energy efficiency
COUNCIL

The World's First Fuel

How energy efficiency is reshaping global energy systems

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Acknowledgements

Over the past three years I have met with energy experts from North America, Europe and Asia to talk about their countries' energy management policies. This report is my attempt to distil these conversations about global best practice in energy efficiency to support Australia's energy debate.

To ensure the accuracy of this report, I verified as much information as possible from written sources. This has resulted in greater coverage of policies in English-speaking countries; as a result, there is significant potential to build on this report with information from a broader range of countries.

This work wouldn't have been possible without the many experts that generously shared their time with me. There were too many people involved in the development of this project to list them all, but I would like to especially thank the following individuals for going above and beyond:

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Rob Murray-Leach

Head of Policy
Energy Efficiency Council

About the Energy Efficiency Council

The Energy Efficiency Council is Australia's peak body for energy efficiency, energy management and demand response. The EEC is a not-for-profit membership association, which exists to make sensible, cost effective energy management standard practice across the Australian economy.

We work on behalf of our members to promote stable government policy, provide clear information to energy users and drive the quality of energy management products and services. Our members include governments, experts and businesses that provide smart energy products and services.

Energy Efficiency Council Sponsor Members

The Energy Efficiency Council would not be able to deliver reports like this without the support of its members. In particular we'd like to thank our Sponsor members:

Contents

Key terms

Demand management and **energy management** mean any form of managing energy use, including energy efficiency and demand response.

Demand response means changing when we use energy use in response to conditions in the grid. For example, a home could shift its energy use (e.g. water heating) from periods when energy supply is limited to times when energy supply is plentiful. Demand response doesn't necessarily reduce the total amount of energy that we use, but it can dramatically reduce the cost of energy infrastructure, such as poles, wires and storage.

Energy conservation means using less of an energy service (e.g. heating). Energy conservation can be valuable in an emergency (see section 2.4), but if it is encouraged in the wrong situations it can result in a loss of comfort and productivity. Energy conservation is very different to energy efficiency.

Energy efficiency means getting more output or service from each unit of energy. For example, a modern LED light bulb can deliver the same light as an incandescent light bulb while using 90 per cent less electricity.

Energy intensity is a measure of how much energy is used to generate gross domestic product (GDP).

Energy productivity is a measure of how much value we're getting from each unit of energy – it's a useful metric for energy efficiency. At a national level it's generally measured in GDP per unit of energy consumption.

Final energy consumption is the total energy consumed by end users, such as households and manufacturing, and excludes the energy used by the energy sector (e.g. energy lost in the burning of coal).

Primary energy consumption refers to total energy consumed, including the energy lost when a fuel is converted to electricity (e.g. the total energy in coal).

Acronyms

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
ASBEC	Australian Sustainable Built Environment Council
CAFE	Corporate Average Fuel Economy
CBD	Commercial Building Disclosure (Australia)
CCA	Climate Change Agreement (United Kingdom)
CCL	Climate Change Levy (United Kingdom)
CFL	Compact fluorescent lamp
COAG	Council of Australian Governments
ECCJ	Energy Conservation Centre, Japan
EEC	Energy Efficiency Council (Australia)
EEO	Energy Efficiency Opportunities (Australia)
EES	Energy efficiency scheme
EESL	Energy Efficiency Services Ltd (India)
EPC	Energy Performance Certificates (United Kingdom)
ERCOT	Electricity Reliability Council of Texas (United States)
ERS	Emergency Response Service (United States)
ESB	Energy Security Board (Australia)
FCAS	Frequency Control Ancillary Services
GDP	Gross domestic product
GEMS	Greenhouse and Energy Minimum Standards (Australia)
IEA	International Energy Agency
LED	Light-emitting diode
Mtce	Million tons of coal equivalent
Mtoe	Million tonnes of oil equivalent
NABERS	National Australian Built Environment Rating System
NAPE	National Action Plan on Energy Efficiency (Germany)
NCC	National Construction Code (Australia)
NECP	National Energy and Climate Plans (European Union)
NEM	National Electricity Market (Australia)
NTRI	National Top Runner Initiative (Germany)
PAT	Perform, Achieve, Trade (India)
PJM	Pennsylvania New Jersey Maryland energy market (United States)
WECC	Wisconsin Energy Conservation Corporation (United States)
ZEV	Zero-Emission Vehicle

