Economic Assessment of Utility Strikes in Australia

November 2024

CLEAR RIDGE CONSULTING

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Limitations

This report has been prepared specifically for Before You Dig Australia by Clear Ridge Consulting. It reflects the data and conditions available at the time of writing. While we've done our best to ensure everything is accurate and helpful, this report shouldn't be used for other purposes without undertaking your own verification.

Acknowledgements

Clear Ridge Consulting recognises and appreciates the support of BYDA member organisations who provided the data for the case studies: Multinet Gas Networks, Jemena, Endeavour Energy, Western Power, South East Water, Hunter Water, Optus and Telstra.

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1. Executive summary

In Australia, there are over 15,000 reported instances annually where underground excavation work results in asset damage for utility owners. These ‘utility strikes’ often impact essential services such as gas, water, telecom or electricity. The strikes can cause significant financial implications for the asset owner, risks to community and worker safety and cause even bigger impacts to residents and businesses through service interruption.

In total, utility strikes cost the Australian economy $4.6 billion annually.

Economic Context

This report provides a comprehensive economic assessment of utility strikes in Australia, focusing on quantifying the direct and indirect costs these incidents impose on the economy and society. It highlights the substantial economic burden utility strikes place on the Australian economy and recommends measures to reduce these costs.

The report is modelled after a similar international study conducted by the University of Birmingham, which found that the total economic costs of utility strikes in the UK are 29 times higher than the direct repair costs.

Before You Dig Australia

Before You Dig Australia (BYDA) is a national organisation whose primary role is to ensure the safety and efficiency of excavation projects by providing essential information about above- and underground utility infrastructure. Individuals and businesses can request details about the location of underground utilities, such as gas, water, electricity and telecommunications before commencing any digging, excavation and construction work. This helps prevent damage to vital infrastructure, reduces the risk of accidents and ensures compliance with legal requirements.

BYDA therefore plays a crucial role in protecting public safety and minimising costly disruptions to services, making it an invaluable resource for building and construction, and other industry activities that require excavation.

However, despite BYDA's efforts, more than 15,000 utility strikes (and many more thousands of unreported ones) occur annually in Australia, resulting in considerable damage to critical infrastructure and widespread service disruptions. These incidents impose direct repair costs on utilities and contractors, while also leading to far-reaching indirect and social costs, such as traffic delays, business losses and environmental damage.

BYDA commissioned this study to share a better understanding of the economic costs of utility strikes in Australia.

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A costly problem

The direct repair costs of reported utility strikes in Australia are estimated to conservatively exceed $138 million annually. There are many unreported strikes, which could result in a much larger cost of direct repair.

However, the true financial burden is much larger when indirect costs, such as service interruptions, loss of income and trade as well as environmental damage are factored in.

On average, indirect and social costs are 32.4 times higher than the direct costs of repairs, amounting to a total cost of $4.6 billion annually for the Australian economy.

The report draws on 16 case studies across the gas, energy, water and telecommunications sectors to illustrate the magnitude of these costs.

Recommendations

Australia faces an enormous but avoidable cost burden annually due to utility strikes. Several measures can be implemented to reduce the frequency and severity of these incidents. These include:

1. **Implementing nationally consistent legislation for underground asset management:** Currently, only New South Wales mandates the registration of underground assets with BYDA. By harmonising regulations across all states and territories, the consistency and quality of underground asset data can be improved. This is expected to reduce utility strikes by 7%, resulting in annual savings of approximately $322 million.
2. **Establishing minimum data standards and a digital asset register:** Many utilities rely on outdated, low-quality data (Level D under Australian standards) to locate underground assets. Implementing a digital asset register with minimum data standards would improve project planning, reduce accidental strikes and increase public infrastructure efficiency. This could result in a 17% reduction in utility strikes and $782 million in annual savings.
3. **Uplifting skills and capabilities in utility risk management:** Training workers in utility risk management is critical to reducing the number of strikes. Over 3,000 strikes per year are caused by inadequate training. By mandating utility risk management training, similar to successful models in the UK and Canada, Australia could reduce strikes by 8%, translating to $368 million in annual savings.

Conclusion

Utility strikes represent a hidden but significant economic burden in Australia, costing the economy $4.6 billion annually. Adopting the recommendations outlined in this report, including regulatory reforms, improved data management and enhanced training, will reduce the number of utility strikes by 30%, creating annual benefits of $1.38 billion.

2. Background

Before You Dig Australia (BYDA) provides a community service by seeking to reduce the number of asset strikes. This service is fully funded by its members, who are generally underground utility owners.

This service provides users with information on the location of underground services. However, despite the substantial success of BYDA in assisting the reduction of utility strikes, over 15,000 utility strikes damage underground infrastructure every year. These strikes cause direct damage to the infrastructure and often result in service disruption to customers.

While a small number of utility strikes are high profile and cause outage to numerous people and businesses, a very large number of utility strikes go unreported and unnoticed – except by the customers who experience a service outage.

Box 1: The United Kingdom experience – research by the University of Birmingham

A study conducted by the University of Birmingham in 2019 found that the full cost of utility strikes is 29 times higher than the direct cost alone.[1] The researchers used 16 case studies from the UK to assess the total economic impact of utility strikes.

Direct costs refer to the expenses directly incurred for repairs, while indirect and social costs involve additional expenses such as loss of business, traffic delays and environmental damage.

The report also highlights the importance of accurate utility detection and improved excavation practices to prevent utility strikes. Many of the case studies revealed that inaccurate utility maps and failure to use appropriate technology, such as cable avoidance tools, were major contributing factors to the strikes.

The study allows policymakers to better understand the full costs of utility strikes and take proactive steps to prevent them. This, in turn, could lead to more sustainable and cost-effective management of buried infrastructure, ultimately benefiting both the utility industry and the wider public.

