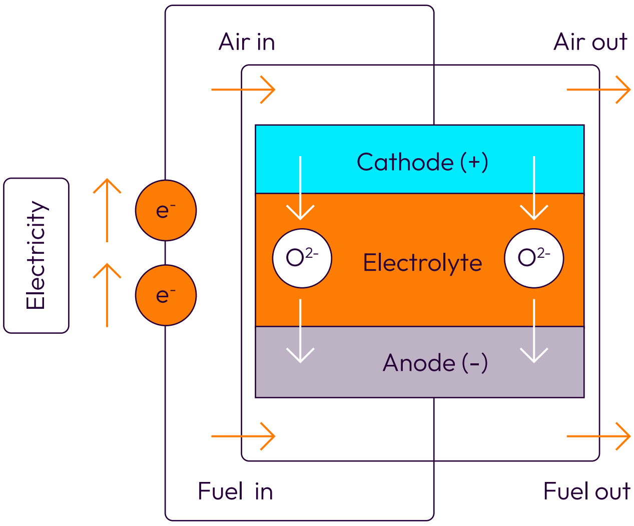


Figure 8: Simplified schematic of how a solid oxide fuel cell operates, showing the flow of fuel and air, ion transport through the electrolyte, and generation of direct current electricity.

3.2. Thermodynamics and the efficiency

Fuel cells are inherently efficient because they convert fuel directly into electricity rather than through combustion. At typical SOFC operating temperatures (approximately 700 to 850 °C for conventional solid oxide systems and 450 to 630 °C for intermediate-temperature designs), the theoretical efficiency is around 70% (LHV). Commercial SOFC systems already achieve 60 to 65% net electrical efficiency (LHV) when operating on natural gas, placing them among the most efficient power generation technologies available at this scale.[31,32]

Because SOFCs produce useful high-grade heat as a by-product, the total efficiency in combined heat and power configurations can rise to over 90%.[33] This is a fundamental thermodynamic advantage over open cycle gas turbines (typically 30 to 40% electrical efficiency, LHV) and reciprocating gas engines (typically 40 to 45%)[34], and is competitive with combined cycle gas turbines (55 to 60%)[35] but at a fraction of the installation size and without the water and emissions burden.

3.3. Materials and cell architecture

The materials used in an SOFC play a major role in determining performance and are often what can differentiate commercial platforms and their ability to scale to gigawatt volumes. SOFCs are broadly composed of four key components: the electrolyte, cathode, anode, interconnect. Each can shape factors such as operating temperature, durability and cost.

Electrolyte: The electrolyte is a dense, gas tight ceramic layer that shapes the fuel cell's operating temperature. Yttria stabilised zirconia (YSZ) has historically been the most widely used SOFC electrolyte, supporting the high operating temperatures of conventional SOFC systems.. The intermediate temperatures of next-generation SOFCs (in the range of 450 - 630°C), is enabled through the use of a ceria-doped electrolyte. This opens the use of more widely available and cost-effective materials (see Section 3.6).

Cathode: The positive electrode where oxygen from the air is converted into ions, which enables the electrochemical reaction that generates electricity. Its design is a key driver of performance and lifetime.

Anode: The electrode where fuel is converted as part of the electrochemical process. Its design influences fuel flexibility, efficiency and overall system performance.

Interconnect: This links cells electrically, and their composition is largely determined by operating temperature. At higher temperatures (above 700 °C) expensive ceramic or specialised alloys are often required. Lower-temperature operation enables the use of widely available ferritic stainless steels, similar to those used extensively in the automotive industry.

3.4. Operating characteristics that matter for on-site power

For the applications addressed in this paper, several operating characteristics matter most.

High reliability. SOFCs are designed for continuous operation and high availability, making them well suited to critical applications where power interruptions are costly or unacceptable.

Modularity. SOFC systems are built from repeatable modules that can be deployed incrementally as demand grows, supporting resilient system designs, allowing maintenance to be carried out on individual modules without disrupting overall site operation.

High electrical efficiency at part load. Unlike many combustion-based power technologies, whose efficiency falls as output decreases, SOFCs maintain exceptionally high electrical efficiency across a broad operating range.[36,37]

Direct current at compute relevant voltages. SOFCs can be engineered to produce 800 V direct current, allowing efficient integration with the power architecture of modern data centres and digital infrastructure. This can reduce the need for conversion equipment while supporting power quality and overall system efficiency.

Very low local air emissions. Since electrochemical processes do not involve combustion, SOFCs produce near zero levels of NO_x, SO_x and particulate matter, helping to minimise local air quality impacts.[38]

Low noise and vibration. With limited rotating machinery, SOFC systems operate far more quietly than conventional combustion technologies, which can hold benefits for planning and permitting (see Section 5.3).[39]

Minimal cooling water demand. Unlike many conventional power generation technologies, SOFC systems require little cooling water (and in some configurations can be net positive), helping to reduce both environmental impact and site constraints.[40]

Service life. Lifetime is an important consideration for on-site power assets as it influences operating costs, maintenance planning, site availability and the overall economics of the asset. SOFC lifetime is affected by factors such as cell architecture, materials selection and operating conditions. As a solid-state device with few moving parts, SOFC systems can also offer a relatively low and predictable maintenance profile compared with many combustion-based alternatives. SOFCs are also modular, allowing stack replacement to be incorporated into planned maintenance schedules rather than requiring major system replacement. For example, the Ceres Endura™ (see section 3.6) platform is designed with an expected stack life of around five years, giving operators a predictable maintenance cycle that can be factored into long-term asset planning.

The attributes of solid oxide technology

Power quality, reliability and resilience

- Direct current power ideal for AI data centres.
- Continuous operation.
- High reliability for sensitive applications.
- Optimised redundancy enabled by inherent modularity.
- Load following capability for variable demand.

Modular, fast deployment and scale

- Factory manufactured in repeatable units.
- Modularity support scalable capacity and phased expansion.

Flexible and built for the energy transition

- Runs on natural gas and other future fuels such as biogas, hydrogen and methanol.
- Compatible with nuclear technologies and carbon capture pathways.

