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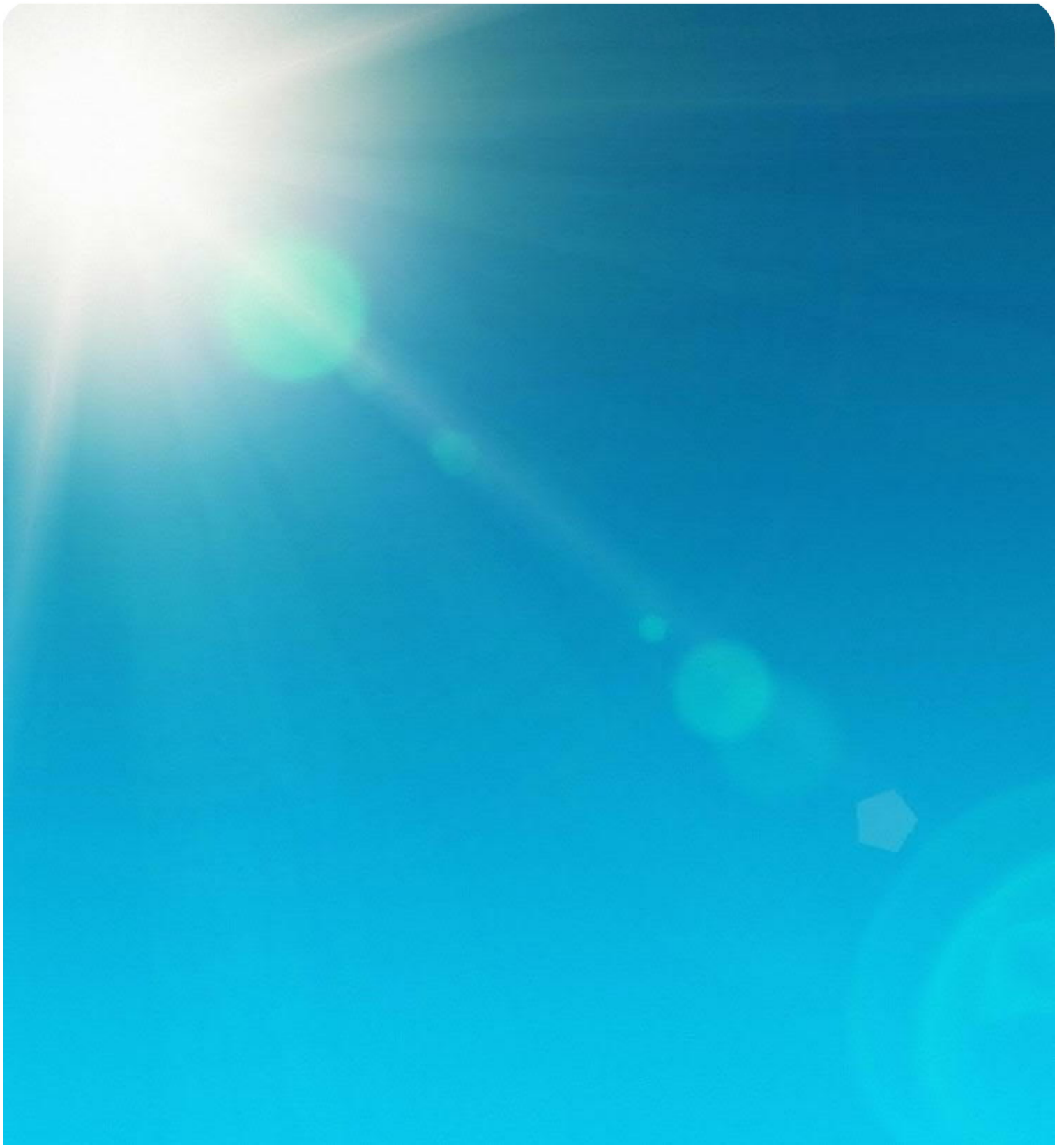
March 2022

Appendix G – Economic Assessment

Australia-Asia PowerLink Environmental Impact Statement



Economic impact of the AAPowerLink to the NT and Australia

March 2022

pwc

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We acknowledge and pay our respects to Aboriginal and Torres Strait Islander peoples as the First Peoples of Australia, whose ancestral lands and waters we work and live on throughout Australia. We honour the wisdom of, and pay respect to, Elders past, present and future.

Artwork by Marrawuy Journeys

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Executive summary

Executive summary

Sun Cable and AAPowerLink

Sun Cable is an Australian company with a mission to deliver systems to supply renewable electricity from resource abundant regions to growing load centres, at scale.

Sun Cable's flagship Australia-Asia PowerLink (AAPowerLink) project will support the creation of an intercontinental power grid supplying Australia and Singapore with reliable and competitively priced renewable electricity. The AAPowerLink (the Project) is a high-capacity solar, storage and transmission system that will transmit renewable electricity from the Barkly Region of the Northern Territory (NT) to Darwin and Singapore markets.

Construction is expected to take five years from FY24, with total capital expenditure (CAPEX) in excess of $30 billion. Zero-carbon electricity from the AAPowerLink is expected to become available to Darwin from 2026 and Singapore from 2027. In FY29 AAPowerLink will be operating at full capacity and will be flexible to respond to volatility in demand.

The Opportunity for the NT and Australia

A significant energy transition is underway in the Asia-Pacific and demand for renewable electricity is accelerating. In a first of its kind for Australia, AAPowerLink integrates multi gigawatt-scale solar generation, significant battery storage and overhead and subsea high voltage direct current (HVDC) transmission systems. Together, these technological elements offer a unique opportunity to provide electricity that is clean, lower-cost, and firmed:

- Clean electricity provision through AAPowerLink supplying renewable electricity at scale. This can support economic growth with reduced carbon emissions and contribute to climate objectives including the NT Government Climate Change Policy.
- Lower-cost renewable electricity provided by AAPowerLink can help improve the NT's competitiveness to attract growth industries (such as green hydrogen, data centres and critical minerals processing). AAPowerLink aims to provide dispatchable electricity at materially lower wholesale prices than the current average cost of gas-based electricity in the NT.
- Stable renewable energy provided by AAPowerLink through the provision of 24/7 firmed renewable electricity. This stable, or firmed, electricity is possible because of AAPowerLink's proposed 36 gigawatt-hour (GWh) battery - what will be the world's largest battery.
- Support Australian exports to Asia through supplying up to 15 per cent of Singapore's electricity needs, establishing a significant new Australian export industry.

Economic impacts of AAPowerLink

This report estimates the economic impact of the development of the AAPowerLink on the NT and Australian economy using Computable General Equilibrium (CGE) modelling.

The development of AAPowerLink will generate significant economic benefits for the NT and national economies. These benefits are largely driven by investment and employment during the construction phase, as well as business expenditure, employment and exports during the Project's operation phase.

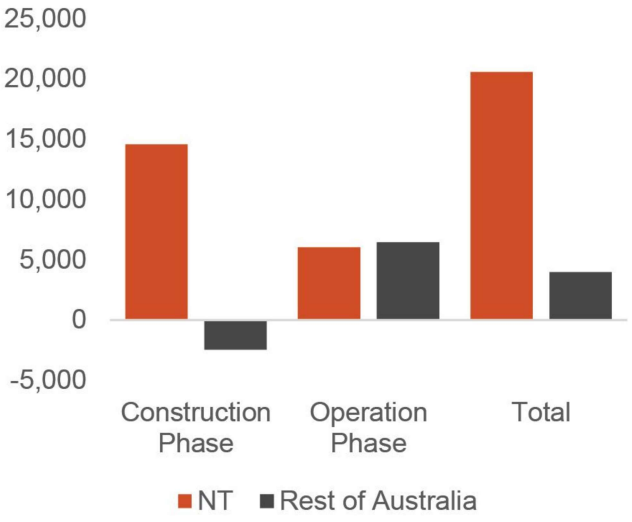
This investment, employment and business expenditure activity will flow throughout the NT and national economies resulting in new economic activity, jobs and household consumption.

Summary of findings[1]

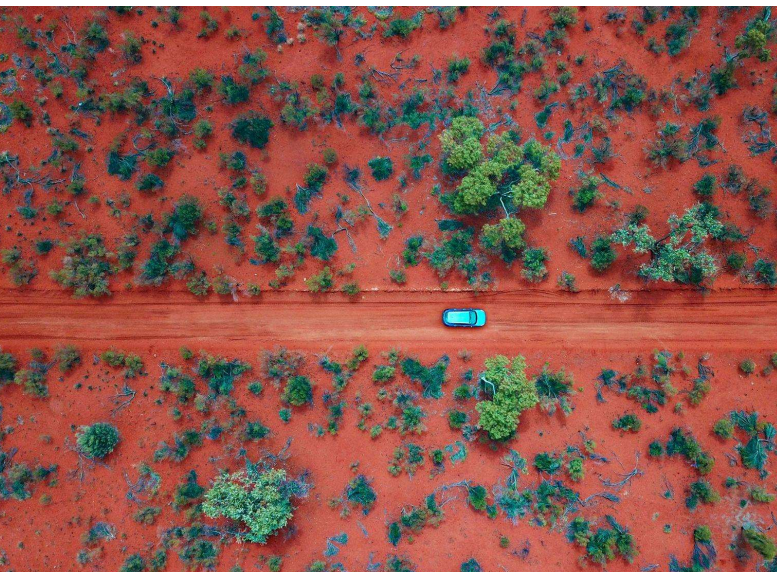
Economic activity (GDP and GTP)

AAPowerLink will stimulate economic activity and raise aggregate demand in the NT economy - observed in an increase in the NT's gross territory product (GTP) (Figure E.1). Real GTP increases by $20.6 billion from FY24-FY69 - an average annual increase in the NT of approximately $2.4 billion and $150 million during the construction phase (FY24-FY29)[2] and operation phase (FY30-FY69) respectively.

Figure E.1: Additional economic activity (GTP/GDP) generated by AAPowerLink by region, real FY22 prices, undiscounted, $ million



Source: PwC analysis, Sun Cable inputs

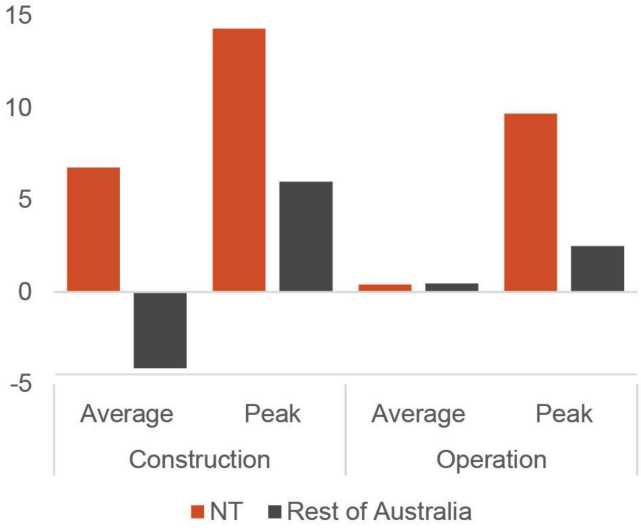


In the rest of Australia, AAPowerLink is projected to increase gross domestic product (GDP) by $4 billion over the 46 years from FY24 to FY69. While in some years there are negative impacts due to resources and capital being attracted to the NT, over the long term there is a net positive impact on economic activity for both the NT and Australia.