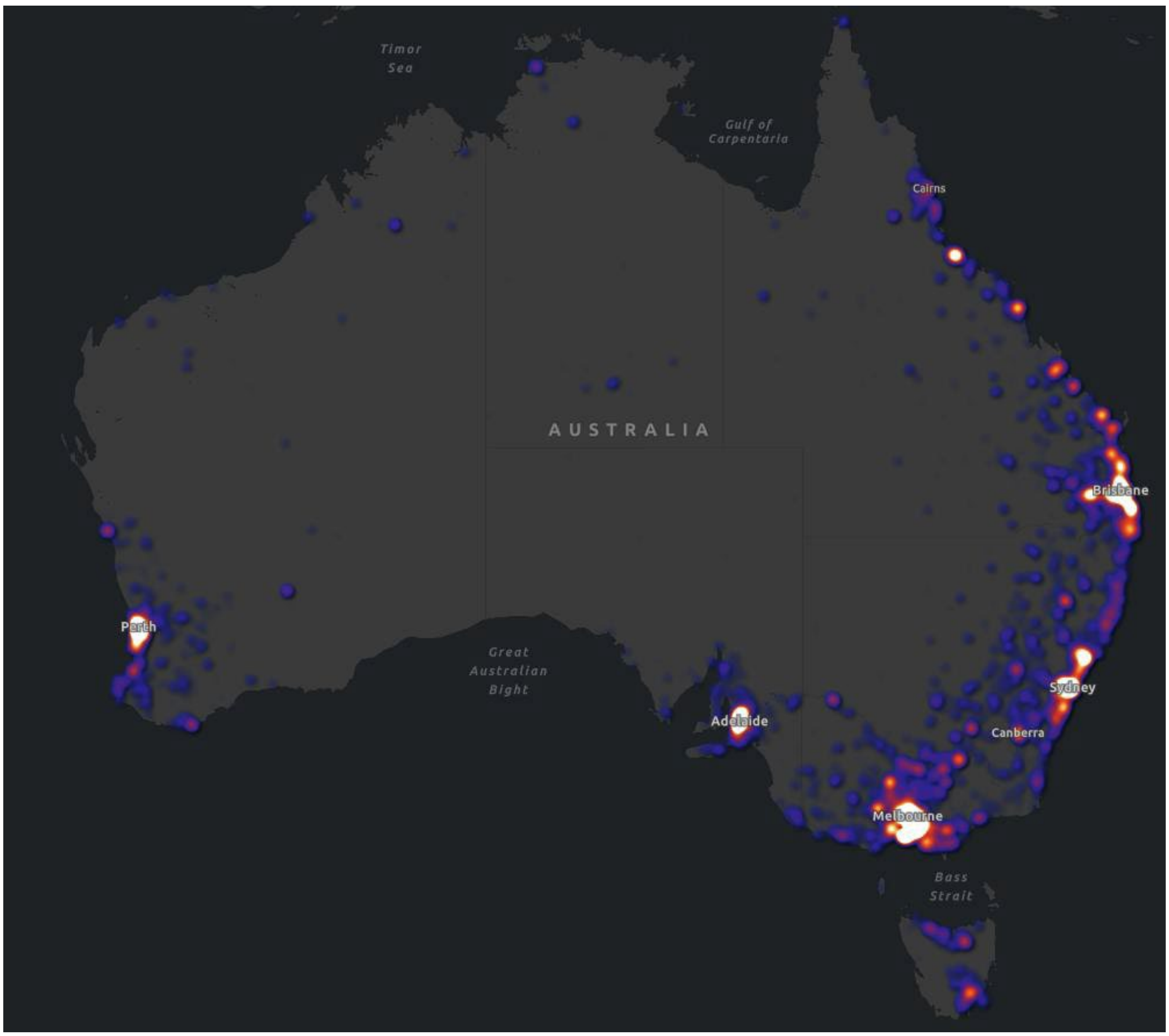
This report seeks to replicate the methodology of the study undertaken by the University of Birmingham and to determine the total economic cost of utility strikes in Australia. Measures to reduce the economic costs are also outlined.

[1] Makana, L, Metje, N, Jefferson, I, Sackey, M & Rogers, C, 'Cost estimation of utility strikes: towards proactive management of street works', *Infrastructure Asset Management*, 2019, vol. 7, no. 2, pp. 64-76. https://doi.org/10.1680/jinam.17.00033

3. Costs

BYDA has approximately 700 members, with 26 tier one members (the largest network operators) currently reporting damage data regularly. These tier one members report more than 15,000 utility strikes per year. The locations of the strikes are shown on the heat map below – clearly there is a concentration of strikes in and around capital cities.

Figure 1: Heat map of utility strikes



These utility strikes cause damage to the underground infrastructure and have other consequences too, including service interruption.

3.1. Direct costs

When an asset is damaged, there is a direct cost of repair. Often there is a direct financial record as the cost of the repair is paid for by the party incurring the damage.

The total value of direct costs to repair damage caused by utility strikes is at least $138 million annually. This cost is likely understated as many utilities do not record the costs and report their data.

This substantial cost is borne by the utility (unless it can be recovered from the party that caused the damage) and is likely included in customer prices.

While direct costs alone are substantial, the indirect and social costs associated with underground damage are much higher.

3.2. Indirect and social costs

Indirect costs are the additional costs associated with asset strikes incurred by the utility. They can include loss of income, compensation and regulatory fines.

Social costs are caused by the utility strike but are borne by society and the environment. They include the costs to residents and businesses associated with the cost-of-service outage, the inconvenience associated with the repair (for example, road closures) and environmental costs.

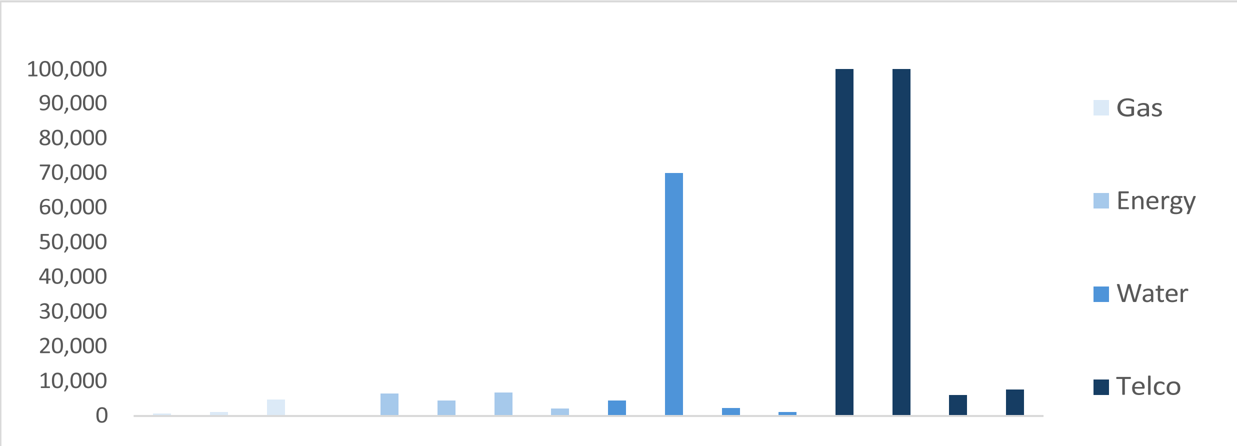
A detailed method for calculating these costs is presented in Appendix A.