Efficient and low impact

- Highly efficient: 60 to 65% electrical efficiency.
- Designed to operate with up to 90% efficiency with heat recovery and reuse.
- Very low NO_x, SO_x and particulates.
- Low noise.
- High purity water recovery.

Figure 9: Overview of key attributes of SOFC systems.

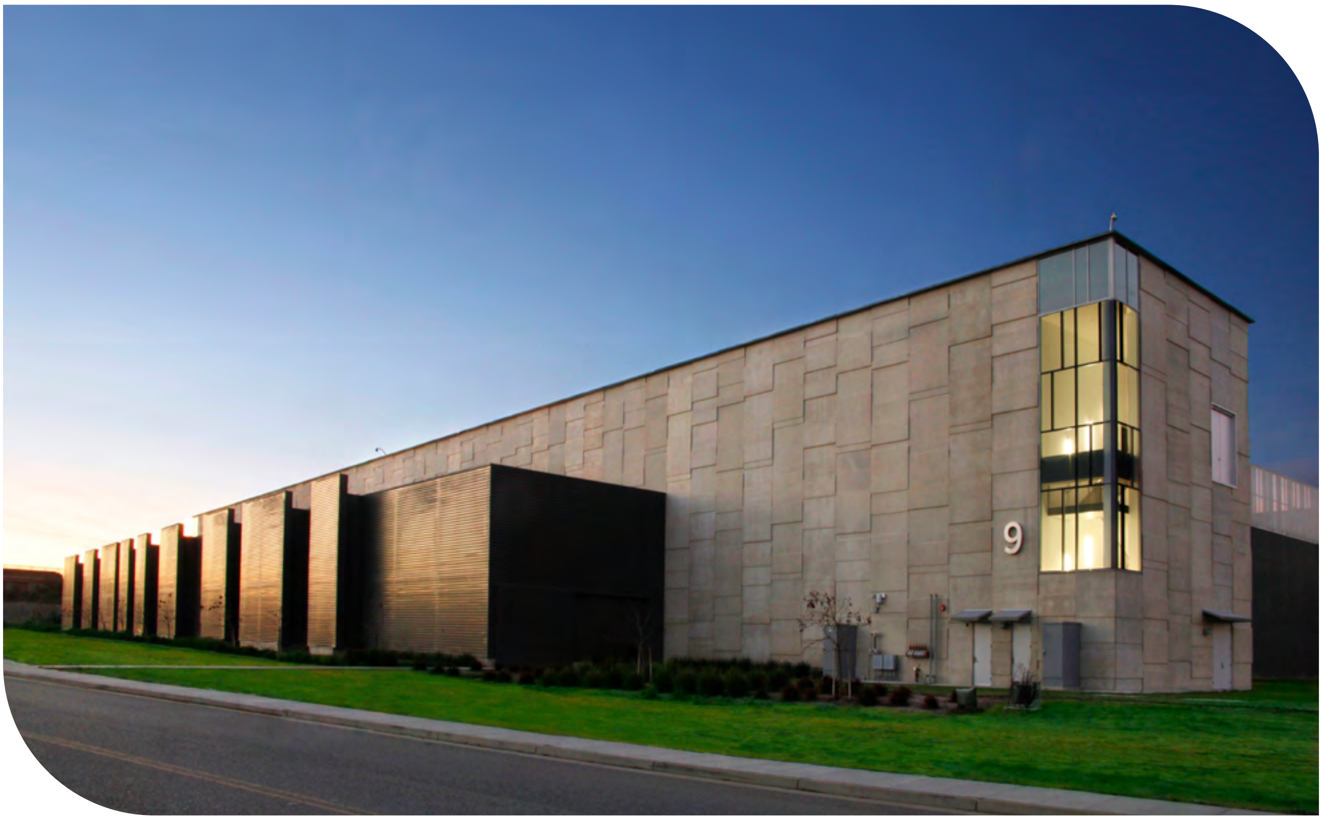
3.5. Deployment at commercial scale

The transition from bespoke installation to infrastructure scale deployment shifts the binding constraint from technical performance to manufacturing scale, supply chain depth and installation cadence. Goldman Sachs has identified manufacturing capacity as the historical rate limiter on fuel cell deployment. Solving that constraint is now a commercial and industrial exercise as much as a scientific one.[41]

> Behind-the-meter deployment of SOFCs has moved from pilot to operational infrastructure over more than a decade.

Behind-the-meter deployment of SOFCs has moved from pilot to operational infrastructure over more than a decade. Bloom Energy, a US-based manufacturer of solid oxide systems, has more than 1.5 GW of fuel cell generation deployed globally[42], with early deployments at retail and commercial sites (Stop & Shop and comparable customers[43]) and increasingly at data centre and cloud infrastructure operators (Equinix[44], CoreWeave[45]). That momentum is accelerating: In April 2026, Bloom and Oracle announced an expanded collaboration targeting up to 2.8 GW of SOFC capacity to support AI and cloud infrastructure[46]. Equinix operates SOFC capacity at its SV 5 data centre in Silicon Valley, US as behind-the-meter power. At the same time, manufacturing capacity is scaling: Doosan Fuel Cell has taken Ceres-licensed SOFC technology into mass production in South Korea with a dedicated 50 MW per year facility.[47]

Figure 10: The Equinix SV 5 data centre in Silicon Valley, US uses SOFCs for behind-the-meter power.



3.6. The Ceres Endura™ platform as an example of a scale-ready platform

Earlier generations of SOFCs are predominantly based on the ceramic supported technologies outlined above. These systems have played an important role in establishing SOFCs as a technically credible technology and enabled many of the first commercial and demonstration installations. However, some ceramic-supported designs can face challenges around robustness, handling and high-volume manufacture.

> The platform runs at the lower operating temperature window of 450 to 630 °C which enables the use of ferritic stainless steel.

Figure 11: Illustration of the Ceres Endura™ solid oxide platform, showing its role as the core stack technology used within systems for power generation and hydrogen production.

