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Global **Transmission** Report

Knowledge Partner
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POWERING DATA CENTRES: AUSTRALIA

CONTENTS

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EXECUTIVE SUMMARY

Data centres have emerged as the most transformative source of electricity demand in Australia. Driven by the rapid expansion of cloud computing infrastructure and energy-intensive artificial intelligence (AI) workloads, data centre electricity consumption is projected to increase from approximately 3.9 TWh in 2024-25[1] to around 34 TWh by 2049-50, representing almost 10% of total underlying demand in the National Electricity Market (NEM) at that point[2].

This growth coincides with a fundamental transition in Australia's electricity system, encompassing the retirement of coal-fired generation, the large-scale integration of renewable energy, proliferation of rooftop solar and battery storage, and a transmission infrastructure programme without historical precedent in the NEM. The addition of large data centre loads to already congested urban network corridors is compounding these pressures, with demand growth outpacing the delivery of supporting infrastructure and amplifying the policy challenge of system coordination.

Australia has emerged as a preferred location for data centre investment within the Asia-Pacific region. Several factors account for this position, including land availability, abundant renewable energy resources, relative political stability, established data governance frameworks, and proximity to major regional demand centres. The Clean Energy Finance Corporation (CEFC) estimates that Australia's data centre sector will attract between AUD85 billion and AUD135 billion in domestic and international investment over the next decade[3]. The scale of this investment is already registering in the electricity system. As of March 2026, about 5 GW of data centre maximum demand was progressing through NEM transmission connection processes across 11 large projects, concentrated in New South Wales (NSW) and Victoria[4].

Some proposed facilities are larger than any existing load on the networks to which they seek to connect. While demand can materialise within a few years, major transmission investments typically require five to ten years from planning to energisation. In addition to the network implications of increasing complexity of AI-driven power demand, this mismatch between load growth and infrastructure delivery has emerged as the principal constraint on data centre integration.

In response to the grid implications of this growth, Australia has developed policy and regulatory frameworks spanning federal, market, and state levels, each linking digital infrastructure development to electricity system outcomes. These initiatives establish that data centres are expected to contribute to new renewable capacity, support network investment, provide demand flexibility where feasible, and meet energy efficiency standards.

Three factors will determine the pace and efficiency of data centre integration into Australia's electricity system.

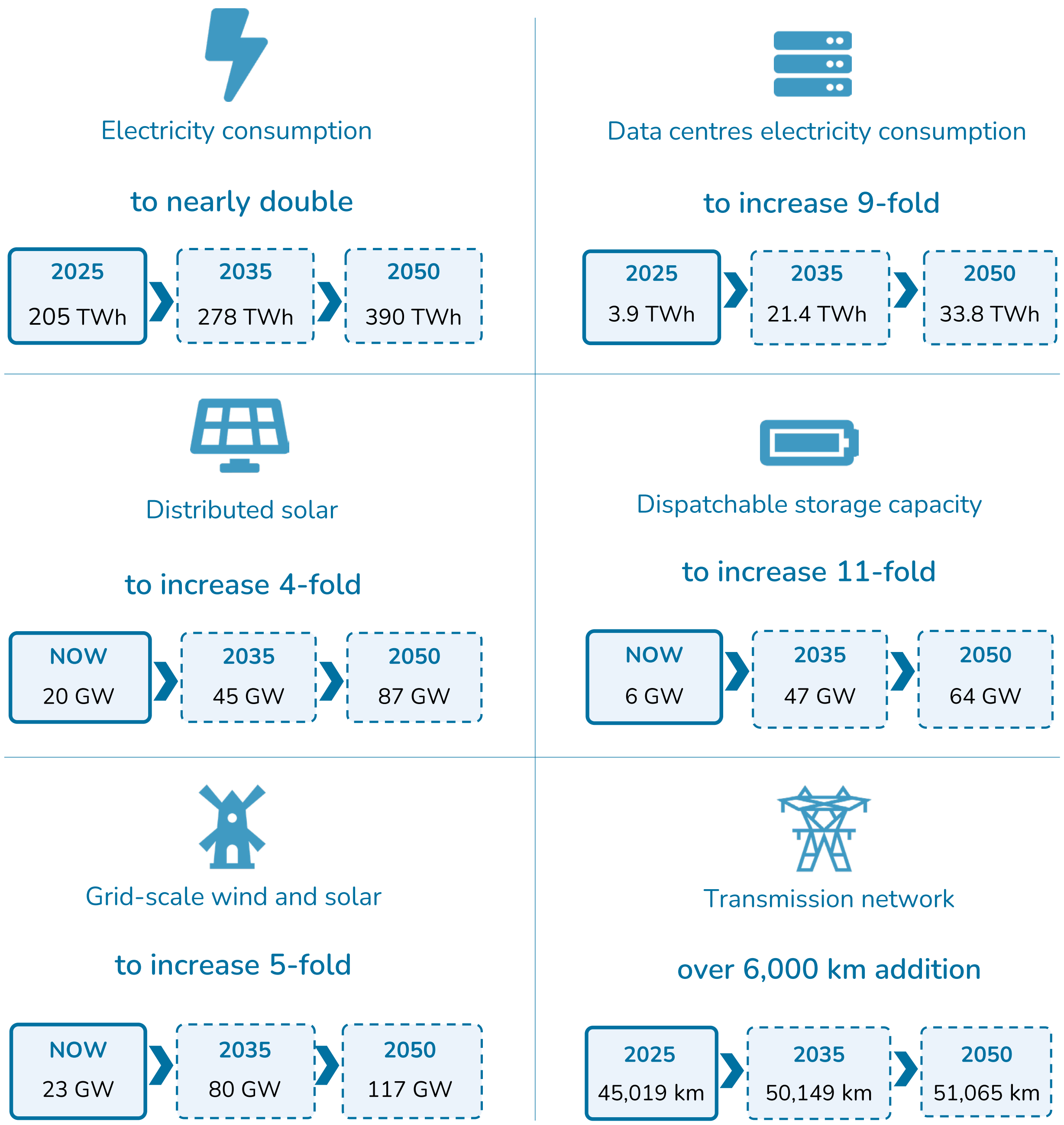
First, connection frameworks must adapt to accommodate a growing volume of large-load applications, providing greater transparency, predictability, and speed for both project developers and network planners.

Second, the scale of capacity expansion necessary to meet data centre targets requires significant investment in utility-scale renewable energy and storage, as well as hybrid on-site energy systems. The development of the transmission network must align with shifting generation characteristics and portfolios, which necessitates a long-term, coordinated, and holistic approach to network planning as well as a shift from a project-by-project to a programme-based approach. Providing early and robust demand signals will be crucial to ensure the availability of grid equipment such as large power transformers and switchgear.

Third, the deployment of enabling technologies must keep pace with the rate of demand growth. Grid Enhancing Technologies (GETs), demand-side flexibility, Battery Energy Storage Systems (BESS), High Voltage Direct Current (HVDC) interconnection, and advanced energy management systems can each improve system utilisation and reliability while reducing integration costs.

The regulatory frameworks, policy instruments, and technologies required to support this transition are largely identified. Outcomes will depend on how effectively investment in infrastructure, generation, and enabling technologies is coordinated and sequenced relative to the pace of demand growth now materialising. ■

Figure 1: Expected Energy Transition in the NEM, 2025-50



Source: AEMO, 2026 Integrated System Plan (ISP)

INTRODUCTION

1

For much of the past decade, Australia's grid-supplied electricity consumption remained broadly flat, held in check by efficiency gains and the widespread uptake of rooftop solar. That period of demand stability has ended.

