



OXFORD  
ECONOMICS  
AUSTRALIA

# 2025 IASR PLANNING AND INSTALLATION COST ESCALATION FACTORS

REPORT FOR AEMO

FEBRUARY 2025

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## February 2025

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# TABLE OF CONTENTS

Executive Summary .....	3
1. Installation Cost Escalation Analysis .....	7
1.1 Introduction .....	7
1.2 Purpose .....	7
1.3 Methodology .....	8
1.4 Construction Supply Chain and Construction Costs .....	8
1.5 Demand and Supply Outlook .....	13
1.6 Cost Escalation Outlook .....	17
1.7 Results .....	18
1.8 Areas for Future Research .....	22
2. Lead Time Analysis .....	24
2.1 Introduction .....	24
2.2 Purpose .....	24
2.3 Methodology .....	26
2.4 Discussion of Key Drivers of Pre-construction Lead Times .....	27
2.5 Results .....	35
2.6 Areas for Future Research .....	45
Appendix A: Installation Cost Assumptions .....	47
Appendix B: Lead Time Assumptions .....	49
Appendix C: Development Approval Fees .....	51

# EXECUTIVE SUMMARY

2024 marked the hottest year on record, with global emissions continuing to rise, exacerbating the climate crisis. In Australia, emissions have not significantly decreased since 2020. This persistent challenge underscores the need for timely action to decarbonise Australia's energy infrastructure. Furthermore, the declining reliability and exit of coal to meet the needs of a well-functioning electricity grid necessitates new and sustainable sources of reliable energy generation. However, rapidly scaling up the delivery of renewable energy projects is challenged by supply chain constraints and escalating project costs and timeframes. These challenges must be addressed to ensure that Australia meets its ambitious climate goals and mitigates the severe impacts of climate change.

This report examines two key factors critical to the success of Australia's energy transition: installation costs and lead times for energy projects. Installation costs represent a substantial portion of the total development cost of energy infrastructure, making it essential to understand their dynamics in planning and budgeting. Similarly, lead times—the duration from project initiation to completion—are a key factor in determining how quickly Australia can build the infrastructure and install the equipment needed to meet its energy targets and replace Australia's aging fleet of coal generators. Understanding these components is crucial for ensuring that the country can rapidly scale its energy transition while keeping costs manageable.

Oxford Economics Australia (OEA) was engaged by the Australian Energy Market Operator (AEMO) to inform the assumptions to be considered in the 2026 Integrated System Plan (ISP) regarding the impact of supply chain disruptions on electricity infrastructure installation costs, and to enhance understanding of pre-construction and construction lead times. This report presents original analysis, quantitative results, and recommendations for further research on these topics.

## Supply Chain Impacts on Installation Costs

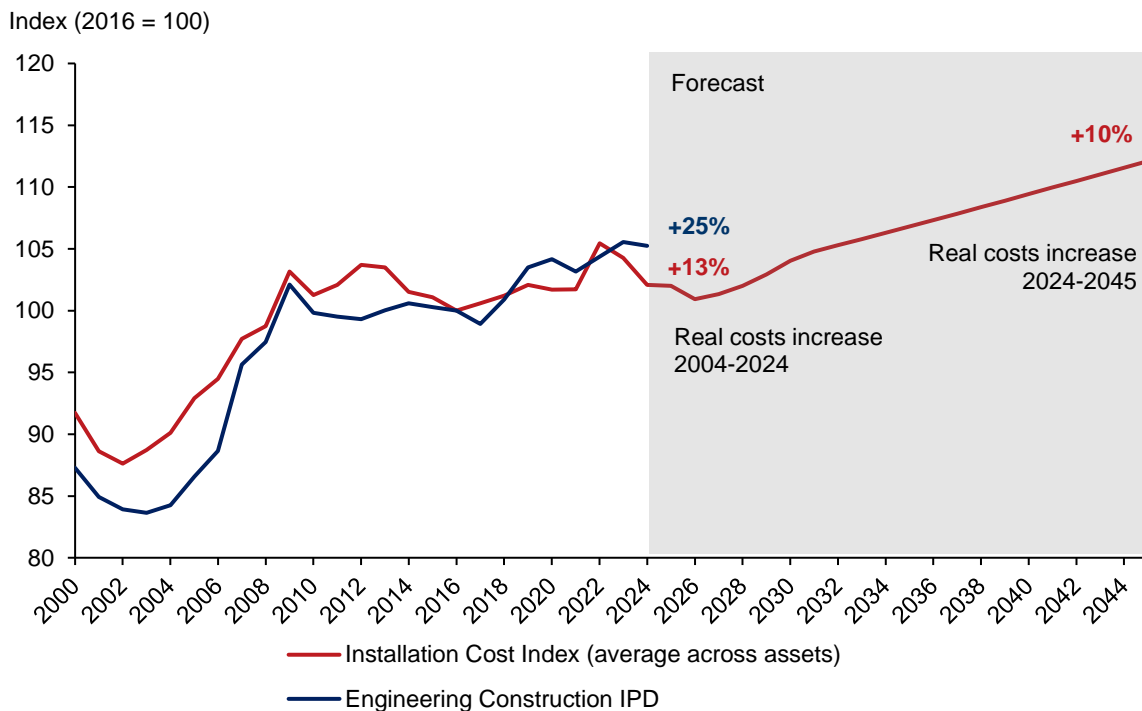
OEA's analysis builds upon previous work conducted by CSIRO in their *GenCost* reports, focusing specifically on isolating and quantifying changes in real (inflation-adjusted) installation costs. These installation costs play a significant role in shaping the real capital cost growth path of electricity technologies. OEA has developed an Installation Cost Index, which tracks real installation cost trends for 15 different electricity infrastructure assets across each of the five States considered in the ISP. The movement of this index provides insights into how real costs of installation for various technologies will evolve over time.

This analysis is intended as an input for CSIRO and AEMO to model the real capital cost growth path for electricity technologies over time. While the report addresses the impact of supply chain disruptions on installation costs, it does not include assumptions related to the costs of specialised technological equipment (e.g. wind turbines, gas turbines, PV panels, transformers, etc.), as these are influenced by other factors such as learning rates and technological advancements, as modelled by CSIRO. Thus, while the analysis focuses on the evolution of installation costs, it does not provide a comprehensive overview of the entire cost structure of electricity technologies.

The results of OEA's analysis suggest that, without significant improvements in construction industry productivity, real installation costs for electricity infrastructure are likely to rise in the coming years.

This pattern reflects historical trends, where long-term real growth in installation costs has already been observed. Real engineering construction costs have risen around 25% over the past 20 years (see Figure 1) while an average measure of real installation costs developed by OEA for this study has risen by 13% over the same period. Real installation costs are forecast to ease moderately over the next two years until FY26, before accelerating again toward FY30-31, when costs will be approximately 1-3% higher than FY24 levels. By FY45, real installation costs are expected to be around 10% higher than FY24 levels, consistent with long-run trends observed in the construction sector.

**Fig 1. Long-run trend of real construction cost growth as measured by the Installation Cost Index and the ABS’s Engineering Construction Implicit Price Deflator (IPD)**



Source: Oxford Economics Australia, Australian Bureau of Statistics (ABS)

Queensland is expected to experience the highest *growth* in real installation costs over the period to FY45, with an annual average increase of 0.6%, compared to 0.5% for New South Wales, 0.4% for Victoria and Tasmania, and 0.3% for South Australia. These regional differences are primarily driven by variations in forecast construction wage growth, which is influenced by broader economic factors such as demand for skilled labour across the construction industry.

The analysis also reveals that more labour-intensive asset types, such as traditional carbon-based generators (e.g. coal and gas plants), are expected to experience higher rates of real installation cost escalation. In contrast, modular and mechanised projects, such as onshore wind and electricity distribution, which require less labour, are expected to face lower real installation cost escalation.

## Lead Times for Energy Infrastructure

In addition to supply chain impacts on installation costs, OEA's analysis examines pre-construction and construction lead times across various asset types and jurisdictions. Building on previous work by Aurecon, this study provides State level estimates for the lead times of 15 infrastructure asset types in each region, drawing from a database of 579 energy infrastructure projects. OEA's projections also consider ongoing efforts by various levels of government to streamline planning approval processes, with the goal of reducing lead times and facilitating faster project delivery.

The findings indicate that total lead times for infrastructure projects vary across states, with the most significant differences driven by pre-construction lead times. Industry consultations have suggested that changes in project timelines are typically absorbed into the pre-construction period, highlighting the importance of streamlining this phase to reduce overall project duration and deliver the energy rollout quickly.

In general, estimated lead times in New South Wales are at or above the national average, while Queensland and South Australia tend to have shorter lead times for most asset types. Victoria and Tasmania typically experience lead times that are aligned to the national average. The variation in lead times is particularly pronounced for larger developments, projects involving emerging technologies, or in states with less experience in specific technologies.

## Further Research Directions

Given the evolving nature of the energy infrastructure landscape, this report identifies several key areas for further research to refine future modelling and forecasting efforts. As with the ongoing review of specialised equipment and technology costs, it is recommended that the Installation Cost Index and forecasts be updated annually to reflect changing supply chain conditions and broader construction industry demand.

Future research could explore regional differences in installation cost escalation within states, as supply chain challenges and construction profiles may vary significantly between regions. In particular, areas with high concentrations of Renewable Energy Zones may face unique challenges that influence cost escalation and project delivery.

Another area of potential research is the escalation of non-project construction costs, such as the costs associated with enabling infrastructure. These include regional road upgrades and other necessary infrastructure developments to accommodate the transportation of large equipment. Incorporating these costs into future analyses would provide a more accurate estimate of the total cost structure for energy infrastructure projects.

Additionally, there is considerable value in investigating the construction industry's productivity challenges. By identifying the root causes of poor productivity and exploring potential solutions, it may be possible to mitigate the modelled growth in installation costs over the long term. Improving productivity within the construction sector is crucial for ensuring that energy infrastructure projects are delivered on time and within budget.

Finally, expanding the scope of research related to project lead times may be useful. Conducting more granular, intra-state analysis of lead times would help to understand the impact of local planning

processes, especially in high-priority regions or for specific asset types. Understanding the impact of longer pre-construction lead times on project costs, as well as potential efficiency gains from “learning by doing” in projects developed in close proximity to each other, could provide valuable insights into how to optimise project delivery.

### **Conclusion**

The findings in this report provide critical insights into the factors that drive the cost and timelines of electricity infrastructure projects in Australia. By understanding the dynamics of installation costs and lead times, industry stakeholders, policymakers, and planners can better navigate the challenges of scaling up the nation’s energy infrastructure to meet decarbonisation targets. Addressing these challenges will be key to ensuring that Australia can accelerate its transition to a low-carbon future, while managing costs and meeting its climate goals.

# 1. INSTALLATION COST ESCALATION ANALYSIS

## 1.1 INTRODUCTION

Oxford Economics Australia (OEA) was engaged by AEMO to enhance assumptions relating to supply chain impacts on electricity infrastructure installation costs for the 2026 Integrated System Plan (ISP).

To do so, OEA has developed a quantitative measure of installation cost escalation (an Installation Cost Index) specific to the installation of 15 different electricity infrastructure assets across each of the five jurisdictions considered in the ISP.<sup>1</sup> The Installation Cost Index is a measure of the real cost of installing or constructing each technology on site. It excludes changes in the cost of specialised equipment (e.g. wind and gas turbines, PV panels, transformers, electrolyser units, etc.) and enabling infrastructure such as road widening.

Changes in the Installation Cost Index (based at 100 in 2024) effectively represent the real change in installation costs over time due to the rise or fall in the prices for key materials (e.g. concrete, steel) and labour inputs. The prices for these materials and labour inputs are in turn influenced by dynamic demand (i.e. construction industry activity) and supply chain factors, both domestic and international.

## 1.2 PURPOSE

This work builds on previous work by CSIRO's *GenCost* reports by isolating and quantifying movements in real (i.e. inflation-adjusted) installation costs which contribute to the real capital cost growth path of electricity technologies over time. The share of total costs driven by installation (as distinct from the cost of purchasing specialised electricity plant and equipment) varies significantly by technology as reported by Aurecon and so the impact of movements in installation costs on the overall capital cost growth path will also differ by technology.<sup>2</sup>

This work is intended to be used as an input for CSIRO and AEMO in the modelling and quantification of the real capital cost growth path of electricity technologies over time. An important finding of this analysis is that real installation costs for electricity assets, absent improvements in construction industry productivity, are likely to rise over time, mirroring long run historical experience.<sup>3</sup> Real growth in installation costs is likely to differ substantially from real growth in the costs of specialised electricity plant and equipment as the latter will disproportionately derive cost *benefits* over time from economies of large-scale manufacturing, innovation and learning.

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<sup>1</sup> The list of electricity assets covered in this analysis is provided in Appendix A. Note that Electricity Transmission considered in this report is a broad single categorisation and does not consider individual technologies or subcomponents.

<sup>2</sup> Aurecon (2024) *2024 Costs and Technical Parameter Review*

<sup>3</sup> Productivity growth in the construction industry is assumed to be zero for this analysis. This is close to currently available long run measures of construction industry multifactor productivity reported by the ABS which show an annual average productivity *decline* of -0.1% since 1990. Other assumptions used in the modelling for this chapter are presented in Appendix A.

### 1.3 METHODOLOGY

The Installation Cost Index for each asset is derived via a bottom-up approach in which the prices for individual inputs to installation (e.g. labour, materials and construction plant and equipment) are forecast, based on supply-demand dynamics, then a weighting is applied to each input based on the proportion of each inputs' contribution to the overall installation cost. The weighted inputs are then summed to produce the Installation Cost Index.

Figure 2 presents a general equation for the index, where for each *asset* in a given *year*,  $\Delta Price$  is the change in price of each input, and *Weight* is the inputs share of total installation cost for each asset.

**Fig 2. General equation for the Installation Cost Index**

$$Index_{year}^{asset} = Index_{year-1}^{asset} * \sum \Delta Price_{year}^{input} * Weight_{asset}^{input}$$

The selection of inputs and their weights were based on desktop research and consultation with industry (see Appendix A). ABS Producer Price Indexes and Wage Price Indexes were then selected for each input to capture the historical price movements of the inputs.

Changes in the price of inputs were empirically modelled to identify the historical relationship between the price of the input, the supply of key intermediate inputs (e.g. iron ore for steel production) and the demand for the input (e.g. construction activity).<sup>4 5</sup> These historical relationships were then applied to the outlook for supply and demand variables to produce a forecast for the price movements of each input over time.

### 1.4 CONSTRUCTION SUPPLY CHAIN AND CONSTRUCTION COSTS

Installation costs are impacted by demand and supply side factors affecting the prices of construction inputs. Historically, rapid or sustained increases in the level of domestic construction activity (demand) have coincided with periods of heightened construction cost inflation (referred to as cost escalation). This is because construction supply chains can be placed under greater strain when there is an upswing in construction activity, particularly when there is very strong growth in demand or the level of activity surpasses previous peaks. To meet demand in these circumstances, new output capacity may need to be added, or additional employment recruited and trained, which may not occur quickly enough to meet rising demand, resulting in rising prices for materials and wages.

Construction costs can also rise due to supply side shocks independent of construction activity. In particular, construction costs can vary due to changes in 'globally determined' commodity prices for key imports (including steel and oil), as well as variations in exchange rates. During the early 2020s, supply side shocks from Covid-19 (which disrupted industrial production as well as transport and shipping costs) and, later the conflict in Ukraine (which impacted global supplies of energy and timber products) both contributed to a surge in construction cost escalation.

<sup>4</sup> Australian Bureau of Statistics (September 2024), Producer Price Indexes, Australia, ABS Website

<sup>5</sup> Australian Bureau of Statistics (September 2024), Wage Price Index, Australia, ABS Website

Notwithstanding these events, the ability to access additional supply of construction inputs via imports can help mitigate the risk of cost escalation. However, relative to other industries, the construction sector relies on a greater proportion of material inputs, particularly material inputs which are only economical to source domestically or even regionally (e.g. quarry materials, concrete and timber). As a result, significant increases in domestic construction activity can place relatively greater stress on the construction supply chain relative to other industries.

### 1.4.1 Long Run Construction Costs

The value of electricity infrastructure construction in Australia is captured in the Engineering Construction Survey, published quarterly by the ABS since the mid-1980s.<sup>6</sup> Since the inception of this release, growth in the Engineering Construction Implicit Price Deflator (a broad measure of price growth in engineering construction work done) has averaged 3.4% growth per annum against 3.1% per annum average growth in the Consumer Price Index (CPI).<sup>7</sup> Since the 2000s, this difference has only become starker, with the Engineering Construction Implicit Price Deflator (IPD) growing at an average rate of 3.7% per annum against 2.8% per annum average growth in the CPI.

The significance of engineering construction costs outpacing broader inflation is that construction costs grow in real terms over the long run. Inputs to construction are very different to the basket of goods and services captured by broader price indices such as the CPI and so it is not unusual that growth in construction costs is not aligned to CPI growth over the long run.