3.3. Case studies

To replicate the UK study, 16 case studies were selected – four each across the gas, water, energy and telecommunications sectors. The mix of case studies was selected to provide a variety of projects across a range of sizes.

Two cases studies are described below: one from the water industry and one from the telecommunications industry.

Figure 2: Direct cost of each case study ($000)

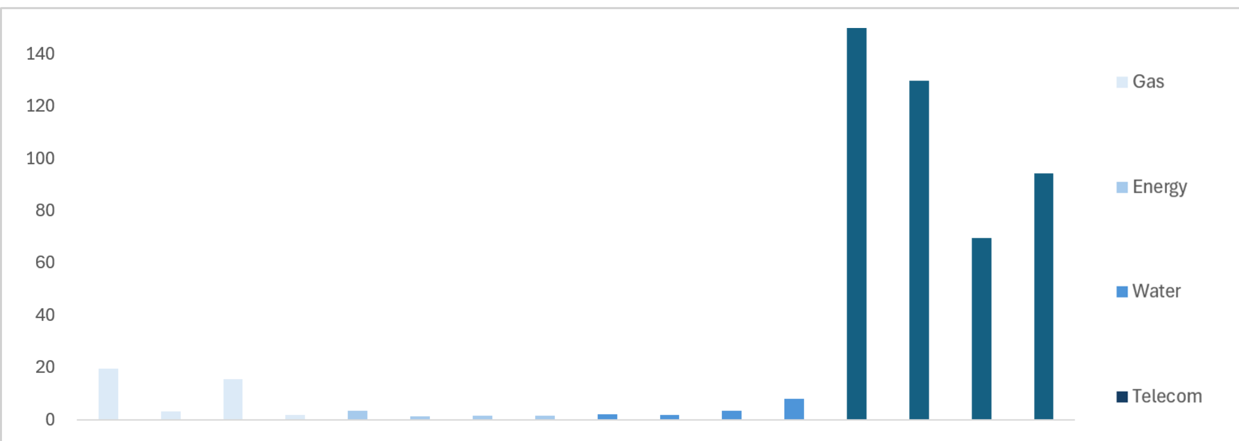


Note: The y-axis is truncated at $100,000. Two telecom case studies' costs are $140,000 and $170,000.

The relatively large direct costs associated with the telecommunications examples are due to the expensive nature of fibre-optic cable repair.

For each case study, the indirect and social costs were calculated. The method to determine the full economic costs is presented in Appendix A. The results are shown in the figure below.

Figure 3: Ratio of total costs to direct costs



The simple average across the sectors is 32.4 – meaning that for every $1 of direct damage caused, a further $32.40 of indirect and economic costs are caused. These additional costs have a real impact on Australian businesses and residents.

Table 1: Summary of findings

Sector	Direct cost $	Indirect cost + social cost $	Ratio
Gas	621	12,266	19.8
	1,112	3,733	3.4
	4,733	74,411	15.7
	227	450	2.0
Energy	6,468	23,257	3.6
	4,422	6,066	1.4
	6,669	11,518	1.7
	2,110	3,616	1.7
Water	4,391	9,132	2.1
	70,000	141,448	2.0
	2,301	8,136	3.5
	1,018	8,171	8.0
Telecommunications	170,000	27,202,218	160.0
	140,000	18,200,028	130.0
	6,044	421,249	69.7
	7,601	718,166	94.5
Total	**$427,717**	**$46,843,866**	**32.4**

The derived ratio of 32.4 is a simple average of the individual case studies. It is not weighted for the size of the direct cost or for the relative size of each sector. Scenario analysis is presented in Appendix C, which shows that the 32.4 ratio is conservative.

3.3.1. Case study examples

Two case studies are described below to give a description of the approach taken. These relate to the water and telecommunications sectors.

Case study 1: Damage to a potable water main

Damage: A potable water main was damaged by a jackhammer attachment on an excavator.

Consequence: The damage to the main caused the pipe to break and for 29 customers to be without water for almost two hours. The customers included a childcare centre and a medical centre. The incident impacted a local road and required traffic management.

Costs: The repair required rapid attention, resulting in a cost for labour, material and reinstatement of $4,391. The indirect costs associated with the utility strike include the cost of the internal asset protection team and traffic management costs of $1,675.

The economic cost of the outage was $88 per household and $1,908 for a business. Given the number of household and businesses impacted, the total economic cost of the service interruption was $6,181.

Outcome: The indirect and social costs were 2.08 times the direct cost. This relatively small multiplier reflects the short duration of the outage and the relatively small number of customers involved.

Case study 2: Damage to a telecommunications cable

Damage: A telecommunications cable was damaged by an excavator.

Consequences: The damage to the cable resulted in 4,997 customers being impacted for four hours while the repair was undertaken.

Costs: The direct cost of the repair was $6,044.

However, the average economic cost to this large number of customers over this period of time was $83.7. This reflects a combination of lost business income, business interruption and residential impacts. This led to a total economic cost of $420,000.

Outcome: The indirect and social costs were 69.7 times the direct cost. This relatively large multiplier reflects the long duration of the outage, and the large number of customers involved. It reflects the value that customers placed on reliable telecommunications services. This high multiplier is consistent with findings in other jurisdictions.

3.3.2. Comparison with University of Birmingham findings

Overall, the total average ratio of direct costs to indirect and social costs for the UK study and this study is very similar. This verification supports that finding that indirect and social costs are approximately 30 times the direct costs of utility strikes, and the total size of the problem is very significant.

Table 2: Cost ratio comparison

Sector	Australian ratio	UK ratio
Gas	10.0	5.73
Energy	2.1	5.59
Water	3.9	2.59
Telecommunications	114	886
Total	**32.4**	**29**

Note: The large UK ratio for telecommunications was based on a sample size of 1 and may not be reflective across the whole industry.

The smallest ratio in the UK study was 1.43, compared to 1.98 for this study. Likewise, the highest ratios for each study related to telecommunications.

3.4. Extrapolation of case studies

Each year in Australia, approximately 15,000 utility strikes are reported to BYDA. These are summarised by sector, below.

Table 3: Breakdown by sector

Sector	Number of strikes	%
Gas	2,521	17%
Energy	2,139	14%
Water	3,208	21%
Telecom	7,409	49%
Total	**15,276**	**100%**

The average direct cost of the case studies we examined was $26,732. This is likely higher than the average cost across all incidents. BYDA has advised that a conservative direct cost is $9,000 per strike.

This results in a total direct cost of $137.5 million. While this cost alone is significant, the application of the derived 32.4 multiplier means that the indirect and social costs are $4.46 billion. In total, the cost to the Australian economy and community is $4.597 billion.