Economy-wide electrification and the emergence of large-scale digital infrastructure are driving a sustained increase in electricity demand across the National Electricity Market (NEM). The NEM is simultaneously managing the retirement of coal-fired generation, the large-scale integration of variable renewable energy, a surge in rooftop solar, and a substantial expansion of transmission infrastructure. These transitions are occurring in parallel and reshaping planning assumptions, investment requirements, and regulatory priorities.

Within this context, data centres have emerged as a distinct and rapidly growing load category. Electricity consumption patterns of data centres, both for information technology (IT) and artificial intelligence (AI) based workloads, differ significantly from those of conventional electricity consumers, necessitating different operational and planning considerations. As individual facilities grow in scale and geographic concentration, their effect on an already-constrained power system is drawing greater attention from network planners and regulators.

In response to the grid implications of this growth, policy and regulatory frameworks are taking shape across federal, state, and market levels. The 2025 National AI Plan, intergovernmental renewable procurement arrangements under the Energy and Climate Change Ministerial Council (ECMC), and draft rule changes from the Australian Energy Market Commission (AEMC) are each establishing clearer integration requirements for large data centres. Translating these frameworks into investment outcomes will require coordinated action across generation, transmission, and distribution networks, supported by demand-side flexibility, on-site energy solutions, and enhanced system planning tools.

This report focuses on how data centre growth is impacting Australia's electricity system and the developments taking place in response across policy, regulation, market design, and technology. ■

THE TRANSFORMING LOAD CURVE

2

Australia's electricity consumption is projected to grow strongly over the coming decades, reversing a prolonged period of almost stagnant grid demand. Total consumption in the NEM reached 205 TWh in 2024-25 and is projected to nearly double to 390 TWh by 2049-50, driven by the progressive electrification of transport, industrial processes, space heating and cooling, and digital infrastructure[5]. This indicates the need for simultaneous investment in generation capacity, network expansion, and technologies and solutions to maintain grid reliability and stability.

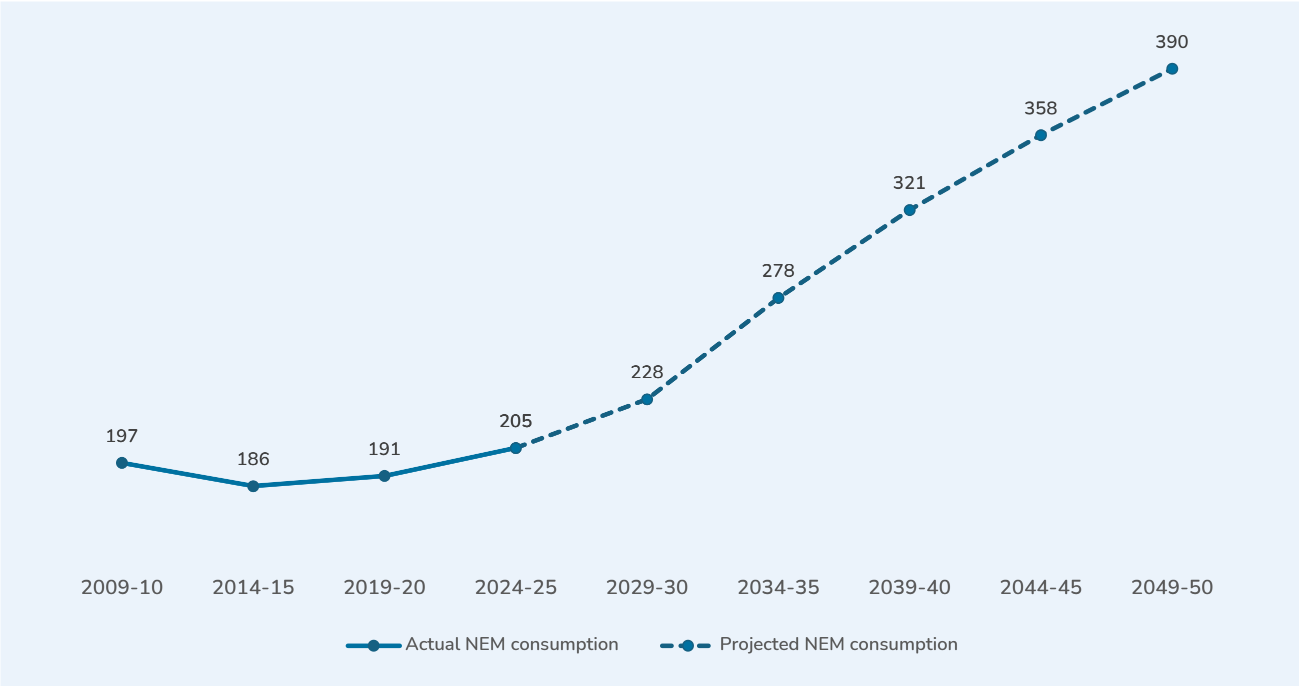
Unlike distributed electrification, these facilities create large, spatially clustered demand nodes with considerable implications for network planning, system security requirements, and investment timing. Their pace of growth, physical scale, and inherent forecast uncertainty have led the Australian Energy Market Operator (AEMO) and transmission planners to treat them as a separate load category in long-term planning.

2.1 Data Centres as a New Demand Category

Australia has emerged as a favourable destination for global data centre investment, enabled by a combination of factors such as availability of land and energy, rapidly maturing regulatory frameworks, and political stability. Data centres have grown from a modest grid load to the fastest-growing source of new electricity demand in the NEM within a few years.

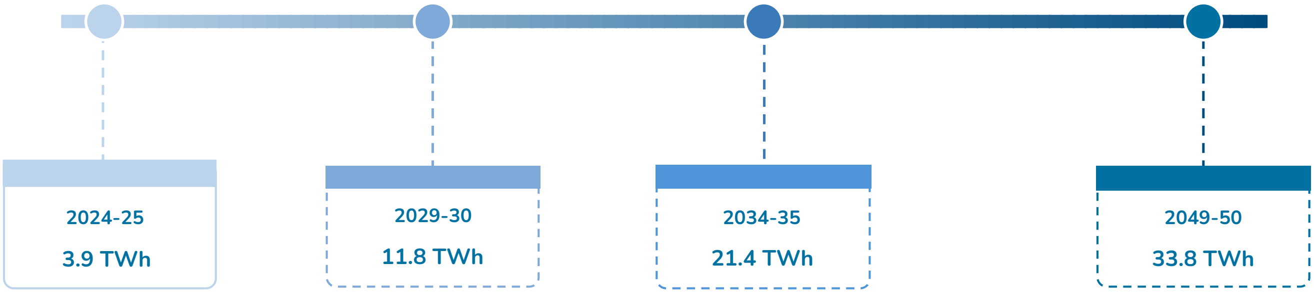
In 2024-25, Australian data centres consumed an estimated 3.9 TWh[1]. The NEM accounted

Figure 2: Growth in Electricity Consumption in the NEM (TWh)



Source: AEMO, 2026 ISP

Figure 3: Data Centre Electricity Demand Forecast (TWh)



Source: AEMO, 2026 ISP

for almost 98% of this consumption, equivalent to roughly 2% of grid-supplied NEM demand[1]. AEMO projects that demand from data centres will increase by around 25% annually, reaching around 33.8 TWh and representing almost 10% of NEM's underlying demand by 2050 – four times today's share, and the equivalent of 20% of today's total grid consumption[4]. This growth is large and geographically concentrated, with the majority of demand and pipeline capacity situated in New South Wales (NSW) and Victoria.

