



ENGINEERS
AUSTRALIA

The State of the Engineering Profession

Engineering in Australia

2017

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The State of the Engineering Profession 2017

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Foreword by the National President



Following overwhelming support for Engineers Australia's 2016 State of the Engineering Profession report, I am delighted to share our insights for 2017, specifically the change required to realise this country's political, social, and economic aspirations.

The resources boom and strong population growth have driven Australia's economic expansion, but despite this, our standard of living is declining. Like many developed countries, we now face the challenges of reduced productivity; an aging population; energy security; and, of course, the very real effects of climate change.

As the trusted voice of the engineering profession, Engineers Australia recognises that innovation is the key to meeting these challenges. Innovation requires bold and decisive action, supported by long-term government policies that will fuel Australia's industrial and economic pursuits.

Innovation is about turning ideas into reality – and ours is the profession most capable. You could almost say that innovation is in our DNA.

The time to act is now, because we no longer have the luxury of endless tomorrows.

We call on governments, of all persuasions, to ensure that their policies foster a well-trained and highly qualified engineering workforce to meet the challenges before us. We strongly encourage greater promotion of STEM subjects and the influence engineers have on shaping the landscape of our global community.

Engineers Australia is eager to work with governments, industry and academia to future-proof the profession and in doing so, fortify the nation.

John McIntosh

FIEAust CPEng EngExec NER APEC Engineer IntPE(Aus)

National President & Chairman



About Engineers Australia

With 100,000 members across all engineering disciplines, Engineers Australia is the national body for member professional development, and for the advancement of engineering. As the association for professional engineers, engineering technologists and engineering associates, we strive to advance the science and practice of engineering for the benefit of the community.

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1.

Policy decisions to promote economic prosperity

1.1

Drive productivity with innovative policies

Engineers Australia is calling on the federal government to lead the way with key policy decisions to promote Australian economic prosperity over the next 10 years, and set expectations for the states to follow.

The Productivity Commission's Discussion Paper 'Increasing Australia's Future Prosperity' notes that multi-factor productivity in Australia has stalled since 2004, and indicates that incentives to invest for the future are weak¹. If Australia fails to develop the policies most relevant to future higher productivity, future generations could be burdened with the eventual adjustment cost, and if nothing changes, it will be increasingly difficult to achieve Australians' expectations.

Australia cannot afford to be laissez-faire in the hope that trickle-down policies will work on their own. Policy action must begin now for Australia to remain a prosperous nation with high standards of living. We need decisive and committed medium- to long-term policies for growth that will drive productivity and increase our self-reliance.

A FOCUS ON INNOVATION

To improve Australians' standard of living in the coming decades, productivity gains must be underpinned by innovation. Australia's GDP continues to rise, but this has been on the back of strong population growth. At the same time Australians' standard of living, as measured by real net national disposable income per capita, has been going backwards for most of the last five years².

The windfall benefits of the resources boom are over and the fall in commodity prices endangers the economic viability of many new resources projects.

Australia needs to adjust to the decline in investment in the resource sector, and boost productivity by shifting its focus towards innovation, ensuring infrastructure is capable of supporting productivity.

Focused innovation policies can include targeted research and development, better university and business linkages and effective and efficient financial support for research³. It also requires building the skilled workforce necessary to adapt and to drive this change in the coming years.

This skilled workforce will need to solve community and economic problems associated with an aging population and a transition to a low-carbon economy, all while trying to preserve our standard of living. Engineers play a pivotal role in solving these problems in modern society, and will be indispensable in the future.

Engineers Australia is the trusted voice of the engineering profession. We are the global home for engineering professionals renowned as leaders in shaping a sustainable world.

1: Australian Government Productivity Commission, November 2016. Increasing Australia's future prosperity: Productivity Commission Discussion Paper.

2: Janda, M, 14 October 2016. ABC News, Population growth masking weak economy, making households worse off: CBA economist. www.abc.net.au

3: OECD, 2016. Australia - Economic Forecast Summary (June 2016). www.oecd.org

1.2

The value of engineers in Australia

TURNING IDEAS INTO REALITY

In a modern society, practically every good and service consumed or used in production embodies engineering. New and innovative ideas are the beginnings of technological advance, but it is engineers that translate new ideas into practical and commercially valuable new products and services.

Engineers have the ability to turn ideas into realities, which have a positive effect on people's everyday lives⁴. Engineers contribute valuable services to the Australian economy at all stages of the innovation supply chain:

- Engineers undertake applied research, designing and engineering prototypes into valuable new commercial products and services suitable for domestic and international markets.
- Engineers manufacture new products and constantly improve existing products.
- Engineers are heavily involved in the development and operations of digital systems.
- Engineers are primarily responsible for the design, construction, operation and continuous improvement of infrastructure facilities that provide a framework in which an innovative economy can thrive.

Engineers' analytical capacity and problem solving skills are prized within a wide range of industries beyond those normally associated with engineering.

THE INDUSTRY AUTHORITY

Engineers Australia sets standards for the education and practice of engineering for Australia, in line with international benchmarks. Our 100,000 members include professional engineers, engineering technologists and engineering associates. Engineers Australia manages the National Engineering Register (NER) – the uniform national compliance benchmark standard of professionalism in engineering practice. It corresponds to the standards of competence required in legislated systems.

Australia's engineering profession comprises individuals who hold recognised engineering qualifications and who work in occupations closely related to engineering. Like other professions, engineering also requires new graduates to satisfactorily complete a process of professional formation in order to be recognised as a competent, practicing engineer.