By contrast, Ceres has launched the Ceres Endura™ solid oxide platform, developed to support scalable, high-volume manufacture and deliver high-efficiency power, around 65% with natural gas.[36] Ceres Endura™ is a stack: the core power generating component within a fuel cell system that combines several of the material choices discussed above into a platform with distinctive characteristics.

- **Steel-supported cell architecture.** The platform runs at the lower operating temperature window of 450 to 630 °C which enables the use of ferritic stainless steel. The platform is over 85% steel by mass and features robust, steel-supported cell technology that significantly improves durability and reliability when compared with higher temperature, ceramic supported solid oxide architectures. This supports high volume, repeatable manufacture and improved tolerance to real-world deployment including thermal cycling and emergency stops, load changes and transient events. Steel is an abundant and recyclable material, supporting improved lifecycle performance, including end-of-life recovery and reuse.
- **Single platform technology.** Ceres Endura™ is also a flexible, dual-use platform. The same production line can be used to manufacture stacks for SOFC power generation and SOEC hydrogen production. This provides optionality, allowing manufacturing investments made today to support growth across both power and hydrogen markets.
- **Licensed manufacturing model**. The platform is paired with a licensee-based route-to-market. Partners include Delta Electronics (Taiwan)[48], Denso Corporation (Japan)[49], Weichai Power (China)[50], Thermax (India)[51] and Doosan Fuel Cell (South Korea)[52]. This global manufacturing ecosystem supports scale across multiple regions while distributing manufacturing risk.

Figure 12:Manufacturing facility of Doosan Fuel Cell Co. Ltd. in South Korea, illustrating dedicated production capacity of 50 MW per year for solid oxide fuel cell stack and systems based on Ceres technology. Image courtesy of Doosan Fuel Cell Co., Ltd.

4: Environmental and societal performance

For new power infrastructure, local impacts are not a secondary consideration. Emissions, air quality, noise and water use increasingly influence community acceptance and the ability of projects to secure planning approval.

4.1. Carbon intensity

The direct CO_2 emissions of an SOFC operating on natural gas are typically cited in the region of 300 g CO_2 per kWh, a function of the high electrical efficiency of the electrochemical reaction.[38] This compares with 350 to 500 g CO_2 per kWh for typical open cycle gas turbines[53] and in excess of 600 g CO_2 per kWh for stationary diesel generators.[54] Emissions can reduce further where waste heat is recovered for heating or cooling applications or where systems are compatible with carbon capture approaches.[55] Waste heat capture and utilisation can further reduce the carbon intensity per unit of useful energy delivered.

The forward comparison is against a decarbonising grid. UK grid carbon intensity is projected to fall below 100 g CO_2 per kWh by 2030 in central scenarios, driven by the continued build out of renewables and nuclear.[1] On a marginal basis, however, the picture is more nuanced: incremental grid demand added ahead of new low carbon capacity is typically served by combustion-based generation, which can be materially more carbon intensive than average. Behind-the-meter SOFC capacity that reduces reliance on this incremental generation could therefore be carbon neutral or positive relative to system wide average grid intensity, even before considering the transition pathways discussed in Section 6.

4.2. Local air quality

Since electrochemical processes do not involve combustion, SOFCs emit near zero levels of NO_x, SO_x and particulate matter[38], orders of magnitude below combustion alternatives, and below the thresholds that trigger the most stringent air quality restrictions in urban and suburban locations. This can be an important advantage for SOFCs in populated deployment environments.

Power source	Efficiency	Carbon intensity	Noise	NO_x, SO_x, particulate matter	Water consumption	Time-to-power
Grid	N/A	Low	Low	Low	Low	High
Open cycle gas turbine	Low	High	High	High	Low	Medium
Combined cycle gas turbine	High	Medium	High	High	High	High
Reciprocating engine	Low	High	High	High	Medium	Medium
SOFC	High	Medium	Low	Low	Negligible	Low

Table 1: Comparative assessment of selected power supply options across cost, performance, environmental impact and delivery timelines, illustrating the trade-offs that influence technology selection. The comparative assessments presented in this table draw on a combination of publicly available data, referenced industry sources and Ceres analysis where external data is limited or not directly comparable. The comparative assessment is intended to provide directional comparison and may vary depending on system configuration, application and operating conditions. [1, 31-32, 38-40, 56-70]

4.3. Noise and water

SOFCs present a lower noise profile than conventional combustion technologies, typically operating at 65 to 75 dB(A) at the enclosure boundary, comparable to normal conversation at 1 m and can be brought down to background levels with minimal noise mitigation.[69] By comparison, unmitigated open cycle gas turbines can exceed 120 dB(A)[60], comparable to a police siren passing close by. Reciprocating engines commonly reach 110 to 115 dB(A).[66] For projects near residential or commercial developments, the permitting and community acceptance implications are substantial.

Water consumption is also negligible.[39] Where water is a reaction product, some configurations recover potable quality water for site use. This differentiates SOFCs from combustion generation reliant on evaporative cooling, which is increasingly constrained by water use and wastewater discharge regulation.

Typical sound level (unsilenced), dB(A)

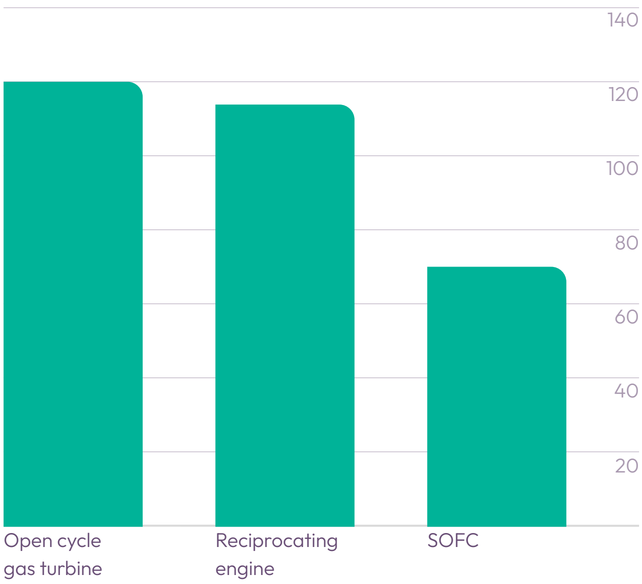


Figure 13: Combustion technologies are significantly louder than SOFC technology. Comparison of typical operational noise levels, without noise mitigation.[39, 59-60, 65-66, 69]