The speed of this demand shift is reflected in how rapidly utility load forecasts are being revised. AEMO and Transmission Network Service Providers (TNSPs) have updated their data centre load projections multiple times in recent planning cycles. Transgrid revised its NSW data centre load forecasts from near zero to over 6.7 TWh by 2035 within a single annual planning update cycle in 2025[6]. These revisions reflect the difficulty in constructing reliable long-run forecasts for a demand segment undergoing rapid transformation.

Data centre demand is growing not only in the number of facilities under development but also in their individual scale and power density. Typical new developments have increased from 50-100 MW to 400 MW or more[7], driven by the computational intensity of AI workloads. Graphics Processing Unit (GPU) rack densities have risen from approximately 10-26 kW per rack in 2020 to 100-150 kW today[7]. Some next-generation liquid-cooled AI systems are expected to exceed 500 kW per rack later this decade, reflecting the growing power density of AI infrastructure[7]. While computational efficiency per operation has continued to improve, physical constraints in chip-to-chip interconnect design have reinforced denser compute architectures that concentrate electrical load in smaller physical footprints.

These requirements are producing large integrated campus-scale facilities without precedent in the NEM. Illustrative examples include Keppel's proposed 720 MW AI campus at the former Hazelwood Power Station site in Victoria's Latrobe Valley, linked to the Gippsland Renewable Energy Zone (REZ)[8]; IREN's proposed 800 MW AI data centre campus at Bundey in South Australia, located within the Mid North South Australia REZ[9]; a cumulative total of over 1.2 GW capacity across five campuses operated by AirTrunk[10]; and NEXTDC's AUD7 billion Eastern Creek facility in Sydney, with OpenAI as a major customer[11].

2.2 Geographic Distribution

Australia has over 160 operational facilities[4]. Sydney and Melbourne account for the majority of existing capacity and the bulk of the national development pipeline, with a secondary tier of markets emerging in Brisbane, Adelaide, and Canberra. The scale of this pipeline is now visible in transmission connection queues. For the first time, AEMO's Q1 2026 Quarterly Energy Dynamics report included data centre connection data across the NEM. At the end of March 2026, 11 large data centres representing a total of over 5 GW of maximum demand were in the connections pipeline[12]. Around 60% of this capacity is in NSW and 40% in Victoria[12].

Sydney is Australia's most developed data centre market. Western Sydney, particularly the Eastern Creek corridor, functions as the primary hub for large-scale facilities, supported by proximity to transmission infrastructure, fibre connectivity, and available industrial land. Major operators active in this corridor include NEXTDC, Canberra Data Centres (CDC), and AirTrunk, with projects already operational, under construction, and in advanced planning stages. Macquarie Park in northern Sydney remains one of the country's most established interconnection and enterprise data centre precincts.

Data centres in Sydney currently consume 2.6 TWh of electricity per annum, representing 4% of NSW's grid-supplied electricity[13]. By 2029-30, this is expected to nearly triple to 11% and reach 18% by 2049-50, when data centres in Sydney are expected to consume 17.2 TWh of energy[13].

Melbourne is the second major data centre market. Data centres in Melbourne currently consume 0.8 TWh of electricity per annum, representing 2% of Victoria's grid-supplied electricity[14]. This is expected to increase to 8% by 2029-30 and to 19% by 2049-50, when Melbourne's data centres are expected to consume 14.1 TWh of electricity[14]. A notable feature of the Melbourne market is the low share of data centre load currently connected at the transmission level. Only 1.5% of Victoria's, and by extension Melbourne's, data centre consumption is transmission-connected today, a figure projected to reach 32% by 2029-30, reflecting the scale of planned hyperscale developments[15].

Melbourne's locational advantages include lower-cost industrial land in outer metropolitan and regional growth corridors and proximity to Victoria's expanding REZs.

Beyond Sydney and Melbourne, Brisbane, Adelaide, and Canberra are emerging as Australia's next-tier data centre markets, each with a distinct locational rationale.

Brisbane's growth is supported by Queensland's lower land costs and available network capacity. Several projects exceeding 100 MW are in advanced planning in Queensland, including the proposed Quinbrook Supernode campus in Brendale, which integrates hyperscale compute with large-scale battery storage.

Adelaide's data centre market is at an earlier stage of development, with its competitive position built around lower land and energy costs, government and defence workloads, and South Australia's classification of large data centres as essential infrastructure, which enables streamlined planning approvals.

Canberra serves a distinct market segment as the seat of the federal government, with a concentration of facilities oriented towards government, defence, and high-security workloads. Operators, including Macquarie Data Centres and NEXTDC, have established dedicated government-grade facilities in the city.

The geographic concentration, physical scale, and operational characteristics of data centre demand have established the sector as a distinct load category within Australia's energy system. This has prompted a coordinated response across federal policy, electricity market regulation, and state planning frameworks, as examined in the following Chapter. ■

POLICY AND REGULATORY RESPONSES

3

Data centres are being treated as infrastructure with system-wide implications rather than purely commercial development. Federal policy is establishing a strategic direction through AI and infrastructure frameworks that position digital infrastructure as a matter of national interest. States are operationalising this through planning approvals and investment facilitation. Electricity market institutions are adapting grid connection standards and cost allocation rules to reflect the scale and operational characteristics of large new loads.

3.1 Federal Frameworks

National AI Plan and Data Centres Expectations

The 2025 National AI Plan established the first explicit federal link between AI development, data centre investment, and energy system planning. It positions data centres as critical national infrastructure and frames access to reliable, low-emissions electricity as a condition for sustained sector expansion.

This framing was operationalised in March 2026 through the release of "Expectations of Data Centres and AI Infrastructure Developers"[16]. It is expected to shape regulatory prioritisation, investment facilitation decisions, and state-level policy alignment.

The Expectations define five areas of alignment: national interest and data sovereignty; support for the energy transition; sustainable resource use; workforce development; and domestic innovation capability. From a grid planning and operation perspective, energy transition-related expectations are most relevant. Data centre developers are expected to work with the energy regulators and suppliers to:

- Secure new and additional clean energy generation and/or storage to offset demand
- Cover their share of transmission and distribution infrastructure costs
- Minimise their energy demand and emissions by adopting industry-leading efficiency measures and technologies
- Improve the overall security and stability of the energy grid, including by enhancing demand flexibility and opportunities for peak-load management and appropriate sharing of consumption data

Building on these Expectations, on July 15, 2026, the federal government announced its plans to develop standards for AI, and established an Office of AI within the Department of the Prime Minister and Cabinet to lead the national AI framework and roll out the standards. The Office will coordinate AI policy across state governments, ensure consistent regulation of AI systems and data centres, and streamline infrastructure approvals while meeting energy, water, and safety requirements.

NABERS Efficiency Requirements

An important preceding step was the extension of the National Australian Built Environment Rating System (NABERS) to data centres hosting federal government workloads. From July 2025, facilities serving federal agencies are required to achieve a minimum five-star NABERS Energy rating under the Net Zero in Government Operations Strategy, or an equivalent environmental rating, such as a Power Usage Effectiveness (PUE) of 1.4 or less[17]. Although the requirement is limited to federal procurement, it is becoming a de facto market benchmark, particularly for hyperscale providers. Compliance is enforced through the Digital Transformation Agency's data centre panel, with non-compliant providers at risk of removal.

3.2 Energy Market and Network Regulation

Renewable Procurement Obligation

A key distinction in renewable procurement policy is whether certificate-based procurement is sufficient or whether operators should be required to underwrite new physical generation and storage capacity. The distinction matters. While certificate-based procurement can support renewable project revenues, mechanisms that more directly support investment in additional generation and storage capacity guarantee necessary generation capacity expansion, avoid greenwashing, and offer improved demand management to match the hourly load profile.