4: National Academy of Engineering, 2008. Changing the Conversation: Messages for improving Public Understanding of Engineering. www.nae.edu

1.3

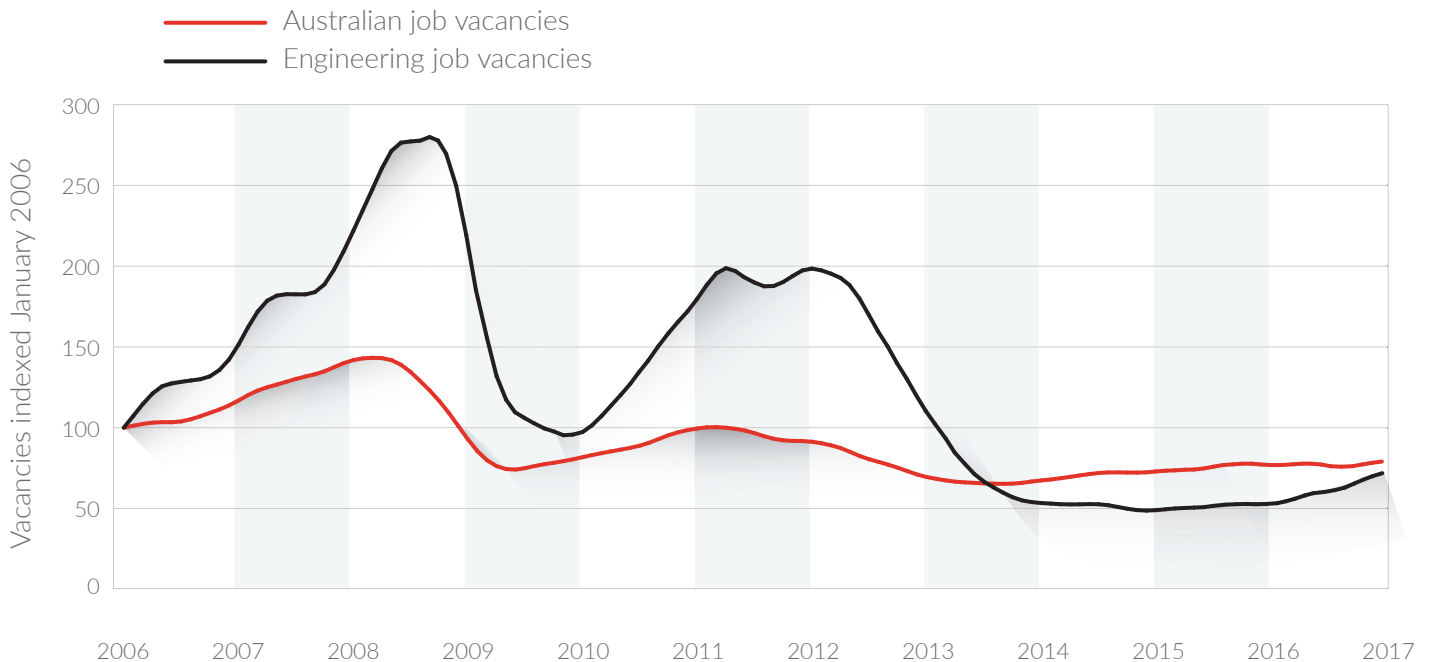
Changes to the engineering profession over the last decade

Strong migration policy, and solid economic growth driven by the resources boom has steered significant population growth over the last decade. The Australian economy also successfully weathered the global financial crisis (GFC), which sent most major developed economies into a deep recession⁵.

After the GFC, the engineering labour force recovered in 2010 and 2011, but this recovery was short lived. The engineering labour market fell rapidly from December 2012 when engineering vacancies began a thirty-month slide. This deterioration continued right through to 2015, and has now stabilised at low levels.

Over the decade to 2012, the Australian engineering workforce grew significantly to meet the high demand for engineers during the construction phase of the resources boom and supporting a booming economy. The extraordinary pressures experienced by the resources sector distracted attention away from the fact that the high demand for engineers was widespread throughout the economy.

Engineering job vacancies follow boom and bust cycles



5: McKibbin, W, and Stoeckel, A, 2009. The Global Financial Crisis: Causes and Consequences. Lowy Institute, Working Papers in International Economics, No 2. 09.

1.4

Australia's future: Our recommendations

Australia's future depends on promoting growth through innovation and productivity

Now that the resources boom is over, Australia needs to transition from a resources-based economy to an innovative, high tech, knowledge-based economy.

We need government to develop positive and influential medium- to long-term growth policies so we can remain a prosperous nation with high standards of living.

Engineers Australia's recommendations are based on policy priorities set by the Engineers Australia Board and developed through member consultation.

1.



Skilled workforce

An educated and skilled workforce that is ready to meet contemporary and future challenges.

2.



Strong defence industry policy

A revitalised industry policy that leverages defence capability needs.

3.



Considered energy policy

Domestic energy policies that can sustain long-term climate targets and energy security.

4.



Improved infrastructure

Modern infrastructure that works efficiently and does not impede productivity.

2.

Australia's future depends on a skilled workforce

Australia needs an educated and skilled workforce that is ready to meet contemporary and future challenges.

Engineers Australia recommends governments at all levels recognise the critical role of engineers and implement policies and programs to ensure Australia has sufficient competent practicing engineers for the long term.

STRATEGIES

- Plan to replenish our aging engineering workforce
- Encourage gender diversity
- Encourage educational foundation subjects for engineering at school
- Promote the engineering 'brand'
- Pursue a balanced approach to the engineering labour force

2.1

Plan to replenish our aging engineering workforce

Australia's ambition is to become an innovative, technically progressive and globally competitive nation. Innovation and technical progress do not just happen and innovation is much more than research and development. Innovators move outside existing paradigms, improve existing processes and functions, and disseminate new activities and new ideas.

For Australia to achieve this goal, we must carefully plan the development of our future engineers. However, an innovative future for Australia could be at risk as the engineering workforce ages and older engineers retire.

The age structure of engineers in the workforce is characterised by proportionally more engineers in older and younger age groups. In 2011, 28 per cent of the engineering labour force was aged 50 or older, and many may have retired in the last five years.

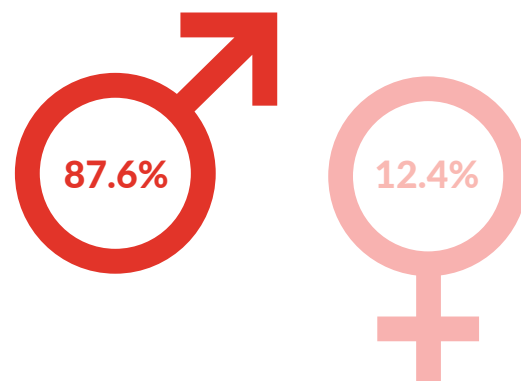
2.2

Encourage gender diversity

The lack of gender diversity starts with an alarmingly low number of young women participating in the critical foundation subjects for engineering. Young women who accept places in engineering courses however, have better ATAR scores than young men.

From the male dominated courses grows a male dominated profession, which is an unsustainable situation given our national ambitions. We need to encourage interest in engineering-related subjects from both genders equally.