Finding

Utility strikes cost the Australian economy and community $4.6 billion every year.

4. Recommendations

Australia faces a large, hidden problem that costs $4.6 billion a year. It need not be this large. This section outlines the recommendations and benefits of reducing the direct and indirect costs of utility strikes to the Australian economy. Appendix B provides further information on the implementation of these recommendations.

In addition to the cost of a utility strike once it has occurred (as outlined in the previous section), considerable effort is also spent on avoiding a utility strike. This slows down the design and construction process.

One specific on-site efficiency improvement relates to resumption cost savings. Resumption costs are the costs associated with pausing and then restarting projects after encountering an underground asset. This includes reworking costs such as labour and equipment rental for replanning and resurveying the site. Investigations by external regulatory bodies can also slow down work and negatively impact productivity.

With better access to underground asset data through a standardised platform, teams can avoid these disruptions altogether, allowing projects to proceed without costly interruptions.

4.1. Legislative improvements

Currently, each state and territory separately legislates and regulates underground assets. Only New South Wales mandates the registration of underground electricity, gas and oil assets with BYDA and the compulsory use of the service by those breaking ground.

On-site teams often have to interpret multiple plans from various asset owners, which takes additional time and creates potential for errors. By consolidating this information into a single, integrated platform, on-site teams can work more efficiently, thereby reducing the time spent on interpreting data and avoiding miscommunication.

This diversity of approach creates compliance problems, resulting in poor underground asset reporting. Harmonising the national laws would enhance the safe and efficient identification of utilities during excavation, reduce the likelihood of damage to infrastructure and ensure compliance with risk mitigation practices.

The cost to government to do this would be very low, and likely lead to a 7% reduction in utility strikes. This benefit is worth $322 million annually.

Recommendation 1: Implement nationally consistent legislation for underground asset management.

4.2. Establishing minimum data standards

Currently, utility location data is often low quality and accuracy, predominantly at Quality Level D (the lowest standard under Australian Standard 5488), and is typically delivered in PDF format. Reliance on outdated methods persists despite the availability of higher-quality digital data, such as engineering-validated as-built plans, surveyor reports and utility locator information.

BYDA is well-positioned to lead the development of a secure, digital platform for verified users in the construction sector in a way that meets the stringent cyber security requirements. Despite this, the utility sector remains resistant to transitioning from the current low-accuracy PDF-based system.

The opportunity for Australia to meet international best practices and position itself to be a leader in underground asset management is available now. With BYDA ready to support and develop a national digital asset register, collaboration between state and federal governments is critical to ensure the successful implementation of these advancements. This coordinated effort will not only improve safety and reduce project costs but also enhance the overall efficiency and sustainability of the nation’s infrastructure development.

If a digital asset register with minimum data standards is implemented, it becomes easier to plan and execute excavation and infrastructure projects. One of the primary benefits comes from reducing the frequency and severity of project interruptions caused by unexpected underground assets. When accurate data is available about the location and type of assets, teams can plan and design more effectively, thereby avoiding costly delays and rescheduling that often occur when assets are unexpectedly encountered.

Introduction of better-quality and more accurate data will reduce accidental utility strikes during construction, resulting in safer workplaces. It will also result in improved efficiency in public infrastructure projects.

This improvement is worth $782 million annually.

Recommendation 2: Establish minimum data standards and a digital asset register for utility locations.

4.3. Uplifting skills and capabilities in utility risk management

Currently, there is no mandatory training requirement in utility risk management for construction and trade sectors. Consequently, approximately 3,000 strikes a year are caused by inadequate training.

International models from the UK and Canada demonstrate the success of mandatory utility risk management training. In these countries, entry-level workers must complete training to manage utility risks before undertaking any excavation or construction work, which ensures a safer work environment and reduces the likelihood of damage to utility infrastructure.

BYDA recommends Australian Skills Quality Authority (ASQA) and the relevant job skills councils collaborate with the utility sector to identify the trades and qualifications that should include a mandatory unit of competency on utility risk management. Furthermore, appropriate content and learning outcomes must be developed to meet industry standards.

Uplifting the skills of professional utility locators is crucial to ensuring accuracy and safety in utility mapping and excavation activities. To achieve this, BYDA recommends implementing a formal traineeship delivered through the ASQA framework. This approach would provide structured, nationally recognised training that adheres to industry standards, equipping locators with the technical expertise and practical experience needed to handle complex projects. A formal traineeship would not only enhance the quality of work within the industry but also create clearer career pathways for individuals, supporting long-term workforce development and the reliable delivery of utility locating services.

Application of this approach will bring an annual benefit of $368 million per year.

Recommendation 3: Uplift skills and capabilities in utility risk management

4.4. Benefits of implementing the recommendations

The benefits of implementing similar recommendations are well known through international experience. The table below sets out the reduction in utility strikes associated with each recommendation. Overall, utility strikes would be expected to decrease by 30%, which would save the economy $1.4 billion annually.[2]

This estimated decrease in utility strikes has been drawn from international research and experience. Detailed research was undertaken by the UK Geospatial Commission who estimated the relationship between prevention activities and strikes reductions. The table below draws on this research to align our recommendations with strike reductions.

The annual benefit is then determined by taking into account the strike reduction and the total economic cost that strikes cause on the Australian Economy.

[2] Geospatial Commission, *National Underground Asset Register (Nuar) Economic Benefits Paper*, 2021.

Table 4: Recommendations and resulting utility strike reductions

Recommendation	How is a strike avoided?	Reduction of strikes	Annual benefit
Implement nationally consistent legislation for underground asset management	Ensuring that all underground assets are on a relevant plan. This will lead to more comprehensive data that shows most available underground assets on plans.	7%	$322m
Establish minimum data standards and a digital asset register for utility locations	Ensuring accurate plans presented in a common format, scale, comprehensively shown in a singular base map will show all underground assets accurately on plans.	2%	$92m
	More accessible data that is also easier to orient on-site will reduce pressure on site workers who are working to tight deadlines.	11%	$506m
	Better quality and comprehensive data will support better assessment of work required and avoid high-risk activities within the dig.	4%	$184m
Uplifting skills and capabilities in utility risk management	60% of asset strikes occur in the construction industry. Improvement in skills in this sector will reduce strikes and highlight to asset owners where their data may need improvement.	8%	$368m
Total		**30%**	**$1,380m**

5. Conclusion

Utility strikes in Australia impose significant economic and social costs, totaling $4.6 billion annually. While direct repair costs are substantial, the indirect and social costs far exceed them, impacting businesses, residents, and infrastructure.