In particular, three key characteristics of the construction supply chain have contributed to the real increase in engineering construction costs since the 2000s:

- The construction sector is more exposed to the volatile prices of raw commodities such as oil, coal, copper and quarry products, and upstream manufactured products such as steel, cement and concrete. The prices local suppliers pay for domestically sourced energy commodities, such as gas and thermal coal, are also generally set by international markets given Australia’s increasing integration into the global economy.
- Real wage growth in the construction sector has typically outpaced both CPI and the national average growth in wages (Figure 4). Real construction wages averaged 0.9% annual growth over 2000 to 2019<sup>8</sup>.
- Real wage increases have not been met with sustained improvements in productivity, which has meant increasing wages have resulted in increased costs to delivery (Figure 4)

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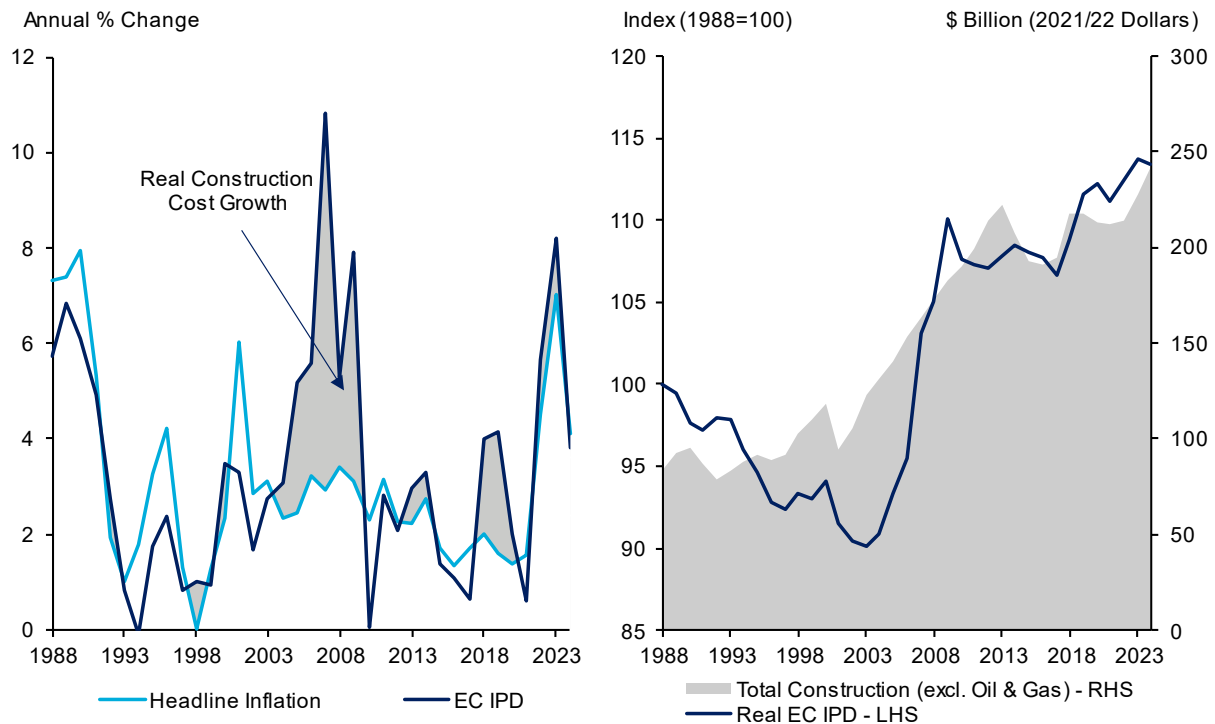
<sup>6</sup> Australian Bureau of Statistics ‘Engineering Construction Activity, Australia,’ ABS Website. Importantly for this analysis, the survey focuses on the onsite installation, assembly and erection costs of electricity generation, transmission and distribution infrastructure and excludes the cost of machinery and equipment purchased separately and not an integral part of the structure (this includes the cost of turbines and other generation technologies which are also excluded from this analysis).

<sup>7</sup> The Engineering Construction Implicit Price Deflator is explicitly derived over time by dividing the nominal (or ‘current price’ value of total engineering construction by its real (or ‘constant price’) counterpart, with both series published by the ABS in the Engineering Construction Survey.

<sup>8</sup> As measured by the Australian Bureau of Statistics’ Wage Price Index (WPI). This figure excludes 2001 given the artificial inflationary shock produced by the introduction of the GST.

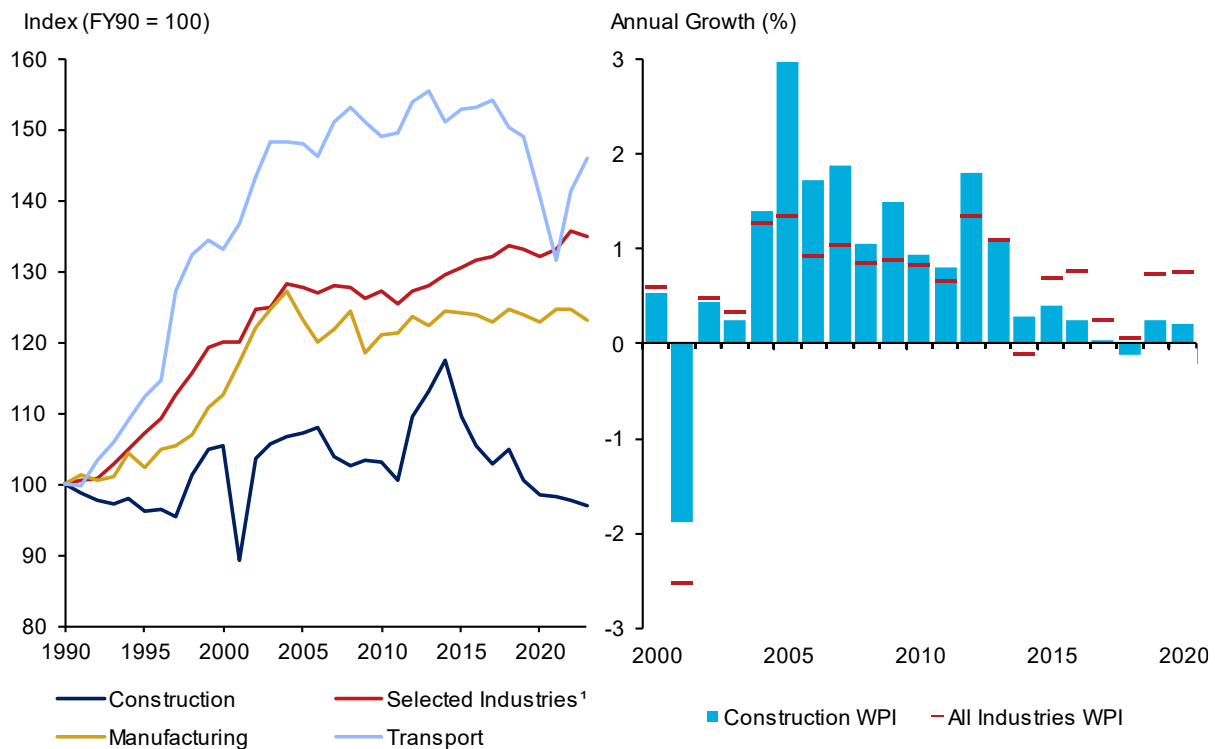
The starkest example of demand driven cost escalation in the construction sector occurred over the second half of the 2000's, when the mining boom prompted a surge in mining, transport and utility related construction (both directly from investment in mining activities and indirectly from wider economic stimulation). A 50% rise in total construction from 2003 to 2009 coincided with a 22% increase in the Engineering Construction IPD as domestic supply chains were put under significant stress. In particular, strong demand for labour over this period led to construction wage growth greatly outpacing the national average and contributing significantly to rising engineering construction costs. Cost escalation began easing over the first half of the 2010s as the level of construction activity peaked and domestic supply chains adjusted. However, cost escalation never reversed even as construction activity eased back and the price levels of key materials and labour remain well above their 2000s levels.

**Fig 3. Left: headline inflation and engineering construction IPD. Right: real engineering construction costs and total construction activity.**



Source: Oxford Economics Australia

**Fig 4. Left: construction sector and related industries productivity. Right: construction and all industries real wage increases**



Source: Oxford Economics Australia

1. Selected Industries includes the following: Agriculture; Forestry and Fishing; Mining; Manufacturing; Electricity; Gas; Water and Waste Services; Construction; Wholesale Trade; Retail Trade; Accommodation and Food Services; Transport, Postal and Warehousing; Information, Media and Telecommunications; Financial and Insurance Services; Arts and Recreation Services.

### 1.4.2 Recent Supply Chain Challenges

The past five years has seen renewed cost escalation in the construction sector, with supply chain constraints from the Covid-19 pandemic and the conflict in Ukraine coinciding with strong growth in construction activity (demand). Infrastructure Australia’s 2024 *Market Capacity Report* notes that “for years, demand has been outweighing supply leading to cost increases and project timelines being delayed.”<sup>9</sup>

In 2020, the Covid-19 pandemic, and particularly the policy responses to mitigate the spread of the virus created a substantial supply-side shock, with global lockdowns and border closures causing significant disruptions to industrial production as well as global shipping and transport. The initial loosening of pandemic restrictions in 2021 drove a sharp rebound in global economic activity (demand), which placed pressure on fragile supply chains impacting prices.

These pressures were exacerbated by a further supply chain shock – the Russian invasion of Ukraine in early 2022, which created an energy commodity crisis resulting in surging prices for energy, steel and timber products. Construction cost escalation was further exacerbated by increased import costs due

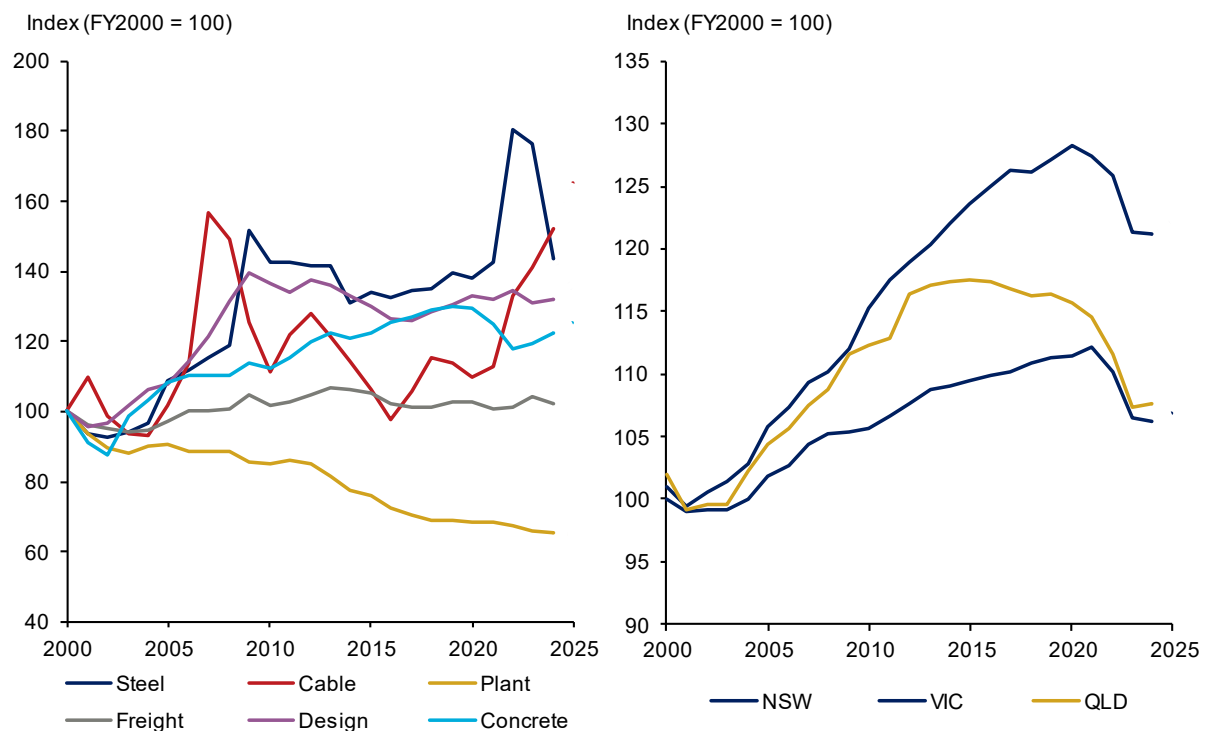
<sup>9</sup> Infrastructure Australia (2024) *Infrastructure Market Capacity 2024 Report*, p4.

to a depreciation in the Australian dollar, rising shipping costs due to reduced shipping capacity, and other supply disruptions related to the pandemic (including weak industrial production out of China due to their ongoing, prolonged lockdowns). Domestically, higher levels of household savings during the pandemic provided a basis for consumption to strengthen, while fiscal stimulus targeted at infrastructure and housing continued to drive up demand for local construction materials.

Many of the global supply chain pressures, such as shipping and commodity prices, have moderated over 2024, which has contributed to slower nominal growth in construction cost escalation (as measured by indices such as the engineering construction IPD). While global supply chain risks remain, domestic supply chain challenges have re-emerged as the key driver of growth in Australian construction costs.

In particular, the Australian infrastructure market remains challenged by a shortage of skilled labour to meet demand. Infrastructure Australia’s 2024 *Market Capacity Report* estimates a shortage of 197,000 infrastructure workers as of August 2024 – a 13% decrease from the shortage of 229,000 workers predicted in 2023.<sup>10</sup> The tight labour market is contributing to a significant acceleration in nominal wage growth, in both the construction industry as well as key supply chain sectors such as manufacturing. While real wages in the construction industry fell significantly as inflation surged in recent years, new wage bargains in the construction industry are expected to lock in real wage growth in coming years.

**Fig 5. Left: real prices for key construction inputs. Right: real prices for state level construction wages. Dotted lines denote estimates for FY25**



Source: Oxford Economics Australia

<sup>10</sup> Ibid, p51.

## 1.5 DEMAND AND SUPPLY OUTLOOK

For the construction sector as a whole, demand is captured by the ABS's Construction Work Done release which measures the level of activity directly associated with on-site construction. Nationally, Oxford Economics Australia expects construction activity to reach record levels by the end of the decade, excluding for oil and gas.<sup>11 12</sup> This will be underpinned by significant new investment in the residential sector and several policy priorities including the energy transition. On the supply side, domestically sourced inputs materials are expected to be put under moderate pressure, whilst construction labour supply is set to tighten, particularly for skilled labour.

### 1.5.1 Demand Outlook

National construction activity reached a record \$242bn in FY24, surpassing the previous mining boom induced peak of \$223bn in FY13.<sup>13</sup> Moving forward, the level of national construction activity is forecast to continue strengthening steadily in real terms, rising a cumulative 13% to \$274bn by FY30.

At the sectoral level, residential building construction activity is forecast to surge over the back half of the decade, rising to over 40% on FY24 levels by FY30 (from around \$70bn to \$100bn, annually). Several years of pent-up dwelling demand and easing borrowing costs will stimulate a surge in private residential investment. Furthermore, government housing targets and supportive policies will help facilitate the next upswing in residential construction.

Engineering construction activity is set to continue rising over the near term on the back of publicly funded transport infrastructure and renewed mining investment. However, the completion of several major transport projects over the back half of the 2020s will see overall engineering construction activity ease back from around FY27. Transport infrastructure investment has been a key driver of construction activity over the 2020s, although it is anticipated that this will shift towards the utilities sector over the 2030s as investment in water supply and electricity generation and transmission steps up to meet the needs of both a growing population and the energy transition. Overall, engineering construction activity is forecast to be at a similar (real) level in FY30 compared to FY24, at around \$115bn, with a modest uptick then downturn during the intervening years.

It is worth noting that residential construction is relatively more labour intensive per dollar spent relative to engineering construction, with engineering typically involving a greater degree of mechanised works. Therefore, the next upswing in residential construction is expected to place greater strain on the construction labour market compared to a commensurate upswing in engineering construction.

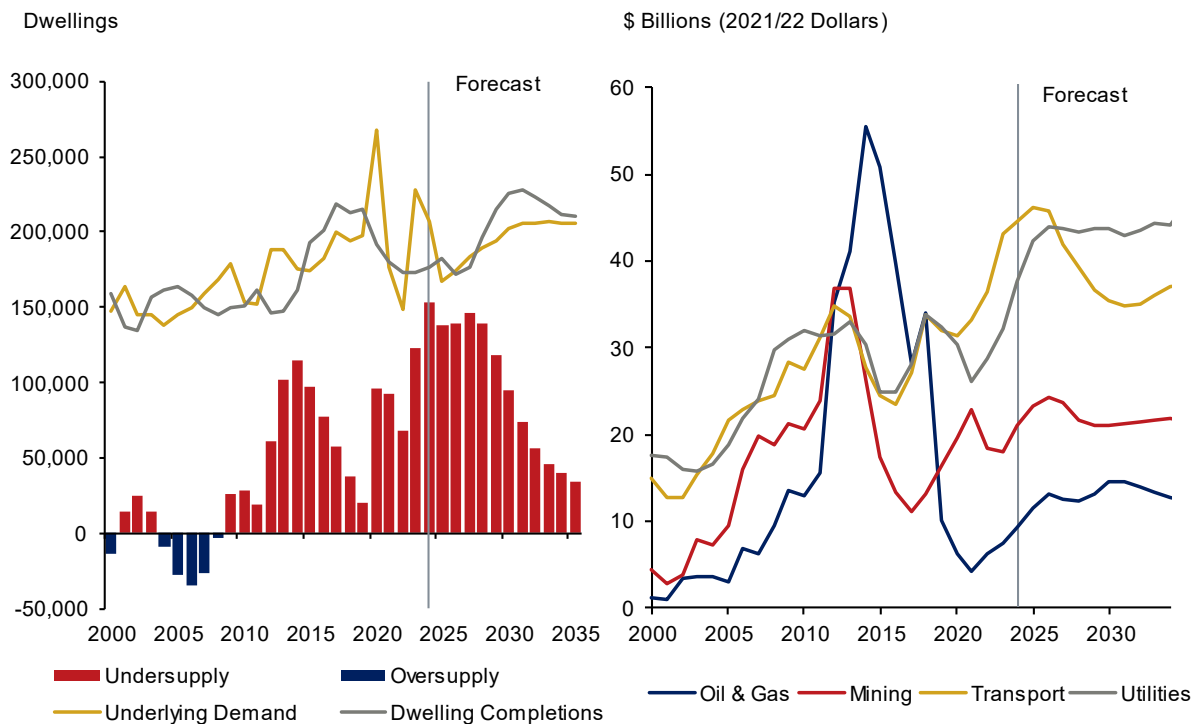
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<sup>11</sup> Australian Bureau of Statistics (September 2024), Construction Work Done, Australia, Preliminary, ABS Website

<sup>12</sup> Oil and Gas construction work done is typically excluded from assessments of total construction activity on demand for construction inputs given this sector's significant use of overseas fabrication of modules and proportion of imported components which the ABS includes in its construction statistics at time of arrival into Australia.

<sup>13</sup> All construction values discussed are measured in constant 2021/22 dollars.