Employment[3]

Similar to GTP and GDP, there are substantial employment impacts unlocked in the NT, in particular during the construction phase (Figure E.2). Construction of the Project is estimated to support a total of 6,800 jobs in the NT economy on average each year, reaching a peak of 14,300 in FY28.

Figure E.2: Average and peak annual employment (FTE) generated by AAPowerLink by region, 000s jobs



Source: PwC analysis, Sun Cable inputs

The average annual increase in employment in the NT is over 1,200 from FY24-FY69, with an average of approximately 6,800 annual jobs created during the construction phase.

This increase in NT employment is partially supported by a reallocation from the rest of Australia of around 100 jobs on average per year over the period FY24-FY69. This is linked to AAPowerLink investment incentivising both labour and capital from other parts of the country to relocate to the NT. Overall, an average of 1,100 total jobs are estimated to be supported annually at a national level (including the NT) over the entire Project - a net benefit to national employment.

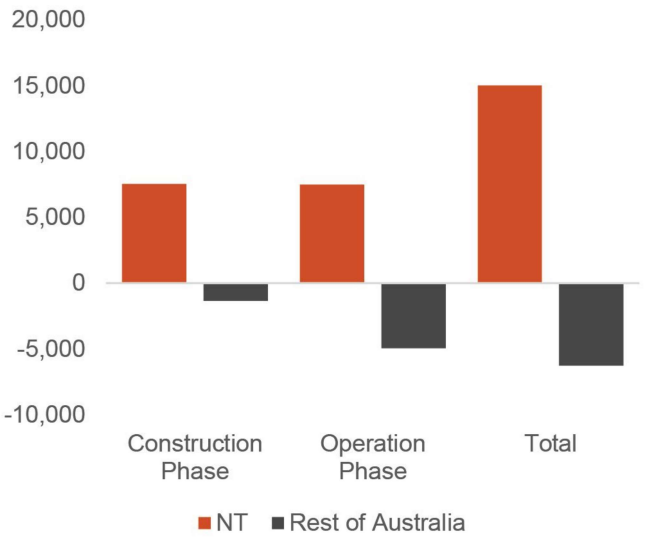
1. Economic modelling was undertaken over the period FY22 to FY69 with results reported for the NT and nationally. All monetary values are given in undiscounted, real terms FY22 prices unless stated otherwise.
2. A relatively small amount of additional CAPEX occurs in FY42-FY43 for battery replacement at the end of their life cycle. This value is not included in the reporting of construction phase results.
3. Employment values in this report are reported as full time equivalent (FTE) jobs and include both direct and indirect employment. These values are not directly comparable with other estimates of AAPowerLink employment as they are derived from a CGE model. See Appendix A: Modelling approach.

Household consumption

The increases in employment and expenditure as a result of AAPowerLink will result in higher levels of household disposable income (Figure E.3) which in turn drive growth in household consumption. This is a key measure of economic welfare which evidences households ability to consume goods and services.

Households in the NT will benefit from a total of $15 billion additional consumption across the construction and operation phases. This equates to $1.3 billion and $190 million on average per year in the construction and operation phases respectively.

Figure E.3: Additional household consumption generated by AAPowerLink by region, real FY22 prices, undiscounted, $ million



Source: PwC analysis, Sun Cable inputs

Conclusion

The investment proposed to construct and operate AAPowerLink is estimated to provide significant benefits to the Australian economy.

AAPowerLink is expected to have a net positive impact on economic activity, employment and consumption in Australia, with substantial benefits for the NT.

Combining these impacts with the compelling environmental case for the provision of renewable, low-carbon electricity, AAPowerLink has the potential to deliver positive outcomes for Territorians and Australians for years to come.

Key economic impacts of AAPowerLink in the NT and Australia

Sun Cable is developing the Australia-Asia PowerLink; a high-capacity solar, storage and transmission system that will transmit renewable electricity from the Barkly Region of the Northern Territory to Darwin and Singapore markets.

Key AAPowerLink stats

$30+ billion
capital expenditure over the construction period

Multi-billion dollar
additional annual exports from the sale of electricity to Singapore

Northern Territory benefits

$20 billion
additional economic activity in the NT

14,000
peak additional jobs during the construction phase annually in the NT

$15 billion
additional household consumption in the NT

National benefits

$4 billion
additional economic activity in the rest of Australia

1,000
additional jobs annually in Australia (including the NT)

$8 billion
additional household consumption in Australia (including the NT)

Economic activity and household consumption values reported undiscounted in real FY22 prices.

Economic activity, household consumption and employment impacts are estimated over the period FY24-FY69 comprising a construction and operational phase.

The construction phase is assumed to occur in FY24-FY29 (with a relatively small amount of additional capital expenditure (CAPEX) occurring in FY42-FY43 for battery replacement at the end of their life cycle), and the operation phase is assumed to occur from the end of construction in FY30 to FY69 (Sun Cable, PwC analysis).

1. Introduction

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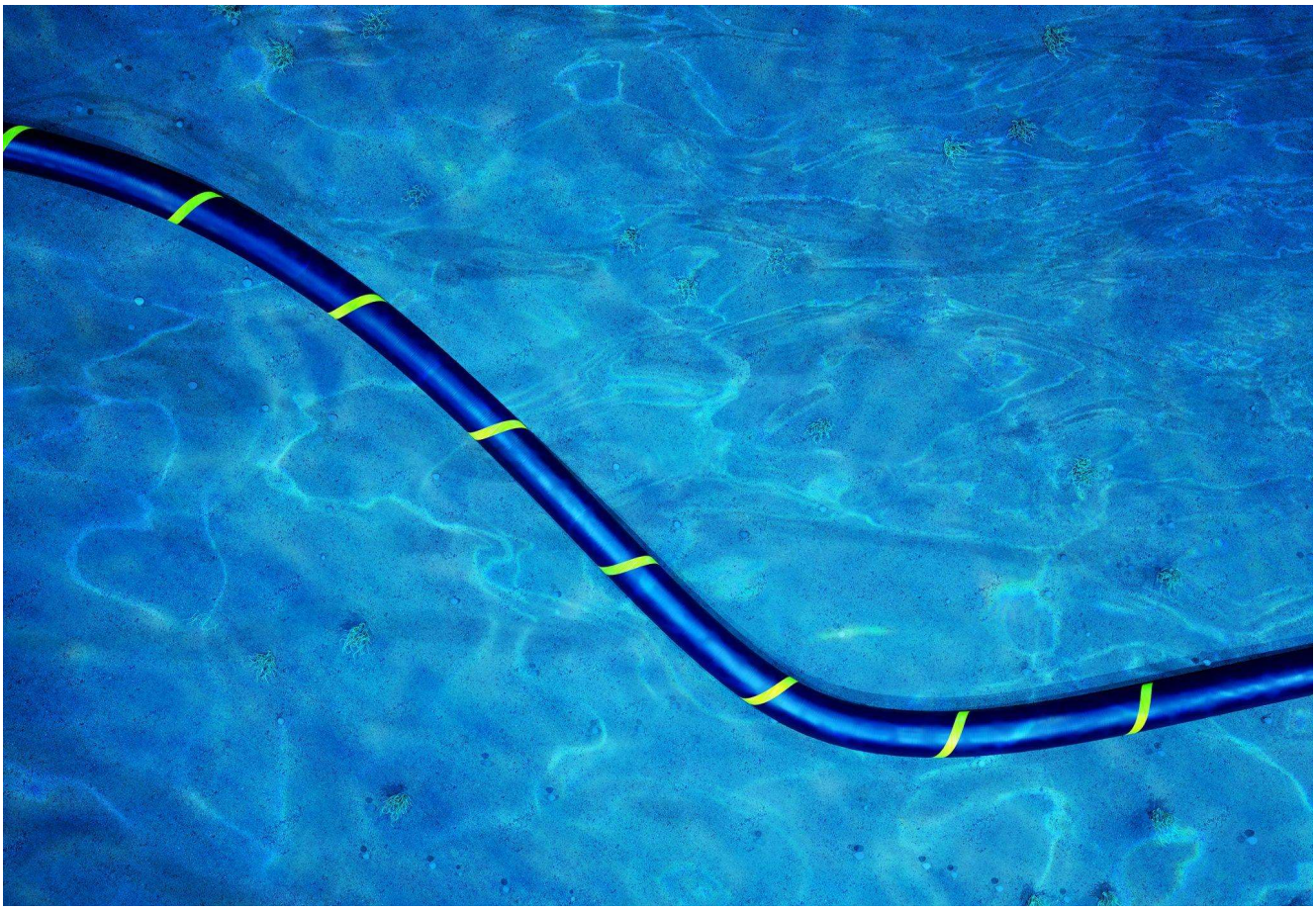


1.1 Sun Cable and the Australia-Asia PowerLink

1.1.1 Sun Cable

Founded in 2018, Sun Cable's mission is to deliver systems to supply renewable electricity from resource abundant regions to growing load centres, at scale. Sun Cable's energy projects will position Australia, Singapore and other markets in Asia as world leaders in the intercontinental transmission of renewable electricity. This infrastructure will facilitate the electrification of new and existing industries, supporting large-scale economic development, whilst reducing greenhouse gas emissions.

Sun Cable has an international presence with offices in Sydney, Darwin, Brisbane, Singapore and Jakarta. It is a company of experts across a range of fields, including renewable power development, electrical, photovoltaic and civil engineering, high voltage direct current (HVDC) transmission, planning and approvals, international relations, Indigenous relations, economics and project management.

1.1 Sun Cable and the Australia-Asia PowerLink

1.1.2 AAPowerLink

Sun Cable is developing the Australia-Asia PowerLink (AAPowerLink, the Project), a high-capacity solar, storage and transmission system that will transmit renewable electricity from the Barkly Region of the Northern Territory (NT) to the Darwin and Singapore markets.

Rapid advancements in renewable energy and battery technology, combined with advances in HVDC transmission systems (reducing cost and increasing efficiency and reliability) have made it technically viable to transmit electricity over long distances and between continents.

By providing high quality, dispatchable renewable electricity supply, the Project will accelerate the renewable energy transition in Darwin and Singapore and support both markets to achieve their renewable energy targets and economic ambitions.