Australia can reduce the frequency of utility strikes by up to 30% by:

- implementing nationally consistent legislation
- establishing minimum data standards
- improving utility risk management training.

These measures have the potential to save the economy $1.38 billion annually while improving safety, efficiency and the overall management of underground assets.

Appendix A: Detailed methodology

The economic costs of associated with utility strikes consists of three main categories, which are:

- direct repair costs
- indirect costs
- social costs.

The method used to calculate each of these is set out below.

1. Direct repair costs

When as asset is damaged, there is a direct cost of repair. Generally, this cost is well understood, as the utility owner undertakes the repair and may invoice the party who incurred the damage.

We worked with eight individual utility organisations to collect this data. These costs included:

- labour
- materials
- testing
- traffic management
- supervision of construction
- planning and design.

2. Indirect costs

The indirect costs can be much harder to quantify as many of these are often 'hidden' in overheads, being absorbed as part of doing the 'day job' or exceptional expenditure and are thus difficult to trace.

The types of indirect costs incurred by the utility we sought to capture are outlined in the following table:

Table 5: Indirect costs incurred by the utility

Indirect cost category	Description	Data sources
Internal cost of underground asset protection management	Each utility interviewed had a dedicated asset protection team. The size and cost of this team depends on the number of its assets that are damaged.	Company records, direct interviews, industry standards
Loss of income	Measure the amount of time that an asset is not able to be operated. Calculate the loss of income for this duration based on revenue earned at a comparable time.	Company records, direct interviews
Compensation payments	Compensation can be required by the relevant regulator through a standard of service agreement.	Company records, direct interviews
Regulatory fines	On occasion, fines can be issued as a result of service interruption.	Company records, direct interviews, public records

3. Social costs

These costs are caused by the utility strike but are borne by society.

These include the costs to residents and businesses associated with the cost of the service outage, inconvenience associated with the repair (for example, road closures) and environmental costs.

The social costs will depend on the nature of the utility strike. The most substantial social costs will come from the service outage and the associated impact of repair (traffic delay, health and safety, etc.).

Method to calculate the social cost of a power disruption

A power disruption impacts different customers in different ways, depending on a range of factors including:

- disruption of household activities
- loss of production
- damage to plant and equipment
- cost of restarting
- time of occurrence
- area impacted.

For each case study, we calculated the economic impact of the power outage based on the steps below.

Table 6: Steps to calculate the economic cost of a power interruption

Step	Description
1. Determine the duration of the power disruption	The length of the power disruption impacts on the size of the economic cost (a longer disruption is more costly than a shorter one). This information was provided by the utility.
2. Determine the number of customers affected, location and type	The cost of the outage depends largely on the type of customer impacted and their location. This information was provided by the utility.
3. Determine the amount of unused power	The impact of a power outage depends on how much power is unused – which depends on a number of factors including time of day and day of the week. We estimated the total unused power based on information provide in the Ausgrid 2022–2023 Local Council Community Electricity Report.
4. Apply the relevant value of customer reliability	To each kilowatt hour (kWh) of unused power, we will apply the relevant Value of Customer Reliability (VCR)
5. Calculate the total economic cost	$TEC=\sum(D_i \times N_i \times U_i \times VCR_i)$

Table 7 and Table 8 reproduce the data needed to calculate the value of customer reliability. Table 7 presents the data for residential connections.

Table 7: Residential values of customer reliability

Residential customer segment	State or territory	Value ($/kWh)
Climate Zone 1 Regional	Queensland (QLD)	28.08
Climate Zone 2 CBD & Suburban	QLD, New South Wales (NSW)	26.90
Climate Zone 2 Regional	QLD, NSW	29.97
Climate Zone 3 & 4 Regional	QLD, NSW, Victoria (VIC), South Australia (SA)	31.03
Climate Zone 5 CBD & Suburban NSW	NSW	34.32
Climate Zone 5 CBD & Suburban SA	SA	38.96
Climate Zone 5 Regional	QLD, NSW, SA	28.80

Climate Zone 6 CBD & Suburban	NSW, VIC, SA	24.91
Climate Zone 6 Regional	QLD, NSW, VIC, SA	25.52
Climate Zone 7 CBD & Suburban	ACT, VIC	25.07
Climate Zone 7 Regional	NSW, VIC, Tasmania (TAS)	19.89
Northern Territory (NT)	NT	21.47

Source: AER, *2023 Values of Customer Reliability Annual Adjustment,* 2023.

Table 8 presents data for business connections by industry.

Table 8: Business Values of Customer Reliability (VCR)

	Agriculture	Commercial	Industrial (<10MVA)	Industrial (>10MVA)	Services	Metals	Mines
2023 Business VCR	44.40	52.20	74.49	138.34	12.36	23.23	41.22

Source: AER, *2023 Values of Customer Reliability Annual Adjustment*, 2023.

Method to calculate the social cost of a telecommunications disruption

For each case study, we calculated the economic impact of the power outage based on the steps below.

Table 9: Steps to calculate the economic cost of a telecommunications interruption

Step	Description
1. Determine the duration of the telecommunications disruption	The length of the telecommunication disruption impacts on the size of the economic cost (a longer disruption is more costly than a shorter one). This information was provided by the utility.
2. Determine the number of customers affected, location and type	The cost of the outage depends largely on the type of customer impacted and their location. This information was provided by the utility.
3. Estimate the willingness to pay to avoid a service interruption	There is a relationship between the cost and reliability of telecommunications services. Using data from the ACCC, we quantified this relationship to determine the cost of an outage from the customers perspective.
4. Calculate the total economic cost	TEC=(D×NB×R)+(D×NR×ECH)

The Australian and Consumer Commission (ACCC) publishes quarterly data that measures the reliability of service providers. This data is shown below.