The engineering profession in 2016 is male dominated⁶



6: The Engineering Profession: A Statistical Overview, 13th edition, Engineers Australia, February 2017



2.3

Encourage educational foundation subjects in engineering at school

The medium term challenges for Australia are enormous. Australia will need to solve community and economic problems associated with an aging population, as well as a transition to a low carbon economy, all while attempting to preserve our increasing standard of living. The future workforce, especially those with science, technology, engineering and mathematics (STEM) qualifications, will be critical to achieving these goals.

Many countries throughout the world rely on developing STEM skills to build their knowledge-based communities and economies⁷. Engineering graduates are far more adaptable than graduates in other STEM fields both in the areas of their training and in the wider economy⁸.

Australia’s capacity to produce its own engineers begins at school. Building the technical workforce of the future is undermined by entrenched trends in school studies away from vital enabling subjects. These trends are serious constraints impeding Australia’s capacity to build its engineering and scientific capacities.

2.4

Promote the engineering ‘brand’

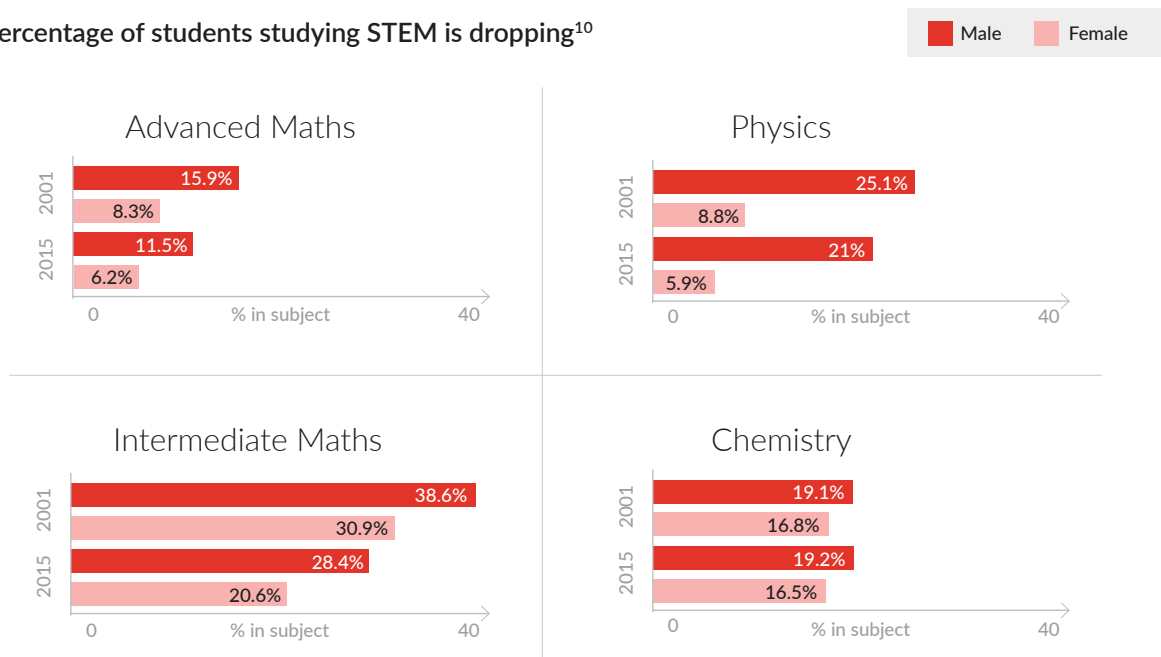
Before we can boost the numbers of the next cohort of home grown-engineers, we need to understand how engineers are perceived by the public, especially among young adults and teenagers, as they are our future.

Their perception will be strongly focused on the need for mathematics and science skills. This entirely overlooks the other vital aspects of engineering which must also be promoted such as creativity and teamwork⁹. How we communicate with young people is of paramount importance.

Mathematics and science will remain necessary skills for engineering, but we need to change the messaging to appeal to younger people. Let’s shift the focus away from the subjects students need to study to become engineers, and showcase examples of how engineers benefit society, improving the everyday lives of Australians by creating new innovative products for us to enjoy.

This will subtly demonstrate the variety of skills engineering values: creativity and collaboration, as well as maths and science.

The percentage of students studying STEM is dropping¹⁰



7: Office of the Chief Scientist. 2013. Science, Technology, Engineering and Mathematics in the National Interest: A Strategic Approach. www.chiefscientist.gov.au
 8: Grattan Institute, Mapping Australia’s higher education 2016, 7 August 2016. www.grattan.edu.au
 9: National Academy of Engineering. 2008. Changing the Conversation: Messages for improving Public Understanding of Engineering. www.nae.edu
 10: Engineers Australia 2017, Engineers Makes Things Happen

2.5

Pursue a balanced approach to the engineering labour force

Australia has enjoyed the advantage of migrant engineers throughout most of its history to alleviate skill shortages and build national engineering capability. But dependence on migration has become unbalanced: 70 per cent of new supply is from overseas and only 30 per cent is from Australian graduates. There are serious and unnecessary risks associated with this situation.

Australia must do more to produce engineers, especially if it is to meet national ambitions to become a more productive and innovative nation.

The annual number of engineers produced by Australian education institutions has slowly increased over the past decade but this trend is about to reverse. There has been a substantial fall in the number of school students accepting places in university engineering courses in each of the past two years and this will soon follow with an alarming drop in course completions which will lead to a broken pipeline of future engineers.

Permanent migration policies aim to supplement the long term output of our educational institutions to meet future workforce requirements, and it is acknowledged that skilled migration may continue to be required as an adjunct to domestic supply. It ensures that there are sufficient engineers to meet long term requirements.

However, present policies assess the qualification of migrants but do not take into account the professional formation necessary to be recognised as fully competent practising engineers. The permanent migration program also fails to account for future engineering requirements.

Australian institutions produce many graduates in civil, mechanical and electrical engineering, but are less successful in emerging areas of engineering such as mechatronics, robotics and nanotechnology. Most permanent migrant engineers have qualifications in the traditional disciplines so the chance to boost skills in emerging fields and those most affected by employment cycles is being missed.

As a consequence, too many talented engineers come to Australia but fail to add to the nation's capability: only 57 per cent of overseas born male engineers and 45 per cent of overseas born female engineers find engineering related employment. We believe the skilled migration system needs to be overhauled to focus on building Australia's engineering capability rather than just delivering a general skills uplift.