Construction is planned to commence in FY24 and is expected to be fully completed within five years. Prior to full completion of construction, supply of electricity to the NT is planned to commence in FY26 and transmission to Singapore is planned to commence in FY27. In FY29, the AAPowerLink will be operating at full capacity and will be flexible to respond to volatility in demand.

The Project comprises six key components (Figure 1.1):

- Powell Creek Solar Precinct, covering 12,000 hectares that will generate 17-20 gigawatts (GW) from the solar photovoltaic (PV) arrays, with 36-42 gigawatt-hours (GWh) of energy storage to enable 24/7 dispatchable electricity, at Powell Creek Station near Elliott in the Barkly Region of the NT
- approximately 800 kilometres (km) of 6 GW capacity overhead transmission line (OHTL) from the Powell Creek Solar Precinct to the Darwin Converter Site at Murrumujuk
- a Darwin Converter Site including Voltage Source Converters (VSC), energy storage and network connection to supply up to 800 megawatts (MW) of renewable electricity to the Darwin region
- cable transition facilities to enable transition of power cables between land and sea
- a subsea cable system extending approximately 4,200 km from the Darwin Converter Site to Singapore with approximately 2 GW of capacity leaving Darwin
- a Singapore converter site including a VSC, network connection and energy storage capable of supplying up to 15 per cent of Singapore's energy needs.

Figure 1.1: The Australia-Asia PowerLink

Source: Sun Cable

1.2 Objectives of the economic impact assessment

This report has been prepared by PricewaterhouseCoopers Consulting (Australia) Pty Ltd (PwC) on behalf of Sun Cable to present our analysis of the economic impact of Sun Cable's AAPowerLink proposal.

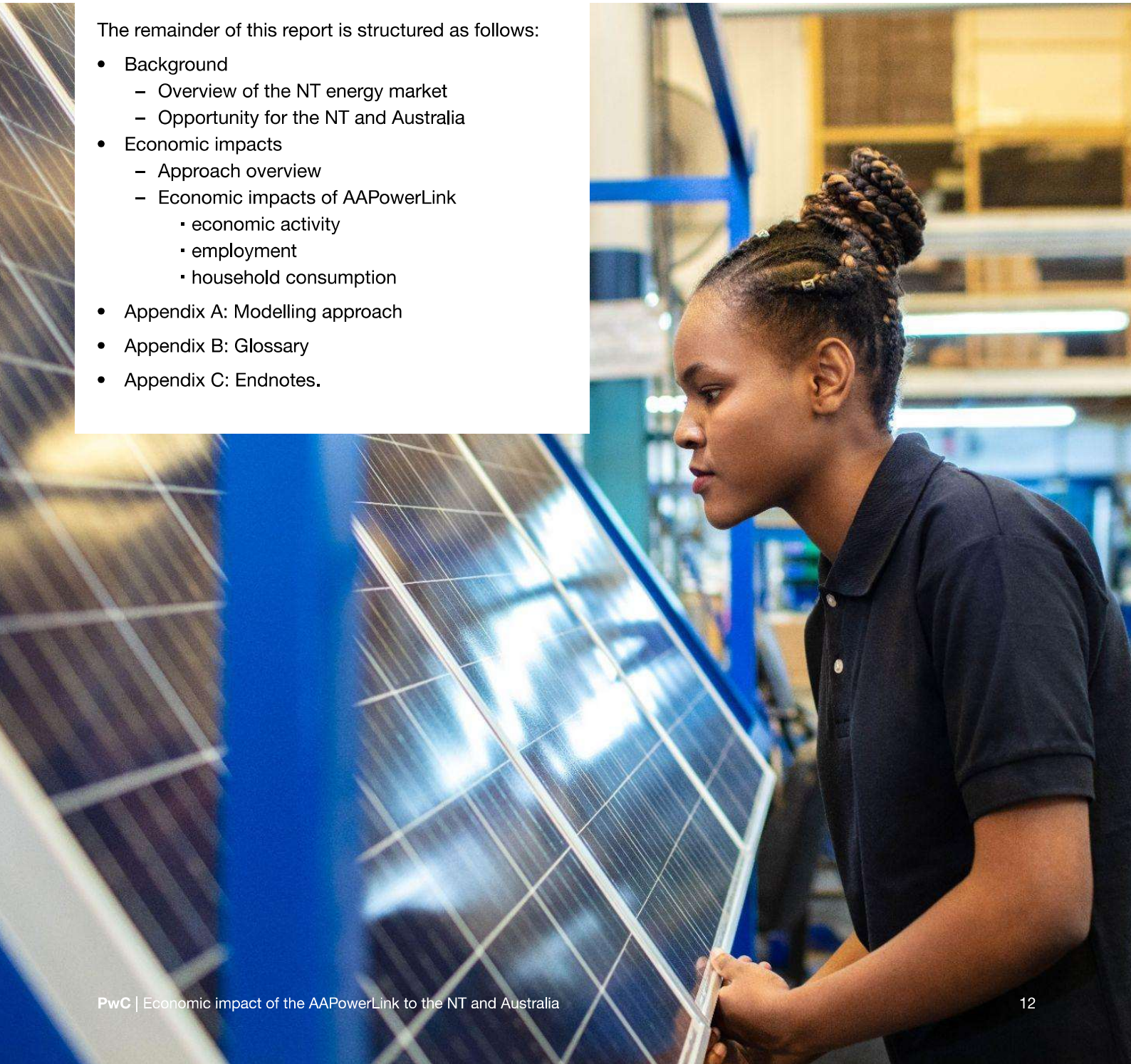
This report presents the total economic impacts (comprising both direct and indirect or flow-on benefits) of AAPowerLink on the Australian national and NT economies, including impacts on:

- economic activity (gross domestic product (GDP) and gross territory product (GTP)): a monetary measure of the value of all goods and services produced
- employment: the number of full time equivalent (FTE) jobs
- household consumption: a monetary measure of the value of all goods and services purchased by households.

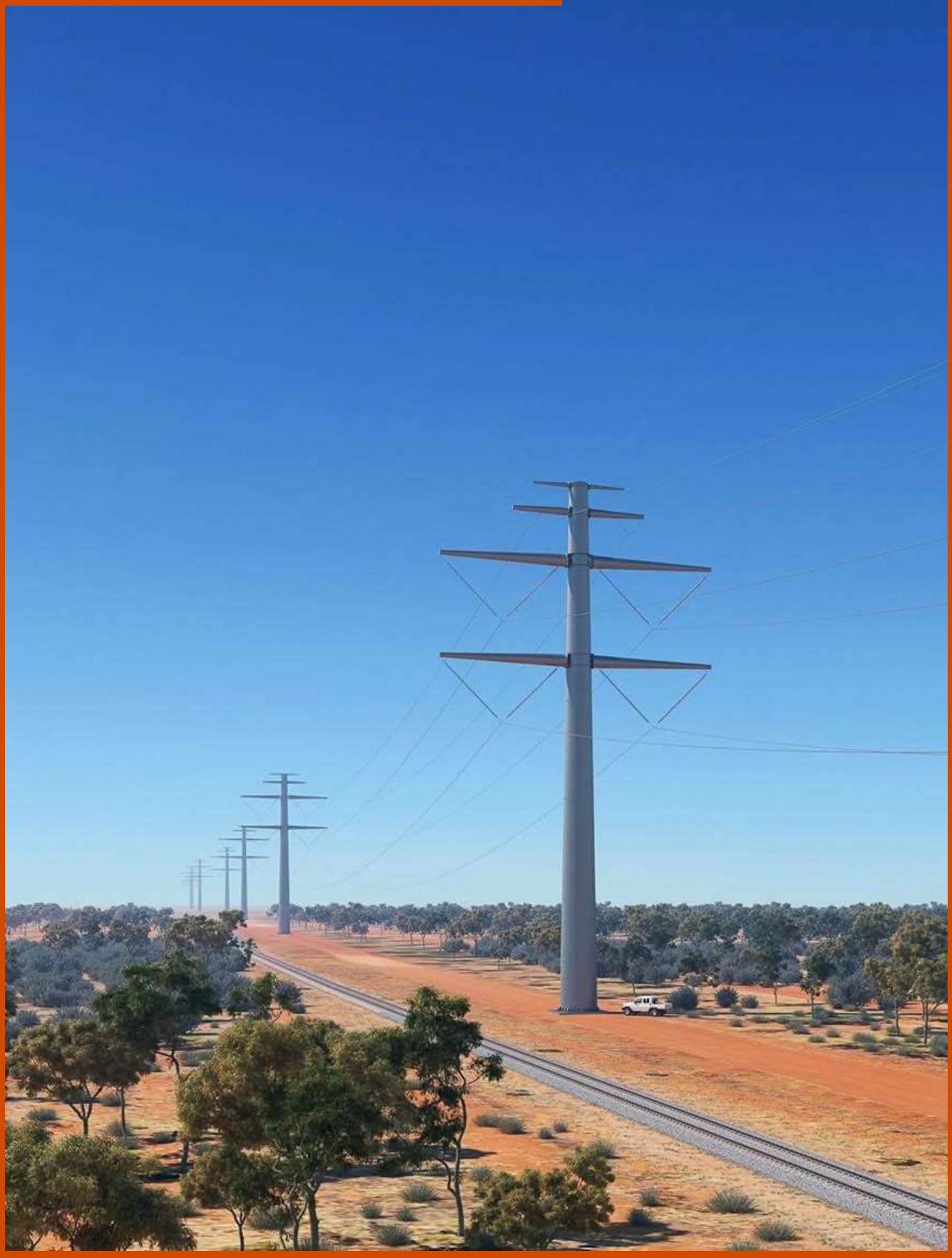
1.3 Report structure

The remainder of this report is structured as follows:

- Background
  - Overview of the NT energy market
  - Opportunity for the NT and Australia
- Economic impacts
  - Approach overview
  - Economic impacts of AAPowerLink
    - economic activity
    - employment
    - household consumption
- Appendix A: Modelling approach
- Appendix B: Glossary
- Appendix C: Endnotes.



2. Background



2. Background

2.1 Overview of the NT energy market

2.1.1 The electricity supply chain

The NT electricity supply chain has three key components: generators, distributors and retailers. These roles are primarily fulfilled by government-owned corporations mainly due to the NT's relatively large geographic size and small customer base.