4.4. Waste heat recovery

SOFC systems produce high-grade waste heat which can be recovered and reused, increasing total system efficiency compared with electricity-only operation. The temperature and quality of this heat are highly dependent on system architecture and operating conditions. Applications include:

- **Absorption chilling** for data centre cooling, converting waste heat into chilled water and materially reducing electrical cooling load.
- **Process heat** for industrial customers with continuous thermal demand.
- **District heating** where local networks exist or can be developed. For example, Equinix's PA10 data centre in Paris exports waste heat to a neighbouring swimming pool and district network serving approximately 1,000 homes.[71]

As discussed in Section 3.2, effective heat recovery can increase total system efficiency from around 60 to 65% to over 90% in some cases and lowers emissions per unit of energy produced, extracting additional value from the same fuel input.[33]

> Ceres' fuel cell technology represents a meaningful opportunity to address pressing power needs and plug gaps in our existing infrastructure.

4.5. Materials and end of life

The materials used in a SOFC shape the environmental and geopolitical exposure of its supply chain. High-temperature, ceramic-based systems relying on scarce or geographically concentrated ceramic components are exposed to supply chain risk and are more difficult to recycle at end of life. Technologies such as Ceres Endura™ that are dominated by abundant, mature, well recycled materials, can ease both upstream security and downstream recovery at end-of-life.

5: Economics, permitting and operations

Beyond the technology itself, projects must be financed, permitted and integrated into real-world operating environments. These factors can be the difference between capacity being deployed quickly or not at all.

5.1. Capital, funding and delivery models

Where grid access is uncertain, some customers are funding on-site generation directly. xAI's acquisition of five 380 MW gas turbines to support US data centre expansion[72] and British Sugar's investment in on-site gas generation[73] are two visible examples. However, direct capital deployment on this scale is neither feasible nor desirable for most operators.

Eaas models can address this challenge. Under an EaaS structure, the developer or utility owns and operates the on-site power asset and sells electricity (and, where applicable, heat) to the customer under a long-term contract. The customer shifts capital expenditure into predictable operating expenditure, retains balance sheet flexibility and shares fuel, market and technology risk with a counterparty that is better able to manage it.

The Centrica and Delta Electronics partnership is an example of this model applied to SOFCs at scale .[74] Centrica brings project delivery, gas supply, network expertise, long-term operation and maintenance, and financing. Delta Electronics brings manufacturing scale to SOFC systems based on Ceres-licensed stack technology. The customer receives contracted, on-site, low local-impact power on a delivery timescale independent of the grid queue. This is the delivery model behind-the-meter power infrastructure needs to become a general-purpose growth enabler, not a bespoke engineering exercise.

5.2. Total cost of ownership

For customers procuring under an EaaS structure, the relevant metric is contracted GBP per MWh delivered energy. At current UK gas prices and grid electricity tariffs, competitively structured SOFC EaaS propositions can now offer contracted energy at or below grid tariff levels for large commercial and industrial customers, before accounting for the value of avoided delay or capital release.

Total cost of ownership (TCO) for on-site SOFC power is a function of capital cost, fuel cost, efficiency, availability, maintenance regime and residual value. As manufacturing volumes scale, unit capital costs are on a downward trajectory. Fuel cost dominates lifetime economics. When compared to combustion alternatives, the 60 to 65% electrical efficiency and over 90% total efficiency (in CHP applications)[34] SOFCs can deliver, translate into materially lower fuel bills per unit of energy. Modular stack replacement, predictive maintenance driven by continuous monitoring, and remote diagnostics can limit unplanned downtime and maintenance labour intensity.

5.3. Planning and consent

Planning is often the gate that determines whether a project delivers to schedule. UK regulations require an Environmental Impact Assessment (EIA) for major power installations above 300 MW and for electricity, steam and hot water producing installations occupying 0.5 hectares or more.[75,76] Most SOFC deployments sit comfortably below both thresholds. Site-specific factors (designated landscapes, air quality management areas, listed neighbours) remain decisive.

The lower local impact profile of SOFCs relative to combustion alternatives (Section 3.4) can materially ease permitting. In California, SOFC systems certified by the Air Resources Board can bypass local Air District Permit-to-Operate requirements; an example of regulatory frameworks catching up with the technology's real-world impact.[77] Comparable simplification could accelerate UK deployment.