**Fig 6. Left: national dwelling demand and supply. Right: national engineering construction by sector**

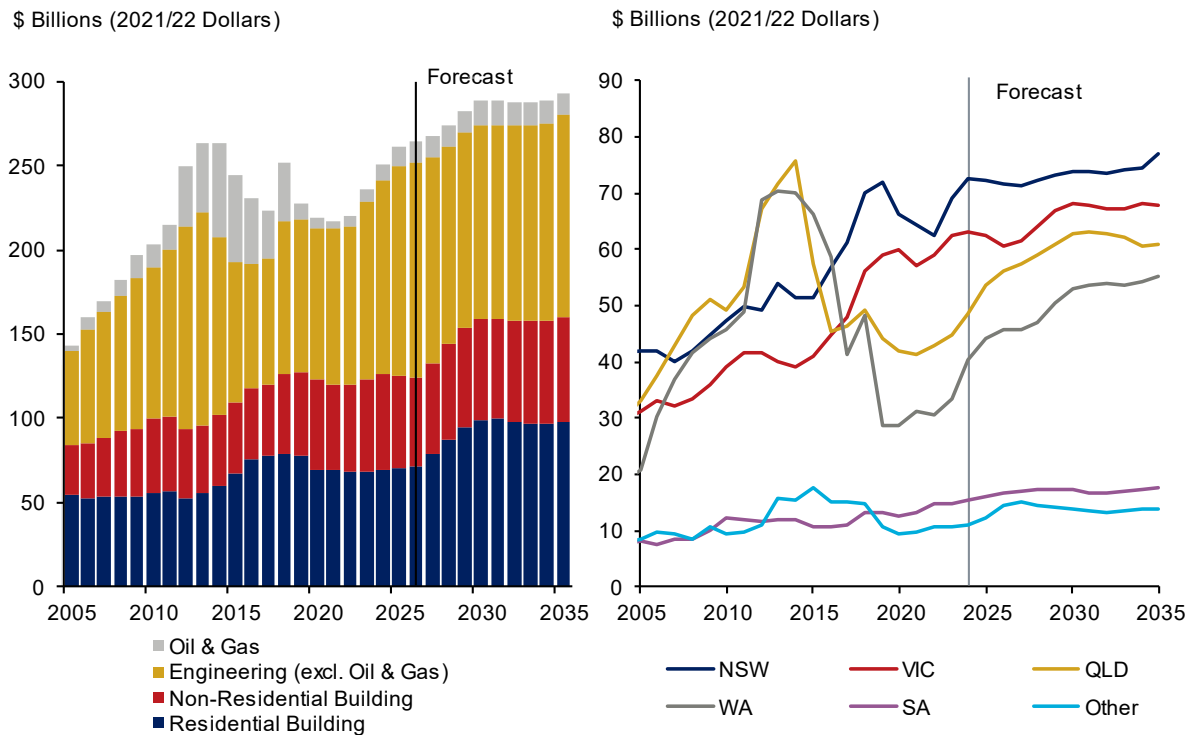


Source: Oxford Economics Australia

New South Wales and Victoria currently contribute the greatest to national construction activity, owing to building construction associated with their larger populations and significant investment in their transport infrastructure in recent years. It is expected that both states have reached a near term peak in construction activity, with a modest downturn in interest rate sensitive building construction and the completion of major metro road and rail projects driving a softening in total construction activity over the next three years. A strong increase in residential construction is forecast to drive New South Wales activity to a new peak by FY30, with a more muted result in Victoria.

Of all states, Queensland is expected to see the greatest step up in construction activity, with sustained growth over the second half of the decade. Infrastructure works related to the 2032 Brisbane Olympic Games and the \$62bn Queensland Energy and Jobs Plan will support activity during this period. In addition, fundamental drivers of demand in the state economy are expected to outpace national averages over the next decade, including Queensland's population growth.

**Fig 7. Left: Construction Work Done Australia. Right: Construction Work Done by State**



Source: Oxford Economics Australia

### 1.5.2 Supply and Market Capacity Outlook

Global supply side challenges continue to present forward risks for Australia's infrastructure market, with consequences for installation costs. While global supply chain pressures have generally eased from those experienced between 2021-2023, increasing conflict in the Middle East is driving increases in the cost and scheduling of shipping (as trade routes are diverted). Weak global economic growth now (and weak growth in China, particularly) is seeing further normalisation in commodity prices although stronger economic growth in coming years is expected to place renewed pressure on supply chains and put a floor under further commodity price declines.

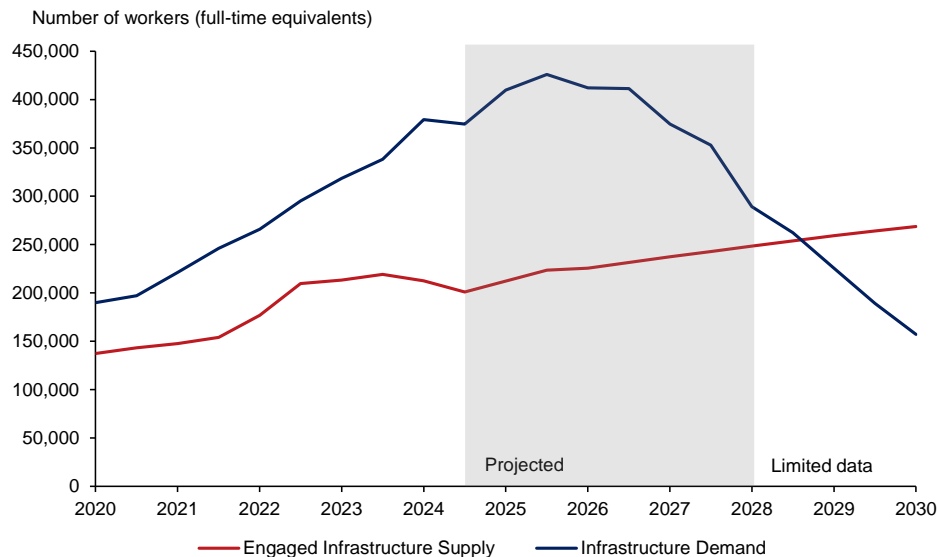
Domestically, access to labour and local construction materials is expected to continue placing pressure on wages and materials prices especially given the demand outlook. While Infrastructure Australia's *2024 Market Capacity Report* projects a general easing in infrastructure workforce constraints from 2026 (with the estimated workforce gap falling from 197,000 to a more "balanced" market by 2029, it is critical to note that much of this improvement derives from a sharp fall in measured infrastructure demand from 2026 (see 8 below) – not a large increase in supply. By 2029 infrastructure demand for labour is projected by Infrastructure Australia to be below that experienced in 2020, with a substantial further fall in 2030.

However, in practice, it is highly unlikely that the workforce gap in the Australian infrastructure market will be eliminated by 2029, and Infrastructure Australia itself note that projections beyond 2028 are

based on limited data and will likely be exceeded.<sup>14</sup> Critically, the infrastructure pipeline used for the labour demand estimates are based on a strict, “bottom up” approach that includes only currently known projects over a threshold value. Basing longer term demand projections only on known projects will always create a downward bias in later years as known projects move to completion without new (currently unknown) projects being added.

Further, the infrastructure pipeline is based on public sector funded projects only (hence its heavy bias towards transport projects) and so excludes the demand generated by privately funded infrastructure investment. For the energy sector, this means that the pipeline includes major publicly funded transmission projects but excludes privately funded new generation investment – which is anticipated to grow significantly over the next five years. Relaxing the constraints used by Infrastructure Australia in modelling workforce demand is likely to see substantial workforce gaps sustained into the early 2030s, particularly considering the strong growth in demand expected from privately funded housing and energy investment.

**Fig 8. Demand and supply of infrastructure workers for major public sector projects**



Source: Infrastructure Australia, 2024 Market Capacity Report, p51

With regards to the energy market, modelling undertaken by the Institute for Sustainable Futures, University of Technology Sydney (ISF) in collaboration with AEMO for the RACE for 2030 co-operative research centre in 2024 indicates that the electricity workforce will need to grow strongly over all three scenarios considered in the Integrated System Plan.<sup>15</sup> Under the Step Change Scenario, which is most closely aligned to the 2030 Renewable Energy Target, the electricity workforce is projected to double in size (from 33,000 to 66,000 workers) by 2029. Under the Green Energy Export Scenario, the electricity workforce is modelled to nearly treble to 96,000 workers by the late 2020s and remain sustained at a very high level until 2032. Even the more limited Progressive Change Scenario will

<sup>14</sup> Infrastructure Australia (2024) Public Infrastructure Workforce Supply Dashboard

<sup>15</sup> Rutovitz, J., Gerrard, E., Lara, H., and Briggs, C. (2024). *The Australian Electricity Workforce for the 2024 Integrated System Plan: Projections to 2050*. Prepared for RACE for 2030.

require a rapid increase in the workforce to 52,700 workers by 2029. As a consequence, the report notes:<sup>16</sup>

“The rapid increase in requirements for in-demand occupations brings with it a high risk of skill shortages compromising the achievement of the ISP’s optimal development path. Skill shortages create the risks of delays, increased project costs (wage inflation, recruitment costs and liquidated damages), and increased cost of capital to reflect increased risk.”

Apart from labour, the relatively robust construction outlook is also expected to place pressure on supply chains for local construction materials, particularly quarry products, cement and concrete which can make up a considerable proportion of installation costs for energy projects. These inputs are relatively low value but high cost in terms of transport which means they are typically sourced close to developments. While recent studies indicate that there are sufficient reserves of quarry materials in the ground, data on the availability to access these reserves remains weak, with local government restrictions on quarry production capacity and truck movements potentially limiting the market’s capacity to respond to rising demand.<sup>17</sup> As engineering construction activity moves away from major transport projects in metropolitan regions to energy, water and resources projects in remote and regional areas over the next five years, this is likely to create new supply chain pressures for sourcing construction materials, impacting prices. These pressures may be exacerbated if there are competing projects within the same region.

## 1.6 COST ESCALATION OUTLOOK

Record levels of non-oil and gas construction activity over the next five years is expected to contribute to construction industry price pressures. Looking forward, we anticipate a continued easing in construction cost escalation which will persist through the middle of the decade. However, rising construction activity is forecast to drive a re-acceleration in construction cost escalation from FY27, with elevated construction cost pressures forecasted to persist until the early 2030s. Beyond this, escalation rates are assumed to trend towards their long-run averages.

The softening of escalation rates over the next two years will be driven by normalising supply and demand dynamics across international commodity markets. Policy responses to recent inflationary pressures have muted global economic demand which, along with a weak Chinese economy, is seeing a softening in demand (and prices) for commodities. However, domestic labour cost pressures are expected to place a floor under the deceleration in construction cost escalation and is expected to drive the next cycle of price growth later in the decade. The construction labour market is expected to remain tight, underpinned by rising construction activity and stagnant productivity growth in the sector. In particular, the decline in real wages in recent years and the strong bargaining position of a relatively highly unionised workforce is expected to drive strong and sustained wage growth outcomes over the near term.

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<sup>16</sup> Ibid, p12

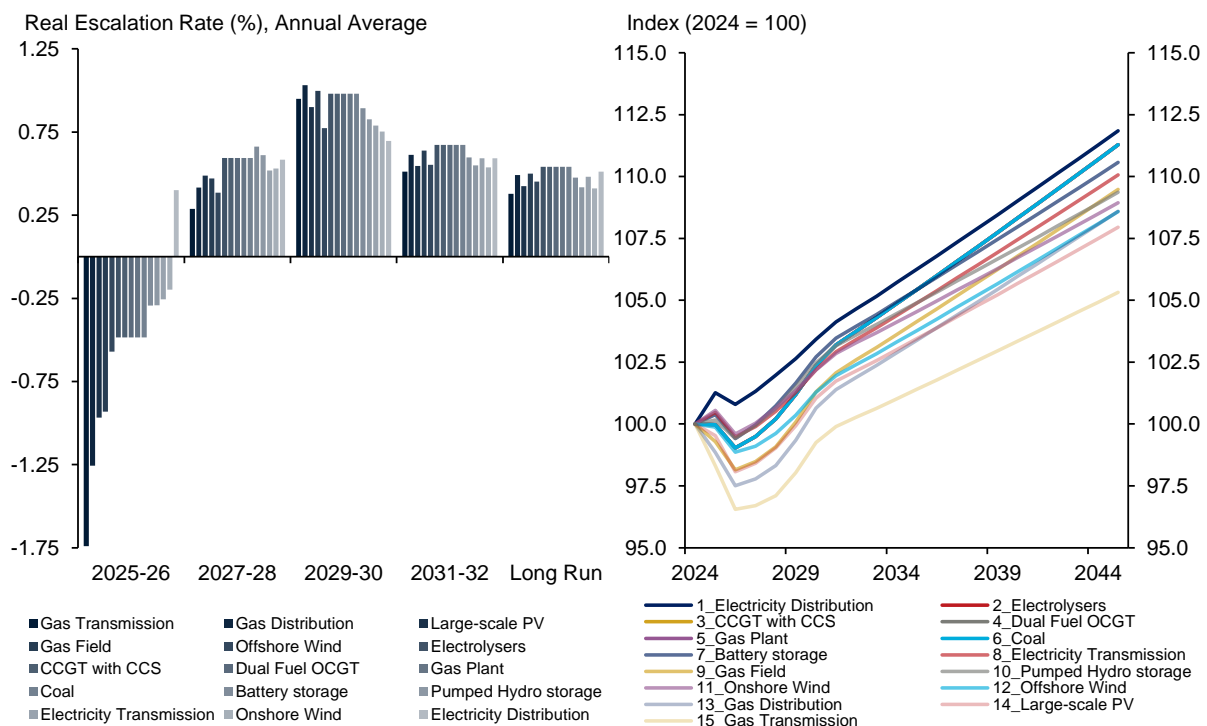
<sup>17</sup> Oxford Economics Australia (2023) Queensland Quarry Demand and Supply Risks, Report for Queensland Department of Resources And Cement Concrete & Aggregates Australia.

### 1.7 RESULTS

For all 15 asset types considered in this study, real installation costs are forecast to rise moderately over the forecast period.<sup>18</sup> Real installation costs will broadly ease over the next two years to FY26, before accelerating again until around FY30-FY31, at which point costs will sit around 1-3% above FY24 levels. By FY45, real installation costs are expected to be around 10%, on average, above FY24 levels, in line with historical long run trends.

Falling prices for steel, concrete, machinery hire and freight now and over the near term is expected to drive softer installation cost escalation growth for all asset types. An expected normalisation in commodity markets and rising real construction activity over the back half of the 2020s is expected to see growth in cost escalation reaccelerate from FY27 and peak in FY30. Over this four-year period, cost escalation across all asset types is forecast to average 0.8% annually. Queensland is expected to record the strongest growth in real cost escalation over this period (1.1% annually), compared to 0.7% for New South Wales, Victoria and Tasmania, and 0.6% for South Australia. State differences in real cost escalation are principally driven by differences in forecast construction wages growth, which is in turn influenced by growth in construction activity (demand). With Queensland expected to see the largest growth in construction activity – in addition to competition with the mining sector for transferable skills – construction cost escalation in Queensland is forecast to outpace the national average.

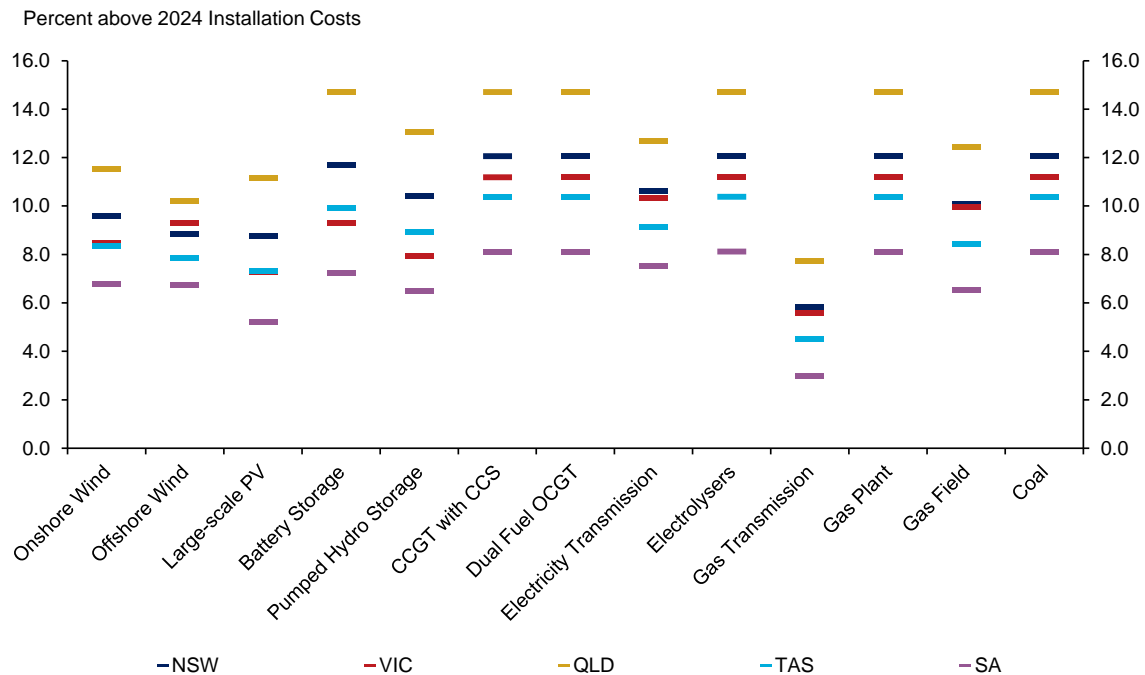
**Fig 9. Installation cost index for the 15 asset types, NEM average**



Source: Oxford Economics Australia

<sup>18</sup> The real installation cost escalation rate is derived by subtracting CPI from the nominal installation cost escalation rate

**Fig 10. FY45 installation costs, percentage above FY24 levels, by state**



Source: Oxford Economics Australia

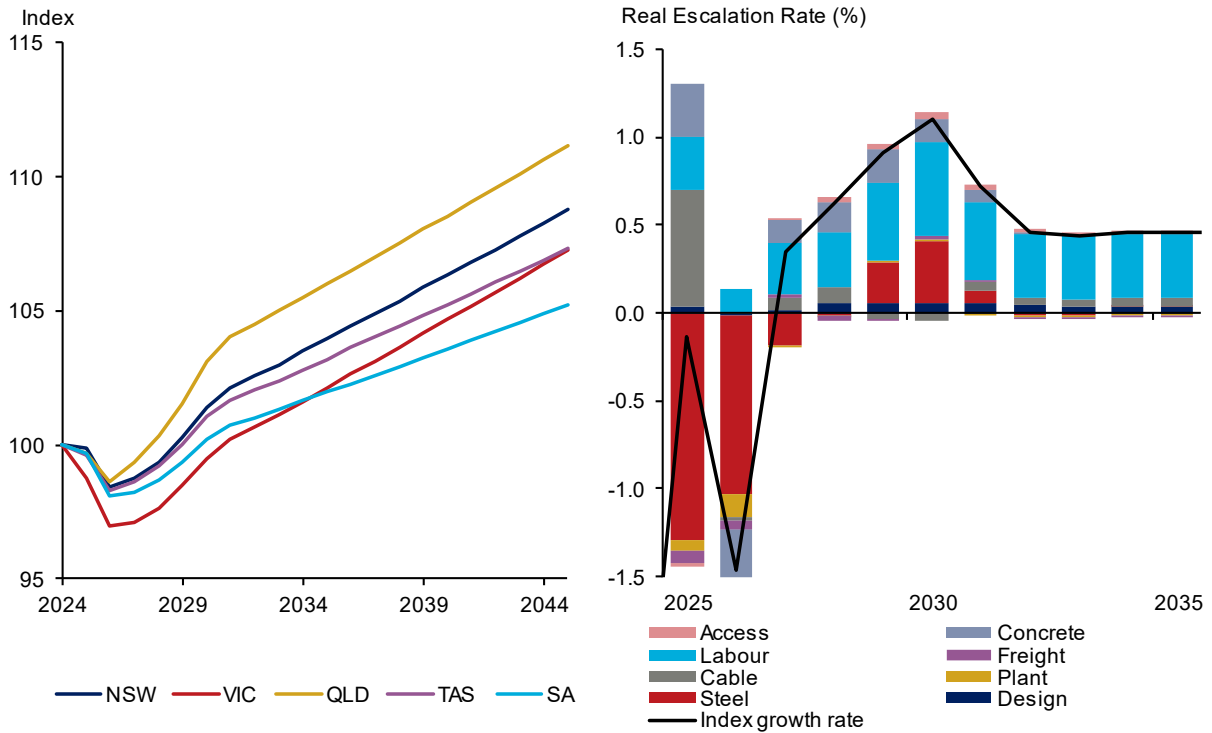
The growth in real installation costs (cost escalation rate) is expected to begin softening from FY31 as the next construction cycle comes off its peak. Escalation rates are then assumed to move towards their long run averages by FY33, at which point they remain at a constant rate over the remainder of the forecast period. Long run installation cost escalation rates are forecast to range between 0.4% to 0.5% per annum across the asset types and is driven by the historical real wage increase of around 1% per annum for the construction sector (with labour costs accounting for around 40-50% of installation costs). Figures 11-14 show the Installation Cost Indexes for four asset types across each of the five states (left panel). The weighted contributions of each input to the installation cost index are depicted in the right panels.