Through the ECMC, federal, state, and territory energy ministers (except for Queensland) have agreed that data centres must fully offset their electricity consumption by investing in new renewable energy and storage infrastructure, going beyond green power certificates to underwrite genuinely new capacity.

The agreement directly reinforces the first expectation under the Expectations framework and signals that consistent principles will be applied across state and territory planning and approval processes.

The Electricity Services Entry Mechanism (ESEM)

A related reform is the ESEM. This new mechanism is the practical counterpart to the ECMC offset obligation. New renewable energy projects in Australia require long-term revenue certainty to reach financial close, while major buyers, including data centres, have generally been unwilling to commit beyond three to five years. The ESEM fills the commercial gap between what data centres are willing to commit to and what renewable energy developers need to proceed.

Emerging from the NEM Wholesale Market Settings Review, it will succeed the Capacity Investment Scheme (CIS) when it concludes in 2027[18] and will be embedded in the National Electricity Law. A 'Central Buyer' will run competitive auctions and award revenue support contracts covering years four to 15 of a project's operation[19]. This makes it practical for data centre operators to contribute to new renewable capacity, as distinct from procuring Large-scale Generation Certificates against existing generation.

In May 2026, all energy ministers except Queensland agreed to develop a legislative package for ESEM. An industry working group is co-designing contract terms, with term sheets expected by November 2026 and the first tender anticipated in late 2027[20].

Demand-Side Flexibility Obligations

The ECMC agreement also addressed the demand side, stating that data centres should provide demand flexibility services where feasible, rather than operating as purely passive, inflexible loads. In practice, this could mean shifting or reducing consumption during periods of peak demand or system stress, participating in demand response programmes, or drawing on on-site batteries and backup generation to support the grid rather than simply consuming from it.

The underlying objective is to avoid additional system costs being passed on to consumers. The AEMC has been tasked with developing advice on implementation options, a recognition that data centres, given their scale, have both the potential and the responsibility to actively support grid stability.

Grid Connection Reforms and Technical Standards

Australia's grid connection reform programme is being implemented by the AEMC through two complementary packages. Package 1 addresses the connection of clean energy resources[21]; Package 2 addresses the system security implications of large new electricity loads[22].

Package 1, which came into effect in August 2025, modernises NEM access standards for renewable energy projects, batteries, High Voltage Direct Current (HVDC) links, and other inverter-based resources. The reforms provide clearer and more consistent technical requirements and revise connection assessment processes for renewables and storage.

Package 2, for which a draft determination was released in March 2026, addresses the system security risks posed by large inverter-based loads (IBLs), including AI-driven hyperscale data centres. The principal risk is the uncoordinated, simultaneous disconnection of such loads during a network disturbance, as well as uncoordinated ramp-up as algorithm training cycles commence, both of which can destabilise system frequency and voltage. The AEMC has sought to align the draft rules with comparable jurisdictions globally, for example, Texas, Finland, and Ireland.

The draft introduces mandatory disturbance ride-through requirements – voltage and frequency ride-through and post-fault active power recovery – for distribution-connected loads above 30 MW[23]. Transmission-connected IBLs follow 5.3 standards under National Electricity Rules (NER) regardless of size. The reforms also require large IBLs to provide information on their ride-through capability to NSPs and AEMO, improving visibility of load behaviour and enabling more efficient system operation. Large IBLs must also detect, respond to, and avoid contributing to the instability of converter control interactions.

The package further permits fast ramp-down as an alternative to block disconnection for Under-Frequency Load Shedding (UFLS), reflecting IBL's capability to modulate demand dynamically, alongside complementary updates to protection requirements, system strength obligations and compliance arrangements.

Overall, Package 2 modernises the NEM access standards framework by treating large IBLs as having generator-like system security impacts, aiming to enable digital infrastructure growth without compromising power system reliability.

Consultation on the draft rule closed in May 2026, with a final determination expected later in 2026. The outcome will have direct implications for connection conditions, investment requirements, and system reliability standards applicable to large-scale data centre developments across the NEM.

Cost Recovery and Network Investment

A parallel development is occurring in network pricing and cost allocation rules. Regulators are now applying cost-causation principles to ensure that connection-driven network augmentation is not broadly socialised across the consumer base. Incremental costs associated with large new loads are expected to be borne by the developers creating that demand. The Expectations framework also establishes that data centre operators, rather than electricity consumers or taxpayers, should fund their share of transmission and distribution infrastructure costs.

For data centres that directly connect to the distribution grids, the approach is well established, with developers typically responsible for these costs. For example, Ausgrid has introduced cost-reflective connection tariffs requiring proponents to fund the infrastructure their load necessitates.

However, applying this principle to transmission network augmentation is more complex. Large-scale network upgrades tend to benefit multiple users rather than a single data centre operator, making it impractical for one developer to fund them alone. While cost-sharing among multiple developers could be more efficient, it raises questions around how contributions should be allocated and how commercial risks should be managed. This issue is currently being tested through state-level inquiries. It highlights the need for a regulatory framework that enables coordinated funding of shared upgrades, while still ensuring data centre operators contribute fairly to the cost of the transmission capacity they require.

3.3 State Implementation: Planning and Infrastructure Coordination

State governments regulate land zoning, grid interconnection, and infrastructure approvals. Therefore, the pace, scale, and structure of data

Figure 4: Key Emerging Regulatory Obligations for Data Centre Developers

Renewable procurement

– Must fully offset consumption via new renewable capacity
– Goes beyond green certificates; must underwrite genuinely new generation & storage
– ESEM enables direct investment in new capacity

Demand-side flexibility

– Expected to provide flexibility, not operate as a passive, inflexible load
– Shift or reduce consumption at peak demand; join demand response programmes
– On-site batteries & backup generation can support, not just draw from, the grid
– AEMC tasked with developing advice on implementation options

Grid connection reforms & technical standards

– Package 1 (effective Aug 2025): modernised access standards for renewables, storage, HVDC
– Package 2 (draft Mar 2026): mandatory ride-through for IBLs above 30 MW at distribution
– Transmission-connected IBLs apply full Schedule 5.3 standards, regardless of size
– Fast ramp-down for UFLS & instability detection; final rule expected later in 2026

Network investment & cost recovery

– Cost-causation principle: incremental costs borne by developers creating the demand
– Cover their share of transmission and distribution infrastructure costs

centre development reflect each jurisdictions regulatory settings.

NSW hosts the largest concentration of data centre activity in Australia and has the largest pipeline of new projects. In 2025, the NSW government received around 3.67 GW of proposed capacity across 22 projects under the State Significant Development pathway[24]. In March 2026, 15 projects worth almost AUD52 billion were prioritised through the Investment Delivery Authority[25], which provides coordinated planning and cross-agency facilitation.

In the same month, Infrastructure NSW released a Data Centres Consultation Paper seeking stakeholder input on planning principles, cost recovery frameworks, and the potential role of regional locations in diversifying the pipeline beyond constrained metropolitan corridors[26]. Submissions closed in May 2026, with policy outcomes expected to inform planning framework updates later in the year.

Victoria has adopted a more integrated approach through its Sustainable Data Centre Action Plan (2026)[27], which coordinates planning, energy procurement, water management, workforce development, and innovation policy within a single framework. This reflects a deliberate policy choice to treat data centres as enabling infrastructure for the state's broader AI and digital economy strategy.

Across other jurisdictions, policy settings vary in specificity. South Australia has classified large data centres as essential infrastructure, enabling streamlined planning approvals. Western Australia is prioritising subsea cable connectivity to strengthen its latency position relative to Asian markets.