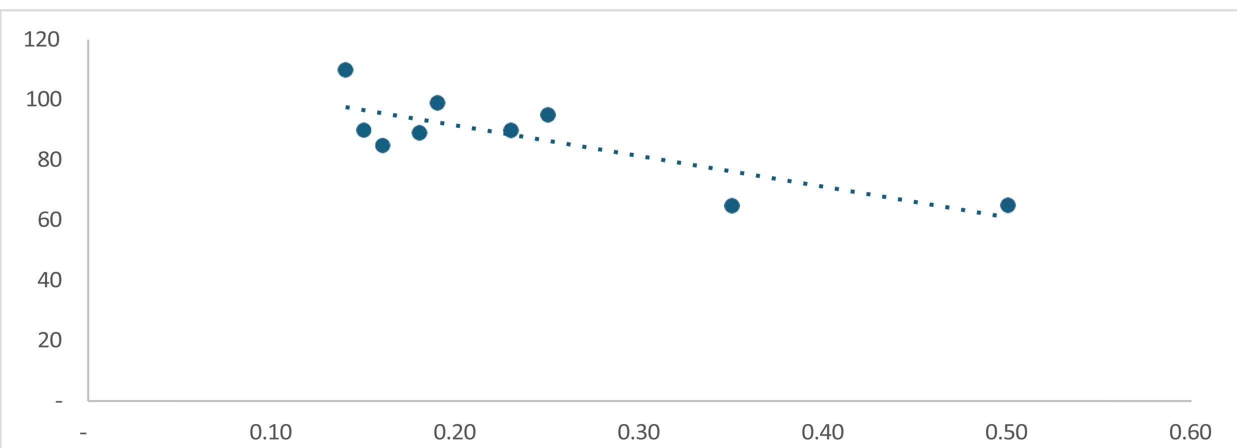
Table 10: Average daily outages per user lasting longer than 30 seconds

Provider	Number of outages
Aussie Broadband	0.25
Dodo & iPrimus	0.35
Exetel	0.16
iiNet	0.15
Launtel	0.20
Leaptel	0.14
Optus	0.19
Superloop	0.18
Telstra	0.14
TPG	0.50
Vodafone	0.23

Source: ACCC, *Broadband performance data*, ACCC website, accessed on 18 September 2024.

This reliability data can be compared with the monthly price of a 100/20 Mbps service. This strong relationship is shown below.

Figure 1: Relationship between cost and reliability



Method to calculate the social cost of a water service disruption

A water service disruption impacts business and residential customers in different ways. To calculate the economic impact of the water service outage, the following steps are required for each case study:

Table 11: Steps to calculate the economic cost of a water service interruption

Step	Description
1. Determine the duration of the water disruption	The length of the water disruption impacts the size of the economic cost (a longer disruption is more costly than a shorter one). This information was provided by the utility.
2. Determine the number of business customers affected	This information was provided by the utility.
3. Determine the number of residential customers affected	This information was provided by the utility.
4. Apply the relevant willingness to pay metric	The willingness of customers to avoid service interruptions will be calculated, based on available willingness to pay studies. Refer to the tables below.
5. Calculate the total economic cost	$TEC=(D \times NB \times WTP_{business}) + (D \times NR \times WTP_{household})$

Table 12 sets out the willingness of households and business to pay to reduce the probability of service interruption by 1%. This was converted from a probability to a certainty, to reflect the actual outage, and escalated to 2024.

Table 12: Willingness to pay for a 1% decrease in the chance of an unplanned interruption

Length of service interruption	Customer type	$ per year
1–3 hours	Household	0.73
5–8 hours	Household	1.45
1–3 hours	Business	0.47
5–8 hours	Business	2.23

Source: CIE, *Customer willingness to pay,* prepared for Hunter Water, 2021.

Table 13 sets out the financial impact of a loss of water supply for a business.

Table 13: Financial impact of water interruptions on businesses

Duration of interruption	Mean $	Median $
1-hour water interruption during business hours	1,590	155
5-hour water interruption during business hours	10,879	250

Source: CIE, *Customer willingness to pay*, prepared for Hunter Water, 2021.

Method to calculate the social cost of a gas service disruption

Table 14: Steps to calculate the economic cost of a gas interruption

Step	Description
Determine the duration of the gas disruption	This information was provided by the utility.
Determine the number of customers affected, location and type	The cost of the outage depends largely on the type of customer impacted and their location. This information was provided by the utility.
Estimate the willingness to pay to avoid a service interruption	This was estimated based on willingness to pay studies and escalated to 2024. See below.
Calculate the total economic cost	$TEC=(D\times NB\times R)+(D\times NR\times ECH)$

Table 15 sets out the willingness to pay of households and business to avoid a service interruption, escalated to 2024.

Table 15: Willingness to pay to avoid events

Willingness to pay	Per customer, per event, 2003	Per customer, per event, 2024
To avoid a gas outage in winter – residential	$28	$56
To avoid a gas outage not in winter – residential	$20	$40
To avoid a gas outage – commercial	$228	$456

Source: NERA, *Willingness to Pay Research Study*, 2003.

Method to calculate cost of traffic disruption

Where the utility strike has an impact on transport infrastructure, the impact on traffic delays needs to be included as an economic cost. The method to calculate this is set out below. The approach applied is consistent with the approach used by Makana (2021) but was refined to use Australian data sources.

Table 16: Steps to calculate the economic cost of a traffic delay

Step	Description	Data sources
Determine a traffic control plan	Choose a traffic control plan that best represents the traffic disruptions for the specific area in Australia where the utility strike occurred. This will depend on the specific infrastructure such as lane width, length of detour, and type of traffic control (e.g., flag person, signalised zone).	Tighe S, Lee T, McKim R and Haas R, 'Traffic delay cost savings associated with trenchless technology', *Journal of Infrastructure Systems*, 1999, vol. 5, no. 2.
Determine the duration of the traffic disruption	Calculate the total duration of traffic disruption caused by the utility strike. This includes the time from the start of the disruption until normal traffic flow resumes.	Direct interview with utility.
Obtain average annual daily traffic (AADT) data	Determine the average traffic volumes.	Each jurisdiction collects and disseminates this data separately. For example, in NSW this data is managed by Transport for NSW and made available through the Traffic Volume Viewer. Alternatively, data is held by data.gov.au and local councils.
Calculate cost of traffic disruption	Use the traffic control plan and the total duration of disruption to select the appropriate cost equation. An example of these calculations is set out in Table 17.	Tighe S, Lee T, McKim R and Haas R, 'Traffic delay cost savings associated with trenchless technology', *Journal of Infrastructure Systems*,1999, vol. 5, no. 2.

Step	Description	Data sources
Calculate the total economic cost	$T=T_{cp}+(D_t \times V \times C_t) \times M$	Where: T_{cp} is derived from the selected traffic control plan and the specific conditions such as lane width, detour length, and traffic control method. D_t is the total duration of traffic disruption caused by the utility strike. V is obtained from jurisdictional data or sources like the Traffic Volume Viewer. C_t is calculated using the traffic control plan and the duration of disruption. M is adjusted based on density of the urban area and other local factors which might include noise pollution, air pollution, loss of business, and health issues.

Table 17 sets out the cost equations used to calculate the cost of traffic disruption.