Broadly speaking, installation cost escalation rates across each of the 15 asset types are forecast to move in similar directions over the forecast period. Driving this result is the universal impact labour escalation rates has on overall installation costs for all asset types, with labour costs being a significant (and typically largest) share of total installation costs. However, over the next two years some asset types (whose installation is more steel and concrete intensive) are expected to see real declines in installation costs, these asset types include Gas Infrastructure and large-scale PV. These same asset types will then see modestly lower escalation rates over the FY27-28 period as the next upswing in construction activity materialises.

With construction activity expected to peak around FY29 and FY30, real installation cost escalation rates across all asset types are expected to be at their greatest, ranging from 0.7% to 1.0% annually, with those assets which are more labour-intensive experiencing higher escalation rates. These asset types include more traditional builds such as carbon-based generators (e.g. coal and gas plants).

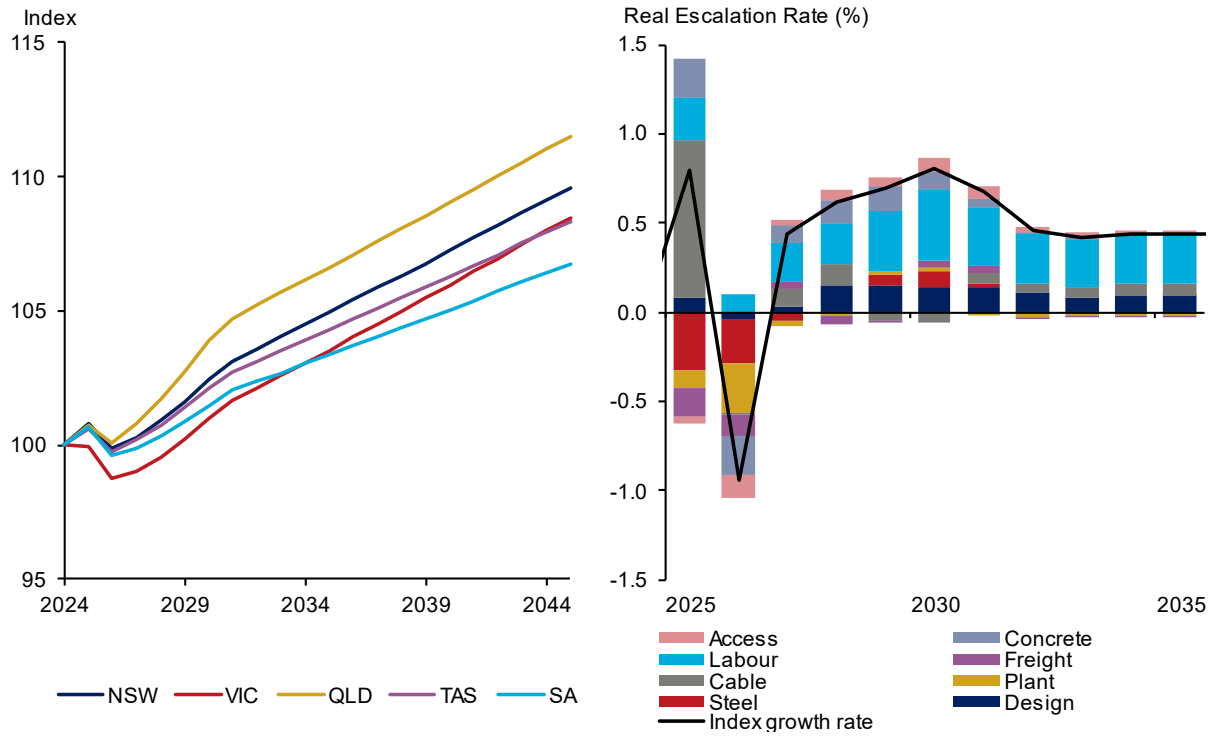
Assets which are more modular and mechanised and consequently less labour intensive are expected to see lower escalation rates. These projects include onshore wind and large-scale PV. Over the long run, installation cost escalation rates across each asset types are forecast to converge around 0.4% and 0.5% annually, with the minor deviations between asset types driven by their relative labour intensities.

**Fig 11. Large-scale PV. Right: Installation Cost Index, by state. Left: Weighted Contribution of Inputs to the Installation Cost Index growth rate, NSW**



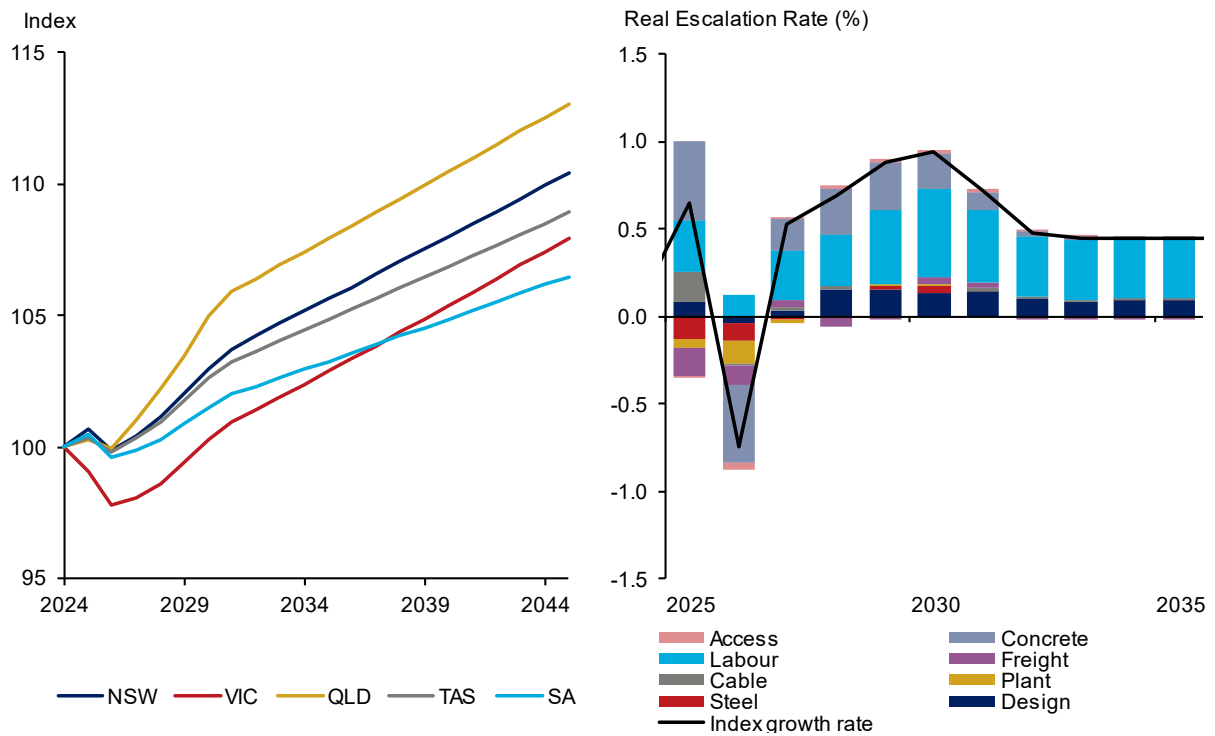
Source: Oxford Economics Australia

**Fig 12. Onshore Wind. Right: Installation Cost Index, by state. Left: weighted contribution of each input to Installation Cost Index growth rate, NSW**



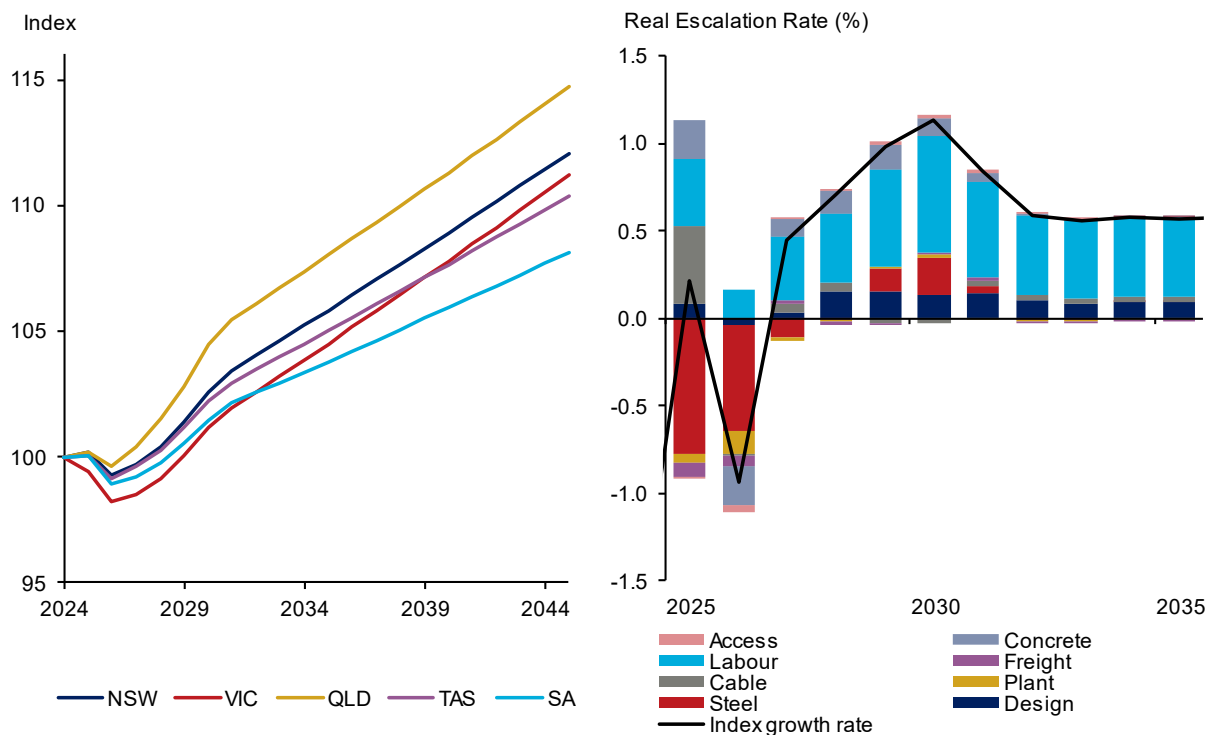
Source: Oxford Economics Australia

**Fig 13. Pumped Hydro Storage. Right: Installation Cost Index, by state. Left: weighted contribution of each input to Installation Cost Index growth rate, NSW**



Source: Oxford Economics Australia

**Fig 14. Gas Plant. Right: Installation Cost Index, by state. Left: weighted contribution of each input to Installation Cost Index growth rate, NSW**



Source: Oxford Economics Australia

### 1.8 AREAS FOR FUTURE RESEARCH

It is expected that, as with reviewing costs of specialised equipment and technologies each year, the Installation Cost Index and forecasts be updated annually to take into account changes in supply chain conditions and forecasts of construction industry demand which can influence installation costs, particularly in the near term.

Based on consultations and research undertaken for this report, there is also likely to be significant benefits in expanding the scope of work in future iterations to include:

- More granular intra-state cost analysis. Installation Cost Index outputs by technology for this study are limited to the state level and in turn are based on state and or national level price indices for construction inputs. However, the rollout of new energy infrastructure will be highly regional in practice, with different regions within states likely to have different experiences of cost escalation based on distinct regional supply chain challenges and differing regional construction profiles. Previous research undertaken by Oxford Economics Australia, for example, has identified regional differences in supply, demand and market capacity to deliver across 37 Functional Economic Regions of New South Wales.<sup>19</sup> Deeper

<sup>19</sup> BIS Oxford Economics and Turner and Townsend (2022) *Regional NSW Infrastructure Projects Delivery Capability Assessment*, report prepared for Public Works Advisory, Department of Regional NSW.

regional analysis in future studies may reveal significant differences in the growth path of real installation costs across different regions of the same state.

- Examining and incorporating, where appropriate, the escalation of other measurable construction costs associated with the installation of new energy infrastructure. This could include, for example, the escalation of associated enabling infrastructure costs (e.g. regional road enhancements and upgrades to accommodate large and wide loads) as well as other costs relating to transport, accommodation, storage and logistics.
- Undertaking or leveraging deeper research into the construction industry's poor productivity performance and identifying potential solutions. The findings in this analysis are based on a 'business as usual' assumption regarding construction industry productivity – notably, that there is no long run productivity growth in the construction industry (mirroring existing long run trends).<sup>20</sup> Conversely, a sustained improvement in industry productivity over the outlook period will help mitigate the modelled growth in real installation costs presented in this report. With this in mind, there is likely to be considerable value in undertaking deeper research into the causes of the measured poor productivity performance of the construction industry (and identifying potential solutions) as well as developing better measures of productivity that are more specific to the installation of energy assets.

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<sup>20</sup> As detailed in ABS (2025) *Estimates of Industry Multifactor Productivity*. It is noted that ABS multifactor productivity measures are only published annually at the industry level.

## 2. LEAD TIME ANALYSIS

### 2.1 INTRODUCTION

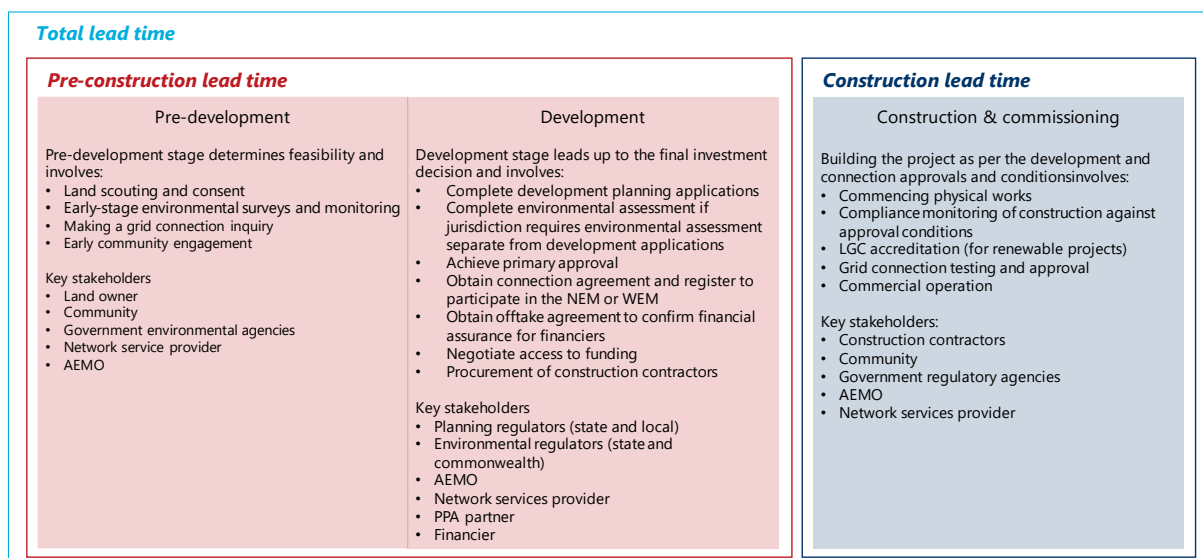
Oxford Economics Australia (OEA) was engaged by AEMO to enhance assumptions relating to the state distribution of project lead times across 15 of the asset types within the ISP.

The project development pathway of different energy infrastructure assets follows a similar structure through pre-development, development, construction and commissioning.<sup>21</sup> For the purposes of this work:

- **Pre-construction lead times** include pre-development and development (i.e. planning and environmental approval). Pre-construction typically represents a larger share of total lead time, although this may differ by asset type and typically decreases as the asset type becomes more mature.
- **Construction lead times** include construction and commissioning.

OEA conducted consultation, a literature & data scan and collected project level data for 579 energy projects to estimate the distribution of project lead times across the NEM jurisdictions for each asset type. We also discuss common reasons for approval delays and rejections as well as expected changes in the planning environment across states.