Territory Generation is the main supplier of electricity to the grid. They own 597 MW of installed capacity and contract an additional 5.1 MW from individual power producers.[1] This government owned corporation uses gas, diesel and solar technologies.[2]

Distributors, or network providers, transport electricity from generators to final users - homes, industry and businesses. Power and Water Corporation (Power and Water) is the government-owned corporation responsible for distribution of electricity (and water services) to over 244,000 Territorians. Power and Water maintains over 37,000 km of poles and towers and 10,500 km of overhead lines across 1.3 million km^2 of the NT.[3]

Retailers are the primary end user interface, purchasing electricity from generators and selling this on as a range of retail products to homes and industry. Jacana Energy is the government-owned corporation which retails to more than 85,000 customers across the NT.[4] (Retailers have also been able to procure electricity directly from generators since 2015).[5]

2.1.2 NT energy users

There are three main market segments in the NT:

- Residents and small businesses who use less than 750 megawatt hours (MWh) of electricity each year. This segment purchases electricity from the grid. Prices are regulated and subsidised by the NT Government via a community service obligation (CSO), which helps maintain the network and provide consumers with lower electricity prices[6]
- Non-residential customers using between 750 and 2,000 MWh each year. This segment also purchases electricity from the grid
- Large scale industrial users, who generally opt to self generate. This includes Darwin Liquefied Natural Gas, Ichthys Liquified Natural Gas, South32, Rio Tinto and Glencore.

2.1.3 The NT's electricity networks

The NT's transmission grid consists of five separate electricity networks powered by eight power stations. Three of these networks are regulated by the Australian Energy Regulator (AER) and managed by Power and Water, including the NT's largest network, the Darwin-Katherine electricity system (Darwin-Katherine).

Darwin-Katherine supplies electricity to approximately 150,000 NT residents and is primarily fueled by thermal generation (80 per cent in 2021).[7] Darwin-Katherine has a number of unique attributes which set it apart from other Australian grids:

- On a national scale, Darwin-Katherine services a small market, comprising about 1 per cent of the National Electricity Market (NEM), which makes economies of scale difficult to achieve[8]
- Darwin-Katherine is a standalone network, with no interconnections with other regional networks. This often necessitates a bespoke approach to infrastructure, delivery and regulation[9]
- The Darwin-Katherine region is prone to volatile and harsh weather conditions. This poses potential security and supply outage risks.[10]

2.2 Opportunity for the NT and Australia

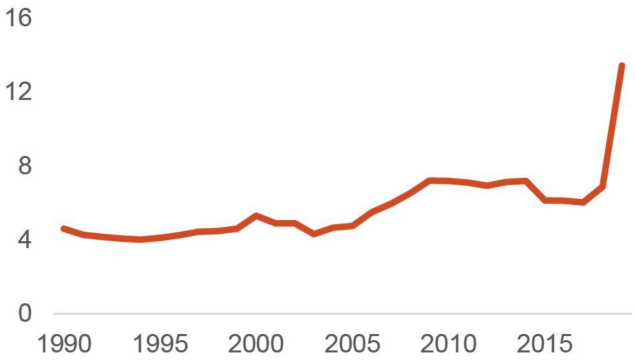
In a first of its kind for Australia, AAPowerLink integrates multi gigawatt-scale solar generation, significant battery storage, and overhead and subsea HVDC transmission systems. Together, these technological elements offer a unique opportunity to provide electricity that is clean, lower-cost, and firmed.

2.2.1 Clean electricity provision

Both the NT and national governments have the stated goals of reducing carbon emissions. The NT Government has set a target of achieving net zero emissions by 2050.[11] Nationally, the Commonwealth Government has treaty obligations under international law to reduce greenhouse gas emissions by 26 to 28 per cent based on 2005 levels by 2030.[12]

The NT's annual carbon dioxide (CO_2) emissions from the energy sector have increased by an estimated 192 per cent since 1990, to 13.4 megatonnes (Mt) (Figure 2.1).[13]

Figure 2.1: NT CO_2 emissions 1990-2019, Mt



Source: Department of Industry, Science, Energy and Resources[14]

Developing alternative, low-emissions sources of energy generation is important, not just to meet government and treaty obligations, but to help reduce global emissions and mitigate Australia's exposure to climate risk.

In 2020, the NT Government tasked the Territory Economic Reconstruction Commission to develop a strategy for a post-COVID economic recovery that would see the NT economy grow from $23 billion to $40 billion by 2030. The Territory Economic Reconstruction Report, published in December 2020, forecast a shortfall of this target by around $5 billion.[15] The energy and mining sector was identified as a growth opportunity sector, critical to closing this gap. The strategy also outlined the need for 'a dramatically expanded role for renewables' alongside renewable exports, the creation of low emissions manufacturing and green hydrogen industries.[16]

AAPowerLink could provide the type of industrial scale renewable power necessary to help grow the NT economy by supporting the NT's transition to a more resilient and sustainable energy mix. AAPowerLink aims to support economic growth objectives alongside climate objectives in the NT Government Climate Change Policy.[17]

2.2.2 Lower-cost renewable electricity

NT's average wholesale (unsubsidised) electricity price of $148.40 per MWh is the second highest price in Australia. This compares to $114.10 per MWh in Victoria, $116.80 per MWh in New South Wales, $129.40 per MWh in Western Australia and $171.10 per MWh in South Australia (Figure 2.2).[18]

Figure 2.2: Wholesale electricity price by region, 2018/19, $ per MWh

Source: Australian Energy Market Commission[19]

AAPowerLink aims to provide dispatchable electricity at materially lower wholesale prices than the current average cost of gas based electricity in the NT.

Lower clean electricity prices could help improve the NT's competitiveness to attract growth industries (such as green hydrogen, data centres and critical minerals processing).

2.3.3 Stable renewable electricity

As of 2021, Darwin-Katherine (representing 530 MW capacity) consisted primarily of thermal generation (80 per cent), followed by small-scale solar (16 per cent) and large-scale solar (4 per cent).[20] The NT Government has identified Darwin-Katherine as having an aging thermal generation fleet which needs to transition and the system is targeting a 50 per cent penetration of renewables by 2030 - which would require current renewable sources to increase output by over 150 per cent. The NT Government has identified that achieving their 50 per cent renewable energy target will require technology and system reform as outlined in the Darwin-Katherine Electricity System Plan (DKESP).[21]

No purchasing agreements are currently in place, however AAPowerLink has the potential to provide 24/7 firmed renewable electricity via Darwin-Katherine. Firm sources of power are those which can maintain output from a variable, intermittent source, such as wind or solar, for a committed period of time. In this instance, firming is possible due to the 36 GWh battery at the solar farm precinct - what will be the world's largest battery. This storage technology allows the cost and emissions reduction benefits of solar energy to be harnessed while maintaining grid reliability.

2.3.4 Support Australian exports to the Asia

The AAPowerLink project offers an opportunity to generate up to 15 per cent of Singapore's energy supply from 100 per cent renewable sources. This is a unique opportunity for Australia to export large volumes of renewable energy, supporting both regional energy needs and economic growth.

Export revenues are expected to reach multi-billion dollars on an annual basis - essentially establishing a significant new Australian export industry.

The export component of the Project also has the potential to unlock economies of scope and scale in two key ways. With regards to scope, exporting to Singapore enables the fixed costs of the Project to be spread across a larger, intercountry customer base. This larger customer base also enables greater economies of scale across the supply chain, including domestic mining and component manufacturing opportunities that may not be viable for smaller projects.

Sun Cable has also committed to establish a Renewable Centre of Excellence in the NT. The Centre will be established to support the development and operations of AAPowerLink and future opportunities related to the growth of exports in renewable electricity. Sun Cable seeks to work with the NT Government to expand research, commercial development and investment opportunities between Australia, Indonesia and Singapore. In doing so, Sun Cable's initiative will support Northern Australia's emerging electricity export industry, help to unlock the potential of the NT's regions and help attract investment.

3. Economic impacts

3. Economic impacts

3.1 Approach overview

3.1.1 Overview of AAPowerLink scenario

The impact of AAPowerLink on the NT and Australian economies was estimated by applying an economic impact assessment framework using Computable General Equilibrium (CGE) modelling.[1] CGE modelling is useful for exploring the economic implications of projects because it estimates direct and indirect, or flow-on, macroeconomic impacts to sectors and regions. Impacts were dynamically modelled, which means the model allows for adjustments in underlying labour supply and capital to occur over time.

Key inputs include capital costs, operating costs and the value of exports to Singapore which were applied to the energy generation and transmission industries in the NT.

3.1.2 Impact on the NT energy market, energy prices and economy

AAPowerLink aims to provide dispatchable electricity at materially lower wholesale prices than the current average cost of gas-based electricity in the NT. Lower-cost renewable electricity provided by AAPowerLink can help improve the NT's competitiveness to attract growth industries (such as green hydrogen, data centres and critical minerals processing).

The development of AAPowerLink will generate significant economic benefits for the NT (and national) economy. These benefits are largely driven by:

- Investment and employment during the construction phase: impacts as a result of expenditure on the development of AAPowerLink including capital expenditure (CAPEX)
- Business expenditure, employment and export revenue during the operation phase: impacts related to the operation and ongoing maintenance of the solar energy infrastructure network and sale of electricity overseas once AAPowerLink is fully operational. Operational impacts include the day-to-day activities that occur at the various facilities.

This investment, employment, export and business expenditure activity will flow throughout the NT and national economies resulting in additional economic activity, jobs, GTP and GDP.

This activity will result in:

- Increased demand for goods and services throughout AAPowerLink's supply chain, in the construction and operations phases
- Increased demand for consumer oriented industries that cater to the spending of the personnel and contractors working in the NT as a result of AAPowerLink
- Changes to the cost of business inputs (including goods, services and labour costs) as a result of the additional activity generated by AAPowerLink.

3.1.3 Inputs and assumptions

The economic impact assessment analyses the economic impacts of AAPowerLink drawing on Sun Cable financial data relating to investment and exports in the NT. These were used as inputs to the CGE model to estimate total economic impacts to the economy. Essentially, the CGE model which has been applied works by showing the impact on the equilibrium economy of certain 'shocks' i.e. additional investment as a result of AAPowerLink. A base case (no AAPowerLink) and project case (AAPowerLink) are modelled and the difference is reported as the net impact attributable to AAPowerLink.

Total CAPEX for AAPowerLink is estimated to be approximately $30 billion with multi-million dollar operating expenditures (OPEX) occurring annually post-construction. CAPEX and OPEX assumptions have been developed by Sun Cable drawing on a range of technical and cost expertise based on the Association for the Advancement of Cost Engineering's International Recommended Practices.[2]

For this analysis, investment (CAPEX and OPEX) which occurs in Australia was used as an input, and investment outside Australia was excluded in order to isolate economic impacts to Australia. The model itself has in-built assumptions which account for where input goods are sourced from (i.e. imports).

Modelling was undertaken over the period FY24 to FY69 with results reported for the NT and nationally. The modelling assumes:

- the construction phase occurs in FY24-FY29 (with a relatively small amount of additional CAPEX occurring in FY42-FY43 for battery replacement at the end of their life cycle)
- the operation phase occurs from the first full year of operation in FY30 to FY69.