Table 17: Summary of cost equations – traffic control plan 1

Lane width (m)	Job duration (h)	Equation	R^2
3.75	40	log(cost) = 0.00022AADT + 3.2545	0.982
3.75	50	log(cost) = 0.00022AADT + 3.3515	0.982
3.75	80	log(cost) = 0.00022AADT + 3.5556	0.982
3.75	100	log(cost) = 0.00022AADT + 3.6525	0.982
3.75	160	log(cost) = 0.00022AADT + 3.8566	0.982
3.75	200	log(cost) = 0.00022AADT + 3.9536	0.982

Appendix B: Implementing recommendations

Three recommendations are made for economic research solutions.

1. Recommendation 1: Nationally consistent legislation for underground asset management

Current situation

- Only New South Wales mandates asset registration for electricity, oil and gas assets with Before You Dig Australia and explicitly mandates the use of the service by those breaking ground.
- Other states and territories have less explicit requirements under Work Health and Safety (WHS) laws.
- The regulatory landscape is fragmented due to a lack of nationally unified legislation.

It is recommended that legislation be harmonised across all Australian states and territories to reinforce the use of BYDA as the national platform for underground asset registration, location information, and safety support.

Currently, New South Wales is the only state that mandates, under the Electricity and Gas Acts, that network owners and operators register their assets with BYDA. Additionally, New South Wales requires all entities conducting excavation work to access asset location data through the BYDA service, supported by penalties for noncompliance. In contrast, other states and territories have far less explicit requirements under WHS laws simply stating People Conducting a Business or Undertaking (PCBUs) should access utility location plans prior to commencing work. All jurisdictions lack a uniform obligation for asset owners, including those in the water, telecommunications, and local government sectors, to register their underground assets with BYDA.

This fragmented regulatory landscape creates uncertainty for the utilities sector and users. It leads to gaps in the national underground asset registry and confusion for those attempting to access accurate asset location information. The lack of a comprehensive, unified framework increases the risk of incidents during excavation and delays critical infrastructure projects.

Harmonising legislation to leverage BYDA's role as Australia's national not-for-profit utility safety partner will provide significant benefits without imposing financial costs on governments or the public. Additionally, BYDA is seeking to have consistent reporting of utility damages to ensure the size of the problem can be measured, as well as the impact of interventions. BYDA's existing technology and infrastructure can support both the utility sector and the broader community, including the construction industry. The primary government action required is the drafting and passage of the necessary legislative amendments.

The benefits of this approach are clear – a comprehensive national underground asset register will enhance the safe and efficient identification of utilities during excavation, reduce the likelihood of damage to infrastructure and ensure compliance with risk mitigation practices. This will ensure that all individuals and businesses breaking ground are legally required to identify underground utilities before commencing work, ultimately improving public safety and network integrity.

Benefits

- Enhanced safety during excavation.
- Reduced likelihood of infrastructure damage.
- Improved compliance with risk mitigation practices.
- Cost-effective solution utilising existing not-for-profit infrastructure.

Economic impact

- Potential reduction in the estimated $5 billion annual cost of utility damage caused by third parties.
- Improved efficiency in infrastructure projects.

2. Recommendation 2: Establish minimum data standards and a digital asset register for utility locations

Current situation

- There is low-quality/accuracy utility location data (predominantly Quality Level D).
- There is a reliance on outdated PDF formats.
- Adoption of modern digital solutions in the utility industry is slow.
- Inconsistent understanding of cyber security legislation, including the *Security of Critical Infrastructure Act 2018*.

It is recommended that minimum data standards for utility location plans be introduced across Australia to improve the quality, accuracy, and format of information provided to the construction sector.

Utility location data is often of low quality and accuracy, predominantly at Quality Level D (the lowest standard under Australian Standard 5488), and is typically delivered in PDF format. This reliance on outdated methods persists despite the availability of higher-quality digital data, such as engineering-validated as-built plans, surveyor reports and utility locator information. The utility industry has, as a whole, been either slow to adopt modern digital solutions – such as interactive Geographic Information System (GIS) mapping – or share higher quality plans that could significantly enhance project design, risk assessment and the avoidance of accidental utility strikes during construction and ground breaking activity.

The reliance on low-quality information has a significant financial impact, with utility damage caused by third parties costing an estimated $5 billion annually. BYDA is well-positioned to lead the development of a secure, digital platform for verified users in the construction sector, in a way that meets the stringent cyber security requirements. Despite this, the utility sector remains resistant to transitioning from the current low accuracy PDF-based system.

International experience highlights the potential benefits of adopting digital utility data platforms. Countries such as the United Kingdom, Scotland and Singapore and several states in the United States have developed federated subsurface asset registers or subsurface digital twins. In the UK, the National Underground Asset Register is projected to deliver annual economic benefits of at least £350 million by improving efficiency and reducing asset strikes.

In addition to the transition to digital data, the inherent accuracy of the capture of utility location information needs to be addressed. Public infrastructure projects routinely allow for cost overruns of 8–12% due to utility location issues and strikes. A study by Arup for Infrastructure Victoria indicated that improving the accuracy of utility asset location data could save up to $44.4 million annually on Victorian public infrastructure projects.

The development of improved location capture technology has not been consistently utilised with a reliance on 'indicative' only plans being provided. BYDA is uniquely positioned to work with the utility infrastructure owners and the construction sector to examine ways to convey information with a higher degree of location accuracy without compromising any security concerns. The move toward higher-accuracy, secure, digital GIS based information will drive efficiency, reduce the risk of costly utility strikes and lead to significant savings for public infrastructure projects.

The opportunity for Australia to meet international best practices and position itself to be a leader in underground asset management is available now. With BYDA ready to support and develop a national digital asset register, collaboration between state and federal governments is critical to ensure the successful implementation of these advancements. This coordinated effort will not only improve safety and reduce project costs but also enhance the overall efficiency and sustainability of the nation’s infrastructure development.

Benefits

- Enhanced project design and risk assessment capabilities.
- Reduced accidental utility strikes during construction, safer workplaces.
- Improved efficiency in public infrastructure projects.

Economic impact

- A reduction in 8–12% public infrastructure project cost overruns routinely allowed for utility location issues.
- Potential savings of up to $44.4 million annually for Victorian public infrastructure projects (based on 2024 ARUP study). A Queensland study by 2023 Roads Australia. Fellows estimated the Department of Transport and Main Roads could achieve a saving of $15 million annually on Queensland roads projects.
- Alignment with international best practices (e.g. the UK's National Underground Asset Register projecting annual economic benefits of at least £350 million).

3. Recommendation 3: Uplifting skills and capabilities in utility risk management

Current situation

- There is no mandatory training requirement in utility risk management for construction and trades sectors.
- Approximately 1,100 utility strikes occur monthly in Australia.
- Over 60% of incidents involve the building and construction sector.