An innovative, technically based and productive economy depends on a highly educated, technically oriented work force. Australia's engineering capability is an indispensable element for Australia to achieve this ambition and should be valued by policy makers and the community for this reason.

It is unlikely that Australia will ever be in a position to do without skilled migration but developing our national innovative and technical capacity requires us to do more to develop our own engineers and make best use of the skilled migrants willing and able to move to our shores.

Australia must do more to produce engineers, especially if it is to meet national ambitions to become a more productive and innovative nation.

The Engineering Skills Pipeline

1.

Year 12 participation in foundation subjects

- Fewer students completing foundation subjects results in fewer students commencing university engineering courses



2.

Domestic students commencing entry level engineering courses

- 2013: **17,590** (peak)
- 2014: **17,364**
- 2015: **16,512**
- 2016: **Expected fall**



3.

Domestic students completing entry level engineering courses

- 2013: **7,675**
- 2014: **8,179**
- 2015: **8,443** (peak)
- 2016-20: **Expected fall**



4.

Skilled migrants added to the supply

- 2012-13: **21,878** (peak)
39.8% permanent,
60.2% temporary
- 2015-16: **20,240**
65.5% permanent,
34.5% temporary



5.

Engineering labour force (2016)

- **89%** of engineers are in the labour force
- **57.1%** work in engineering roles
- **42.9%** contribute to the economy in other occupations



6.

Professional formation

- Build on degree knowledge with on-the-job development of engineering practice
- Engineering registration and Chartered Status



7.

Lifelong career

- Adds value to services across the economy
- Drives competitiveness and innovation





3.

Australia's future depends on a considered energy policy

Engineers Australia recommends that governments put forward a more comprehensive strategy for emission reduction targets. This must include policies and programs leading with opportunities in energy efficiency, and including changes to the transportation system and the electricity generation sector.

STRATEGIES

- Focus on energy efficiency to meet emission reduction targets
- Focus on the transport sector
- Consider social objectives in electricity generation policy

3.1

Focus on energy efficiency to meet emission reduction targets

Future Australian energy policy will be constrained by the Paris COP21 agreement with Australia's commitment to an emissions reduction target of 26 to 28 per cent on 2005 levels by 2030. This target will be exceedingly difficult to achieve unless all aspects of energy use are targeted, and the nation looks to transition to a new energy paradigm.

Current government policy is insufficient as it focuses only on energy productivity, which relies too heavily on the current trends in industry restructuring. We need to set targets for energy efficiency as

well. This broader approach would be a major and cost effective step towards Australia achieving the emission reduction target and containing the cost of restructuring energy use in Australia towards lower or zero emissions.

Improvements in energy efficiency will:

- achieve the largest share of improvements in overall energy productivity, and quickly
- save on the cost of energy; in most cases this will provide financial returns to the investor and potential economic benefits for the country as a whole¹¹.

To see the full benefit that energy efficiency improvements can bring, the federal government needs to change policies to eliminate barriers to the adoption of new approaches. These barriers include:

- split incentives
- information failures
- lenders favouring existing approaches while assigning higher risks to new approaches
- early adopter disadvantages
- barriers to the commercialisation of new prototypes.

Engineers will play a critical role in the research, development, production and implementation of energy efficiency measures, providing reliable energy to Australian consumers, while at the same time helping to meet Australia's emission reduction targets.

11: ClimateWorks Australia. March 2015. Australia's Energy Productivity Potential. www.climateworksaustralia.org

3.2

Focus on the transport sector

The transport sector is one of the largest energy users and greenhouse gas emitters in Australia, but has yet to be targeted by formal energy efficiency policy. There are two important facets to transport energy use.

TRANSPORT ENERGY SECURITY

Australia has become increasingly dependent on imported fuels as our supply of crude oil suitable for domestic refineries cannot meet the demand for transport fuels. This exposure is compounded by our persistent failure to comply with the International Energy Agency requirement on emergency oil stocks.

ENERGY CONSERVATION

We need to reduce emissions by improving efficiency in the use of existing fuels, using more efficient vehicles, and adopting alternative fuels to change the transport modal mix. Just as consumers have moved ahead of policy makers in other areas of energy use, many Australian motorists have chosen more fuel-efficient cars leading to some improvements in these areas.

POLICIES NEEDED

Australia has no energy efficiency (nor emissions reduction) policies for transport, meanwhile approximately 80 per cent of the global light vehicle market, including the USA, the EU, China, Japan and India all have mandatory fuel efficiency or emissions standards for light vehicles.

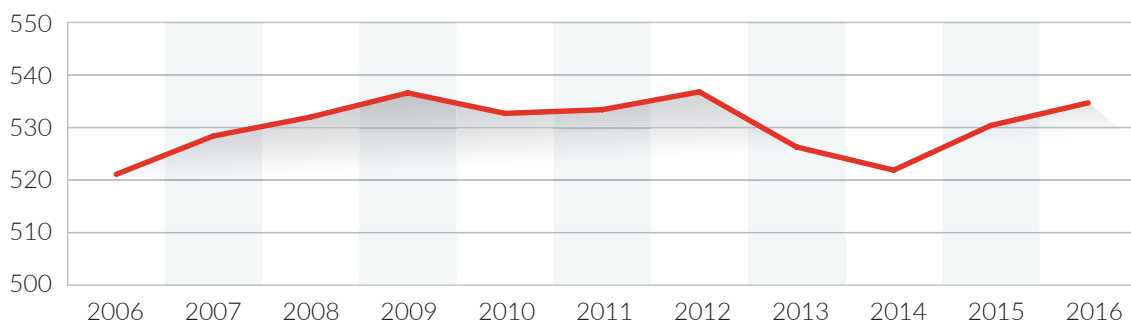
Australia has considered the implementation of new measures to address fuel efficiency, but has to date favoured a 'business as usual' approach. Engineers Australia believes this approach is inadequate to achieve meaningful change.

Motor vehicle technology is changing with more hybrid-fuelled and electric vehicles becoming available, and new hydrogen fuel cell vehicles emerging. Many countries actively encourage adoption of alternative fuel vehicles, but similar policies have not been considered in Australia. Conventionally fuelled vehicles have improved efficiency potential, but there are limits to progress and it is prudent for government policies to embrace a diversity of potential solutions.