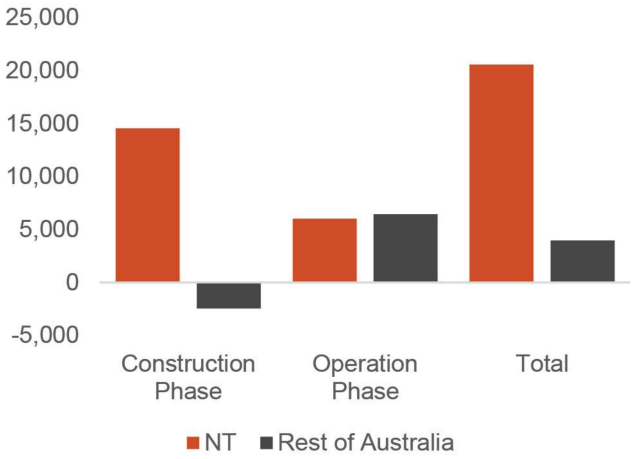
3.2 Economic impacts of AAPowerLink[3]

Initially, the impact of AAPowerLink is observed through additional construction activity in the NT. These direct economic impacts represent capital expenditure and employment resulting from the Project and largely occur in the NT where the solar energy infrastructure network will be located. Second round or flow-on effects occur as the supply chain of the energy industry is stimulated and as business and consumer demand is encouraged in the economy. AAPowerLink will create opportunities for businesses and suppliers, as well as innovation and investment in Australia, and will generate employment and activity across Australian businesses. These impacts flow throughout the NT and national economies resulting in additional economic activity, jobs and household consumption.

3.2.1 Economic activity (GTP and GDP)

AAPowerLink will stimulate economic activity and raise aggregate demand in the NT economy - observed in an increase in the NT's GTP (Figure 3.1). Real GTP increases by $20.6 billion from FY24-FY69 - an average annual increase in the NT of approximately $2.4 billion and $150 million during the construction phase (FY24-FY29)[4] and operation phases (FY30-FY69) respectively.

Figure 3.1: Additional economic activity (GTP/GDP) generated by AAPowerLink by region, real FY22 prices, undiscounted, $ million

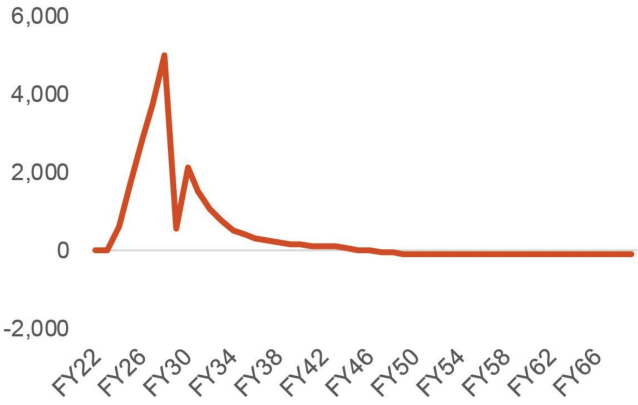


Source: PwC analysis, Sun Cable inputs

Impacts are concentrated during the construction phase, peaking at more than $5 billion additional activity expected in the NT in FY28 - reflecting the level of investment at the outset of AAPowerLink. Impacts on employment growth and household consumption follow a similar trajectory.

During the operation phase, real GTP in the NT declines slightly relative to the base case after FY45 (Figure 3.2). This is because the advantages of the capital intensive AAPowerLink decline as a share of the Australian economy as the economy grows over time. This leads to relative disadvantages for local service industries due to increased competition for resources. Cumulatively over the assessment period there is a net positive impact on economic activity for both the NT and Australia.

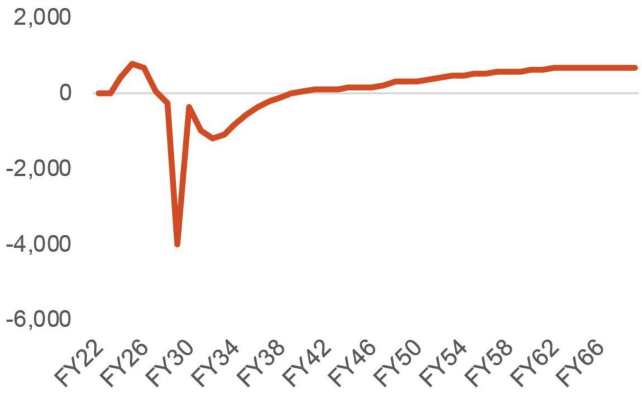
Figure 3.2: Additional economic activity (GTP) generated by AAPowerLink in the NT, real FY22 prices, undiscounted, $ million.



Source: PwC analysis, Sun Cable inputs

In the rest of Australia, AAPowerLink is projected to increase GDP by almost $4 billion from FY24-FY69. The concentration of investment in the NT is reflected in the relative size of the impacts in the NT compared to other states and territories (Table 3.1).

Figure 3.3: Additional economic activity (GDP) generated by AAPowerLink in the rest of Australia, real FY22 prices, undiscounted, $ million.



Source: PwC analysis, Sun Cable inputs

Post construction, economic activity in the rest of Australia declines at a sharper rate than in the NT (Figure 3.3). This reflects that during construction, real wages are anticipated to rise in the NT relative to elsewhere in Australia. At the end of the construction phase these cost pressures suddenly cease and real wages in the NT begin to move to their new equilibrium. Real wages respond sluggishly in the model and actually rise in relative terms in the rest of Australia, causing an exaggerated employment and GDP response. In reality, any drop off in economic activity is likely to be less precipitous than the modelling may suggest, because employees and owners of capital will be aware of when AAPowerLink plans to finish construction.

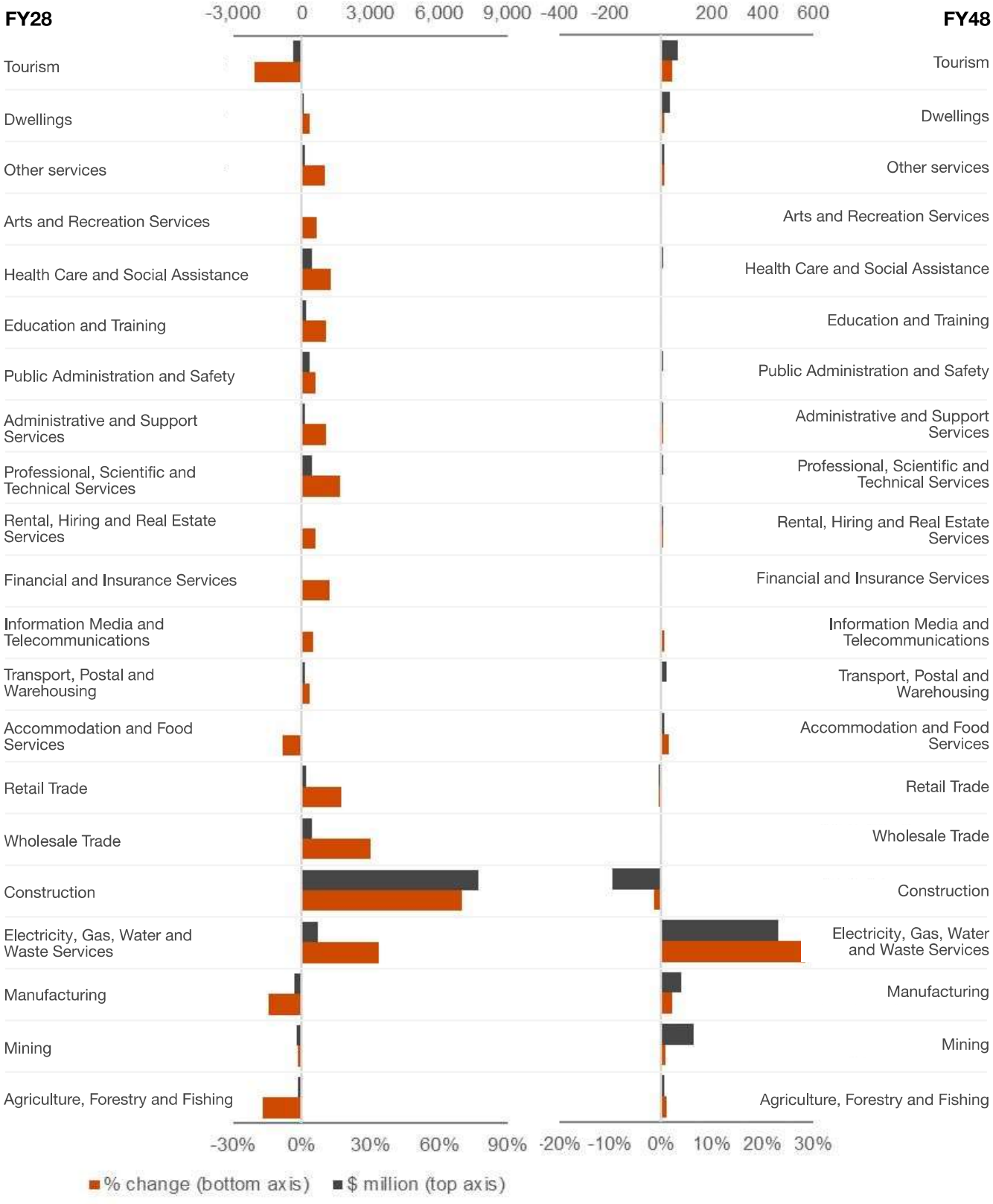
Table 3.1: Economic activity impacts by region FY22-FY69, real FY22 $ million

Measure		Total period FY22-FY69	Construction phase FY24-FY29	Operational phase FY30-FY69
Rest of Australia GDP	Undiscounted	$4,000	-$2,500	$6,400
	4% discount rate	-$2,400	-$1,600	-$800
NT GTP	Undiscounted	$20,600	$14,600	$6,000
	4% discount rate	$16,100	$11,600	$4,500