**Fig 15. General development pathway from inception to completion**



Source: DCCEEW, Oxford Economics Australia

### 2.2 PURPOSE

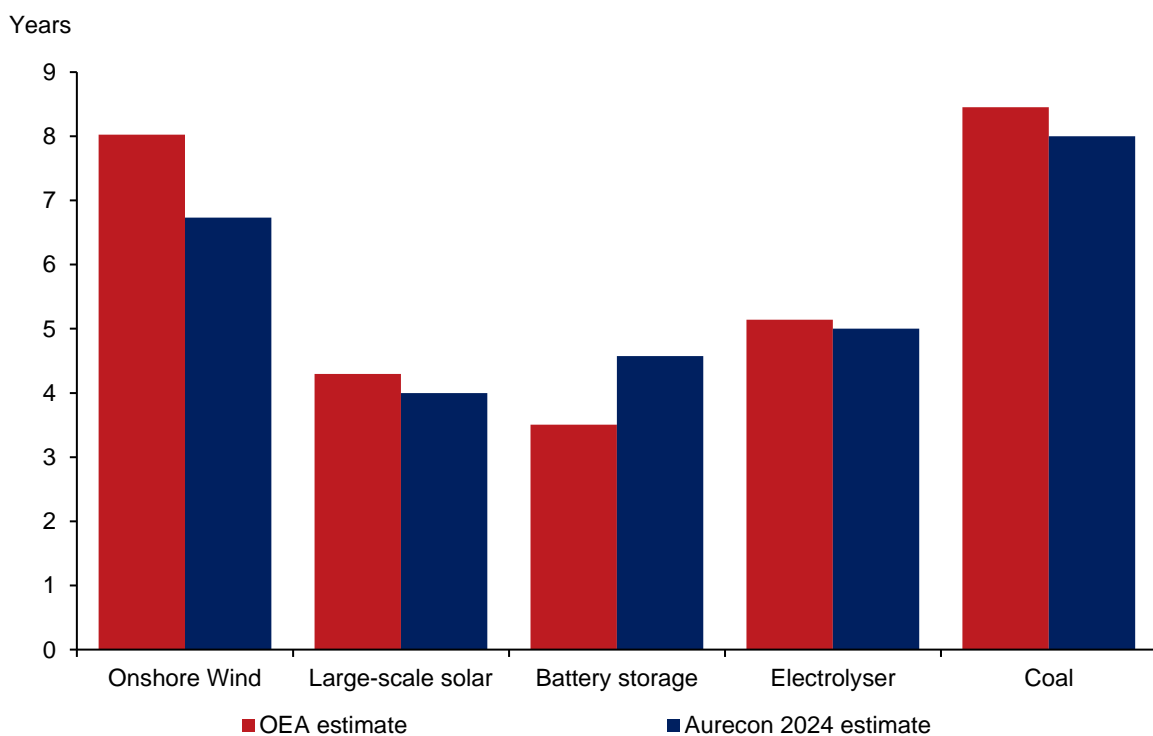
Building on previous work by Aurecon, this study provides State level estimates for the lead times of 15 infrastructure asset types in each region. Aurecon provides estimates for a representative

<sup>21</sup> DCCEEW *Australian large-scale renewable energy project development journey*

hypothetical project based on what is envisaged as a plausible project for installation in the NEM in 2024.<sup>22</sup> OEA analysis in this report estimates the distribution of pre-construction, construction and total lead times in each of the NEM jurisdictions around these estimates. Our NEM average estimate is normalised to Aurecon’s estimate, set at 1 in 2024 for each asset type and therefore our results can be interpreted as a multiplier to Aurecon’s 2024 lead time estimate.

The purpose of this analysis is to estimate the distribution of lead times by jurisdiction around Aurecon’s representative hypothetical project, they are not intended to replace Aurecon’s estimates. OEA estimates of project lead times align relatively closely with Aurecon estimates for asset types where project data from completed projects can be compared on a like-for-like basis.<sup>23</sup>

**Fig 16. Aurecon 2024 estimates and OEA observed total lead times by comparable asset types**



Source: Aurecon, Oxford Economics Australia

<sup>22</sup> This work builds on 2024 Aurecon estimates of ‘Time for development’ which includes pre-feasibility, design, approvals and procurement; ‘Total lead time’ which refers to the time between notice to proceed and when equipment arrives on site; and ‘Construction time’ which is the time from equipment delivery to practical completion.

OEA analysis in this report considers ‘pre-construction lead time’ the sum of Time for development and Total lead time and, Construction time to be ‘construction lead time’. The sum of pre-construction and construction lead time is then ‘total lead time’. We will refer to these definitions for the remainder of the report.

For asset types including offshore wind, pumped hydro storage, CCGT with CCS, Dual fuel OCGT proxy project data was used to partially inform the estimated state distribution and so estimates cannot be compared with Aurecon estimates in a like-for like manner. Additionally, Aurecon: 2024 Cost and Technical Parameters Review does not include lead time estimate coverage of some asset types.

Note: OEA estimates are based on all observed project level lead times, covering projects starting in multiple years. Whereas Aurecon 2024 estimates are of a representative hypothetical project based on what is envisaged as a plausible project for installation in the NEM in 2024.

Raw OEA estimates are typically somewhat higher than Aurecon because OEA estimates are based on observed project level lead times over the last 30 years (though the majority occurring after 2010). In contrast, Aurecon 2024 estimates are of a hypothetical project, “based on what is envisaged as a plausible project for installation in the NEM in 2024” (emphasis added).<sup>24</sup> As the purpose of our analysis is to determine the state distribution of lead times around the Aurecon 2024 central estimates, we consider the use of historical project data as appropriate given the increased data coverage gained from extending project coverage beyond just those beginning in 2024.

Aurecon’s 2024 report does not include lead time estimate coverage of some assets included in OEA coverage. AEMO asked OEA to consider the following asset types which are not covered in the Aurecon report:

- Electricity Transmission
- Electricity Distribution
- Gas Transmission
- Gas Distribution
- Gas Plant

In these cases, the state distribution is provided as a ratio of our own estimate of the NEM average lead time, corroborated by other academic sources where possible.<sup>25</sup>

## 2.3 METHODOLOGY

Lead time estimates are based on observed total, pre-construction and construction lead times from a database of 579 projects (488 in NEM states and territories). The database was constructed from a variety of sources including Oxford Economics Australia project listings, Clapin, Longden (2024), AEMO General Information and Global Energy Monitor project listings.<sup>26 27 28</sup> A table detailing project coverage by jurisdiction and asset type is included in Appendix B.

To collect data for observed lead times, a similar methodology to Clapin, Longden (2024) was used to identify project inception dates, using Australian Company Number (ACN) registration with ASIC where possible, and corroborated by desktop research. Construction commencement and completion dates were taken from the sources listed above and additional desktop research. Some assumptions

<sup>24</sup> Aurecon (2024) *2024 Energy Technology Cost and Technical Parameter Review*

<sup>25</sup> GHD (2018) *AEMO costs and technical parameter review*; Rand, Manderlink, Gorman, Wisser, Ryan, Seel, Kemp, Jeong, Kahrl (2024). *Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2023*. Lawrence Berkeley National Laboratory; Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*; Gumber, Sana, Steffen (2024) *A global analysis of renewable project commissioning timelines*; IEA (2023) *Energy Technology Perspectives*.

<sup>26</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

<sup>27</sup> AEMO *General Information* October 2024

<sup>28</sup> Global Energy Monitor *Global Integrated Power Tracker*, Global Coal Plant Tracker, Global Oil and Gas Extraction Tracker, Global Oil and Gas Plant Tracker, Global Gas Infrastructure Tracker

were required where sufficient data was unavailable. These assumptions are listed in section 2.4.2 and Appendix B.

To estimate lead times for each state and asset type, we used OLS regression to estimate the total, pre-construction and construction lead times individually based on observed lead times and controlling for project size (capacity and/or cost). Where minimal data was available due to asset maturity or a lack of public information, completed project data was supplemented by future project lead times disclosed by developers or builders and project data for assets of a similar type.

In some cases, individual components of total lead time (pre-construction and/or construction) had more data availability than total lead-time. Each component was estimated individually and normalised to align estimates to a sum of pre-construction and construction to total lead time. Normalisation was considered on an asset and state basis based on data availability for each component and the impact of outliers. The NEM average lead-time for which we can then compare the Aurecon 2024 estimate was calculated as the weighted average of all states and territories within the NEM based on project activity for each asset type.<sup>29</sup>

Forward-looking lead times estimated to currently be above the NEM average in 2024 are assumed converge to the 2024 NEM average by FY33. This assumption is made to reflect efforts from various levels of government to streamline planning processes and implies a convergence in planning and construction processes towards a national standard.

## **2.4 DISCUSSION OF KEY DRIVERS OF PRE-CONSTRUCTION LEAD TIMES**

The pre-construction phase of development drives the majority of deviation in overall project lead times of major energy assets across jurisdictions. The processes, barriers and drivers to the efficiency of the planning environment are key to the delivery of energy assets in the NEM. Oxford Economics has completed a data & literature scan and collected data on 70 wind, solar, coal and gas projects that were withdrawn or refused during the planning stage to discuss the following topics of interest to AEMO:

- The typical development pathway for energy assets and associated costs;
- Common barriers to approval and the role of environmental and cultural approvals in the planning process; and
- Recent and expected changes to the planning framework for energy assets.

### **2.4.1 Development pathways**

The complexity of energy asset development pathways is a key contributor to differences across jurisdictions and asset types, potentially contributing to longer lead-times and/or cost increases.

Whilst the general path of energy asset development follows a similar pathway across states, the complexity of planning systems varies by asset type and project size among other factors.<sup>30 31</sup>

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<sup>30</sup> Ibid.

<sup>31</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

Depending on which state the development takes place in, and which technology type is being assessed, this process may require State government or local council approval. Additionally, all developments can be referred for Federal government assessment under the Environmental Protection Biodiversity Conservation (EPBC) Act.<sup>32 33</sup>

Solar and battery storage are typically approved at the local council level, with some exceptions for particularly large developments. Wind, pumped hydro, electrolysers and non-renewable assets typically require a more stringent assessment and robust environmental approvals at the state level and through the EPA and/or the EPBC at the federal level.

Design, development, approval and land acquisition costs in the pre-construction phase typically represent between 2-10% of total development costs for major energy projects but can reach as high as 16%.<sup>34 35</sup> These costs are made up of legal and technical advisory costs, financing and insurance project administration, grid connections studies and land procurement which will vary significantly based on design, size and complexity of the project.<sup>36</sup>

Analysis of fee schedules for each jurisdiction suggests the largest of these fees are typically application fees and/or an assessment fee. However, fees tend to grow more substantially if the project is required to follow a more complex approval pathway, requires approval from state or federal government or requires significant modifications at the planning stage as each modification typically requires additional assessment fees to be paid. A summary table of some of the typical fees levied throughout the approval stage of energy developments is provided in Appendix C.

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<sup>32</sup> The EPBC Act refers to the living things (including plants and animals), habitats and places that need protecting as 'matters of national environmental significance'. This includes World and/or Commonwealth Heritage listed places, wetlands of international importance, listed threatened or migratory species, Commonwealth marine areas, the Great Barrier Reef Marina Park, water resources and any nuclear actions.

<sup>33</sup> DCCEE *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*

<sup>34</sup> Entura (2018) *Pumped Hydro Cost Modelling*

<sup>35</sup> Aurecon (2024) *2024 Energy Technology Cost and Technical Parameter Review*

<sup>36</sup> Ibid.

**Fig 17. Summarised typical approval process by jurisdiction**

State	Typical planning pathway	Notes
<b>NSW</b>	State significant developments and infrastructure	Most energy related projects are state significant developments (SSD) but is also common for network connections and transmission lines to be delivered through State significant infrastructure (SSI) or Critical SSI (CSSI) pathways
<b>QLD</b>	Local government Coordinated projects	Most renewable projects are approved at the local government level with the exception of wind which typically undergo a more robust assessment of environmental impacts and considerations of scenic amenity assessed through the state Assessment and Referral Agency, within the QLD Department of Infrastructure, Local Government and Planning. Gas assets, hydrogen facilities and coal assets also require more rigorous environmental assessment and commonly follow a 'Coordinated project' declaration pathway requiring either an environmental impact statement (EIS) or an impact assessment report (IAR).
<b>VIC</b>	Minister for planning Environmental Effect Statements	The Minister for Planning is the responsible authority for assessing, and approving all energy generation facilities with over 1MW capacity, storage facilities with over 1MW capacity and transmission and distribution lines. The requirements for wind energy facilities are more stringent than those for other renewable energy facilities, and include prohibition of facilities within specified distances from dwellings and other areas and within precise locations. Additionally, Environmental Effect Statement (EES) assessments are often required for wind, transmission, coal, gas and hydrogen projects.
<b>SA</b>	Local councils State significant projects Impact assessed developments	Renewable projects are typically approved by local councils, unless the project is classified as a state significant project, whereby the Minister is responsible for deciding on the proposal. Gas, coal and offshore wind projects typically go through an impact assessed development path to more robustly assess the environmental impact.
<b>TAS</b>	Local councils Major project/infrastructure	Most wind and solar developments are approved by local council, with some requiring EPA and EPBC approval additionally. Particularly large assets including Bell Bay wind farm, Whaleback Windfarm and North East wind farm alongside transmission transmission projects are often assessed as major projects or major infrastructure, to be considered by the minister for planning

Source: State Development Infrastructure and Planning Queensland, NSW Department of Planning & Environment, Department of Planning and Transport Victoria, PlanSA, Tasmanian Planning Commission, Clean Energy Investment Group, Herbert Smith Freehills, Clapin, Longden (2024)

### 2.4.2 Barriers to approval

Approval delays can impact the financial viability of projects, increasing pre-construction lead times and the likelihood of withdrawal and/or refusal during the planning process. The Productivity Commission suggests that a 1 year delay in project development can lead to additional costs of 5-12% of the project's construction cost in net present value terms.<sup>37 38</sup> That is, a one year delay decreases the current value of developing the asset, making project viability less likely and posing a risk to the efficient delivery of Australia's necessary energy infrastructure.

<sup>37</sup> Productivity Commission (2013) *Major Project Development Assessment Process*

<sup>38</sup> This figure is in reference to a standardised major project with capital expenditure of \$473 million. A 1 year delay is estimated to represent a reduction in the net present value of that project of around \$26 million to \$59 million or 5-12% of construction costs.

Oxford Economics Australia completed a literature scan and identified 70 withdrawn or refused wind, solar, coal and gas projects for which a core reason for withdrawal or refusal could be identified. It should be noted that it is common that withdrawal or refusal is driven by a number of reasons, in this case a judgement was made on the core reason for withdrawal or refusal.

Our analysis suggests that planning and policy difficulties, which includes complex planning processes, policy changes and regulatory uncertainty, are the most common drivers of approval delays, withdrawals and rejections. Of the 70 studied projects, 25% were judged to have been withdrawn or refused due to planning and policy difficulties. Delays can come from seeking approvals from multiple authorities and difficulties in accessing and connecting to the grid, with increased grid connection and commissioning processes due to policy change estimated to have delayed projects by 7 to 9.5 months.<sup>39 40</sup>

Changes to approval conditions and regulatory uncertainty is a significant source of financial risk for projects and can be a factor effecting viability and/or cause project delays.<sup>41 42 43</sup> In Victoria, changes made by the Baillieu government new wind farm developments (establishing 'No go zones', a 2 kilometre 'right of veto', whereby a households could block any turbines within 2 kilometres of their home) led to the withdrawal of many wind projects in the 12 months after the policy change and no new proposals were announced.<sup>44</sup> Similarity, the introduction of a "do no harm clause" to Generator Performance Standards after the South Australian blackout in 2016 was estimated to have added 6 to 7 months to total lead times.<sup>45</sup>

Economic conditions have driven several project cancellations and were particularly common in non-renewable asset types. For example, Aviva's investment in the Coolimba Power project fell through in late 2009 with no viable commercialisation path, Delta Energy withdrew plans to replace their Vales Point A power station citing early closure of coal assets as an indicator of the pace of renewable generation, and the Summerfield power station gas project was cancelled in favour of battery storage.<sup>46 47 48</sup>

In the renewable space, economic withdrawals were more typically driven by shifting market conditions and developer priorities. Western Plains Wind Farm and Australia Plains Wind Farm were both withdrawn with the proponents citing a shift in focus towards larger scale developments.<sup>49</sup> Across

<sup>39</sup> Simshauser, Gilmore (2022) *Climate change policy discontinuity & Australia's 2016-2021 renewable investment supercycle*

<sup>40</sup> Longden (2024) *Renewable projects are getting built faster – but there's even more need for speed*, Institute for climate, energy & disaster Solutions ANU

<sup>41</sup> Ciarreta, Pizarro-Irizar, Zarraga (2020) *Renewable energy regulation and structural breaks: An empirical analysis of Spanish electricity price volatility*

<sup>42</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

<sup>43</sup> Productivity Commission (2013) *Major Project Development Assessment Process*

<sup>44</sup> Renew Economy (2015) *Vic Labor ditches 2km wind farm restrictions, reforms planning laws*

<sup>45</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

<sup>46</sup> The West Australian (2009) *Aviva abandons Mid West power project*

<sup>47</sup> Renew Economy (2021) *Delta flagged early closure of Vales Point coal plant when it rejected federal grant*

<sup>48</sup> Renew Economy (2023) *Huge battery projects queue up for approval in world's most intermittent grid*

<sup>49</sup> Renew Economy (2023) *"Wrong project, wrong place:" Plans dumped for controversial Tasmania wind farm*

all assets, financial and contracting issues occurred. The ZeroGen IGCC with CCS project was cancelled when the proponent was liquidated in 2011, Karara Wind Farm, one component of the MacIntyre Wind Farm, was cancelled due to delays and cost overruns and Akuo energy shelved the Granite Hills Wind Farm development citing increased business uncertainty surrounding Covid-19.<sup>50 51 52</sup>

Many studies have been completed globally studying the multitude of factors that affect the delay or refusal of development approval, particularly in the renewable space. Grid connection challenges and associated commissioning delays are frequently cited as the primary concern of renewable energy developers in the NEM.<sup>53 54</sup> AEMO is responding to these challenges through its Connections Reform Initiative. There is evidence that being referred to the Federal government under the EPBC Act lengthens lead-times by 9 to 13 months despite the fact that most referred projects did not undergo the approval process.<sup>55</sup> While each individual project timeframe is influenced by unique factors, proponents are experiencing a range of common problems which lead to uncertain outcomes and delay project delivery.<sup>56</sup>

Environmental and agricultural concerns are commonly flagged as key causes of delays and stakeholder concerns.<sup>57 58</sup> The Jupiter Wind Farm in New South Wales which received more than 400 submitted objections to the New South Wales Department of Planning and Environment and was rejected twice before the proposal was withdrawn due to the environmental impacts outweighing the benefits.<sup>59</sup> Similarly, the Wooroora Station Wind Farm in Queensland, was withdrawn after sitting on EPBC process for 3 years due to its proximity to a world heritage listed rainforest and the Powervault Solar Farm in Victoria was rejected due to the inability to overcome the strong protection of agricultural land in the Mildura planning scheme.<sup>60 61</sup>

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<sup>50</sup> Carbon Capture & Sequestration Technologies at MIT ((2016) *ZeroGen Fact Sheet: Carbon Dioxide Storage Project*

<sup>51</sup> Renew Economy (2024) *Australia's biggest wind farm enters grid management system after delays and cancellations*

<sup>52</sup> Renew Economy (2020) *French company shelves NSW wind project, citing Covid uncertainty*

<sup>53</sup> Clean Energy Council (2023) *Time To Remove Handbrakes On Clean Energy Projects*

<sup>54</sup> Renew Economy (2018) *Grid connection biggest concern for wind, solar and storage projects*

<sup>55</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

<sup>56</sup> Herbert Smith Freehills, Clean Energy Investor Group (2024) *Delivering Major Clean energy projects: Review of the EPBC act for renewable energy projects in Queensland, New South Wales and Victoria*

<sup>57</sup> Deloitte (2024) *Australian Energy Infrastructure Commissioner Community Engagement Review: Stakeholder Engagement Analysis*