It is recommended that a nationally consistent approach be taken to enhance skills and capabilities in utility risk management across the construction and trades sectors. Despite BYDA’s decade-long efforts to provide industry-endorsed damage prevention sessions, there is currently no mandatory training requirement in utility risk management for workers in these sectors. Utility risk management is not covered in the entry-level construction white card, nor is it a mandatory component of any apprenticeship or VET sector qualification. The only voluntary subject available, ‘Identify, Locate, and Protect Utilities’, has been consistently regarded by the utility sector as inadequate in teaching workers how to work safely around utility infrastructure, particularly in areas such as reading and interpreting utility plans.

Data from BYDA reveals that approximately 1,100 utility strikes occur each month in Australia, with over 60% of these incidents involving the building and construction sector. These strikes not only put workers at significant risk but also cause widespread disruption to communities and critical infrastructure. The ASQA, following recent reforms to the VET sector under the National Skills Plan, is focused on enhancing economic and social outcomes through targeted investment in skills development. BYDA believes that an uplift in utility risk management skills is essential to reducing the number of utility strikes and their associated economic impacts. Consistent, industry-endorsed training in utility risk management would ensure workers are adequately prepared to avoid these risks.

International models from the UK and Canada demonstrate the success of mandatory utility risk management training. In these countries, entry-level workers must complete training to manage utility risks before undertaking any excavation or construction work, ensuring a safer work environment and reducing the likelihood of damage to utility infrastructure.

BYDA recommends that ASQA and the relevant job skills councils collaborate with the utility sector to identify the trades and qualifications that should include a mandatory unit of competency on utility risk management. Furthermore, appropriate content and learning outcomes must be developed to meet industry standards. BYDA is well-positioned to facilitate this consultation with the utility sector, helping to create industry-endorsed content that can be licensed to Registered Training Organisations (RTOs) to ensure consistent and high-quality training materials.

Implementing a mandatory utility risk management training program will significantly reduce the number of utility strikes, enhancing safety for workers and minimising disruptions to critical infrastructure. The adoption of industry-approved learning outcomes will ensure that construction workers and relevant tradespeople are equipped with the necessary skills to manage utility risks effectively. By engaging with the utility sector and integrating this training into VET sector qualifications, Australia can follow successful international models and develop a workforce that is better prepared to address the challenges posed by working near utility infrastructure. This initiative will not only reduce economic losses caused by utility strikes but also contribute to a safer, more efficient construction industry.

Benefits

- A reduced number of utility strikes.
- Enhanced safety for workers.
- Minimised disruptions to critical infrastructure for the Australian community.
- A workforce that is better prepared for managing utility risks with career and skills development improving employment opportunities.

Economic impact

- A reduction in economic losses caused by utility strikes.
- Improved efficiency and safety in the construction industry.
- Potential long-term cost savings through decreased incidents and improved project management.

Appendix C: Sensitivity analysis

The analysis in the body of this report sets out the data and assumptions relied upon. To ensure credibility, a conservative set of assumptions was used to determine a total economic cost of $4.6 billion.

Given that the analysis is based on a sample of projects, there is some uncertainty, and varying assumptions will derive different results.

Accordingly, this section sets out the results should some of the input data change. The variables changed to undertake this scenario testing include:

- weighting of the ratio based on the number of strikes per sector
- weighting of the ratio based on size of the direct cost of the strike
- the direct cost of the utility strike
- the number of utility strikes.

The impact of varying these inputs is shown below.

1. Weighting of the ratio based on the number of strikes per sector

In the core analysis, the overall ratio was determined as the simple average of the 16 case studies. There were four case studies across the four major utility sectors. If the ratio for each sector was weighted by the number of strikes in each sector, then the ratio is much higher. This is because the telecommunications sector has the highest ratio and is also the sector with the highest number of strikes (see Table 18).

Table 18: Ratio weighted by number of strikes

Sector	Number of strikes	Simple average of ratio	Ratio weighted by number of strikes
Gas	2,521	10.2	1.7
Energy	2,139	2.1	0.3
Water	3,208	3.9	0.8
Telecommunications	7,409	113.5	55.1
Total	**15,276**	**32.4**	**57.9**

When the ratio is calculated taking into account the number of strikes in each sector, the result is 57.9.

2. Weighting the ratio based on size of the direct cost of the strike

The direct cost of utility strikes varies considerably. When the ratio is determined based on the relative size of the direct costs, the ratio is much higher.

Table 19: Ratio weighted by direct cost

Direct cost	Indirect cost + social cost	Weighted average
$427,717	$46,843,866	109.5

When the ratio is calculated taking into account the relative size of direct cost impacts, the resulting weighted ratio is 110.

3. Direct cost of utility strike

The calculated ratio is applied to an average direct cost estimate. The core analysis was based on an average direct cost of $9,000 across all sectors. This was based on BYDA data and experience.

The average direct cost across the 16 sampled projects was $26,732, while the UK average direct cost was found to be $7,847.[3]

These different costs are then applied to the different ratios (calculated above) to derive the average total cost of each utility strike.

Table 20: Total cost per utility strike

Direct cost of utility strike	Ratio 32.4	Ratio 57.9	Ratio 109.5
$9,000	291,980	520,839	985,685
$26,732	867,256	1,547,027	2,927,742
$7,848	254,596	454,154	859,483

The core analysis is based on an average total cost of each strike of $292,000. This is the second lowest of the scenario outputs and is considered to be a conservative approach.

[3] Converted from pounds to dollars and escalated to 2024.

4. Number of utility strikes

The core analysis was undertaken on the basis of 15,726 utility strikes. This is the number of strikes reported to BYDA and is known to be a considerable under-reporting. While the actual number of utility strikes is unknown, it is considered to be two to three times higher.

5. Results

To determine the overall range of economic models, the range of total costs is multiplied by the range of number of strikes, as set out below.

Table 21: Total cost of utility strikes ($ billion)

Cost per strike $	Number of strikes 15,276	Number of strikes 30,552	Number of strikes 45,828
254,596	3.89	7.78	11.67
291,980	4.46	8.92	13.38
454,154	6.94	13.88	20.81
520,839	7.96	15.91	23.87
859,483	13.13	26.26	39.39
867,256	13.25	26.50	39.74
985,685	15.06	30.11	45.17
1,547,027	23.63	47.26	70.90
2,927,742	44.72	89.45	134.17

This analysis shows the range of outcomes is between $3.9 billion and $134 billion. This shows that the core analysis was undertaken using conservative inputs and results in a credible estimate of the impact of utility strikes on the Australian economy.

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