Source: PwC analysis, Sun Cable inputs

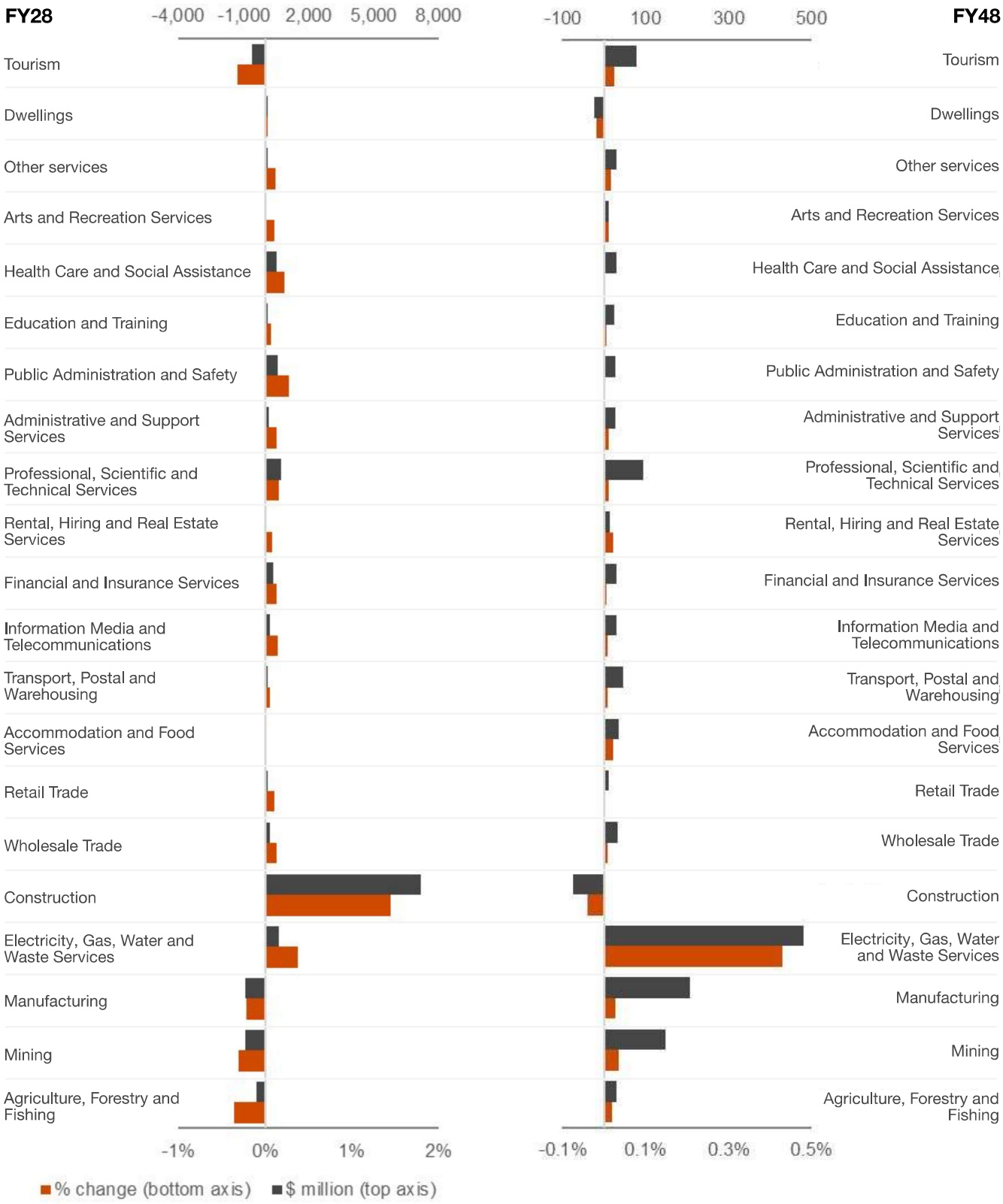
Figures 3.4 and 3.5 outline how additional economic activity is distributed across sectors of the economy, for both the NT and Australia. Data is presented for FY28 and FY48, providing a snapshot of annual impacts in years which are representative of the construction and operation phases respectively.

Figure 3.4: Additional economic activity (gross value added (GVA)) generated by AAPowerLink in the NT by industry, FY28 and FY48, per cent change from base case (bottom axis, %) and dollar value (top axis, real FY22 prices, undiscounted, $ million).



Source: PwC analysis, Sun Cable inputs

Figure 3.5: Additional economic activity (GVA) generated by AAPowerLink in Australia by industry, FY28 and FY48, per cent change from base case (bottom axis, %) and dollar value (top axis, real FY22 prices, undiscounted, $ million).



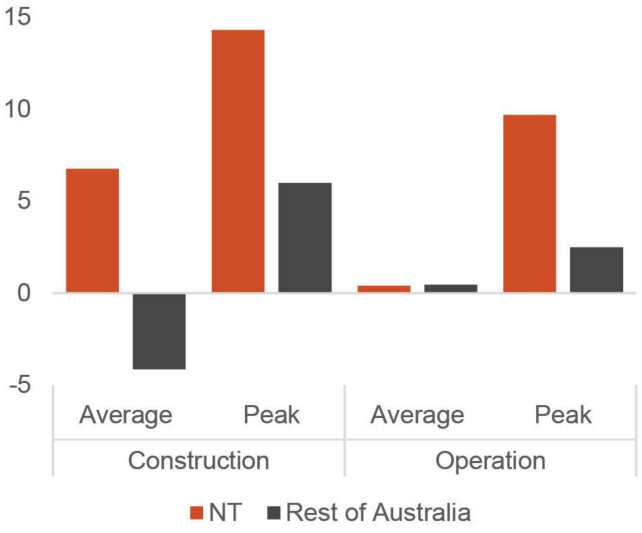
Source: PwC analysis, Sun Cable inputs

At a sector level, impacts are concentrated in the construction and gas sectors through the construction and operation phases respectively. This reflects the capital expenditure at the outset of the Project and the electricity generated during the operational phase. In FY28, the NT's construction sector is $7.7 billion (70 per cent) larger than it otherwise would have been and the national electricity and gas sector is $480 million (0.4 per cent) larger in FY48.

3.2.2 Employment

Similar to GTP and GDP, there are substantial employment impacts unlocked in the NT, in particular during the construction phase (Figure 3.6). Construction of the Project is estimated to support a total of 6,800 jobs in the NT economy on average each year (all employment impacts are reported as full time equivalents (FTE) and totals i.e. including both direct and indirect employment). Employment in the NT reaches a peak of 14,300 in FY28.[5]

Figure 3.6: Annual average and peak employment (FTE) generated by AAPowerLink by region, 000s jobs.

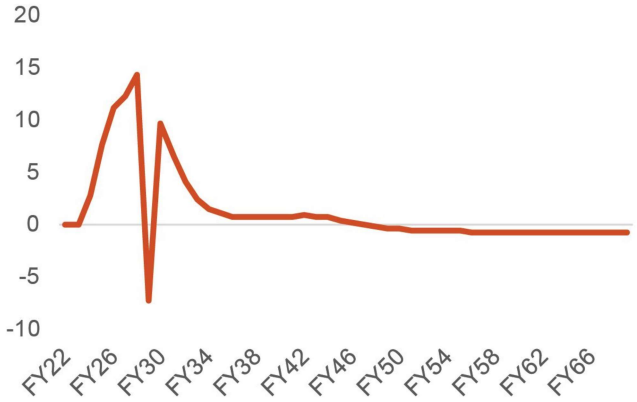


Source: PwC analysis, Sun Cable inputs

The average annual increase in employment in the NT is over 1,200 from FY24-FY69, with an average of approximately 400 annual jobs created during the operation phase.

This increase in NT employment is partially supported by a reallocation from the rest of Australia of around 100 jobs per year over the period FY24-FY69. This is linked to AAPowerLink investment incentivising both labour and capital from other parts of the country to relocate to the NT. Overall, an average of 1,100 total jobs are estimated to be created annually at a national level (including the NT) over the entire Project - a net benefit to national employment.

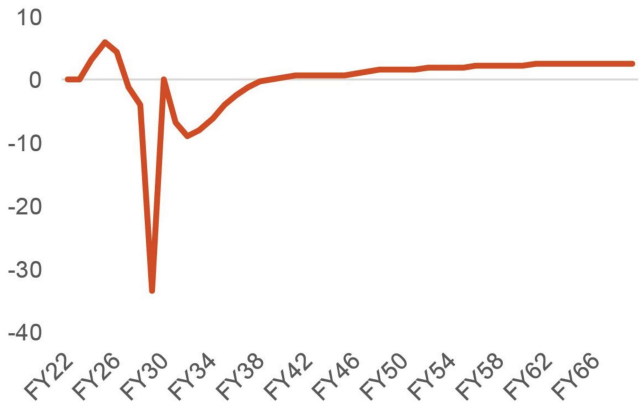
Figure 3.7: Additional employment (FTE) generated by AAPowerLink in the NT, 000s jobs.



Source: PwC analysis, Sun Cable inputs

In CGE models, a shock to the economy such as AAPowerLink does not affect employment at the national level in the long term (which is largely determined by institutional factors such as demographics) however employment in specific regions can vary. Results show that the NT's employment is slightly lower in the very long term (Figure 3.7), because the NT economy will consist of more capital intensive industries. Wages will eventually respond across the NT and rest of Australia to take national employment back to its pre-shock level (Figure 3.8).

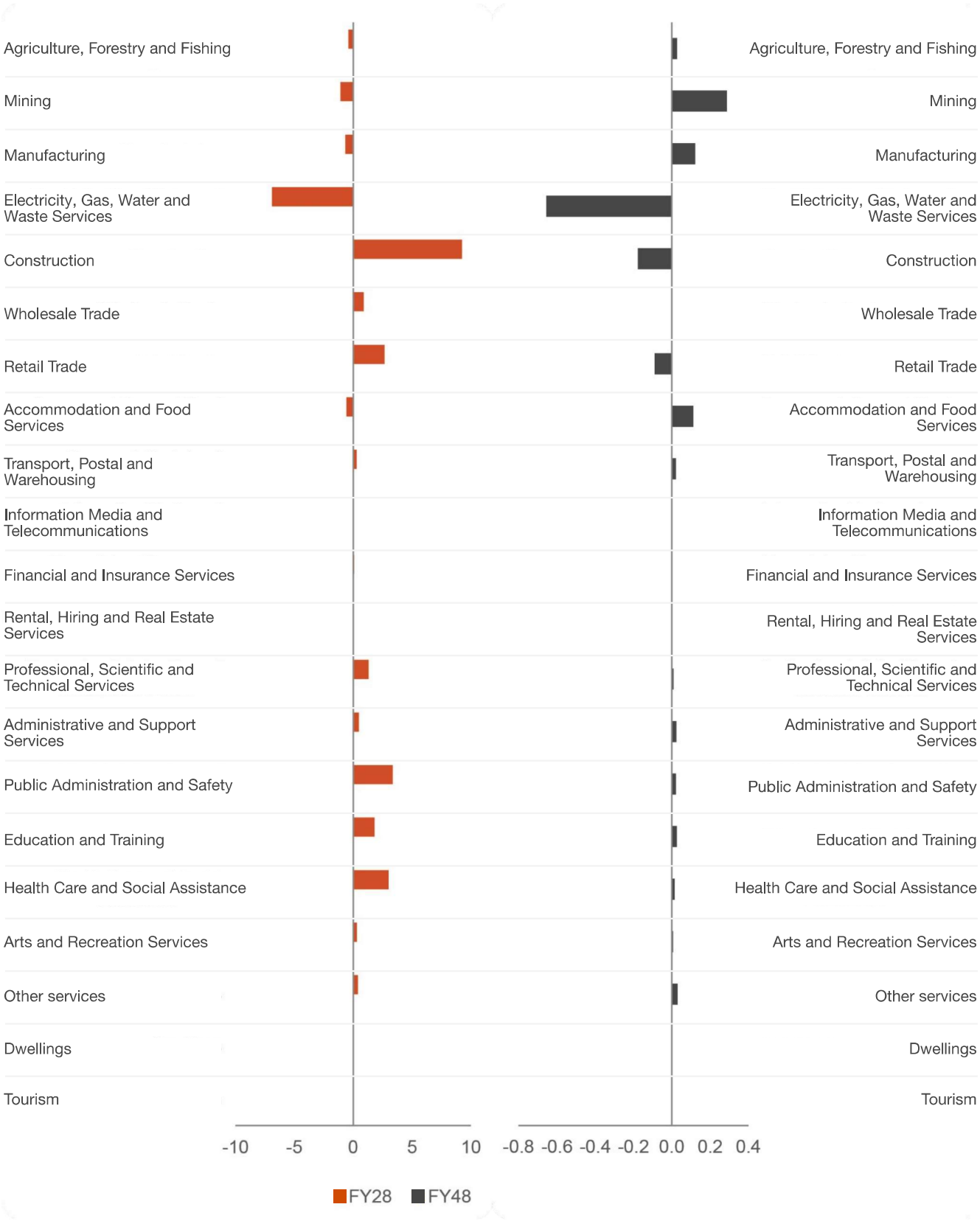
Figure 3.8: Additional employment (FTE) generated by AAPowerLink in the rest of Australia, 000s jobs.