The frameworks described above establish the conditions under which data centre growth is expected to proceed. The grid implications of that growth, across network planning, infrastructure delivery, and system stability, are examined in Chapter 4. ■

GRID CHALLENGES

4

The demand growth documented in Chapter 2 is arriving at a point when Australia's electricity system is already under considerable planning and investment pressure. Coal-fired generation is retiring, renewable energy is being integrated at scale, rooftop solar and battery storage are growing, and transmission infrastructure is being expanded across the NEM. Each of these transitions carries its own planning, investment, and operational requirements. Data centre demand adds to this complexity by concentrating large new loads in urban network corridors where the options for rapid augmentation are most constrained.

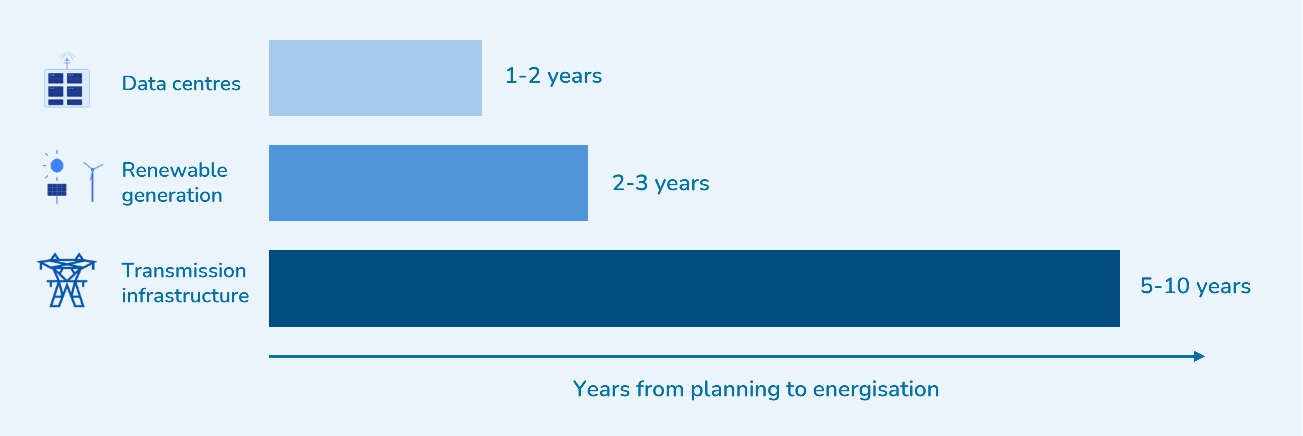
4.1 Infrastructure Delivery Complexities

Scale of system development required: Meeting projected demand growth requires transmission investment on a scale that has no direct parallel in the NEM's history. AEMO's 2026 Integrated System Plan (ISP) identifies approximately 6,000 km of new transmission lines to be delivered by 2050 across the NEM, an almost 14% extension of the current 45,000 km network[28].

Misaligned grid development timelines with load and generation: Delivering this investment is complicated by a timing mismatch. Renewable generation can be developed and commissioned within a few years, while transmission infrastructure requires five to ten years from planning to energisation. Data centre demand is growing faster than generation and transmission expansion combined and is concentrated in urban corridors where both network capacity and utility-scale renewable development are limited. Additional transmission capacity is needed to carry renewable energy from regionally located REZs to urban load centres, a requirement that will take years to deliver at the scale now projected. Speculative data centre grid connection requests are limiting the accuracy of forecasts, as a significant proportion of requests are withdrawn or scaled back each year.

Connection constraints within distribution networks: A large proportion of existing and proposed data centres connect at the distribution level, particularly in metropolitan areas such as Sydney and Melbourne, where large hyperscale facilities can require substantial upgrades to zone substations, feeders, and local distribution assets before connection can proceed. In some urban corridors, available capacity at the distribution-transmission interface is becoming a more immediate

Figure 5: Delivery Mismatch



constraint than bulk transmission capacity itself.

NSW and Victoria are managing connection enquiry pipelines measured in gigawatts, with individual data centre projects in some cases larger than any existing load on the network.

Geographical concentration of data centre development: These pressures are most acute in established data centre precincts where multiple projects are seeking connection within small geographic areas, and where the cumulative load growth is difficult to anticipate within standard network planning cycles. Addressing them requires earlier visibility of development pipelines and closer coordination between transmission and distribution planning processes.

Grid equipment supply chain constraints: Simultaneous demand from renewable energy deployment, grid expansion and modernisation, and data centre construction has contributed to a global shortage and unprecedented lead times for critical grid equipment, such as power transformers, high voltage switchgear, cables, and other substation equipment.

Although the equipment shortage has prompted new investments in manufacturing and supply chain modifications, it has affected the speed of network expansion and data centre construction in major economies across the world, including in Australia.

Large power transformer lead times have roughly doubled since 2020, from one to two years to two to four years, with HVDC cables now taking up to four years. This is slowing transmission and substation buildout, directly impacting data centre connection timelines.

Permitting delays: Social licence has emerged as a critical determinant of transmission delivery outcomes. Projects are increasingly facing delays, route changes, or cancellations due to community concerns over impacts on property values, agricultural land, visual amenity, environmental assets, and Indigenous heritage.

4.2 System Reliability and Stability Risks

Inverter-based instability and system disturbances: The most acute near-term stability risk associated with data centre growth is the simultaneous disconnection of large inverter-based loads during grid disturbances. In July 2024, a fault event in Northern Virginia, US, caused approximately 60 data centres to disconnect simultaneously, reducing load by an estimated 1,500 MW[29]. The challenge is not only to manage the behaviour of large inverter-based loads, but also to accurately model them in advance with high-fidelity and standardised industry-grade models so that their transient and power quality characteristics can be understood before connection.

The AEMC has identified analogous risks in the NEM, where geographically concentrated IBLs raise the potential for correlated disconnection during disturbance events. This directly informed its March 2026 draft connection standards rule, which introduces mandatory ride-through requirements for large loads.

System modelling uncertainty: In addition to challenges associated with modelling individual large loads mentioned above, maintaining accurate and up-to-date network models is also becoming more complex. This is making it more difficult to anticipate interactions between assets, assess system security risks, and evaluate the impact of potential contingency events.

Loss of system inertia: The system risks are compounded by the retirement of synchronous coal generation, which has historically provided the inertia, fault current, and voltage support to ensure power system stability. As coal exits the NEM, these services must be replaced. Options include synchronous machines such as synchronous condensers or gas-fired generation, as well as inverter-based solutions including grid-forming batteries and power-electronics-based devices. Large IBLs can exacerbate this vulnerability without appropriate connection standards in place.

Cooling Technologies and Water Use

The growing power density of AI infrastructure is changing data centre cooling requirements. Traditional air-cooling systems are now being supplemented or replaced by liquid-cooling technologies, including direct-to-chip and immersion cooling systems.

These technologies improve energy efficiency and enable higher rack densities but can alter facility water consumption profiles. Hyperscale data centres can consume between one and five litres of water per kWh of electricity used for cooling, depending on facility design and climate conditions. As data centre development expands into water-constrained regions, planners and policymakers are evaluating electricity and water requirements together.

Several Australian jurisdictions, including NSW and Victoria, are beginning to incorporate water management considerations into broader discussions around data centre planning and sustainability.

Inconsistency between data centre power demand and variable generation: Data centres also create distinct operational pressures at the network level. Unlike residential and commercial electricity loads, data centres require an uninterrupted power supply with limited scheduling flexibility for critical workloads such as IT services. AI-focused data centres differ further. Alongside a continuous baseload, demand can ramp up sharply during model training cycles and fall away once training concludes. Operators are also not currently required to notify the system operator ahead of these ramps, limiting visibility into sudden load swings.