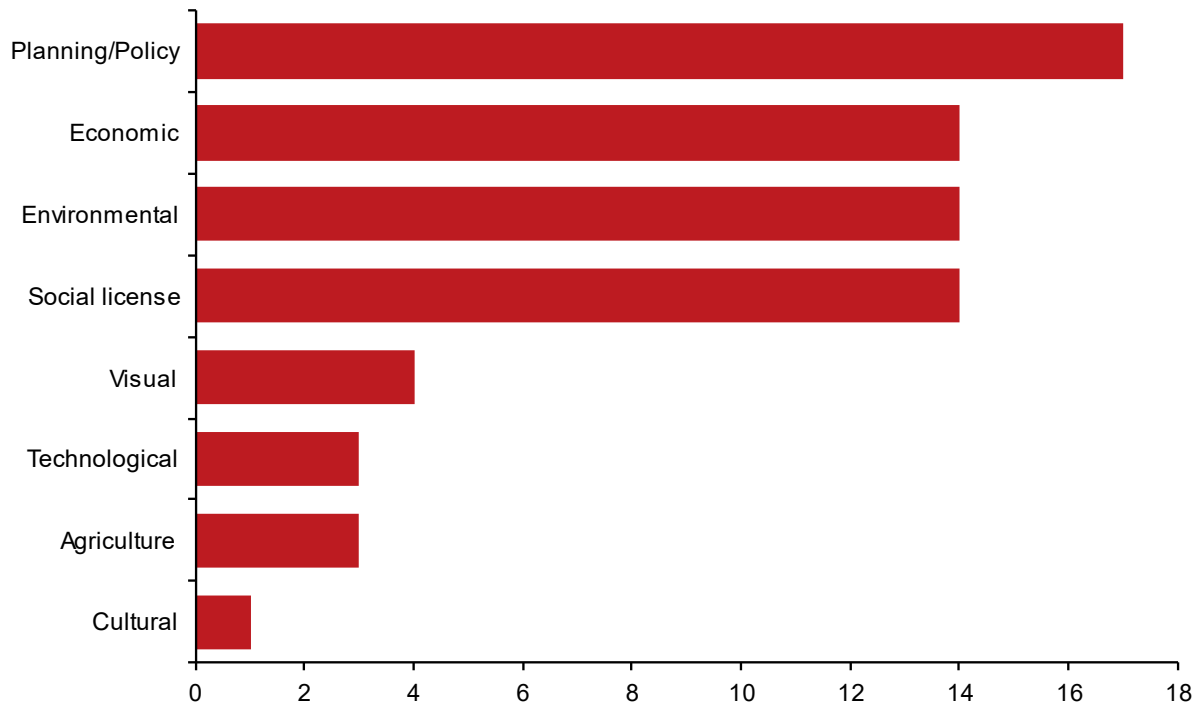
<sup>58</sup> Energy Insights (2024) *Delay and Deny: Renewable projects in approval limbo*

<sup>59</sup> ABC (2018) *Jupiter Wind Farm application withdrawn after 400-plus objections to Department of Planning and Environment*

<sup>60</sup> Ark energy (2024) *Ark Energy withdraws project from EPBC process*

<sup>61</sup> Herbert Smith Freehills (2019) *Recent VCAT refusals for three of five solar projects*

**Fig 18. Observed reasons for project withdrawal or refusal**



Source: Oxford Economics Australia

The impact of cultural approvals is not as commonly cited as a significant cause of observed refused or withdrawn projects. However, as with any part of the approval process, consultation with First Nations people on the recognition, protection and conservation of Aboriginal cultural heritage can take time, which can impact project delivery timeframes and, depending on the outcome of the negotiations, have cost implications for the project.<sup>62</sup> Australia's state and territory governments have broad responsibilities for recognising and protecting Australia's Indigenous heritage, including archaeological sites. Indigenous heritage is protected by various federal and state or territory heritage laws. Typically, state and territory laws automatically protect various types of areas or objects, while enabling developers to apply for a permit or certificate to allow them to proceed with activities that might affect Indigenous heritage.<sup>63</sup>

**Fig 19. Indigenous heritage legislation**

Jurisdiction	Principal Indigenous heritage legislation
<b>AUS</b>	Environment Protection and Biodiversity Conservation Act (EPBC Act) of 1999
<b>ACT</b>	Heritage Act 2004

<sup>62</sup> Herbert Smith Freehills, Clean Energy Investor Group (2024) *Delivering major clean energy projects in Queensland and Victoria: Review of QLD and VIC Statutory Planning Approval Processes*

<sup>63</sup> DCCEEW *Indigenous cultural heritage laws: Protection under state and territory laws*

<b>NT</b>	Aboriginal Sacred Sites Act 1989 Heritage Act 2011
<b>QLD</b>	Aboriginal Cultural Heritage Act 2003 Torres Strait Islander Cultural Heritage Act 2003
<b>SA</b>	Aboriginal Heritage Act 1988
<b>TAS</b>	Aboriginal Heritage Act 1975
<b>VIC</b>	Aboriginal Heritage Act 2006 Heritage Act 2017
<b>WA</b>	Aboriginal Heritage Act 1972

Source: DCCEEW

In practice, project requirements around cultural heritage are relatively similar across states. Typically, if a formal assessment of environmental impacts, whether that be an Environmental Impact Statement in Queensland or an Environment Effects Statement in Victoria, is required the proponent must obtain a cultural heritage management plan (CHMP) with the relevant Aboriginal party.<sup>64</sup> However, even if formal environmental assessment is not required, the development must still meet the cultural heritage duty of care to recognise, protect and conserve Indigenous cultural heritage which often involves entering a voluntary CHMP.<sup>65</sup>

There is a key interaction between environmental, agricultural, cultural and visual drivers of project delays, withdrawals or rejections and social licencing which is difficult to completely unravel from what is cited as a key determinant. It is unusual to have a project delayed, withdrawn or cancelled in response to only one source of community opposition, local opposition is often multi-faceted and amplified by a combination of sources leading to coalitions of opposition groups who often start out as single sources of opposition.<sup>66</sup> In analysing historic project withdrawals we have cited social licence as a key cause in cases where public pressure was implied or directly cited as the key reason for withdrawal. However, as can be seen in the Jupiter and Wooroora wind farm examples mentioned above, social licence difficulties are often common in many other withdrawals and rejections.

Early community engagement can avoid extended delays or project cancellations.<sup>67</sup> Community engagement represents the most common complaint levelled at proposed developments, representing 14% of all complaints received by the Australian Energy Infrastructure Commissioner (AEIC) since 2015.<sup>68</sup> Beyond this, visual, environmental, noise and economic loss are key areas of community complaints, all which could stifle social licence and have been cited in the majority of project withdrawals and rejections. The number of cases received about operating wind farms and other operating projects is significantly lower than complaints about newly proposed projects.

<sup>64</sup> Herbert Smith Freehills, Clean Energy Investor Group (2024) Delivering major clean energy projects in Queensland and Victoria

<sup>65</sup> Ibid.

<sup>66</sup> Susskind, Chun, Gant, Hodgkins, Cohen, Lohmar (2022) *Sources of opposition to renewable energy projects in the United States*

<sup>67</sup> Ibid.

<sup>68</sup> Office of the Australian Energy Infrastructure Commissioner (2024) *2023 Annual report*

**Fig 20. Number of times complaint issue has been raised, 2015-2023**



Source: Australian Energy Infrastructure Commissioner

### 2.4.3 Planning Changes

Recent and likely upcoming changes to planning frameworks on a federal, state or territory level are expected to impact project lead times, particularly for renewable and transmission projects.

The most recent independent statutory review of the EPBC Act has resulted in the Federal Governments Nature Positive Plan. Stage 2 of this plan is currently before Parliament and is focused on improving environmental approval speeds and transparency by establishing statutory bodies to streamline and centralise data management and approval decision making.<sup>69 70</sup> The proposed third stage of these reforms looks to establish new environmental standards and approval processes.

In addition to EPBC reform, legislation in several states and territories has recently, or is currently, undergoing reform to better support the development of energy assets, particularly for renewables. The new planning framework in New South Wales commenced in November 2024, aiming to accelerate the assessment process for State Significant Developments. The new framework has been largely considered as a positive step towards improved lead times and has been welcomed by

<sup>69</sup> Herbert Smith Hills, Clean Energy Investor Group (2024) *Delivering major clean energy projects: Review of the EPBC Act for renewable energy projects in Queensland, New South Wales and Victoria*

<sup>70</sup> DCCEEW EPBC Act reform

industry.<sup>71 72</sup> Changes to the framework have focused on providing more clarity to industry and communities with a key focus on wind energy. It is expected that the updated guidelines for the development of wind energy will have a material impact on the delivery of major wind projects in New South Wales.<sup>73</sup>

The Queensland Government has also recently updated their state code for wind farms. These changes represent a tightening of renewable energy planning guidelines and will require more supporting material to achieve compliance.<sup>74 75</sup> These changes focus on improving protection for ecological important and biodiverse areas, implementing best practice acoustic criteria, increased stakeholder engagement in the pre-lodgement stage and additional reporting for natural hazards, workforce accommodation and decommissioning. Recent announcements by the new Liberal government however make the future of these reforms uncertain.<sup>76</sup>

Victoria has established VicGrid to facilitate the planning of major electricity transmission infrastructure and coordinating renewable energy zone (REZ) development.<sup>77</sup> In 2024, Victorian Parliament passed amendments to the National Electricity (Victoria) Act 2005 to implement the first stage of the Victorian Transmission Investment Framework (VTIF) reforms. The amendments will support the delivery of the Victorian Transmission Plan in 2025, which will set the long-term strategic vision for the development of the state's Renewable Energy Zones.<sup>78</sup> Further reform and investment announcements to support these plans are anticipated.<sup>79</sup> Additionally, the Victorian Parliament has passed a new bill supporting offshore wind energy development. This reform will provide new mechanisms to access the Victorian land and coastal waters required to support the delivery of offshore wind energy targets of at least 2 gigawatts by 2032, 4 gigawatts by 2035 and 9 gigawatts by 2040.<sup>80 81</sup>

## **2.5 RESULTS**

Oxford Economics Australia has collected project level data for 579 energy assets in Australia. These observations provide insight into the key drivers of lead time differentiation across asset types and jurisdictions and form the basis of our results for the estimated lead time deviation around the NEM average.

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<sup>71</sup> Herbert Smith Freehills (2024) *Sweeping changes for wind energy projects under new NSW planning framework*

<sup>72</sup> Allens (2024) *Long-awaited NSW Renewable Energy Planning Framework delivers greater certainty for renewable energy projects*

<sup>73</sup> Herbert Smith Freehills (2024) *Sweeping changes for wind energy projects under new NSW planning framework*

<sup>74</sup> Herbert Smith Freehills (2024) *Queensland Government publishes updated State Code for Wind Farms*

<sup>75</sup> Renew Economy (2024) *Nature, noise, rehab: Queensland tightens wind farm planning rules in renewables regulation overhaul*

<sup>76</sup> AFR (2025) *Qld hits pause on wind farms, and big miners are among those worried*

<sup>77</sup> Herbert Smith Freehills, Clean Energy Investor Group (2024) *Delivering major clean energy projects in Queensland and Victoria*

<sup>78</sup> Department of Energy, Environment and Climate Action Victoria (2024) *Victorian transmission investment framework*

<sup>79</sup> Herbert Smith Freehills, Clean Energy Investor Group (2024) *Delivering major clean energy projects in Queensland and Victoria*

<sup>80</sup> Ibid.

<sup>81</sup> Parliament of Victoria (2024) *Bill paving the way for wind energy passes*

### 2.5.1 Observed Lead Times by Asset Type

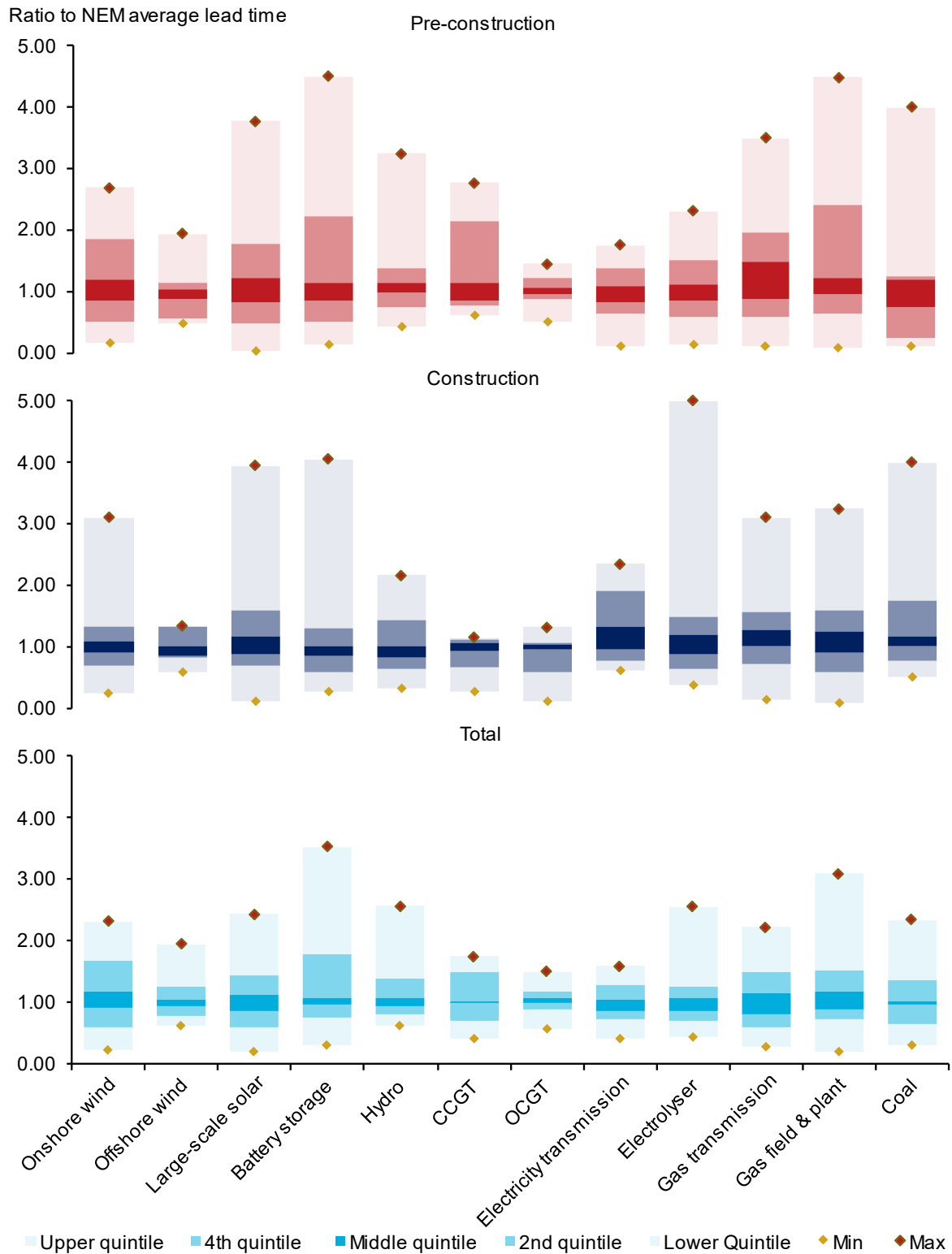
Observed lead times for energy infrastructure assets vary significantly by project and region. Outlier projects are typically larger or are utilising a technology that is relatively new to the region. Similarly, asset types that vary significantly in size between projects typically had a wider range of lead times. Shorter lead times were observed for projects that were expansions or extensions of existing projects or new projects which were collocated near existing assets of the same type.

For some asset types, insufficient data of observed lead times were available. Where minimal data was available due to asset maturity or a lack of public information, completed project data was supplemented by planned project lead times disclosed by developers or builders and project data for assets of a similar type. Specifically:

- Data collected for offshore wind and electrolysers includes revealed lead times for proposed projects that often have not yet begun construction.
- Project level data was not collected for electricity distribution and gas distribution due to limited public availability. Estimates for these asset types use electricity transmission and gas transmission respectively as proxies to estimate the state distribution of lead times.
- Project level data for CCGT developments that do not include CCS technology have been collected as a proxy for CCGT with CCS lead times.
- Project level data for OCGT developments that do not include dual fuel technology have been collected as a proxy for Dual fuel OCGT lead times.
- Where no (or very minimal) project data is available either the NEM average estimate is taken or the same differential from a similar asset type is applied.

These assumptions are additionally listed in Appendix B.

**Fig 21. Distribution of project lead times by phase and asset type as a ratio of NEM average lead time**



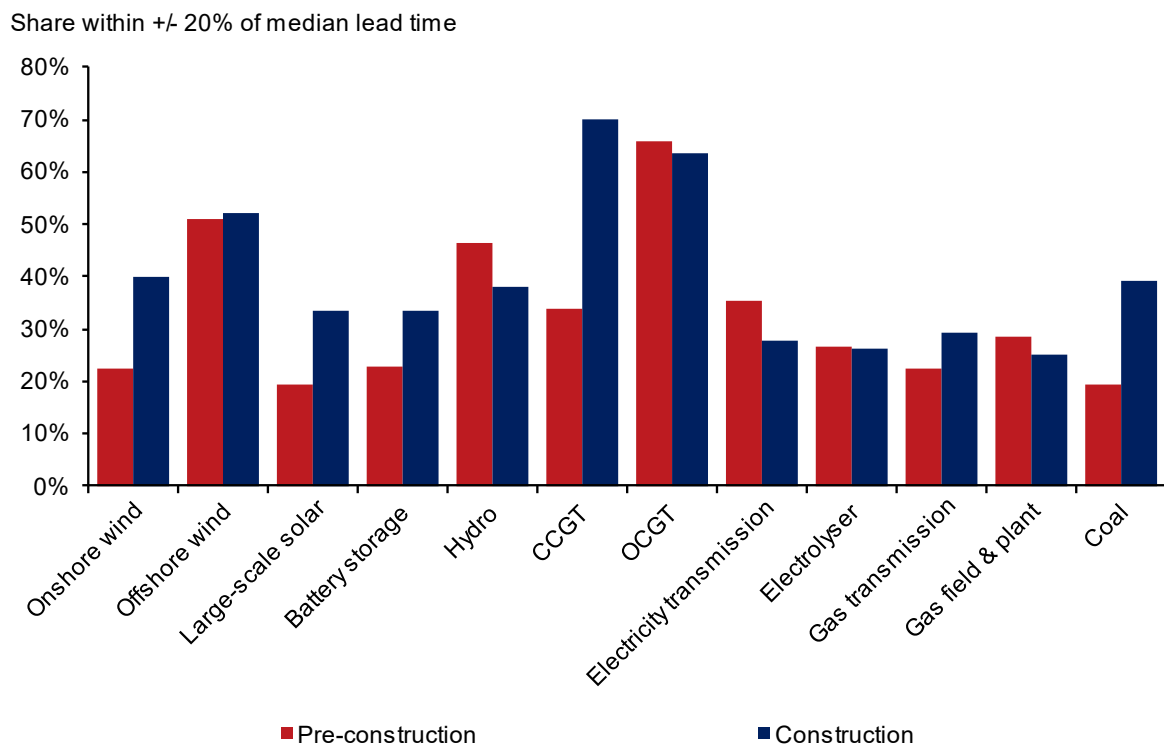
Source: Oxford Economics Australia

Note: Hydro includes both hydro generation and pumped hydro storage projects, OCGT includes OCGT projects without CCS and OCGT includes non-dual fuel OCGT.