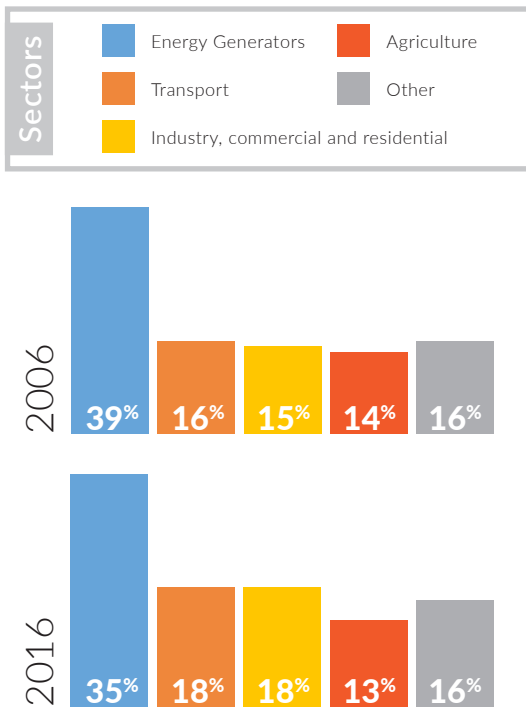
Australia will also need to make an overall transformational change in the transport sector, optimising effective freight, transport and energy strategies, and leveraging economies of scale. Broader changes to existing transport models are required – primarily a shift from road to rail for long haul freight, and from cars to public transport for urban transportation. These issues have been discussed in Australia for some time but there has been little action and overall progress has been slow.

Little change in Australian annual emissions

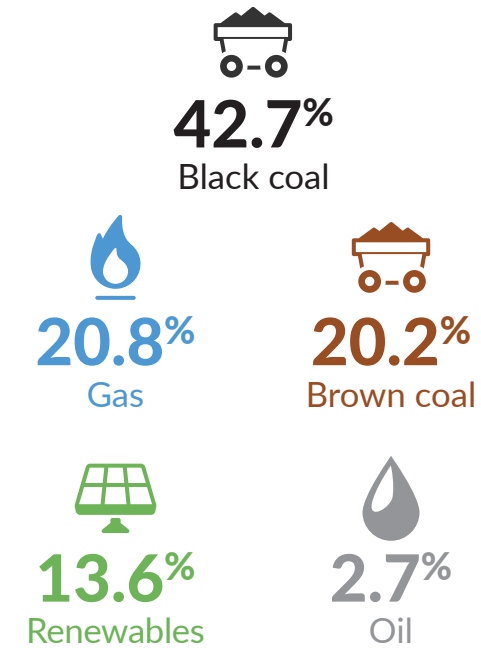
— Megatonnes of carbon dioxide equivalent



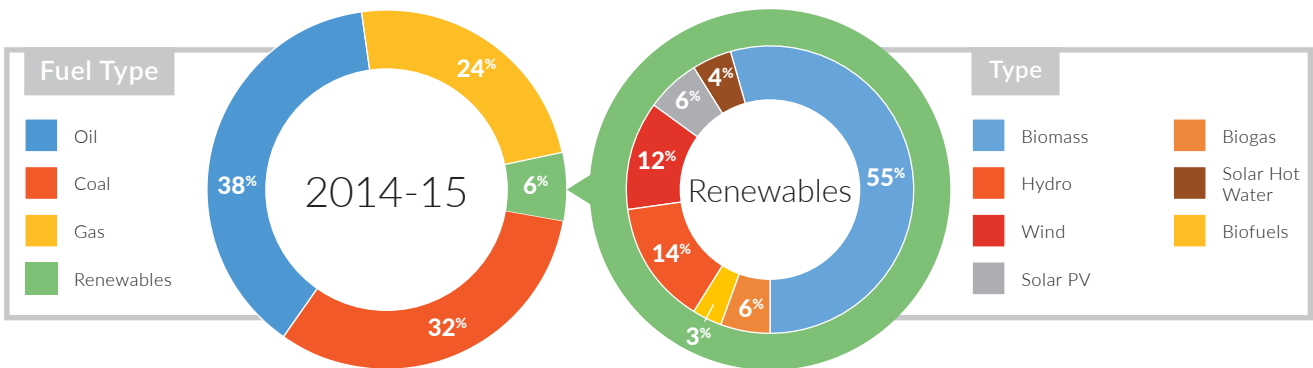
Electricity generation continues to be the predominant source of CO₂ emissions



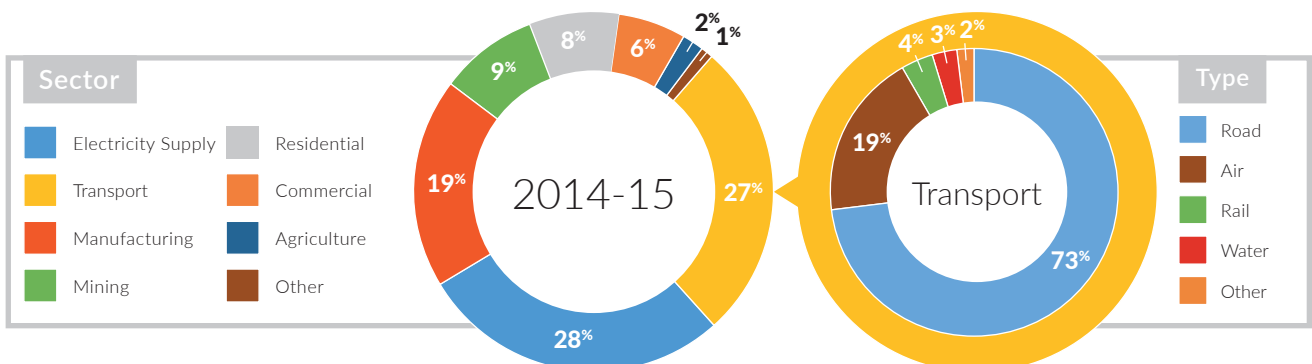
Coal is the dominant fuel type in Australian electricity generation



Renewable energy makes up a small portion of energy consumption



Transport is a key contributor to energy consumption



Source data: Australian Government Department of Environment and Energy, Industry Innovation and Science, Clean Energy Regulator

3.3

Consider social objectives in electricity generation policy

Access to reliable electricity supply is crucial for Australia's continued industrial and commercial prosperity, and to the standard of living enjoyed by Australians. At present, the dominant fuel for electricity generation is coal, supported by gas, but these fuels will come under increasing pressure from renewable energy options.