1 Executive summary

Major global economies, including China, Germany, India, Japan and the United States, are making huge strides to improve their energy efficiency and adjust when they use energy – collectively called 'energy management'. Global private and public investment in energy efficiency was AU$346 billion in 2018.[1] These efforts are delivering huge dividends, with energy efficiency:

- **Reducing energy bills**: energy efficiency reduces German families' energy bills by 30 per cent, saving the average household AU$790 each year.[2]
- **Ensuring energy security:** after the 2011 Fukushima tsunami, energy management in Japan reduced peak demand by 19 per cent. By 2016 energy management had replaced 39 per cent of the output of 49 nuclear generators that had been closed after the disaster.[3]
- **Reducing emissions**: energy management has delivered by far the largest reductions in global greenhouse gas emissions this century.[4]
- **Creating economic growth and jobs**: energy efficiency improvements increased global GDP by an estimated AU$2.8 trillion in 2017.[5] In California alone there are an estimated 310,433 jobs in energy efficiency.[6]

Global leaders in energy management share a key feature – they treat energy management as a core strategy for meeting the energy needs of homes and businesses. They recognise that energy management provides real capacity to energy markets, because every unit of energy that isn't used is energy that doesn't need to be generated.

This is not a marginal issue – energy efficiency improvements since 2000 reduced China's annual energy demand in 2017 by near to 10 per cent. In other words, in 2017 China saved more than twice as much energy as Australia used that year.[7]

In fact, improvements in energy efficiency between 1974 and 2010 delivered more capacity to 11 major economies than any other fuel, including coal, oil and electricity. As a result, the International Energy Agency (IEA) has described energy efficiency as the 'first fuel'. What's more, energy efficiency can deliver capacity at a much lower cost than energy supply.[8]

Energy management is going to become more, not less, important as the proportion of generation coming from renewable energy rises. Reducing our demand for energy and better aligning when we generate and use energy will dramatically reduce the cost of generation, storage and network infrastructure.

This is why our global competitors are aggressively pursuing energy efficiency – they have recognised that it is just as important as energy supply in their energy markets.

> *We affirm that improving energy efficiency is key to decarbonisation of our economies, enhancing energy security and fostering economic growth and should be regarded as the 'first fuel'.*
>
> STATEMENT OF THE G7 ENERGY MINISTERS, 2 MAY 2016.[9]

In contrast, Australia has barely begun to tap the potential of energy efficiency. We have made some efforts on energy efficiency, and these are delivering real benefits to Australian homes and businesses.

1 International Energy Agency 2019, *World Energy Investment 2019*, IEA, Paris.

2 International Energy Agency 2017, *Energy Efficiency Market Report 2017*, IEA, Paris.

3 Ibid.

4 Edenhofer, O., Pichs-Madruga, R., Sokona et al. 2014, *Mitigation of Climate Change. Working Group III Contribution to the IPCC Fifth Assessment Report*, International Panel on Climate Change, Geneva.

5 International Energy Agency 2018, *Energy Efficiency Market Report 2018*, IEA, Paris.

6 E2 2018, *Clean Jobs California*, E2, Washington DC, available online from: https://www.e2.org/wp-content/uploads/2018/09/E2-Clean-Jobs-California-2018.pdf.

7 International Energy Agency 2018, *Energy Efficiency 2018*, IEA, Paris, p.145. Figures for China and Australia are in total final consumption.

8 International Energy Agency 2017, *Market-based Instruments for Energy Efficiency – Policy Choice and Design*, IEA, Paris.

9 G7/G8 2016, G7 *Kitakyushu Energy Ministerial Meeting, Kitakyushu Initiative on Energy Security for Global Growth, Joint Statement*, Ministry of Economy, Trade and Industry of Japan, Tokyo. The statement was made by the Energy Ministers of Canada, France, Germany, Italy, Japan, the United Kingdom, the United States, and the European Commissioner for Climate Action and Energy.