The observed project data shows that there is less variation in construction lead times relative to the pre-construction phase. The share of projects within +/- 20% of the median lead time, a measure of variation, is greater for the construction phase of a project for almost all asset types. This trend is particularly stark for renewable assets (onshore wind, large-scale solar and battery storage).

Asset where there is relatively higher variation in pre-construction lead times include hydro, electricity transmission and gas field & plant assets. These assets have a larger range of project sizes which is likely to have a greater direct impact on construction times than it does pre-construction lead time.

**Fig 22. Share of projects within 20% of NEM average by asset type**

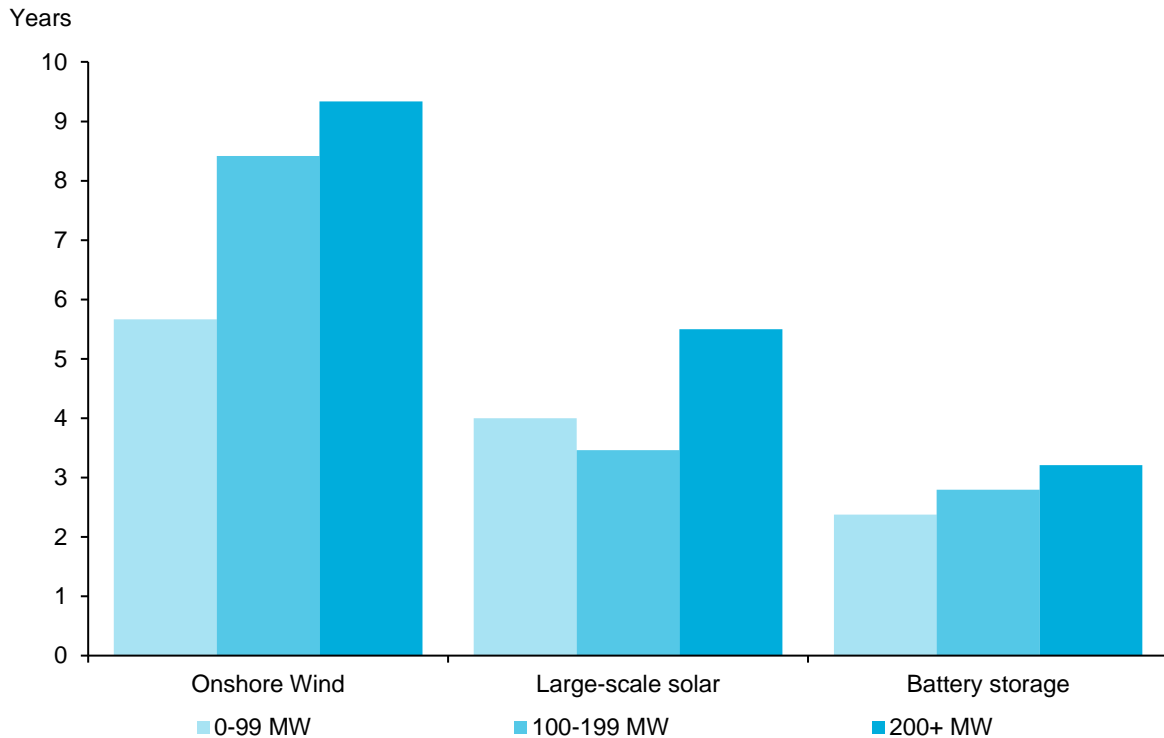


Source: Oxford Economics Australia

Note: Hydro includes both hydro generation and pumped hydro storage projects, OCGT includes OCGT projects without CCS and OCGT includes non-dual fuel OCGT.

Project lead time increases with project size for both onshore wind and battery storage projects. Large scale solar has a more mixed relationship between size and lead time with developments producing 100-199 MW having shorter median lead times than those producing 0-99 MW. This result is likely driven by the year these projects were developed. Smaller projects sized 0-99 MW, typically occurred in earlier years (pre-2010) when the industry was less mature and average lead times for all solar projects was longer.

**Fig 23. Observed total lead time by size for selected asset types**

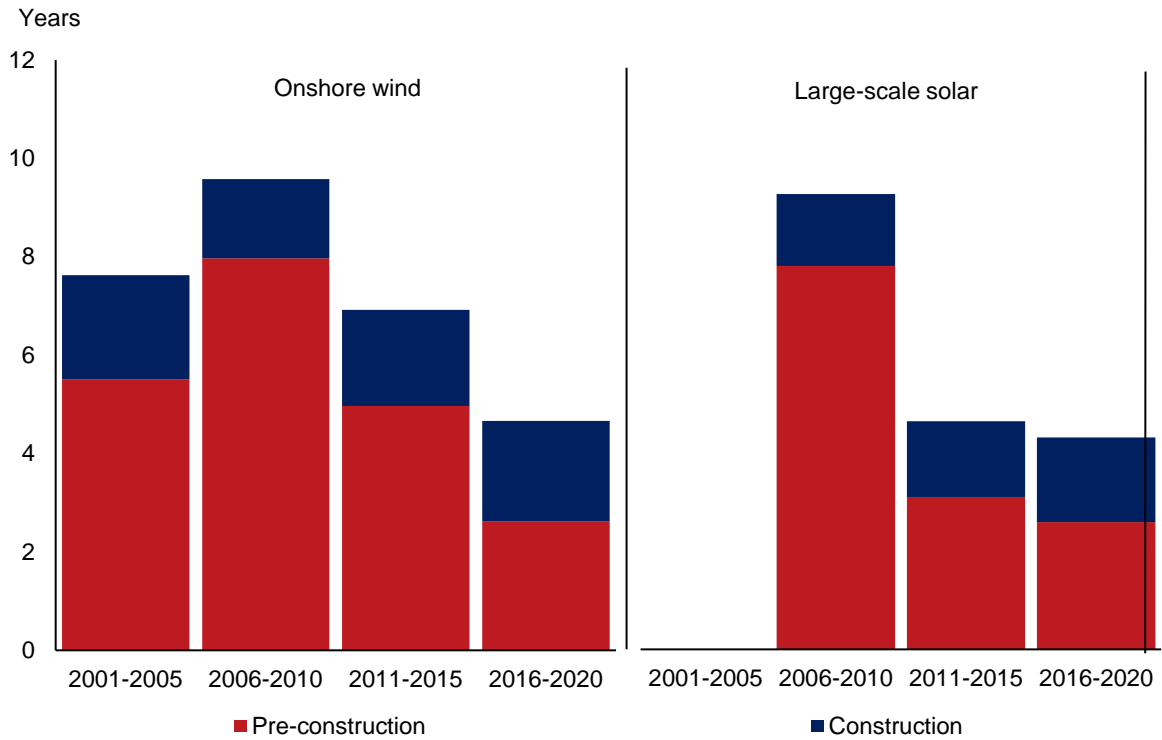


Source: Oxford Economics Australia

Lead times for onshore wind and large-scale solar have been decreasing over time. The vast majority of this decline has been driven by the pre-construction period as more supportive government policy, streamlined planning processes and greater experience of both developers & government approval processes. This trend can be seen across all states where development has occurred. This result is supported by the work of Clapin & Longden (2024) who found evidence that lead times reduce as the cumulative count of solar PV projects developed by project proponents increases (though they caveat that outlier projects with significantly shorter lead times were considered to be a key driver of this result).<sup>82</sup>

<sup>82</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

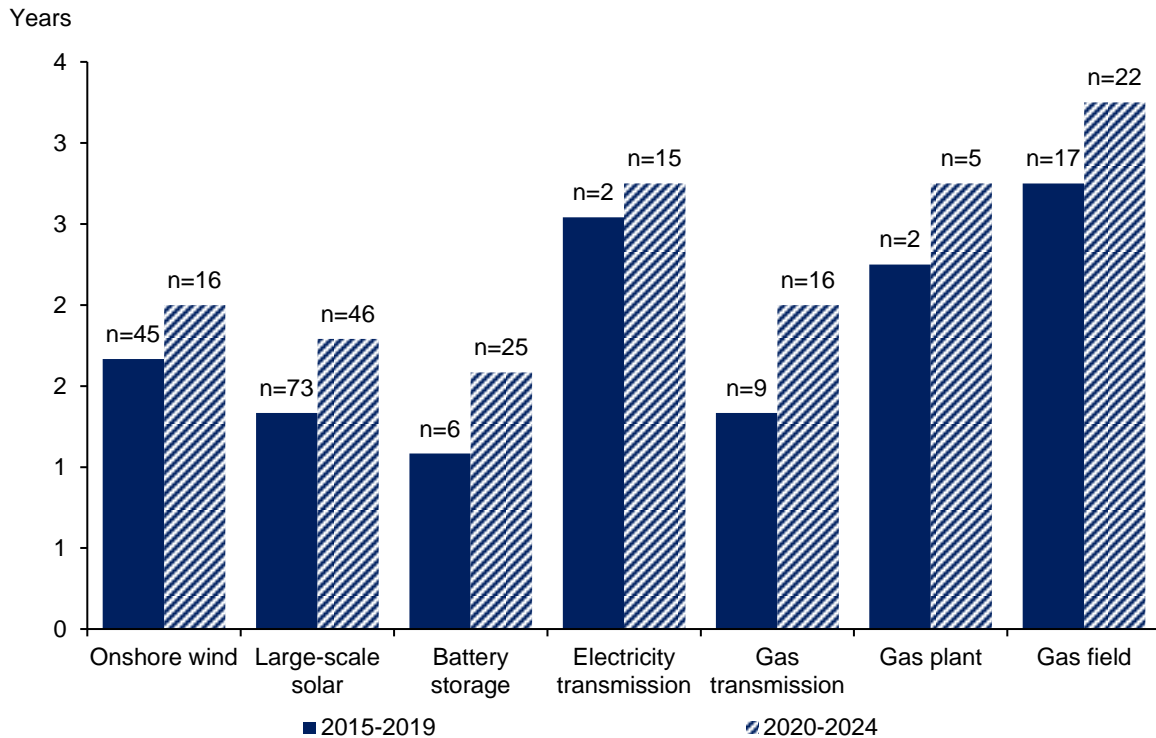
**Fig 24. Construction and pre-construction lead time 2006-2020 by asset type**



Source: Oxford Economics Australia

Consultation suggested that the pre-construction phase typically absorbs the majority of project delays as final investment decision is made on the basis of an agreed construction rollout. This aligns to the observed data for construction lead time changes over time which has been relatively more consistent than for the pre-construction phase.

**Fig 25. Construction lead times 2015-2019 and 2020-2024 for selected asset types**

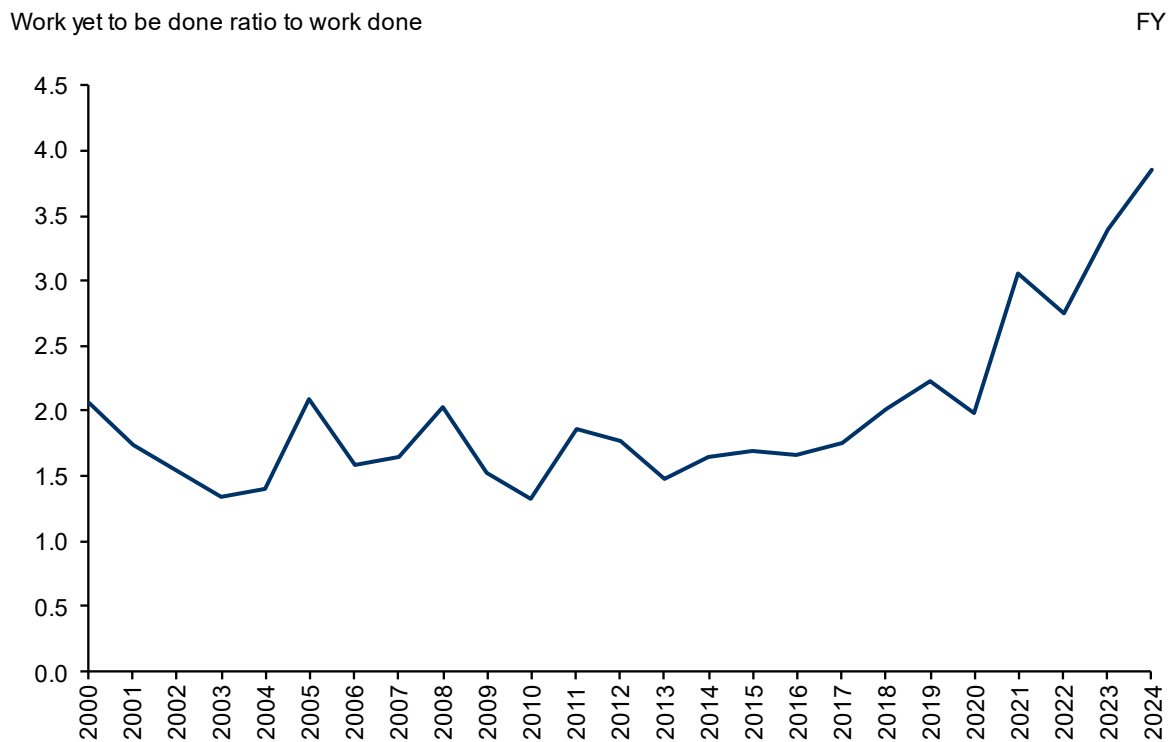


Source: Oxford Economics Australia

Note: Offshore wind, pumped hydro storage, electrolyzers, OCGT, CCGT and coal data is not included as there was insufficient data in the time periods displayed in this chart. Data is not included for electricity distribution and gas distribution as no project level data was collected for these asset types, rather estimates use Electricity transmission and gas transmission as proxies for state distribution as outlined in section 2.4.2 and Appendix B.

However, there is some evidence of increased construction lead times since the beginning of the pandemic. All asset types with observable construction period in the 5 years leading up to the pandemic and the 5 years since 2019 have increased median construction lead times. This coincides with a significant increase in the backlog of work yet to be done in the electricity sector – which measures the value of outstanding work for commenced projects. While this analysis is based on few observed projects for some asset types, does not control for project size and state of construction, there is some evidence that energy asset construction has taken longer over the last few years during a period of significant construction activity and supply chain constraints.

**Fig 26. Electricity generation, transmission and distribution work yet to be done as a ratio of work done**



Source: ABS, Oxford Economics Australia

### 2.5.2 Estimated Lead Times by State and Asset Type

Using the observed project level data, we estimate the distribution of lead times by jurisdiction around Aurecon’s representative hypothetical project across the 15 asset types. Analysis of the raw observed lead times suggest that project size plays a significant role in overall project lead time, and so, regression analysis used to control for project size (capacity and/or cost) in our estimates.

The estimated differences in total lead time are driven predominately by differences in pre-construction lead times. Across all asset types 51% of estimated pre-construction lead times for states are within 10% of the NEM average, compared to 63% for construction lead times. Consultation responses suggested that the pre-construction phase typically absorbs the majority of increases or decreases in total lead time as construction only begins once final investment decision is made which requires strict planning, costing and the majority of material sourcing to have already occurred. From this point, construction occurs on a relatively tight schedule and budget.

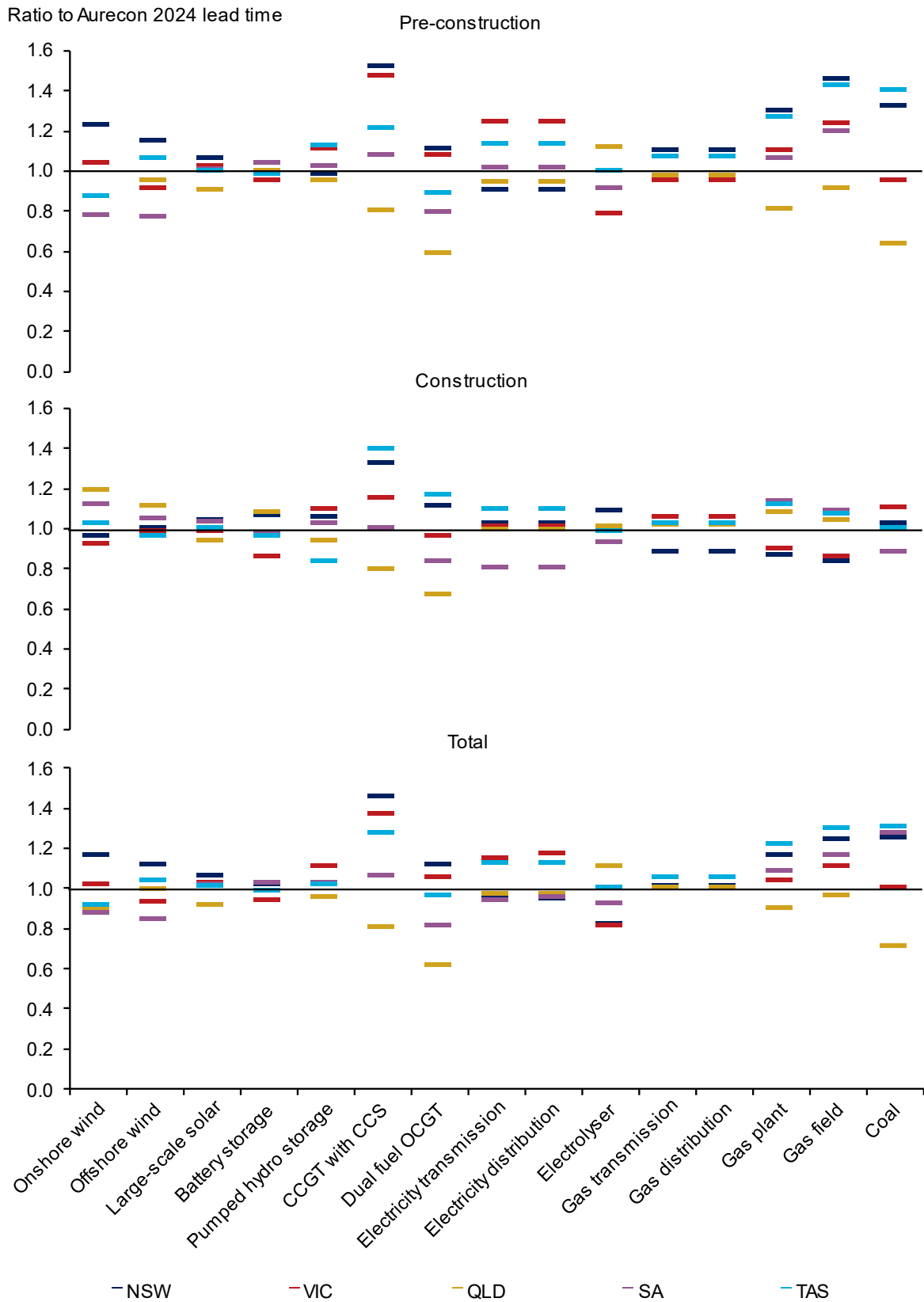
Variability across states is most pronounced for asset types that are predominately developed in just one or two NEM jurisdictions. This is evident for gas assets for which all states except Queensland are above the NEM average for gas field, plant and generators with the exception of South Australian and Tasmanian OCGT developments, though this is based on the relatively small sample of gas developments outside Queensland. The favourable lead times for gas assets in Queensland are likely driven by the significantly larger number of projects developed in the state relative to other jurisdictions, with both state developers and the planning regulators more familiar with pre-construction requirements. Comparatively, total lead time estimates for large-scale solar and battery

storage are within 10% of the NEM average in all states. Additionally, observed lead times for large-scale solar and onshore wind developments have declined over time, driven by a reduction in pre-construction lead times coinciding with a ramp up in development of these asset types.<sup>83</sup>

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<sup>83</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia* and based on analysis of observed project lead times collected for this report.