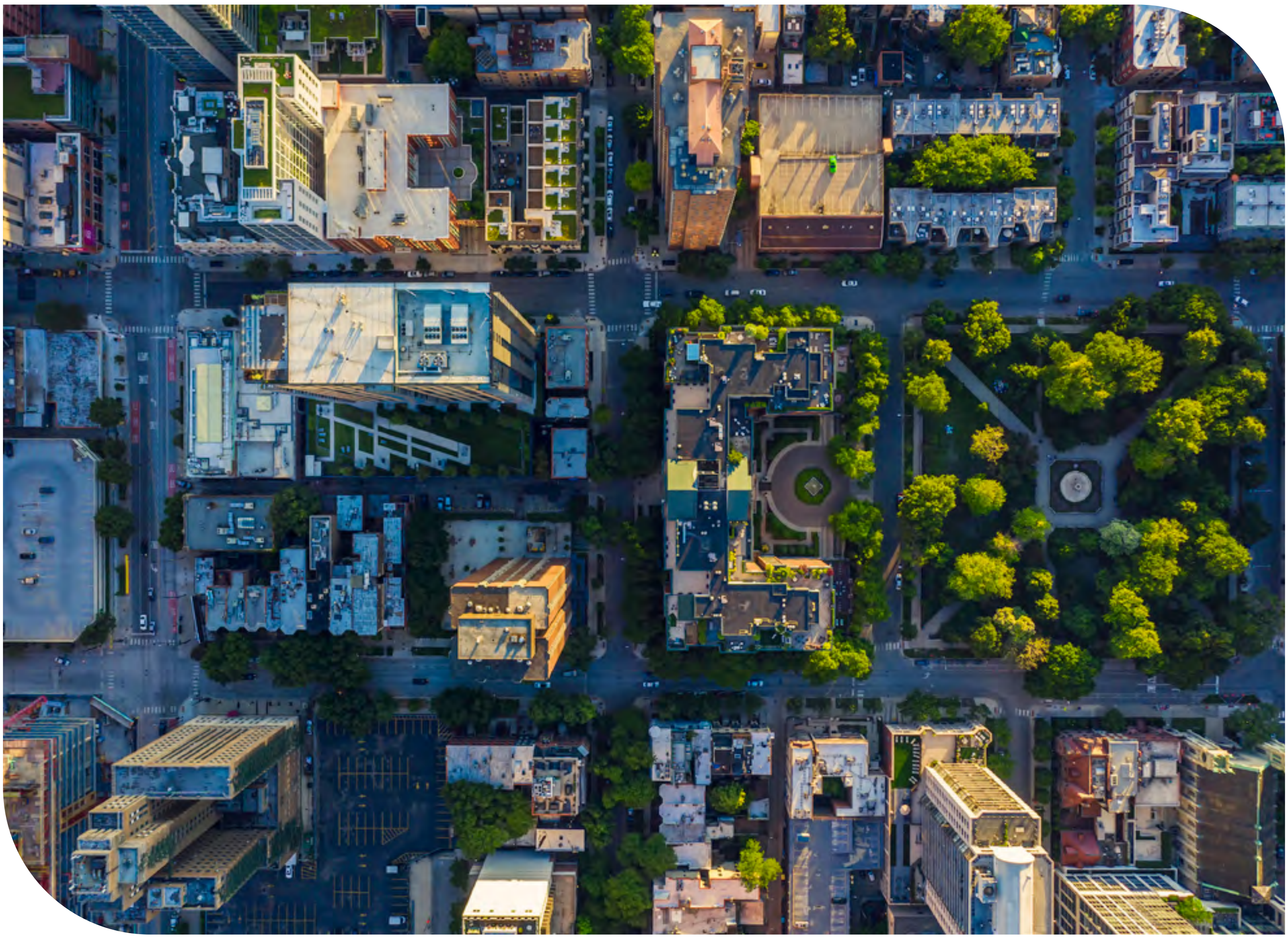
5.4. Operating models and grid integration

Installing behind-the-meter SOFC capacity does not make the grid irrelevant; it changes the customer's relationship with it. Sites typically operate SOFC capacity as primary supply, using the grid as a backup, top-up and export path. When a grid connection becomes available, site owners can decide whether to adopt it as a primary supply, retain or redeploy as backup, or operate grid and onsite capacity in parallel rather than becoming redundant.

This is a strategic point. The value of on-site capacity does not evaporate when grid capacity finally arrives. It converts into resilience, market participation and optionality. Assets financed to solve one problem can end up solving several.

5.5. Policy alignment

Policy is beginning to reflect the physical realities of the on-site power transition. In the United States, the One Big Beautiful Bill Act includes provisions relevant to hydrogen and fuel cell deployment.[78] Meanwhile the EU has targeted that data centres should be carbon neutral by 2030, supporting adaption of technologies such as fuel cells operating on biogas or hydrogen.[79] The EU Cloud and AI Development Act is also expected to further simplify planning for strategically important digital infrastructure.[80] In the UK, the designation of data centres as Critical National Infrastructure is a signal that policy is beginning to treat the delivery of firm power to strategic loads as a national economic priority.[81]



6. From near-term solution to long-term system value

The strategic case for SOFCs is further enhanced by the optionality inherent in the solution. The same platform, in the same location, can remain economically and technically relevant as the surrounding energy system evolves.

6.1. Fuel flexibility

Many SOFCs are inherently fuel flexible. The same stack can operate on fuels ranging from natural gas, biomethane, hydrogen, ammonia (with appropriate reformation) to synthetic natural gas or blends. The economic implication is direct: an asset installed today on natural gas can transition to lower carbon fuels as those become available and cost competitive, without capital replacement. This is a materially different asset profile from combustion technologies, whose fuel envelopes are narrower and whose combustion chemistry is fuel specific.

Figure 14: 1 MW Ceres SOEC system demonstrator operating at Shell's R&D site in Bangalore, India. Image courtesy of Shell Plc.

> The economic implication is direct: an asset installed today on natural gas can transition to lower carbon fuels as those become available and cost competitive, without capital replacement.

6.2. Solid oxide electrolysis and hydrogen

Solid oxide technology can also operate as an electrolyser, consuming electricity and steam to produce hydrogen. This is not a hypothetical. Ceres and Shell have a 1 MW solid electrolysis cell (SOEC) system demonstrator operating in Bangalore[82] and are collaborating on the design of a solid oxide electrolyser ("SOEC") module, for large-scale industrial applications.[83]

Unlike low temperature electrolysis, which relies entirely on electricity to split water, high temperature electrolysis uses both heat and electricity, driving efficiencies in the range of 35 kWh/kg.[84] This can lower hydrogen production costs in applications where high-temperature heat is available. In configurations coupled to industrial waste heat or nuclear steam, effective system efficiencies can rise further.

6.3. Integration with advanced nuclear

Coupling SOEC modules to heat and power from AMRs is a highly efficient pathway to gigawatt-scale low carbon hydrogen production. AMR technologies, including the high-temperature gas cooled reactors Centrica is developing in Hartlepool, produce process-grade heat at temperatures compatible with solid oxide electrolysis. The industrial architecture required (modular electrochemical plant, heat integration, hydrogen offtake, grid interface) is the same architecture being developed today for on-site SOFC power.