Although grid-scale energy storage capacity is increasing in Australia, this compounding demand volatility amplifies the evening peak load ramp, making the system highly dependent on storage and gas-fired peaker plants. Unlike many industrial loads, data centre demand remains relatively inelastic and has historically provided limited demand response capability. Hyperscale operators are now actively exploring workload shifting and other flexibility mechanisms.

Infrastructure delivery constraints, system stability risks, and the pace of demand growth are interconnected, and responses in one area have implications for the others. Addressing them requires coordinated action across technology, market design, and regulation, and near-term operational measures to longer-term infrastructure investment. ■

KEY ENABLERS AND SOLUTIONS

5

Australia's data centre sector is growing at a pace that requires coordinated responses across generation investment, network technology, market design, and operational practice. A range of technology and market solutions is already being deployed in Australia, and a further set of technologies is maturing that could expand options for data centre operators and network planners over the medium term.

This Chapter examines these enablers, covering what can be built, deployed, and operationalised to support data centre growth while maintaining grid reliability and affordability, with a focus on technology and commercial solutions.

5.1 Ensuring Supply: Utility-Scale, On-Site, and Renewable PPAs

Meeting projected data centre demand will require parallel investment in new renewable generation and storage capacity. This investment occurs across three distinct levels. Utility-scale capacity is planned and built at the system level by AEMO, TNSPs, and generators. On-site capacity is built by individual data centre operators on their own campuses. Renewable Power Purchase Agreements (PPAs) and dedicated procurement connect data centre demand to off-site renewable projects, including through co-location.

5.1.1 Utility-Scale Renewable Capacity and Storage Expansion

Utility-scale generation and storage is the most significant lever for meeting Australia's overall electricity demand growth, of which data centre load is one component alongside broader electrification of the economy.

Australia's long-term system planning already factors this in. AEMO's 2026 ISP calls for 120 GW of grid-scale wind and solar and 40 GW of storage to meet rising NEM demand through 2050[30]. The storage options are distinguished as:

- 35 GW of shallow (typically <5 MW behind-the-meter battery owned by customers) and medium storage (typically 5-30 MW battery connected to the distribution grid) for intra-day firming, and
- 5 GW as deep storage (typically >30 MW connected to the transmission grid, such as pumped hydro facilities) for managing seasonal demands and renewable droughts

CEFC modelling indicates that data centre expansion will require additional renewable and storage capacity beyond these baseline projections. Without it, wholesale prices could rise by up to 26% in NSW and 23% in Victoria by 2035[31]. Adding a further 3.2 GW of renewable generation above baseline projections, together with 1.9 GW of additional grid-scale battery storage, would moderate these impacts, limiting price increases to around 3% in NSW and 2% in Victoria[31].

Battery energy storage systems (BESS), connected directly to the grid (front-of-meter assets), can perform multiple functions. These batteries charge during periods of low wholesale prices or high renewable generation and discharge during peak demand, reducing exposure to price volatility and network constraints. They can also participate in Frequency Control Ancillary Services (FCAS), wholesale market arbitrage, and demand response programmes.

5.1.2 On-Site Generation and Storage

This is distinct from utility-scale system planning. Data centre operators can build their own generation and storage on-site to manage part of their power supply directly.

Hybrid on-site energy systems: Hybrid energy configurations combining grid supply with on-site generation and storage are becoming a viable strategy for managing the growing power requirements of data centres. These systems reduce peak grid imports, improve operational resilience, and provide renewable additionality beyond what standalone PPAs typically achieve.

In the Australian context, the most commercially mature on-site solutions are large-scale solar photovoltaic (PV) systems paired with BESS, particularly at campuses with sufficient land availability. Solar reduces daytime grid imports while battery storage manages variable renewable output, optimises electricity procurement, and enhances energy security. On-site generation and storage also help manage the ramp up and ramp down for AI data centres.

These on-site batteries sit behind the meter, sized to serve the site's own load, in contrast to the front-of-meter utility-scale batteries described in Section 5.1.1. As solar and battery costs continue to decline, the economic case for these configurations is strengthening.

Designing, building, and operating on-site generation and storage solutions is a specialised undertaking that sits outside most data centre operators' core business. Third-party ownership and energy-as-a-service models can address this challenge. Specialist developers finance and operate on-site energy assets under long-term agreements, lowering upfront capital requirements for operators. On-site BESS can also participate in the FCAS market by partnering with specialised energy retailers, technology providers, or aggregators.

5.1.3 Renewable PPAs and Dedicated Procurement

Another pathway to securing electricity supply involves data centre operators contracting directly with off-site renewable projects, often anchored to a REZ, or co-locating within REZ infrastructure itself.

REZs are geographical areas identified within the NEM for the development of clusters of large-scale renewable generation, concentrated in locations with the strongest solar and wind potential and connected to the grid through dedicated transmission infrastructure. The REZ programme, encompassing 44 potential zones identified through AEMO's ISP process[32], uses this framework to direct new generation investment to the locations where it can be built most efficiently.

Long-term PPAs linked to REZ projects, including through direct co-location with REZ infrastructure, deliver benefits across the value chain. For data centre operators, particularly hyperscalers shifting from passive grid consumption to self-sufficient supply, anchoring demand to a REZ project helps bypass grid connection queues and accelerate construction timelines.

For renewable energy developers, these long-term contracts provide the revenue certainty that underpins project financing. For network planners and operators, REZ-anchored or co-located demand reduces the transmission distance between generation and load, improves utilisation of renewable resources, and provides a more bankable demand signal than dispersed metropolitan connection enquiries. The Keppel Hazelwood project, introduced in Chapter 2, is the most developed Australian example of this model, combining access to high-voltage transmission, renewable generation, water availability, and long-haul fibre connectivity within a single integrated precinct.

5.2 Network Investment and Grid Expansion

Transmission and distribution infrastructure must expand in parallel with generation. According to AEMO's 2026 ISP, around 6,000 km of new transmission will be needed across the NEM by 2050[28]. This is a near-14% extension of the existing

45,000 km network, of which 3,500 km is already committed or anticipated[28]. Roughly 40% of this build strengthens interstate interconnection, while the remaining 60% connects new REZ capacity within states to demand centres, including large loads such as data centres[28].

Transgrid's 2028 to 2033 regulatory determination will set the investment envelope for the period of peak data centre demand growth in NSW. AusNet has proposed a 115% increase in capital expenditure for 2027 to 2032, driven partly by upgrades to high-voltage nodes serving large data centre connections in Melbourne[33]. Several major transmission projects relevant to data centre growth corridors in NSW and Victoria are already under construction or in advanced planning, with completion dates ranging from 2027 to 2029.

Investment security for new grid investment depends on three interrelated enablers: long-term, holistic, and coordinated planning; anticipatory investment ahead of confirmed demand; and early, meaningful stakeholder engagement, each reinforcing the others.

Long-term, holistic, and coordinated planning: Forward-looking, holistic, and integrated planning is essential to manage the grid infrastructure development and modernisation. Traditional network planning cycles need to consider time horizons of 20-25 years and coordinate electricity grid and network implications in conjunction with generation and load planning.