Australia is in a favoured position with a large variety of natural energy resources as options for electricity generation. Electricity generation policy should be determined by what Australia is aiming to achieve, and this should be underpinned by social objectives while also reducing emissions to comply with international commitments.

Many of Australia's largest capacity power stations are operating beyond their expected commercial lives¹², and are responsible for a large portion of Australia's greenhouse gas emissions. Engineers Australia believes we require an energy generation transition plan that considers all options using a combination of existing and emerging technologies, in a structural policy environment consistent with emissions reductions and matching the demand for electricity.

A secure energy future will be reliant on a diversity of energy options, connectivity between state borders so energy can be traded, and the development of smart-grids to help strengthen resilience. Baseload power that was supplied by fossil fuelled power stations needs to transition to a mix of energy options that, combined, are capable of providing the equivalent of the traditional baseload power, with the ability to supply power on demand.

Delaying a shift away from aging fossil fuel plants to low carbon options increases the likely risks and costs of a transition in the electricity sector, as it can take decades to plan, permit, finance and build new power infrastructure¹³. Engineers Australia believes it is time for a transition plan to be developed which looks at the best options for consumers, the economy and the environment.

Government policy intervention, clearly laid out through a national transition plan, has the ability to shape the future of Australian electricity generation and reduce uncertainty of current and future generators and send the right signals to potential investors.

12: Australian Government, Department of Industry and Science, 2015, Energy White Paper 2015, www.ewp.industry.gov.au

13: Stock, A, 2014, The Climate Council, Australia's Electricity Sector: Ageing, Inefficient and Unprepared, www.climatecouncil.org.au

4.

Australia's future depends on improved infrastructure

Engineers Australia recommends that governments prepare and publish long-term infrastructure plans for cities and regional areas based on rigorous analyses, international standards and cost benefit analyses. The plans need to consider adequate funding for the infrastructure development and/or encourage private sector investment.

STRATEGIES

- Maximise Australia's existing infrastructure assets
- Remove the politics
- Publish long term plans

4.1

Maximise Australia's existing infrastructure assets

The quality of Australia's infrastructure is a key indicator of the nation's economic, social and environmental health. Quality infrastructure enables productivity growth, which in turn improves living standards. The nation's prosperity depends on this relationship continuing.

Australia has a mix of old and new infrastructure assets, and these assets have a mix of old and new technology, which provides highly variable effectiveness. Additionally, much of Australia's infrastructure assets, like major city roads, have been overused as they have had no related price, and the public is more likely to use these infrastructure assets if they are free.

Engineers Australia believes that there needs to be a better way to improve existing assets. Infrastructure assets need to be managed sustainably over their full expected life cycles through regular maintenance programs, consistent with transparent and well publicised infrastructure service standards. Infrastructure services should be priced commercially so that replacements can occur when they are due. Where commercial prices cannot be charged, they should be used for planning purposes in a triple bottom line framework.

Most infrastructure use can also be improved through the sensible application of smart ICT management techniques such as intelligent infrastructure systems, improved freight and port logistics, broadband networks and wireless technologies, as well as large data base analytics. The benefits of such improvements can be substantial, and include better short-term infrastructure performance, cost savings and extended asset lives.

Modern effective infrastructure is an investment in Australia's future and should aim to provide sustainable and productive lives for all Australians. We need high quality infrastructure that draws on the latest digital technologies to manage our current infrastructure assets and develop new ones. We cannot solely rely on our current infrastructure assets to fuel productivity growth.

Engineers design, build, operate, maintain and use infrastructure. Engineers' specialised skills and involvement in almost every sector of the economy gives them a special insight to the capacity, adequacy and innovative potential of infrastructure. Engineers are committed to principles that drive change towards a sustainable world, and effective infrastructure is an important vehicle to achieve this.



4.2

Remove infrastructure planning from political cycles

Recent reviews of infrastructure in Australia have highlighted the fundamental deficiencies with infrastructure planning. The Productivity Commission's review into public infrastructure made critical recommendations that decisions be taken in the public interest, understood as the wellbeing of the community as a whole in a transparent environment devoid of short term politics and with a medium- to long-term perspective¹⁴.

Engineers Australia has long argued that infrastructure investment, planning, and project selection should be de-politicised in favour of politically neutral approaches favouring the overall community. While the government has proposed support to many recommendations made by Infrastructure Australia, politicians are still hesitant to let go of infrastructure announcements, which then become politicised and independent of objective analysis.

When political involvement extends to technical aspects of infrastructure planning it leads to sub-optimal outcomes and often higher costs than necessary. The political and technical responsibilities for infrastructure management and development need to be separated and clearly defined. Governments have a responsibility to provide the context and narrative to the community through comprehensive community consultation processes, and to oversee synergy between infrastructure and land use planning.

Technical decisions and recommendations on engineering matters such as planning, design, specification, final project selection, evaluation of tenders and monitoring of project progress against contractual requirements need to be undertaken by competent practicing engineers. Infrastructure planning should comprehend the full life cycle of infrastructure assets. We need to consider all financing options:

- debt financing at a time of record low interest rates
- various forms of private sector participation in the delivery, financing and operations of major projects
- utilisation of value capture, which is a method that identifies and collects an equitable portion of the value released through zoning and other public improvements so the communities that create this value share in the wealth that it generates¹⁵.

Governments consistently show reluctance to fully embrace some financing options. By treating infrastructure as a cost rather than an investment, they limit infrastructure development to perceptions of what we can afford rather than what we should be investing in our future.