6.4. Carbon capture on concentrated CO_2 streams

SOFCs produce a concentrated stream of CO_2, alongside water vapour, that is largely free of nitrogen. This makes CO_2 easier to separate and capture than from the dilute exhaust streams produced by combustion technologies. A range of established carbon capture technologies can be applied to these streams. Absorption and adsorption processes can achieve 85 to 95% capture rates on such streams and emerging cryogenic techniques may raise this further.[56] For customers whose long-term carbon exposure matters, increasingly all critical infrastructure operators, this is a durable advantage.

6.5. Hybrid energy systems

Solid oxide technology can become a part of hybrid configurations spanning fuel cells, electrolysers, batteries and renewable generation. Solid oxide platforms capable of both power generation and hydrogen production offer the potential to shift between fuel cell and electrolysis mode. Periods of excess renewable generation, for example, can be used to produce hydrogen, and revert to power generation to support demand.

> Solid oxide technology can become a part of hybrid configurations spanning fuel cells, electrolysers, batteries and renewable generation.

Batteries and SOFCs are complements, not substitutes. Batteries are particularly well-suited to sub-hour flexibility and grid-forming services. SOFCs are well-suited to continuous, high efficiency baseload and long duration flexibility via hydrogen. Hybrid architectures combining behind-the-meter renewables, batteries, SOFCs (and, over time, SOEC and hydrogen storage) will define the leading edge of on-site energy systems through the 2030s. Delta Electronics is developing SOEC technology as part of a broader energy system, integrating it with technologies such as UPS, battery energy storage and power conversion systems.[85]

CONCLUSION →

From delivery constraint to strategic infrastructure

The UK is running a race between demand growth and delivery capacity, and delivery is losing. Grid connection delays are not simply a queue management problem; they are a growth problem. Investment that should be building UK productivity is being deferred, reallocated elsewhere, or capitalised at a higher rate of return because it cannot be energised on time.

The long horizon answer is unambiguous. Reinforce and expand the transmission and distribution system. Build renewables at pace. Deliver Sizewell C and commit to an SMR/AMR fleet. Modernise heat, transport and industry to run on cleaner electrons. This is the trajectory that the UK's energy strategy is built around.

However, the long horizon goal does not fit the timescales of the loads driving growth today. A hyperscaler committing capital in 2026 cannot wait until the mid-2030s. A pharmaceutical plant, a battery gigafactory or an NHS trust reliant on uninterrupted power cannot underwrite investment against a queue whose clearing date is unknown. The gap between what the energy system will deliver over the next decade and what the economy needs from it in the next twelve months is exactly the gap that behind-the-meter power is designed to close.

Solid oxide fuel cells are a compelling solution available to close that gap. They are deployable in months. They are modular, scalable and reliable. They deliver continuous, high-quality DC power at the electrical efficiencies and emissions profiles that combustion alternatives cannot match. They are quiet, water light, low impact and can ease planning and permitting. They accept the fuels the UK has today and the fuels it will have tomorrow. They can integrate with heat recovery, carbon capture, hybrid renewable architectures and couple with nuclear to produce hydrogen, across an asset life measured in decades. They preserve customer optionality where combustion technologies foreclose it.

> “Solid oxide fuel cells are a compelling solution available to close that gap. They are deployable in months. They are modular, scalable and reliable.”

The Ceres and Centrica collaboration exists because neither party can address this opportunity alone. Ceres brings Ceres Endura™ - a scalable, steel-supported stack platform manufactured through a global licensee ecosystem, providing the industrial architecture required to move solid oxide from bespoke to infrastructure grade. Centrica brings gas supply, project delivery, long-term operation and maintenance, financing structures, and the customer relationships across UK industrial, commercial and digital sectors within which the technology will be deployed. Together the two organisations can offer customers and the country firm, low impact, contracted power on the site where growth is happening, on a timescale that lets growth actually happen.

That is what strategic infrastructure looks like. Grid delays are a barrier to national economic growth. Solid oxide fuel cells, deployed at scale through a delivery model built for infrastructure, are how that barrier is removed.

Glossary of terms

Term / Acronym	Definition / Explanation
2N	A design approach involving full duplication of systems to provide complete backup capability.
AC (Alternating current)	Electric current that periodically reverses direction, used in grid electricity systems.
Advanced Modular Reactor (AMR)	A next-generation nuclear reactor designed to operate at higher temperatures than conventional reactors.
Anode	The electrode in an electrochemical where a oxidation reaction takes place (i.e. electrons are gained). In a fuel cell, the anode is where hydrogen is split into protons and electrons.
Battery Energy Storage System (BESS)	A system that stores electrical energy for later use, typically providing short-duration flexibility and supporting grid or on-site power stability.
Behind-the-meter (BtM)	Power generation located on or near a customer site, reducing reliance on grid connection timelines and centralised supply.
Black start	Ability of a power system or generation asset to restart and restore electricity supply without relying on an external power source.
Cathode	The electrode in an electrochemical where a reduction reaction takes place (i.e. electrons are gained). In a fuel cell, the cathode is where oxygen is reduced to produce water.
Carbon capture and storage (CCS)	Technologies used to capture carbon dioxide emissions at source and store them to reduce net emissions.
Combined cycle gas turbine (CCGT)	A power generating technology that generates electricity using two sequential processes: first, burning natural gas to drive a gas turbine, then capturing the waste heat from that turbine's exhaust to produce steam, which drives a second (steam) turbine. By using the heat twice, CCGTs achieve significantly higher efficiency than a simple gas turbine alone.
Combined heat and power (CHP)	A system that captures waste heat and reuses it for heating, cooling or industrial processes, increasing overall efficiency.
Direct Current (DC)	Electric current that flows in one direction, generated directly for example by fuel cells and used within electronic systems.
Distributed generation	Electricity generation located close to the point of use rather than at centralised power stations.
Electrolyte	A material (which can be liquid, solid, or membrane-based) that conducts electrically charged ions between the anode and cathode of an electrochemical device such as a fuel cell.
Energy-as-a-Service (EaaS)	A delivery model where a third party owns, operates and maintains energy infrastructure, with customers paying for energy or capacity as a service rather than investing upfront.
Environmental Impact Assessment (EIA)	A formal process used to evaluate the environmental effects of infrastructure projects, often required for large-scale developments.
Fuel cell	A device that generates electricity through an electrochemical reaction using a fuel (such as methane or hydrogen) and oxygen.
Hydrogen	An energy carrier that can be used as a fuel or produced through electrolysis, with emissions dependent on how it is produced.
Islanding	Operation of a power system or site independently from the main grid, maintaining local electricity supply during a wider grid outage.
LHV (Lower heating value)	The actual amount of usable heat energy released when a fuel is burned. It is called "lower" because it assumes that the water vapor created during burning escapes as smoke or exhaust gas, meaning its heat is lost.
Module (SOFC)	A repeatable building block within an SOFC system, typically integrating one or more stacks with supporting components so capacity can be deployed, maintained and scaled incrementally.