Source: PwC analysis, Sun Cable inputs

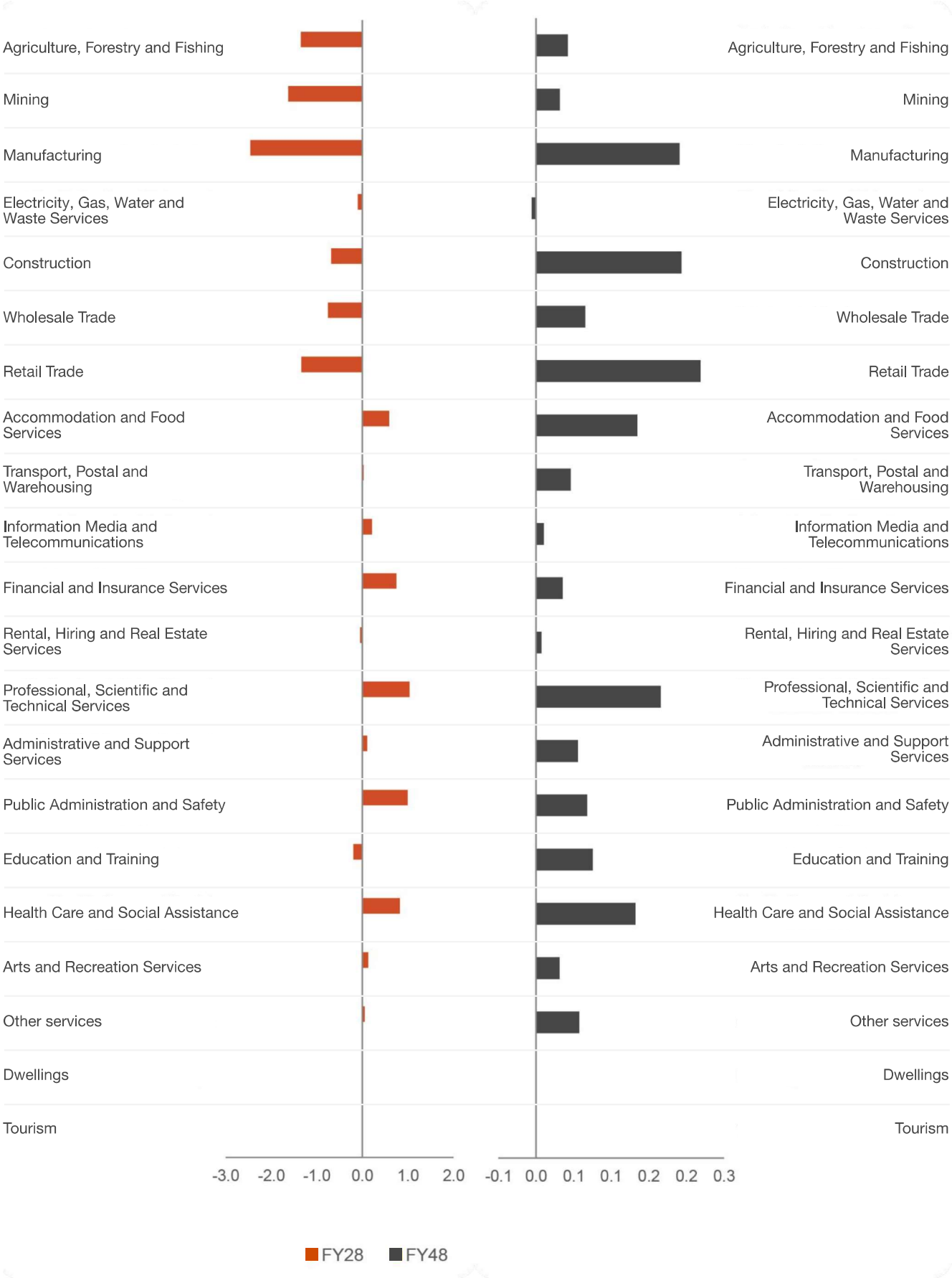
Figures 3.9 and 3.10 outline how additional employment is distributed across sectors of the economy, for both the NT and Australia. Data is presented for FY28 and FY48, providing a snapshot of annual impacts in years which are representative of the construction and operation phases respectively.

Figure 3.9: Additional employment (FTE) generated by AAPowerLink in the NT by industry FY28 and FY48, 000s jobs.



Source: PwC analysis, Sun Cable inputs

Figure 3.10: Additional employment (FTE) generated by AAPowerLink in the rest of Australia by industry FY28 and FY48, 000s jobs.



Source: PwC analysis, Sun Cable inputs

Additional employment in the NT peaks in FY28 at 14,300 jobs per annum and at 6,000 jobs in FY25 in the rest of Australia (Table 3.2).

Naturally, employment in the construction phase is driven by the construction sector, which supports 9,200 (or 65 per cent) of all jobs during the peak in the NT. This flow of jobs into the NT is partially offset by declines in the rest of Australia, concentrated in the manufacturing, mining and agriculture sectors.

In the operation phase, employment impacts are concentrated in energy intensive sectors which benefit from the increase of supply from AAPowerLink. This includes the mining and manufacturing sectors which support over 300 jobs each per annum in FY48.

In FY48, employment in the electricity, gas, water and waste services sector is forecast to decline. While employment in the electricity sector (including renewables) increases, this is more than offset by a decline in the other constituent sectors such as waste and water. These other sectors are more capital intensive than the electricity sector and so overall employment falls.

Table 3.2: Employment impacts FY22-FY69, '000 FTEs

Measure		Total period FY22-FY69	Construction phase FY24-FY29	Operational phase FY30-FY69
Rest of Australia annual employment	Average	-0.1	-4.1	0.5
	Peak	6.0 (FY25)	6.0 (FY25)	2.5 (FY61)
NT annual employment	Average	1.2	6.8	0.4
	Peak	14.3 (FY28)	14.3 (FY28)	9.7 (FY30)

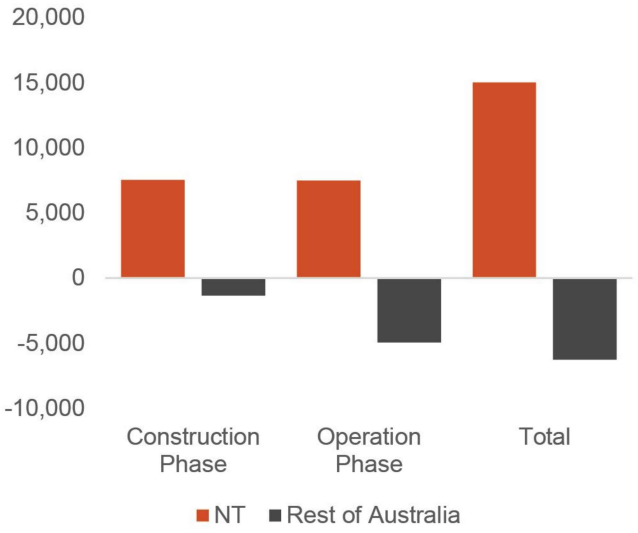
Source: PwC analysis, Sun Cable inputs

3.2.3 Household consumption

Household consumption, or private consumption expenditures, is the largest component of Australia's GDP and captures goods and services bought by consumers.

Consumption is a key measure of economic welfare because it evidences households' capacity to purchase and consume goods and services.

Figure 3.11: Additional household consumption generated by AAPowerLink by region, real FY22 prices, undiscounted, $ million

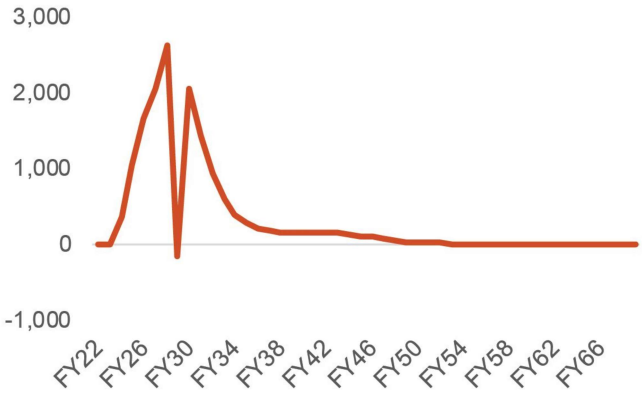


Source: PwC analysis, Sun Cable inputs

The increases in employment and real wages as a result of AAPowerLink result in higher levels of household disposable income which in turn drive growth in household consumption.

Households in the NT benefit from a total of $15 billion additional consumption - with around $7.5 billion of additional consumption across each of the construction and operation phases (Figure 3.11, Figure 3.12). This equates to $1.3 billion and $190 million on average per year in the construction and operation phases respectively (Table 3.3).

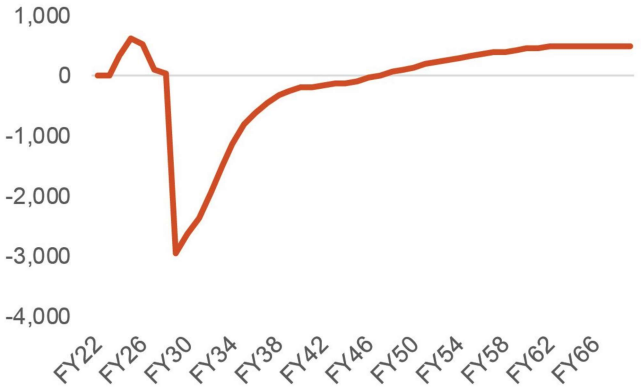
Figure 3.12: Additional household consumption generated by AAPowerLink in the NT, real FY22 prices, undiscounted $ million.