**Fig 27. Estimated lead time by phase, state and asset type as a ratio of Aurecon 2024**



Source: Oxford Economics Australia

Estimated total lead times in New South Wales are generally at or above the NEM average, with New South Wales having the longest total lead time for five of the 15 asset classes. This is driven by longer pre-construction lead-times, with New South Wales having the longest in nine of the 15 asset types compared to just two for construction. Lead times in New South Wales across renewable assets, solar, wind and battery storage, are all above the NEM average and are most pronounced for onshore wind. Electricity infrastructure and electrolysers are the only assets for which New South Wales has below average estimated lead times, with estimates for electrolysers based mostly on revealed lead times for proposed projects that often have not yet begun construction.<sup>84</sup>

Victoria and Tasmania are generally estimated to be near the NEM average lead times for the majority of asset types, with the exception of gas assets and electricity infrastructure. Victoria has particularly favourable estimated lead times for battery storage and electrolyser projects while Tasmania's most favourable lead time is for onshore wind projects, driven by a relatively short estimated pre-construction lead time.

Lead times in South Australia and Queensland are generally at or below the NEM average. South Australia has relatively favourable lead times for both onshore and offshore wind development, likely driven by the significant number of wind developments in SA representing 43% of energy to the grid over the last 12 months, more than double the next highest state or territory in the NEM. Total estimated lead times in Queensland are below the NEM average for all but two asset types, offshore wind and electrolysers, although these estimates are predominately driven by proposed lead times for projects that often have not yet begun construction. The state has the lowest total lead time in nine of the 15 asset types and is particularly favourable for solar, gas and coal assets.

## **2.6 AREAS FOR FUTURE RESEARCH**

Based on consultations and research undertaken for this study, we recommend future iterations of the work consider including:

- More granular intra-state analysis of lead times. Many developments receive approval at a local council level and so the planning experiences in different regions of the same state may vary significantly. Further data gathering and research could identify the nuanced opportunities, challenges and lead time differences in high priority regions.
- Impacts of learning-by-doing on lead times. There are potential efficiency gains from developing assets of the same asset type in closer proximity. As more energy assets are built, government planning departments, the community, developers, builders and other stakeholders may increase their understanding of the development process. Our analysis of observed lead times suggests that states developing a specific asset type more commonly have relatively shorter lead times for that asset type. However, there are also likely time period impacts as lead times have generally decreased over time. Clapin, Longden (2024) also found

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<sup>84</sup> Electricity infrastructure includes both electricity transmission and electricity distribution.

some evidence of learning-by-doing on the level of main project proponents that they noted as an area requiring more data and research.<sup>85</sup>

- Further consultation on the more nascent asset types as well as those with relatively less coverage in the project level data sample gathered in this report. Certain nascent technologies, particularly those with many projects in the planning stage that have not yet begun construction may have significant impacts on the development of our grid in the future. Data analysis in this report has relied partially on proxies and expected lead times for projects that have not yet begun construction to estimate differences across states. Further research and consultation will provide better estimates for lead time differences and enhance our understanding of specific development challenges of these important asset types.
- Further consultation and data gathering on the contribution of project delays to capital cost increases in project development. Quantitative analysis of the contribution of pre-construction and construction delays to overall project cost across asset types and states would require primary research through consultations and survey analysis.

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<sup>85</sup> Clapin, Longden (2024) *Waiting to generate: An analysis of onshore wind and solar PV project development lead-times in Australia*

# APPENDIX A: INSTALLATION COST ASSUMPTIONS

## INPUT WEIGHTINGS

Input	Onshore Wind	Offshore Wind	Large-scale PV	Battery storage	Pumped Hydro storage	Electricity Transmission	Electricity Distribution	Electrolysers	CCGT with CCS	Dual Fuel OCGT	Gas Plant	Gas Field	Gas Transmission	Gas Distribution	Coal
Design	10	10	4	5	10	5	5	10	10	10	10	10	5	5	10
Labour	30	35	40	45	38	40	45	50	50	50	50	50	40	55	50
Concrete	10	-	13.5	20	20	5	5	10	10	10	10	5	5	5	10
Steel	5	20	20	7.5	2	12.5	5	12	12	12	12	15	27.5	22.5	12
Cable	10	10	7.5	7.5	2	12.5	15	5	5	5	5	-	-	-	5
Plant	10	-	5	5	5	5	5	5	5	5	5	10	7.5	7.5	5
Freight	10	5	5	5	10	5	5	5	5	5	5	5	10	5	5
Logistics	5	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Roads	10	-	5	5	3	10	-	3	3	3	3	5	5	-	3
Other	-	20	-	-	10	-	15	-	-	-	-	-	-	-	-

(a) Escalation rates for inputs where no price series exist have their rates set to CPI

(b) Additional 'logistics' associated with transporting wind turbine and transmission infrastructure

(c) Access includes access roads and car parks

(d) Hiring rates for offshore wind turbine installation vessel, tunnel boring machine (pumped hydro storage) and miscellaneous inputs

(e) Input weightings for Pumped Hydro Storage reflects a 50/50 split between closed and open loop build types. Open-looped build types assumed to require a greater proportion of concrete compared to closed-loops build types.

## INPUT SOURCES

Input	Description	Source
Design	Engineering Design and Consulting Services	Table 24 of ABS Release 6427, "Output of the professional, scientific and technical services industries"
Labour	Wage Price Index, Construction (by state)	ABS, unpublished 'Special Run' Series
Concrete	Concrete, Cement and Sand PPI (by state)	Table 18 of ABS release 6427 "Input to the House construction industry".
Steel	Steel Beams and Sections	Table 18 of ABS release 6427 "Input to the House construction industry".

<b>Cable</b>	Electrical Cable and Wire Manufacturing	Table 12 of ABS release 6427 "Output of Manufacturing Industries".
<b>Plant</b>	Other Goods and Equipment Rental and Hiring	Table 23 of ABS release 6427 "Output of the Rental, hiring and real estate services industries"
<b>Freight</b>	Road Freight Transport	Table 21 of ABS release 6427" Output of the Transport, postal and warehousing industries"
<b>Logistics</b>	Consumer Price Index	Table 1 of ABS release 6401 "CPI: All Groups, Index Numbers"
<b>Roads</b>	Road and Bridge Construction (by state)	Table 17 of ABS release 6427 "Output of the Construction industries"
<b>Other</b>	Consumer Price Index	Table 1 of ABS release 6401 "CPI: All Groups, Index Numbers"

# APPENDIX B: LEAD TIME ASSUMPTIONS

For some asset types, insufficient data of observed lead times were available. Where minimal data was available due to asset maturity or a lack of public information, completed project data was supplemented by planned project lead times disclosed by developers or builders and project data for assets of a similar type. Specifically:

- Data collected for offshore wind and electrolysers includes revealed lead times for proposed projects that often have not yet begun construction.
- Project level data was not collected for electricity distribution and gas distribution due to limited public availability. Estimates for these asset types use electricity transmission and gas transmission respectively as proxies to estimate the state distribution of lead times.
- Project level data for CCGT developments that do not include CCS technology have been collected as a proxy for CCGT with CCS lead times.
- Project level data for OCGT developments that do not include dual fuel technology have been collected as a proxy for Dual fuel OCGT lead times.
- Where no (or very minimal) project data is available either the NEM average estimate is taken or the same differential from a similar asset type is applied.

**Fig 28. Project listing coverage by state and asset type**

Asset type	NSW	VIC	QLD	SA	TAS	NEM	Non-NEM	AUS
Onshore wind	20	41	9	21	5	96	0	96
Offshore wind	6	9	0	2	1	18	7	25
Large-scale solar	50	16	46	19	0	131	0	131
Battery storage	11	8	7	9	0	35	0	35
Hydro	10	4	8	0	7	29	0	29
CCGT	1	0	2	2	1	6	0	6
OCGT	4	3	3	2	1	13	0	13
Electricity transmission	9	3	7	3	3	25	3	28
Electricity distribution	0	0	0	0	0	0	0	0
Electrolyser	2	6	15	7	5	35	19	54
Gas transmission	5	7	9	0	0	21	18	39

<b>Gas distribution</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Gas plant</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>9</b>	<b>7</b>	<b>16</b>
<b>Gas field</b>	<b>2</b>	<b>10</b>	<b>34</b>	<b>1</b>	<b>0</b>	<b>47</b>	<b>32</b>	<b>79</b>
<b>Coal</b>	<b>8</b>	<b>6</b>	<b>8</b>	<b>1</b>	<b>0</b>	<b>23</b>	<b>5</b>	<b>28</b>
<b>Total</b>	<b>130</b>	<b>116</b>	<b>151</b>	<b>68</b>	<b>23</b>	<b>488</b>	<b>91</b>	<b>579</b>

\*Hydro includes both hydro generation and pumped hydro storage projects, OCGT includes OCGT projects without CCS and OCGT includes non-dual fuel OCGT.

**Fig 29. Data gap assumptions**

<b>Asset type</b>	<b>Assumptions</b>
<b>Offshore wind</b>	Planned projects used as indicator of expected lead times across states.
<b>Pumped hydro storage</b>	Project level data for hydro generation projects have been collected as a proxy for Pumped hydro storage lead times.
<b>Electricity distribution</b>	Electricity transmission projects used as a proxy for electricity distribution projects.
<b>Gas distribution</b>	Gas transmission projects used as a proxy for gas distribution projects.
<b>CCGT with CCS</b>	Project level data for CCGT developments that do not include CCS technology have been collected as a proxy for CCGT with CCS lead times.
<b>Dual fuel OCGT</b>	Project level data for OCGT developments that do not include dual fuel technology have been collected as a proxy for Dual fuel OCGT lead times.
<b>Multiple</b>	Where no (or very minimal) project data is available either the NEM average estimate is taken or the same differential from a similar asset type is applied.
<b>Multiple</b>	For asset types with minimal coverage, planned but not yet complete projects were included where estimated project construction and completion dates were available

# APPENDIX C: DEVELOPMENT APPROVAL FEES

**Fig 30. Summary of typical fees levied throughout the approval stage of energy developments**

State	Specific approval process	Fee type	Additional information	Fee (\$ unless otherwise specified)
NSW	State significant development / infrastructure	Application fee	Application involving the erection of a building, the carrying out of a work or the demolition of a work or building	\$26,038 - \$333,276+ (depending on project value from \$10 million-\$400 million+)
NSW	State significant development / infrastructure	Additional fee	Application for consideration of planning proposal in relation to a development application for State significant development	\$29,488 base rate + \$1,130 per hectare
NSW	State significant development / infrastructure	Additional fee	Additional fee for application for approval of critical State significant infrastructure	\$65,093
NSW	State significant development / infrastructure	Additional fee	Modification request for State significant infrastructure— (a) involving a minor matter, such as a minor error, misdescription or miscalculation (b) involving minor environmental assessment	\$1,107 - \$6,509
NSW	State significant development / infrastructure	Additional fee	More significant modification application for State significant development or modification request for State significant infrastructure	Greater of— 50% fee paid for original development application or application for approval, or \$6,509
NSW	State significant development / infrastructure	Fees for reviews and appeals	Application for review or appeal against determination of modification application	50% fee that was payable for the application the subject of appeal
QLD	Coordinated project	Coordinated project declaration	Considering an application for declaration of coordinated project	\$22,374 (\$0 if under EPBC assessment)
QLD	Coordinated project	Coordinated project EIS process	Notice of requirement for EIS	\$67,120 (\$32,545 if under EPBC assessment)
QLD	Coordinated project	Coordinated project EIS process	Considering the draft EIS - The Coordinator General decides that the proponent has prepared a draft EIS to his/her satisfaction	\$113,898 (\$41,419 if under EPBC assessment)

<b>QLD</b>	<b>Coordinated project</b>	Coordinated project EIS process	If decision is that the draft EIS is not a final EIS— instructing the proponent on additional information required, considering a revised draft EIS and any submissions and advice on a revised draft EIS	\$59,433 (\$0 if under EPC assessment)
<b>QLD</b>	<b>Coordinated project</b>	Coordinated project IAS process	Considering the draft IAR, submissions and advice on the draft IAR, and preparing a report evaluating the IAR	\$92,449 - \$110,939 (\$17,686 - \$22,130 if under EPBC assessment)
<b>QLD</b>	<b>Coordinated project</b>	Coordinated project IAS process	Considering a revised draft IAR and any submissions or advice on the revised draft IAR	\$44,641
<b>QLD</b>	<b>Coordinated project</b>	Evaluation of change to a coordinated project	Application for evaluation of environmental effects of proposed change to a project or because of a Coordinator-General's decision that the project has changed	\$13,474
<b>QLD</b>	<b>Coordinated project</b>	Evaluation of change to a coordinated project	Considering advice from any entity or additional information from the proponent requested by the Coordinator General, and preparing the change request evaluation report (change report)	\$28,926 - \$62,388 (depending if public notification is required)
<b>QLD</b>	<b>Fraser Coast Council</b>	Impact Fee - Renewable energy facility/Major electricity infrastructure	Assesses a development against the planning scheme's codes, as well as other relevant matters, such as the identified planning need. Impact assessments are more time consuming and involve public consultation. The assessment is "unbounded" and can consider relevant matters outside of the prescribed matters. Impact assessments require public notification.	\$10,605 + \$739 per 500sqm
<b>QLD</b>	<b>Fraser Coast Council</b>	Code Fee - Renewable energy facility/Major electricity infrastructure	Assesses a development against the planning scheme's codes or assessment benchmarks. Code assessments are relatively quick and don't require public notification. The assessment is "bounded" and only considers prescribed matters.	\$7,388 + \$111 per ha
<b>QLD</b>	<b>Fraser Coast Council</b>	Impact Fee - Extractive industries	Assesses a development against the planning scheme's codes, as well as other relevant matters, such as the identified planning need. Impact assessments are more time consuming and involve public consultation. The assessment is "unbounded" and can consider relevant matters outside of the prescribed matters. Impact assessments require public notification.	\$14,580 + \$408 per 5 ha
<b>QLD</b>	<b>Fraser Coast Council</b>	Code Fee - Extractive industries	Assesses a development against the planning scheme's codes or assessment benchmarks. Code assessments are relatively quick and don't require public notification. The assessment is "bounded" and only considers prescribed matters.	\$10,160 + \$408 per 500sqm
<b>VIC</b>	<b>Permitting under the Planning and Environment Act 1987</b>	Fees for permits	Permit fees for developments with value more than \$15 million but less than \$50 million	\$28,292

VIC	Permitting under the Planning and Environment Act 1988	Fees for permits	Permit fees for developments with value more than \$50 million	\$63,589
VIC	Permitting under the Planning and Environment Act 1989	Fees for amending permits	Amendment to a permit to change the statement of what the permit allows or to change any or all of the conditions which apply to the permit	\$1,453
VIC	Permitting under the Planning and Environment Act 1990	Fees for amending permits	Amend an application for a permit or an application to amend a permit	40% of original application fee
VIC	Victorian EPA	Development licences	Fees for development licences	1% of total development cost Maximum fee \$71,550
TAS	Circular head council (local council example)	Permit application	Assessment and determination of a permit application	\$295 + \$1.40 for every \$1,000 of value for use or development
TAS	Tasmanian EPA	Assessment fee		\$36,379 - \$54,566 (depending on project size 30MW - 200 MW+)
SA	PlanSA development applications	Lodgement fee		\$2,059 for projects over \$10 million
SA	PlanSA development applications	Assessment fee	Impact assessed projects	\$1,963 (if minister declared) + 0.25% of development cost
SA	PlanSA development applications	Assessment fee	Performance assessed projects	\$280 + 0.125% of development cost

Source: State Development Infrastructure and Planning Queensland <sup>86 87</sup>, NSW Department of Planning & Environment <sup>88</sup>, Department of Planning and Transport Victoria <sup>89 90</sup>, PlanSA <sup>91 92</sup>, Tasmanian Planning Commission <sup>93</sup>, Fraser Coast Regional Council <sup>94</sup>, Circular Head Council <sup>95</sup>, EPA Tasmania <sup>96</sup>, EPA Victoria <sup>97</sup>

<sup>86</sup> State Development Infrastructure and Planning Queensland, *Overview of fees for coordinated projects*

<sup>87</sup> State Development Infrastructure and Planning Queensland (2024), *Coordinator-General-Assessments and approvals-Coordinated projects-Current projects*

<sup>88</sup> NSW Department of Planning & Environment (2024) *Schedule of planning and development fees and charges for 2024/25 financial year*

<sup>89</sup> Department of Planning and Transport Victoria, *Environmental Assessments-Browse EES projects and referrals*

<sup>90</sup> Department of Planning and Transport Victoria (2016), *Planning and Environment (Fees) Regulations 2016*

<sup>91</sup> PlanSA (2024), *Fees and charges at a glance*

<sup>92</sup> PlanSA (2024,) *Impact assessed development*

<sup>93</sup> Tasmanian Planning Commission, *Assessment and review processes*

<sup>94</sup> Fraser Coast Regional Council, *Development fees & charges*

<sup>95</sup> Circular Head Council, *Planning Services Fees*

<sup>96</sup> EPA Tasmania, *Schedule of Fees*

<sup>97</sup> EPA Victoria, *EPA fees*



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