However, an analysis of the world's 25 largest energy consuming countries ranked Australia as the worst developed country for energy efficiency policy and performance[10] (see section 2). As a result, our energy bills and greenhouse gas emissions are far higher than they need to be.

The good news is that by acting decisively we can dramatically reduce Australians' energy bills, boost energy security, and reduce our greenhouse gas emissions. If we adopt well-established energy management policies, practices and technologies from overseas we can save Australian families and businesses over $7.7 billion each year through lower energy bills and create over 120,000 job-years of employment.[11] Energy management could deliver half of the abatement required to meet Australia's target to reduce emissions by 26-28 per cent by 2030.[12]

This report examines key energy management policies in other countries. It is not intended as an exhaustive review of international practice. Instead it highlights a number of policies and programs that Australia should adopt to ensure that our energy system is affordable, reliable and sustainable. It recommends that Australian governments take actions that include:

- Reforming institutions and introducing policies to ensure that we meet our national target to improve energy productivity by 40 per cent by 2030. While this target should be raised, we are already falling behind our current target.
- Adopting the principle 'energy efficiency first' to ensure that our energy strategies, policies and markets deliver the right mix of energy supply and energy management.
- Ensure that there is either a national energy efficiency scheme (EES) or an EES operating in every state and territory.
- Help manufacturers identify and invest in opportunities to manage energy.
- Introduce strong minimum standards for appliances, buildings and vehicles.

The recommendations from this report are summarised in the following tables. They are only a subset of the Energy Efficiency Council's full suite of policy recommendations, which are laid out in the latest edition of the *Australian Energy Efficiency Policy Handbook*.

10 Castro-Alvarez, F., Vaidyanathan, S., Bastian, H. & King, J. 2018, *The 2018 International Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy, Washington DC.

11 Green Energy Markets 2018, *Energy Efficiency Employment in Australia,* Green Energy Markets, Melbourne.

12 ClimateWorks Australia and WWF 2015, *A prosperous, net-zero pollution Australia starts today*, Melbourne.

Cross-cutting recommendations

Strategic

Australian governments and institutions should:

1. **Make the dramatic improvement of energy management a national and jurisdictional priority.**
2. **Place energy management at the centre of their strategies for energy, emissions reduction and economic growth.**

Ambition

The Australian Government should:

3. **Raise the ambition of its 2030 energy productivity target and complement it with sub-targets for specific sectors, such as buildings.**
4. **Consider setting a target for primary energy consumption in 2030, noting that this will require some flexibility.**

Australian states and territories should:

5. **Complement national targets with their own targets.**

Most critically, Australian governments and institutions should:

6. **Put mechanisms in place, including allocating funding and improving governance, to ensure that new or existing targets are met.**

Energy markets

COAG Energy Council and all Australian governments and institutions should:

7. **Adopt the energy efficiency first principle and undertake a review to determine what actions are required to implement the principle.**
8. **Develop a number of markets for energy services, including:**
   - **A wholesale demand response mechanism; and**
   - **Markets for emergency capacity.**
9. **Commission a review to determine whether to establish regional competitive markets for network capacity.**

Efficiency schemes

The governments of Queensland, Western Australia, Tasmania and the Northern Territory should:

10. **Introduce energy efficiency schemes (EES) with ambitious targets.**

Australian states and territories should:

11. **Consider harmonising some or all of the administration of their EES.**
12. **Explicitly aim to use EES to transform markets for particular energy efficient products and services.**

Appliance standards

COAG Energy Council and all Australian governments and institutions should:

13. **Formalise and streamline the process for introducing new appliance standards and raising standards over time.**
14. **Harmonise Australian appliance standards with our major trading partners, both in their ambition and details.**
15. **Complement appliance standards with processes that help prepare supply-chains to manufacture, distribute and adopt more efficient products.**

The Australian Government should:

16. **Investigate a global approach to setting appliance standards.**

Sector recommendations

Manufacturing

All Australian governments and institutions should:

17. **Re-establish long-term capacity building mechanisms for industrial energy management, which include:**
    - **Helping companies to implement energy management systems;**
    - **End-to-end support programs;**
    - **Funding for the training and accreditation of energy managers; and**
    - **Mechanisms to ensure senior managers focus on energy management.**
18. **Establish a substantial but short-term grants program to help large energy users reduce their exposure to gas prices.**

Buildings

All Australian governments and institutions should:

19. **Commit to a major update to residential building standards in 2022.**
20. **Set a national pathway for tightening the National Construction Code over time, tightening residential and commercial building standards in 2025 and 2028 to achieve net zero emissions by 2030.**

COAG Energy Council and all Australian governments and institutions should:

21. **Introduce a national program to rate the energy efficiency of residential properties at sale or lease. Set a clear timeframe for introducing the scheme, becoming mandatory no later than 2022.**

Australian states and territories should:

22. **Introduce minimum standards for private rental accommodation, focusing on bringing homes up to minimum health, safety and affordability standards.**

All Australian governments and institutions should:

23. **Consider whether grants may be appropriate to help the landlords of low-income properties meet minimum rental standards.**
24. **Consider a minimum standard for rented commercial properties that is phased in over several years.**

Transport

All Australian governments and institutions should:

25. **Introduce strong fuel-efficiency standards for vehicles.**
26. **Collectively develop a national strategy for electric vehicles, with a particular focus on the impact of electric vehicles on the electricity grid.**

2 The world's first fuel

The way that we use energy is just as critical as the way that we generate it. Smarter energy use means:

Lower energy bills

Energy efficiency improvements have reduced households' energy bills in most countries by 10 to 30 per cent. In Germany, energy efficiency saves the average household AU$790 each year off the energy bills for their home and car.[13]

Reduced greenhouse gas emissions

Energy efficiency has been the most significant source of emission reductions this century.[14] In 2014 to 2016, improvements in energy efficiency were responsible for 75 per cent of the stabilisation of emissions from the global energy system.[15]

Improved health and productivity

More efficient buildings are healthier and more productive.[16] Retrofitting building stock in Europe has been estimated to deliver up to AU$138 billion every year in health benefits from improved indoor air quality.[17]

Jobs and economic growth

Energy efficiency improvements increased global GDP by an estimated AU$2.8 trillion in 2017.[18] Energy management itself is a huge economic opportunity, with AU$346 billion of global investment in 2018.[19] Raising the European Union's ambition on energy efficiency has been estimated to increase GDP growth by 4.1 per cent and generate an additional 4.9 million jobs.[20]

Energy efficiency policies have already delivered huge benefits to Australians. Minimum standards for appliances alone save the average Australian household $140 to $220 each year.[21] However, by global standards, Australian governments and institutions have made relatively little effort to improve our energy efficiency, which means that our energy bills and greenhouse gas emissions are far higher than they need to be.

An analysis of the world's 25 largest energy consuming countries ranked Australia as the worst developed country for energy efficiency policy and performance, with particularly poor performance in industry and transportation (Figure 2.1).[22] Separate analysis by the International Energy Agency (IEA) found that, in the period 2000 to 2016, Australia had the fifth-worst improvement in energy efficiency out of 28 countries (Figure 2.2).

Our interviews found that global leaders were taking far more action on energy efficiency than Australia because they see energy efficiency quite differently. Global leaders don't see energy efficiency as an afterthought in their energy system, but as an integral part of the way that they deliver energy to homes and businesses. Global leaders see energy efficiency as a source of cheap, reliable and clean energy capacity. The best way to explain this concept is through an example – California.

13 International Energy Agency 2017, *Energy Efficiency Market Report 2017*, IEA, Paris

14 Edenhofer, O., Pichs-Madruga, R., Sokona et al. 2014, *Mitigation of Climate Change. Working Group III Contribution to the IPCC Fifth Assessment Report*, International Panel on Climate Change, Geneva.