Modularity	A system design approach based on repeatable units that can be deployed incrementally and scaled over time.
N+1 redundancy	A design approach providing additional capacity beyond operational requirements to maintain operation if one component fails.
NO_x (Nitrogen oxides)	Toxic nitrogen oxides produced from high-temperature fuel combustion that cause smog and respiratory issues.
Open cycle gas turbine (OCGT)	A power generating technology that generates electricity by compressing air, mixing it with gas and combusting it, with the resulting hot gases driving a turbine.
On-site power	Electricity generation installed at a customer location to supply part or all the site's demand.
Power Purchase Agreement (PPA)	A contract where a customer agrees to purchase electricity from a provider over a defined period without owning the generation asset.
Power quality	The consistency and stability of electricity supply, including voltage, frequency and absence of disturbances, particularly important for sensitive applications such as industrial processes and digital systems.
Reciprocating engine	A type of engine that generates power through the back-and-forth movement of pistons inside cylinders. In an energy context, reciprocating engines can run on natural gas, diesel, or other fuels.
Small Modular Reactor (SMR)	A nuclear reactor designed for modular construction and deployment at smaller scale than traditional nuclear plants.
SO_x (Sulphur oxides)	Highly toxic sulphur oxides generated by burning fuels that cause acid rain and trigger respiratory damage in humans.
Solid oxide electrolysis cell (SOEC)	A high-temperature electrochemical device that produces hydrogen from water using electricity and heat.
Solid oxide fuel cell (SOFC)	A highly efficient electrochemical device that directly converts the chemical energy of a fuel (such as hydrogen or natural gas). It is characterised by its use of a solid ceramic material as the electrolyte.
Stack	The core functional unit of a fuel cell system, consisting of multiple electrochemical cells combined to produce usable power.
System (SOFC)	A complete power generation unit built around one or more SOFC stacks, including the supporting equipment needed to manage fuel, air, heat, power conversion, controls and safe operation.
Time-to-power	The time required to secure, build and commission electricity supply for a project.
Total cost of ownership (TCO)	The full lifecycle cost of an asset, including capital expenditure, operation, maintenance and financing.
Uninterruptible Power Supply (UPS)	A system that provides immediate short-term backup power during supply interruptions.
Uptime	The proportion of time that a system remains operational and available to deliver power or services, typically expressed as a percentage and used as a measure of reliability for critical applications.

References

1 IEA | Electricity 2026
2 IEA | World Energy Outlook 2025
3 CBRE Investment Management | Data Centres: Ain't No Mountain High Enough
4 UK Government | Government to tackle speculative demand grid connection requests | March 2026
5 Ofgem | Summary Decision Document | 2025
6 Ofgem | Ofgem sets out major reform package in next step to accelerate grid connections
7 House of Lords Deb | 1 September 2025 | Vol. 848, No. 181
8 Data Center Dynamics | How did Iberian operators fare in the great power cut?
9 IEA | The Iberian blackout has highlighted the critical importance of electricity security
10 Visualizing Energy | Global nuclear reactor construction starts and duration, 1949-2023 | September 2024
11 Construction Wave | Hinkley Point C costs approach £49bn as project faces M&E delays - Construction Wave | February 2026
12 Directorate-General for Energy | Commission unveils strategy to bring Europe's first SMRs online by the early 2030s
13 Electricity Info | Ireland | May 2026
14 Commission for Regulation of Utilities (CRU) | Large Energy Users Connection Policy: Decision Paper (CRU/2025236) | December 2025
15 IEA | Key Questions on Energy and AI | April 2026
16 TD Economics | Data Centers in a Grid Constrained World: Challenges and Opportunities for Canada | March 2026
17 The Guardian | Grid connection delays for low-carbon projects 'unacceptable', says Ofgem | May 2023
18 Oxford Economics | The rising challenge of powering data centres | January 2026
19 eco - Association of the Internet Industry | Energy for Digital Structural Change: Emil Issagholian (Rheinenergie) in Conversation | August 2025
20 Ember | Grids for data centres: ambitious grid planning can win Europe's AI race | 2026
21 IEA | Overcoming energy constraints is key to delivering on Europe's data centre goals | November 2025
22 Bloomberg Equity Indices | Data Centres Face Seven-Year Wait for Dominion Power Hookups | August 2024
23 Data Center Knowledge | Gridlocked: How Power Constraints Are Shaping the Future of Data Centers | April 2026
24 Reuters | Poor grid planning could shift Europe's data centre geography, report says | June 2025
25 Introl | Japan's $26 Billion Data Center Paradox: Record Investment Meets Decade-Long Power Waits | January 2026
26 Utility Dive | 5-year waits and rising costs: How demand is redefining the gas turbine market | March 2026
27 IEA | The Path to a New Era for Nuclear Energy | January 2025
28 IEA | Electricity Grids and Secure Energy Transitions | October 2023
29 IEA | Electricity 2026 - Prices | 2026
30 Department for Energy Security and Net Zero | International domestic energy prices | May 2026
31 Department for Energy Security and Net Zero | Energy generation cost projections | January 2026
32 Ceres | Power products
33 Weichai America | Thermal-electric cogeneration efficiency of 92.55% ranks first in the world | March 2023
34 Wärtsilä | Combustion engines vs. Aeroderivative gas turbine: Pulse load efficiency
35 Goldman Sachs | Fuel Cells Could Help Meet the Power Demand from Data Centers | November 2025
36 Ceres | Ceres Endura - Power built to last
37 Bloom Energy | Load Following Solid Oxide Fuel Cell | February 2024
38 Bloom Energy | How Bloom Reduces Emissions: Technical Notes
39 Bloom Energy | How to power the AI economy with fuel cells while supporting local communities | August 2025
40 The World Financial Review | The Water-Saving Power Source: How Bloom Energy Cuts Water Use to Near Zero | September 2025
41 Goldman Sachs | Fuel Cells Could Help Meet the Power Demand from Data Centers | November 2025
42 Bloom Energy | Bloom's Fuel Cells Provide Highly Efficient Power Generation for the Marine Ecosystem - and Now Have ABS Type Approval | September 2025
43 Bloom Energy | Stop and Shop to Convert 40 Stores to Bloom Energy Microgrids | January 2020
44 Bloom Energy | Bloom Energy Expands Data Center Power Agreement with Equinix Surpassing 100MW | February 2025
45 Bloom Energy | Bloom Energy and CoreWeave Partner to Revolutionize AI Data Center Power Solutions | July 2024
46 Bloom Energy | Bloom Energy and Oracle Expand Strategic Partnership to Deploy up to 2.8 GW to Accelerate AI Infrastructure Build-Out | April 2026
47 Ceres | Doosan Fuel Cell begins mass production of fuel cell power systems using Ceres technology | July 2025
48 Ceres Power | Delta Secures License to Hydrogen Energy Technology from UK-listed Ceres | January 2024