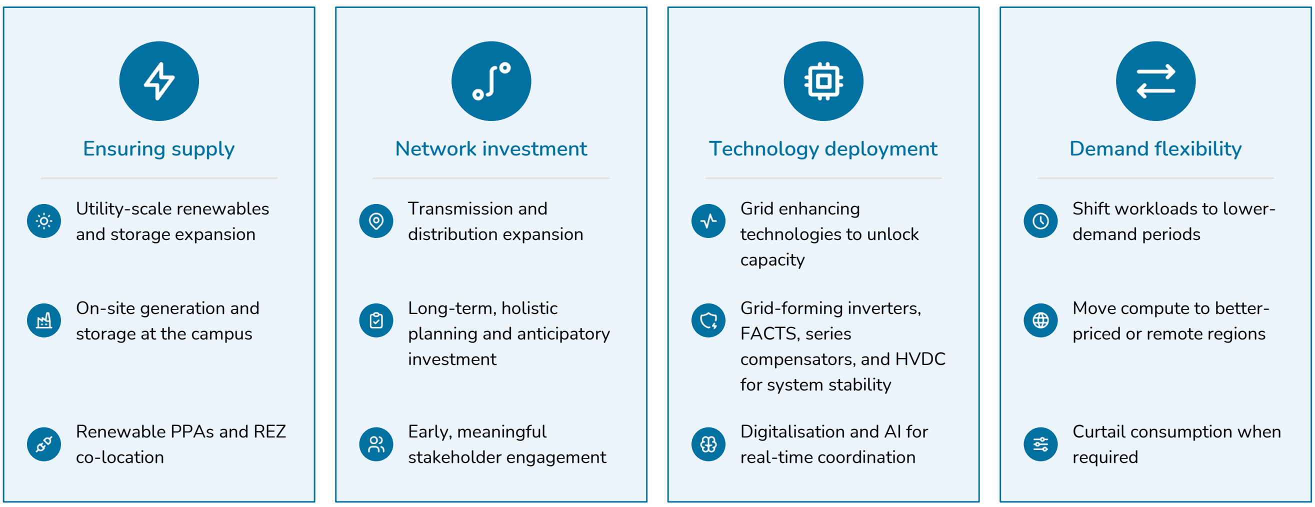
AEMO's ISP already builds this in. It plans out to 2050, and integrates generation, storage and network investment within a single optimal development path rather than as separate planning streams. What has not kept pace, perhaps, is execution. TNSP capital programmes and the Australian Energy Regulator's (AER) revenue determinations are still set on shorter five-year cycles, which can lag behind the system-level view the ISP provides.

Moving from project-by-project approaches towards multi-project, programmatic approaches can help close this gap and significantly accelerate grid development. Furthermore, the relationship between grid developers and equipment manufacturers needs to evolve from transactional procurement to long-term strategic partnerships that allow for co-developed projects. This enables coordinated grid development, reduces administrative burden, and supports scaling through replication.

Large data centre connections require not only additional generation and grid capacity, but also timely access to power transformers, medium- and

Figure 6: Key Enablers and Solutions

Four coordinated levers to support data centre growth while maintaining grid reliability



high-voltage switchgear, and protection systems. For hyperscale and AI-driven campuses, transformer procurement needs to be addressed during site selection and feasibility assessment. Longer lead times for large power transformers can impact energisation schedules and phasing strategies. To mitigate this risk, developers, NSPs, and technology providers should collaborate for earlier demand visibility, standardised transformer and substation designs, framework agreements, capacity reservations, and phased energisation strategies.

Anticipatory investments to improve demand visibility: Planning of grid development in response to confirmed connection requests has led to long interconnection queues across major markets, including in Australia. Adopting a proactive rather than reactive approach to transmission planning and development can provide increased demand visibility to grid equipment manufacturing supply chain and generate a timely manufacturing response.

AEMO's ISP already does this for transmission. It identifies 'actionable' projects that can proceed ahead of individual connection applications, based on system-wide net benefit rather than confirmed demand. The connection process itself remains a key bottleneck, still largely first-come, first-served. AEMO's Connections Reform Initiative, with the Clean Energy Council (CEC) and over 100 industry stakeholders, is addressing this through a Streamlined Connection Process covering pre-application, assessment and commissioning, including for large loads such as data centres.

Stakeholder engagement: Delivering this scale of infrastructure requires more than technical planning and regulatory approval. Early, meaningful, and transparent engagement with communities, landholders, and Traditional Owners before finalizing routes prevents the 'decide-announce-defend' cycle that triggers legal appeals and planning gridlocks. Embedding local feedback into project design and establishing clear accountability can be effective in building the social license for planned grid developments. Without broad community acceptance, the pace of transmission expansion required to meet rising demand will be difficult to achieve.

Technologies to accelerate grid expansion are already available. HVDC transmission is a key example. It enables long-distance power transfer with lower losses and greater controllability than conventional AC networks. This makes it particularly effective for interregional connections and for delivering renewable energy from remote REZs to major load centres. HVDC also contributes to system stability, covered in more detail in Section 5.3.2.

5.3 System Optimisation: Capacity Enhancement, Stability and Digitalisation

Advanced grid technologies, digitalisation and AI improve the utilisation, flexibility and reliability of Australia's electricity system, helping it meet rapidly growing demand from data centres without relying solely on new generation and transmission investment. They contribute in three related ways: unlocking additional capacity from assets that already exist, maintaining stability as both generation and large loads shift towards inverter-based technology, and coordinating it all intelligently in real time. Digitalisation and AI cut across all three, but contribute most directly to the third, adding the optimisation and coordination layer that lets the underlying physical technologies work together as a system.

5.3.1 Unlocking Additional Capacity: Grid Enhancing Technologies

Given the extended lead times associated with new transmission infrastructure, a range of technologies, collectively known as Grid Enhancing Technologies (GETs), can unlock additional capacity from existing transmission infrastructure, often at much lower cost and on much shorter timelines than new construction.

Dynamic Line Rating (DLR): Much of Australia's transmission system is operated using conservative static ratings based on worst-case ambient conditions. DLR systems use real-time measurements of conductor temperature, wind speed, solar radiation, and other environmental factors to continuously calculate the actual safe operating capacity of transmission lines. International deployments have demonstrated conductor capacity increases under favourable climate and geographical conditions.

Advanced Conductors: Replacing existing conductors with advanced high-capacity alternatives, such as composite-core cables, can significantly increase power transfer capability while reusing existing towers and easements. This avoids the land access and environmental approvals that extend new-build timelines.

Advanced Power Flow Controllers (APFC): In AC systems, power flows naturally towards paths of least impedance rather than operator intent, which can leave some lines congested while parallel assets remain underutilised. APFCs are power-electronics devices that actively redistribute electricity across available pathways, improving asset utilisation and increasing effective network capacity.

Network Topology Optimisation: Using real-time system models and automated switching algorithms, operators can determine the optimal configuration of circuit breakers in real time, rerouting power around congested paths dynamically and without any physical infrastructure change.

Some network operators have begun pilot projects. Transgrid has piloted real-time network monitoring technologies in NSW as a precursor to broader DLR implementation. Adoption of GETs in the NEM may still be limited, but recognition of their potential is growing among network planners and operators. As regulatory frameworks mature and technology costs decline, adoption is expected to accelerate, particularly in corridors where data centre demand is concentrating, and new transmission is years away.

5.3.2 Maintaining Stability: Advanced Technologies

As NEM transitions towards a more inverter-based system, maintaining reliability and stability becomes even more important. Solutions such as batteries alone may not be sufficient to provide the grid stability required as AI data centres scale. Advanced GETs that can play an essential role in ensuring grid stability include:

Grid-Forming Inverters (GFI): These devices can actively establish and maintain system voltage and frequency, enabling non-synchronous renewable energy sources such as wind and solar to provide services traditionally supplied by synchronous generators.

As inverter-based resources make up a larger share of NEM supply, these technologies will play an increasingly important role in maintaining system strength. TNSPs such as Transgrid are already incorporating grid-forming battery capacity into their NSW system strength portfolios. Scaling this up will require coordinated adoption, supported by a dedicated grid code for power-electronics-based resources and market mechanisms that support the business case, as grid-forming converters become increasingly ubiquitous.