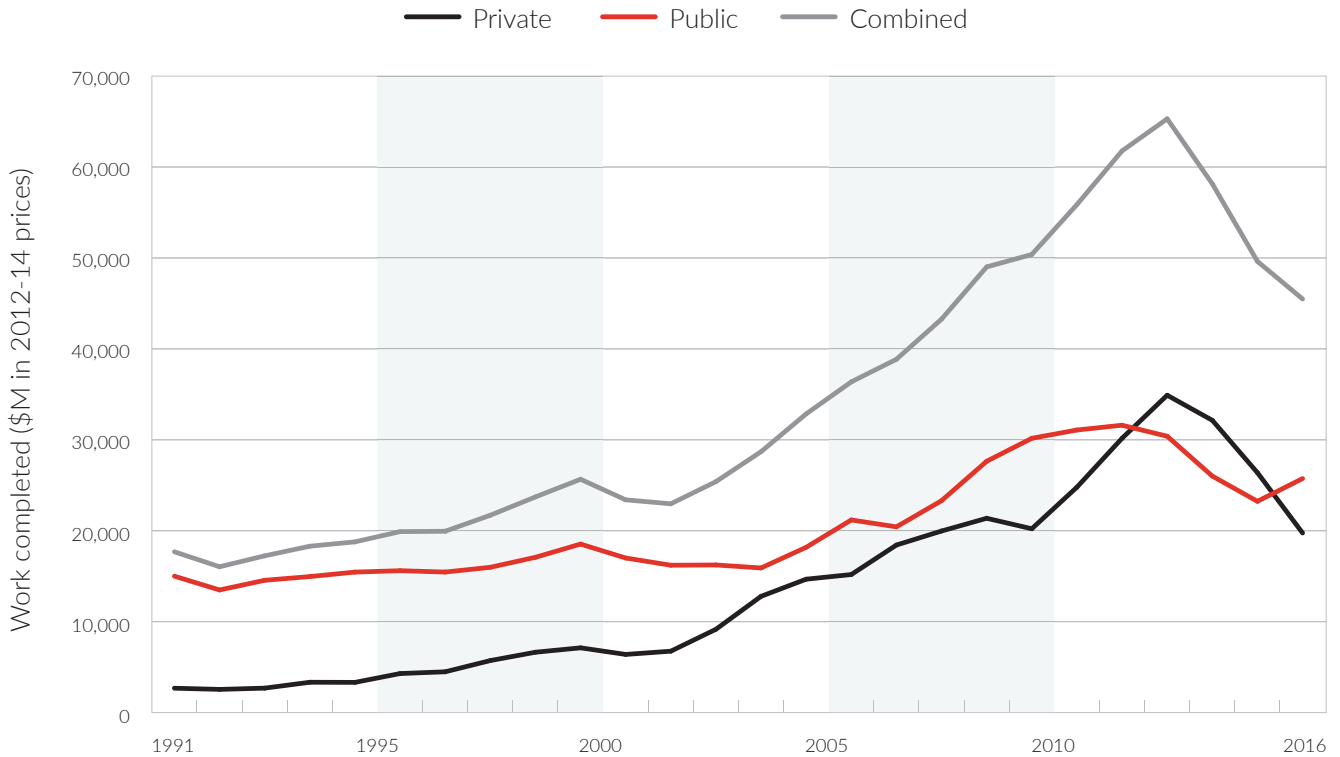
Engineers Australia believes that to be fit for purpose, infrastructure services must run ahead of economic and population growth. To deliver improved infrastructure, and to optimise our existing infrastructure assets, considerations of future infrastructure projects need to be put above political cycles.

The political and technical responsibilities for infrastructure management and development need to be separated and clearly defined.

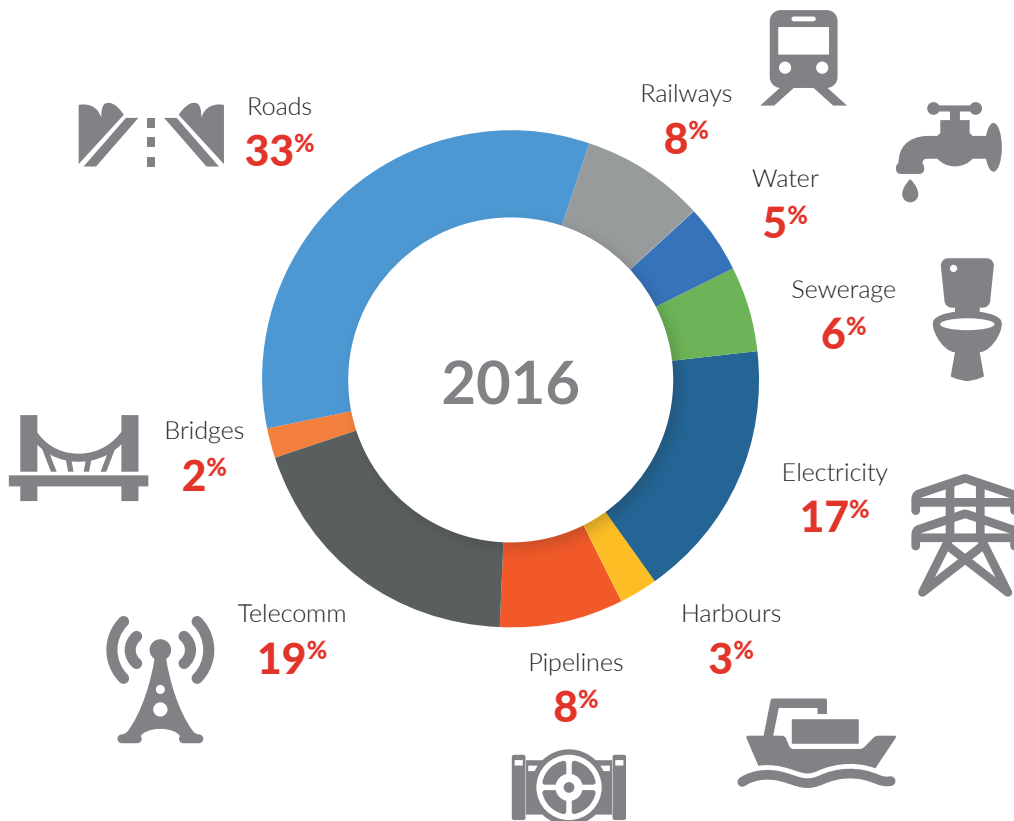
14: Australian Government 2014, Productivity Commission, Public Infrastructure, Productivity Commission Inquiry Report Volume 1, No 71.

15: Consult Australia, AECOM, June 2015, Value capture roadmap. www.consultaustralia.com.au

After a decade of strong growth engineering construction (economic infrastructure) has fallen in recent years



In 2016 roads made up the largest proportion of engineering construction on infrastructure assets



Source: Engineers Australia: Infrastructure in Australia, update June 2016

4.3

Publish long-term infrastructure plans

The successful delivery of new, fit-for-purpose infrastructure has the potential to support a more productive economy as well as a more equitable community¹⁶. A failure to deliver it would leave Australia at risk of missing out on wide-reaching economic and social opportunities.

Infrastructure delivery and procurement decisions should be based on rigorous analyses, international standards and contemporary management technologies. Post construction evaluations of all new infrastructure assets against design specifications should be undertaken to assist future planning and development.