Source: PwC analysis, Sun Cable inputs

This $15 billion of additional spending is partially offset in the rest of Australia which decreases by $1.3 billion and $4.9 billion in the construction and operation phases respectively. This reflects the flow of labour, employment and real wage growth to the NT as a result of investment in AAPowerLink (Figure 3.13).

Figure 3.13: Additional household consumption generated by AAPowerLink in the rest of Australia, real FY22 prices, undiscounted $ million.



Source: PwC analysis, Sun Cable inputs

Table 3.3: Household consumption impacts by region FY22-FY69, real FY22 $ million.

Measure		Total period FY22-FY69	Construction phase FY24-FY29	Operational phase FY30-FY69
Rest of Australia household consumption	Undiscounted	-$6,300	-$1,300	-$4,900
	4% discount rate	-$7,100	-$800	-$6,300
NT household consumption	Undiscounted	$15,000	$7,500	$7,500
	4% discount rate	$10,600	$6,000	$4,600

Source: PwC analysis, Sun Cable inputs

Appendix A: Modelling approach

A: Modelling approach

CGE models

A CGE model is a mathematical model of an economy that is capable of capturing economy-wide impacts and inter-sectoral reallocation of resources that may result from a 'shock' to the economy. CGE models are generally designed for quantitative analysis of:

- resource allocation and technical efficiency issues
- government tax or expenditure policy related issues
- external events that can be represented as price or activity shocks.

The core data of a CGE model is an input-output table, which is provided by the Australian Bureau of Statistics (ABS). An input-output table is a system of accounts which shows, in value terms, the supply and disposal of goods and services within the economy in a particular year. An input-output table captures sales of products to other industries for further processing (intermediate usage) or to the various categories of final demand. It also captures the inputs used in an industry's production, whether they are intermediate or primary inputs (such as labour and capital). The table is balanced such that total inputs to each industry are equal to total outputs from each industry. Essentially, an input-output table is a snapshot of an economy (whether it is a territory, state or country) in a particular year.

A CGE model attempts to 'push forward' the base input-output table through time by utilising a set of equations that capture neoclassical microeconomic theory to determine behaviour of economic agents (such as households, governments, industries) when they are faced with changes in key economic variables, especially relative prices. The equations are solved simultaneously, where some variables are determined by the model (endogenous variables) and some are determined outside the model (exogenous variables). The classification of endogenous and exogenous variables is determined by the user, based on the set of assumptions derived for the specific modelling exercise.

As noted above, the CGE model that has been used by PwC in this analysis is the VURM (also known as MMRF) developed by the Centre of Policy Studies at Victoria University. VURM is a regional CGE model that provides a highly disaggregated representation of the Australian economy. It distinguishes up to eight Australian regions (six States and two Territories) and, depending on the application, up to 144 commodities/industries. The model recognises:

- domestic producers classified by industry and domestic region
- investors similarly classified
- up to eight region-specific household sectors
- an aggregate foreign purchaser of the domestic economy's exports
- up to eight State and Territory Governments and the Federal government.[1]

1. Centre of Policy Studies (2022), The VURM model. Available at: https://www.copsmodels.com/mmrf.htm

Assessing economic impacts

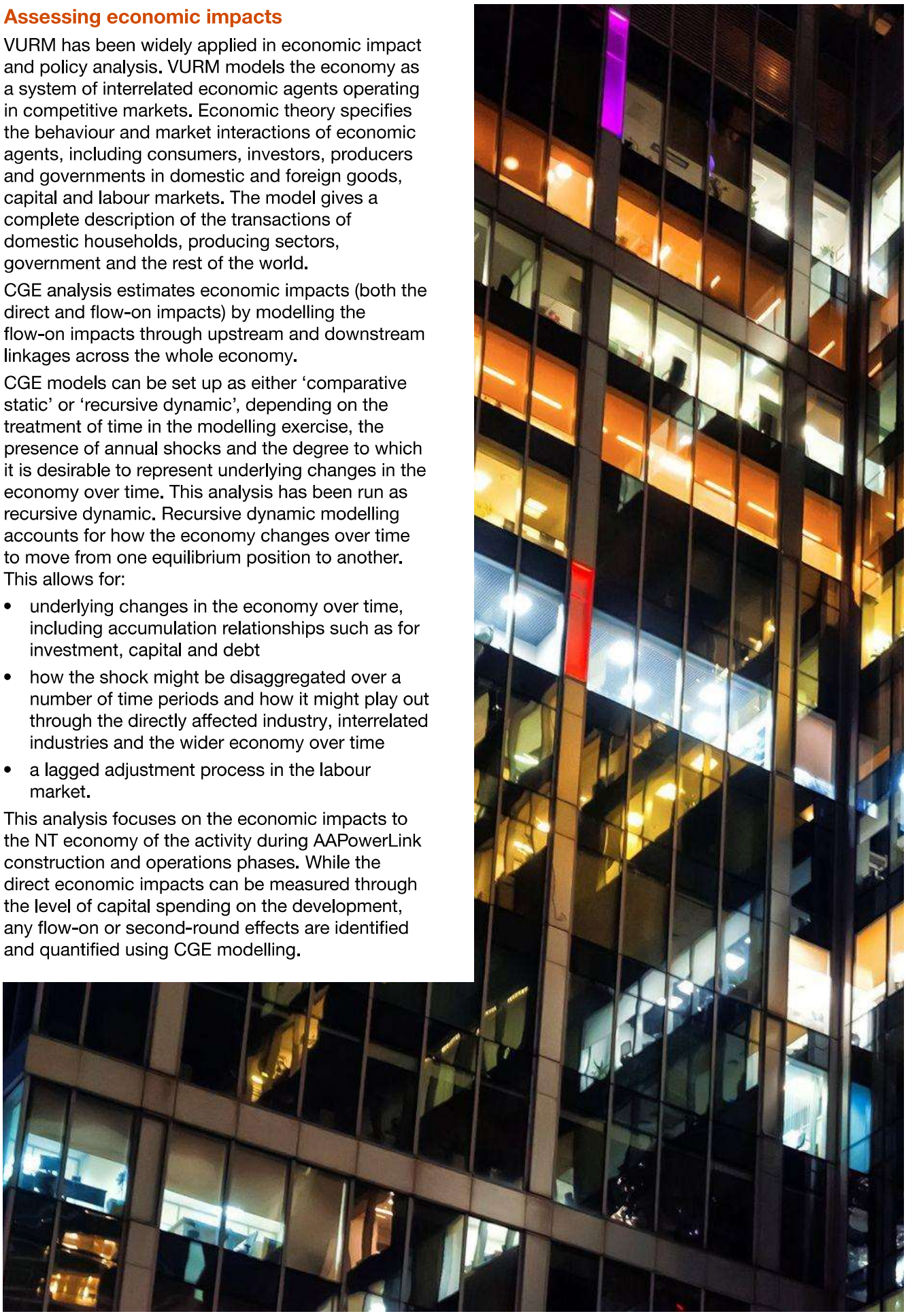
VURM has been widely applied in economic impact and policy analysis. VURM models the economy as a system of interrelated economic agents operating in competitive markets. Economic theory specifies the behaviour and market interactions of economic agents, including consumers, investors, producers and governments in domestic and foreign goods, capital and labour markets. The model gives a complete description of the transactions of domestic households, producing sectors, government and the rest of the world.

CGE analysis estimates economic impacts (both the direct and flow-on impacts) by modelling the flow-on impacts through upstream and downstream linkages across the whole economy.

CGE models can be set up as either 'comparative static' or 'recursive dynamic', depending on the treatment of time in the modelling exercise, the presence of annual shocks and the degree to which it is desirable to represent underlying changes in the economy over time. This analysis has been run as recursive dynamic. Recursive dynamic modelling accounts for how the economy changes over time to move from one equilibrium position to another. This allows for:

- underlying changes in the economy over time, including accumulation relationships such as for investment, capital and debt
- how the shock might be disaggregated over a number of time periods and how it might play out through the directly affected industry, interrelated industries and the wider economy over time
- a lagged adjustment process in the labour market.

This analysis focuses on the economic impacts to the NT economy of the activity during AAPowerLink construction and operations phases. While the direct economic impacts can be measured through the level of capital spending on the development, any flow-on or second-round effects are identified and quantified using CGE modelling.



Appendix B: Glossary

Glossary

Acronym / abbreviation	Definition
AAPowerLink	Australia-Asia PowerLink
AER	Australian Energy Regulator
CAPEX	Capital Expenditure
CGE	Computable General Equilibrium
CO_2	Carbon dioxide
CSO	Community service obligation
DKESP	Darwin-Katherine Electricity System Plan
FTE	Full Time Equivalent
FY	Financial Year
GDP	Gross Domestic Product
GTP	Gross Territory Product
GVA	Gross Value Added
GW	GigaWatt
GWh	GigaWatt hours
HVDC	High voltage direct current
Mt	Megatonnes
MW	MegaWatt
MWh	MegaWatt hour
NEM	National Electricity Market
NT	Northern Territory
OHTL	Overhead Transmission Line
OPEX	Operating Expenditure
PV	Photovoltaic
PwC	PricewaterhouseCoopers Consulting (Australia) Pty Ltd
VSC	Voltage Source Converter
VURM	Victoria University Regional Model

Appendix C: Endnotes

C: Endnotes

Background

1. Territory Generation (2022), Our Power Stations. Available at: https://territorygeneration.com.au/about-us/our-power-stations/
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9. See Background endnote 7.
10. See Background endnote 7.
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19. See Background endnote 18.
20. See Background endnote 7.
21. See Background endnote 7.

C: Endnotes

Economic Impacts

1. The Victoria University Regional Model (VURM) was used in this analysis. VURM (and its predecessor model, MMRF) has been widely applied in economic impact and policy analysis.
2. Sun Cable financial model as of 26 September, 2021.
3. All monetary values are given in undiscounted, real terms FY22 prices unless stated otherwise. Total values include the sum of impacts across both the construction and operation phases.
4. A relatively small amount of additional CAPEX occurs in FY42-FY43 for battery replacement at the end of their life cycle. This value is not included in the reporting of construction phase results.
5. Employment values in this report are reported as full time equivalent (FTE) jobs and include both direct and indirect employment. These values are not directly comparable with other estimates of AAPowerLink employment as they are derived from a CGE model. See Appendix A: Modelling approach.