15 International Energy Agency 2017, *Energy Efficiency Market Report,* IEA, Paris

16 International Energy Agency 2014, *Capturing the Multiple Benefits of Energy Efficiency*, IEA, Paris.

17 Copenhagen Economics 2012, *Multiple Benefits of Investing in Energy-efficient Renovation of Buildings – Impact on Finances,* Copenhagen Economics, Copenhagen.

18 International Energy Agency 2018, *Energy Efficiency Market Report 2018*, IEA, Paris

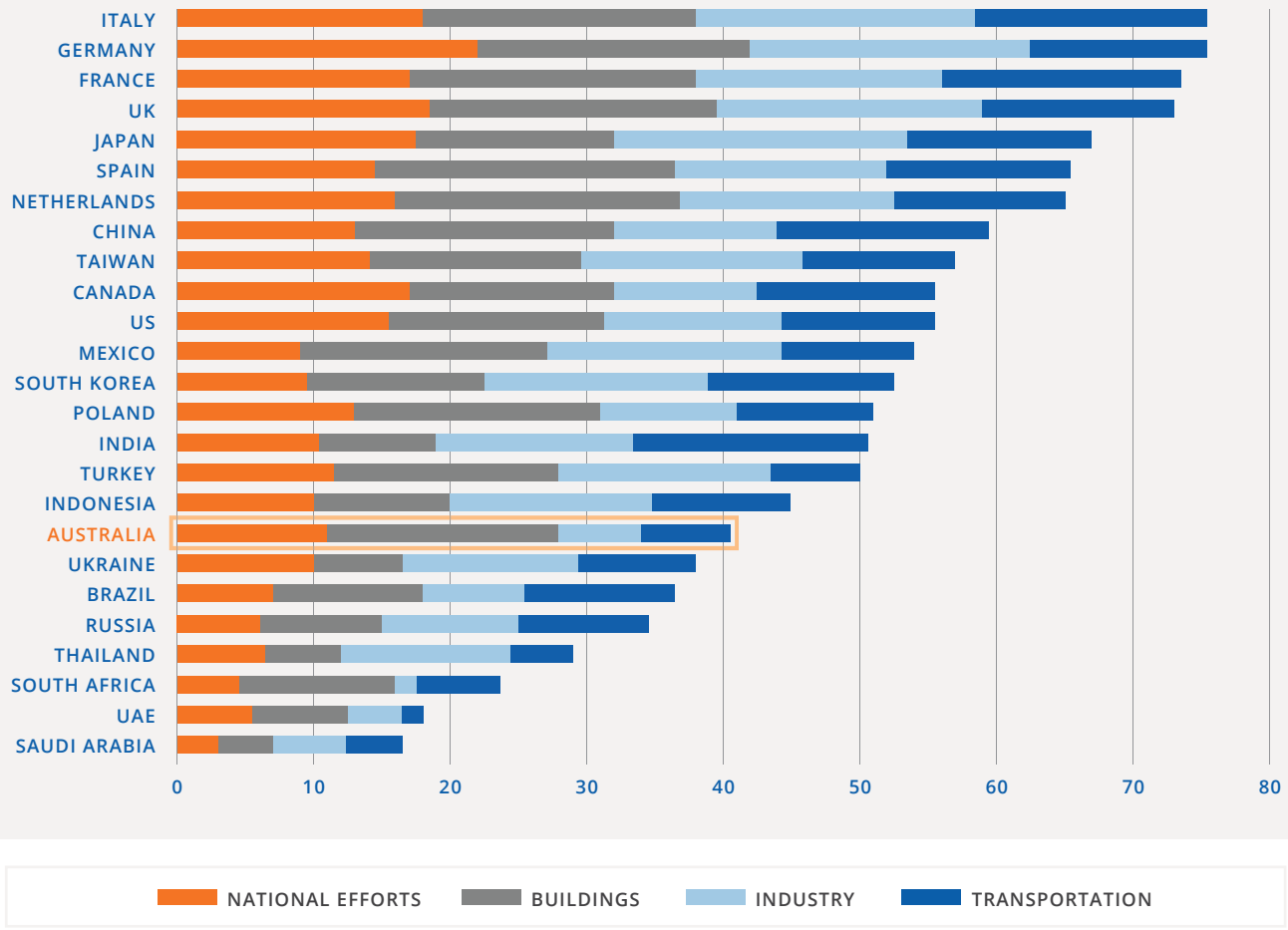
19 International Energy Agency 2019, *World Energy Investment 2019*, IEA, Paris.