A pipeline of key infrastructure projects is essential as it provides greater certainty for infrastructure contractors and investors. It also avoids project intermittency, which makes it difficult to retain skilled and competent workforces at all levels, from professional engineers to tradespeople. When infrastructure projects end, the workforce is dispersed across alternative employment options instead of building on their experience in new projects.

There needs to be efforts to keep infrastructure's technical workforce together to capitalise on skills and knowledge to make informed procurement decisions. During the last three decades there has been

wholesale outsourcing of public sector engineering workforces which has reduced public sector capacity to scope and design infrastructure projects, and weakened the ability to specify and evaluate the engineering components of tenders.

Subsequent efforts to reassemble work forces as new projects begin face additional recruitment costs and often experience shortages of staff with significant industry experience. Intermittency also reduces employer incentives to provide training beyond immediate requirements, including employment and development of graduate engineers.

Engineers Australia believes that reforms depend on the skills base available to procurement agencies, particularly in engineering. Competent, practising engineers should formally sign off procurement decisions on engineering matters. This will help to reduce overall project costs, reduce transaction costs imposed on tender bidders, enhance the adoption of innovative design-and-build features, and ensure value for money.

¹⁶: Infrastructure Australia, 2016, Australian Infrastructure Plan: Priorities and reforms for our nation's future. www.infrastructureaustralia.gov.au

5.

Australia's future depends on a strong defence industry policy

Engineers Australia recommends that governments at all levels should commit to supporting and developing the engineering skills needed to build and sustain defence assets in Australia. Governments should develop a comprehensive industry policy supported by innovate procurement methods to drive economic growth and boost productivity.

STRATEGIES

- Maximise Australian defence capability
- Develop industry policy

5.1

Maximise Australian defence capability

The technical capability of our defence organisations must not fall at a time when the complexity of systems continues to grow and the next generation of military assets is being produced. High defence engineering capabilities and workforce skills are more important than ever.

Defence capability is entirely subsumed within the profession of engineering in the broadest sense and engineers play an important role in all defence inputs, from academia and industry to government resources, both uniformed and civilian. Engineering plays an essential role in the management of defence assets from perceived need through to requirements analysis, research, development, test, evaluation design, construction, integration, acceptance, operation sustainment and disposal.

Through programs such as the future submarines, Joint Strike Fighter and Hawkei, it is critical that state and federal governments support and develop the skills needed to build and sustain these assets. Engineers Australia supports decisions that back local industry options. It is the capability of the people working on the design, development and delivery of our defence systems that create and shape the acquisition, maintenance and operation of our national defence capability.

To be able to make informed decisions, and to be a technically competent owner of engineering intense equipment, specialised workforce skills and expertise need to be engaged throughout the entire asset life-cycle. The development of high-tech skills is an essential public good that benefits the broader economy.

We have an extremely capable engineering workforce, but if industry is to support major platforms it is critical that it is closely involved in the engineering-intensive design and build phase. This will enable development of the skills and experience required to maintain, operate and upgrade those platforms throughout their lives and provide opportunities for local enterprises to innovate and be part of the supply chain.

The technical capability of our defence organisations must not fall at a time when the complexity of systems continues to grow and the next generation of military assets is being produced.



5.2

Defence procurement can drive economic growth

The 2016 Defence Industry Policy needs to be supported by a more comprehensive Australian industry policy, which includes a large focus on manufacturing. Engineers Australia believes that current defence and innovation policies fail to recognise the critical role of manufacturing in driving innovation.

Many basic manufacturing industries have become uncompetitive, but there is the potential to reinvigorate or replace them. Manufacturing can have higher multiplier effects on economic growth than other sectors and it can boost innovation and nationwide productivity across multiple sectors, and is the source of many skilled and well-paid jobs¹⁷.

Engineers Australia believes that governments can take the lead through a comprehensive industry policy. The link between defence procurement and economic benefits has been long

established, and it brings greater access to new technology and global supply chains.

Government exerts minimal influence on broader industry policy, with much left to market forces. However, governments can create conditions where expertise and build phase operations of new capital assets are sourced locally, creating local industrial commons, while also leveraging economies of scale. Governments have made the big decisions on a number of Australia's future defence assets and it is now time to start implementing these projects.

The government has a fundamental responsibility to develop the economy for the benefit of everyone, and this is best done with an innovative and productive manufacturing base. Australia needs a coherent industry-wide policy that begins with a defence industry focus to push the economy forward.

6.

A call to action

Engineers Australia believes implementing the key recommendations in this report is essential if Australia is to grow as a prosperous nation and maintain a high standard of living.

We call on the Australian government to lead the way with an aggressive policy framework to lift medium to long-term growth, and drive productivity. Policy action needs to begin now.

Australia's future depends on economic growth policies that support:

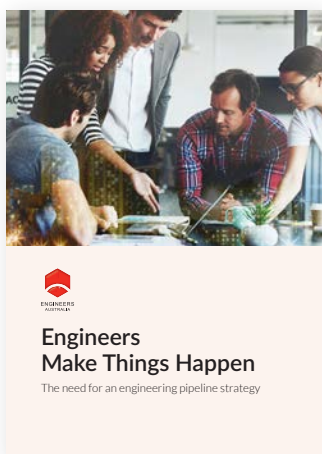
- a skilled workforce
- a considered energy policy
- improved infrastructure
- a strong defence industry policy.

Without an aggressive policy framework, businesses will continue to be reluctant to invest, and our state and territory governments will lack direction.

Engineers Australia calls for proactive action by governments on these important policy issues. It is recognised that governments cannot make positive changes in isolation, and Engineers Australia, with support of its members, has a responsibility to ensure that decision-makers are properly informed and have the benefit of the profession's insight.

We need to work together for a better future.

Other recent publications from Engineers Australia available online



ENGINEERS MAKE THINGS HAPPEN (2017)

Australia's ambition to become an innovative, technically progressive and globally competitive nation is critically linked to increasing the scientific, mathematical and technical competence of our future workforce.



THE FUTURE OF AUSTRALIAN ELECTRICITY GENERATION (2017)

A transition plan is the essential component to energy policy if Australia is to enjoy plentiful, affordable, reliable energy supply that complies with international emission commitments.



THE ENGINEERING PROFESSION: A STATISTICAL OVERVIEW, THIRTEENTH EDITION (2017)

A collection of statistics about engineers to build an evidence base for public policy about engineers and engineering.



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