Flexible AC Transmission System (FACTS): While recent reform measures, such as Package 1 mentioned in Chapter 3, improve the ability of grid-forming inverter technologies to meet NEM connection requirements, they remain largely focused on generation assets such as renewable energy plants. As power electronics-based loads and grid devices become more prevalent, consideration should also be given to the potential role of additional converter-based technologies, including Static Synchronous Compensators (STATCOMs) and other FACTS devices, in providing grid-forming services and supporting system stability.

Mature FACTS technologies such as Static VAR Compensators (SVCs) and STATCOMs can provide fast reactive power support and voltage regulation. E-STATCOMS can further provide active power support through the integration of battery systems.

FACTS can be deployed across both transmission and distribution networks, including at generation connection points and major load centres. STATCOMs can improve power quality and respond within milliseconds, making them particularly relevant for large industrial loads and data centres that are sensitive to localised voltage fluctuations. Planners need to consider grid-forming FACTS applications to support grid stability and reliability.

HVDC: Unlike AC systems, where power flows are governed by network impedance, HVDC links allow operators to schedule and control power transfers directly. HVDC systems with grid-forming controls can also contribute to system stability as inverter-based resources become more prevalent.

Marinus Link Stage 1, a proposed 750 MW HVDC interconnector between Tasmania and Victoria with a planned commissioning date of 2030, would connect Tasmania's hydro resources to mainland demand centres and strengthen NEM-wide supply reliability. As renewable development expands in regions distant from major load centres, HVDC infrastructure is expected to play a growing role in supporting large electricity users, including data centres.

Series Compensators: In high-voltage transmission lines, series compensators can be deployed to neutralize line inductive reactance, thereby increasing power transfer capability, enhancing transient stability, and optimizing active power flow. Solutions include conventional transmission equipment such as Fixed Series Compensators (FSC) and power-electronics-based Thyristor Controlled Series Compensators (TCSC) and Static Synchronous Series Compensators (SSSC).

5.3.3 Operating Intelligently: Digitalisation and AI

Digitalisation and AI provide the intelligence layer that enables advanced grid technologies to operate more effectively. By connecting physical network assets through sensors, advanced monitoring systems, digital substations and secure communications, network operators gain real-time visibility of network conditions, including power flows, voltage performance, congestion and asset health.

Digitalisation thus supports more proactive network management and better assessment of new connections, including large data centre loads. Crucially, this real-time visibility also hardens the grid against external shocks, enabling predictive fault detection during extreme weather hazards and securing the network against cyber threats.

Advanced analytics and digital twins build on this data to simulate scenarios, assess new connections, and identify constraints before they occur, including the real-time topology changes discussed as a GET in Section 5.3.1. These capabilities are operationalised through control systems such as Energy Management Systems (EMS), Advanced Distribution Management Systems (ADMS) and Distributed Energy Resource Management Systems (DERMS), increasingly delivered as integrated platforms rather than separate tools.

Wide area monitoring, protection, and control (WAMPAC) systems combine real time monitoring with protection and control functionality. Furthermore, they can leverage AI functionalities using high-frequency phasor measurement data, allowing distributed inverter-based resources, Intelligent Electronic Devices (IEDs), STATCOMs, and HVDC terminals to provide coordinated damping response, reducing the risk of widespread outages. AI is similarly being applied to asset management, helping predict equipment failures and extend asset life.

Within data centres, AI supports predictive thermal management, workload scheduling and predictive maintenance, thus routing computing tasks to times and locations where energy is cheapest and cleanest, and improving infrastructure efficiency. It can also support participation in demand flexibility services where feasible, consistent with the ECMC's expectation that large loads become active participants in the energy system rather than passive consumers.

At the grid level, AEMO and network operators are applying machine learning to demand forecasting, a task already being made harder by large, uncertain data centre loads. The federal government's data centre Expectations framework already requires data centres to share consumption data with AEMO and network businesses. This is a step towards the operational visibility that more integrated grid management requires.

Advanced grid technologies, digitalisation and AI are not substitutes for investment in new transmission infrastructure. Rather, they complement network expansion by unlocking additional capacity from existing assets, strengthening system security and improving operational efficiency, helping accommodate rapidly growing electricity demand while larger infrastructure projects are delivered.

5.4 Demand Flexibility and Load Shifting

Demand-side flexibility is one of the most cost-effective mechanisms for integrating large data centre loads into the electricity system, creating value for both operators and the broader grid.

The greatest opportunity lies in shifting non-time-critical workloads to periods of high renewable generation and lower wholesale prices. Suitable applications include AI model training, batch processing, data replication, and other delay-tolerant computing tasks.

Not all workloads are suitable. Latency-sensitive AI inference, real-time applications, and mission-critical services have strict performance requirements that limit operational flexibility. Nevertheless, even modest flexibility across a portfolio of facilities can reduce peak demand, alleviate network congestion, and support grid reliability.

International experience demonstrates that these approaches are feasible. Operators including Google, Microsoft, and Amazon are actively exploring workload shifting, geographic load balancing, and AI-enabled scheduling tools to align electricity consumption more closely with renewable generation availability and network conditions.

Data centre demand flexibility can be delivered through three principal mechanisms:

- **Timing:** shifting workloads from periods of network stress to periods of lower demand or higher renewable generation.
- **Location:** moving computational tasks between facilities or regions with different electricity prices, grid conditions, or renewable energy availability.
- **Magnitude:** temporarily reducing or curtailing electricity consumption when required.

Demand flexibility is also gaining recognition in Australia as a valuable system resource. All ECMC jurisdictions except Queensland have agreed that data centres should provide demand flexibility services where feasible. The AEMC has been tasked with developing an appropriate framework to facilitate participation.

The enablers described in this Chapter span a wide range of timescales and levels of commercial maturity, from near-term operational flexibility to longer-term investments. The most effective outcomes will come from combining the relevant solutions reflecting geography, resource endowment, regulatory settings, and the characteristics of each state's data centre pipeline. ■

CONCLUSION

6

Australia's data centre sector is expanding at a pace the electricity system was not designed to accommodate. Transmission connection queues, revised load forecasts, and accelerating network capital programmes are each a reflection of a demand transition already underway.

Three main conclusions emerge from the analysis.

First, the gap between demand growth and infrastructure delivery is the binding near-term constraint. While data centre capacity can be financed, contracted, and brought online within a short development cycle, that is not the case with grid infrastructure. This mismatch is structural, not cyclical, and reflects the realities of planning approval timelines, regulatory sequencing, and construction lead times. The grid investments identified in AEMO's 2026 ISP, alongside more efficient and predictable connection processes, are pre-requisites for accommodating the volume of load progressing through connection processes.

Second, the policy architecture is broadly defined; it needs to be translated now into investment outcomes at the pace or scale the system requires. These frameworks clearly assign expectations around network cost contribution, renewable capacity investment, and demand-side participation. Cost allocation mechanisms, connection frameworks, and demand response participation rules will need to keep pace with the rate of market change.

Third, integration depends on coordination across technologies, institutions, and time horizons. The technology and commercial solutions under consideration are complementary rather than substitutable. No single intervention resolves the integration challenge. Outcomes will therefore be determined by the sequencing, alignment, and implementation of these measures across developers, network operators, and regulators.

These conclusions point to an implementation challenge rather than an intent, resource, or technology constraint. Australia's renewable energy endowment, established market institutions, and the depth of its infrastructure investment pipeline are not in doubt. What will determine outcomes is whether infrastructure delivery, regulatory design, and commercial practices advance in step with a demand transition that is already well underway. ■

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