49 Ceres Power | Ceres confirms Denso as the latest licence partner | August 2024
50 Ceres Power | Weichai sign manufacturing licence for SOFC power | November 2025
51 Ceres Power | Thermax Partners with Ceres for Green Hydrogen Production with Large-Scale Solid Oxide Electrolysis (SOEC) Manufacturing in India | September 2024
52 Ceres Power | Ceres and Doosan sign Collaboration and Licensing Agreement for Korean Market | July 2019
53 Ipieca | Open-cycle gas turbines | November 2022
54 TU Delft | Moving Beyond Diesel Generators: Exploring Renewable Backup Alternatives for Data Centers | 2024
55 Ceres | SOFC with CCS: The Optimal Path to Carbon-Free Electricity from Carbon-Based Fuels | April 2024
56 Department for Energy Security and Net Zero | Fuel mix disclosure data table, 2024-2025 | May 2026
57 CEPA | Electricity Generation Cost Study – Extending the Life of Existing Generation | May 2025
58 SSE Thermal | Appendix 9B: Operational Noise Information – The Ferrybridge Next Generation Power Station Project | February 2024
59 Joint Departments of the Army, Air Force, and Navy | Power Plant Acoustics
60 Trinity Consultants | Synthetic Minor Operating Permit Application (Prepared for CTC Property LLC, Project 240401.0165). Little Rock: Trinity Consultants | 2025 (available upon request)
61 Mott MacDonald | Poolbeg 299MW Open Cycle Gas Turbine (OCGT) Environmental Impact Assessment Report | December 2022
62 U.S. Environmental Protection Agency | Combustion Turbines Inventory TSD | January 2026
63 Joint Environmental Programme | Water Use in Biomass and Combined Cycle Gas Turbine Power Plant with Carbon Capture and Storage | March 2022
64 Burns McDonnell | East Kentucky Power Cooperative - Sound Study Report | November 2024
65 Wärtsilä | Power Plant Noise Control, Turkey | April 2010
66 ESE Partners | Electric Generating Unit Standard Permit for Pecos Power Plant LLC | November 2024
67 Wärtsilä | Combustion engine vs. Aeroderivative gas turbine: Water consumption | 2026
68 https://www.bloomenergy.com/wp-content/uploads/load-following-solid-oxide-fuel-cell.pdf
69 Bloom Energy | The Bloom Energy Server 6.5 Data Sheet
70 BFC Power LLC | Permit Authorization Letter Request, WAQSR Chapter 6, Section 2: BFC Power LLC – BFC Power, Laramie County, WY. Air Quality Division regulatory filing | 2025 (available upon request).
71 Equinix | The internet is sustainably heating Paris and the Olympic training pool
72 The Asia Business Daily | Musk Personally Confirms: U.S. xAI Purchases Five 380MW-Class Gas Turbines from Korea's Doosan Enerbility | January 2026
73 British Sugar | Decarbonising our operations | February 2026
74 Centrica | Delta and Centrica launch scalable off-grid fuel cell power solution | April 2026
75 Department for Communities and Local Government | The Town and Country Planning (Environmental Impact Assessment) Regulations - Schedule 1 | May 2017
76 Department for Communities and Local Government | The Town and Country Planning (Environmental Impact Assessment) Regulations - Schedule 2 | May 2017
77 California Air Resources Board | Executive Order DG-047: Distributed Generation Certification of HyAxiom, Inc. | March 2023
78 Congressional Research Service | Tax provisions in H.R. 1, the One Big Beautiful Bill Act | 2025
79 Climate Neutral Data Centre Pact | The Green Deal needs Green Infrastructure
80 European Commission | Cloud and AI Development Act
81 Department for Science, Innovation and Technology | Data centres to be given massive boost and protections from cyber criminals and IT blackouts | September 2024
82 Ceres Power | Shell - Ceres MW Scale Electrolyser Project Produces First Hydrogen | May 2025
83 Ceres Power | Ceres signs contract with Shell for green hydrogen | June 2024
84 Salcos | Green Industrial Hydrogen
85 Delta Electronics | Solid Oxide Electrolysis Cell (SOEC)