20 European Commission 2017, *The macro level and sectoral impacts of Energy Efficiency policies*, European Union, Brussels.

21 Department of Energy and Environment 2018, *The Independent Review of the GEMS Act 2012 Draft Report*, Commonwealth of Australia, Canberra.

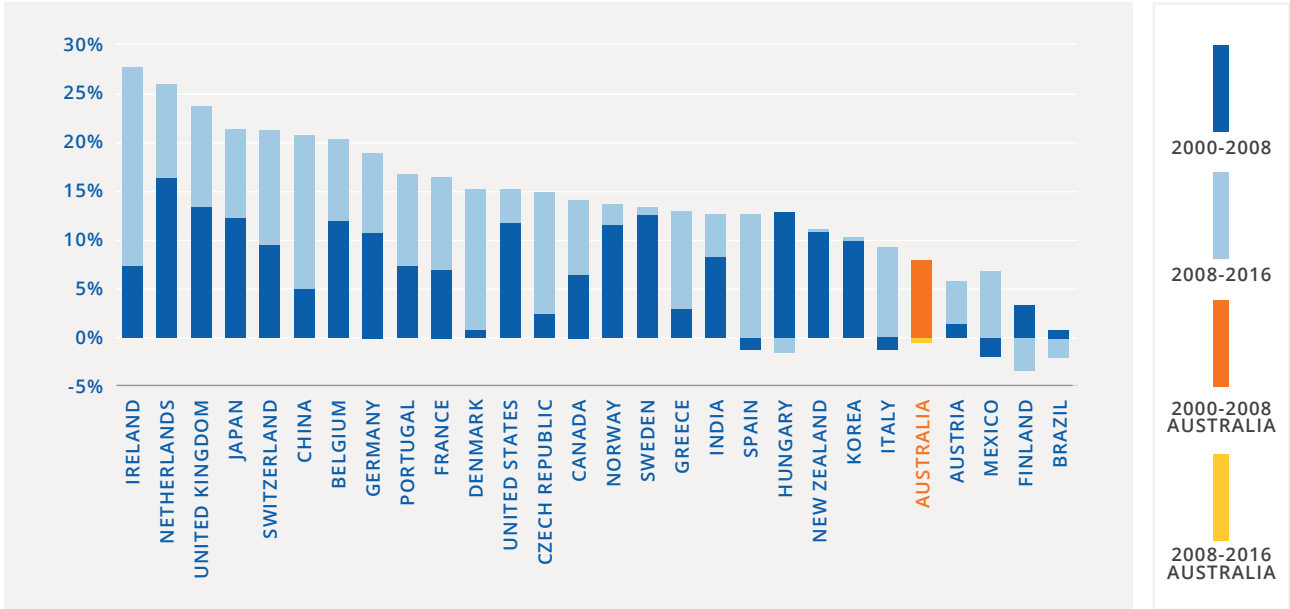
22 Castro-Alvarez, F., Vaidyanathan, S., Bastian, H. & King, J. 2018, *The 2018 International Energy Efficiency Scorecard,* American Council for an Energy Efficient Economy, Washington DC.

Figure 2.1 Energy efficiency policy and practice ratings for the world's largest energy users



Source: Castro-Alvarez, F., Vaidyanathan, S., Bastian, H. and King, J. 2018, *The 2018 International Energy Efficiency Scorecard*, American Council for an Energy Efficient Economy, Washington DC.

Figure 2.2 Percentage improvement in the efficiency effect of various countries, 2000-16



Source: International Energy Agency 2017, *Energy Efficiency Market Report,* IEA, Paris.

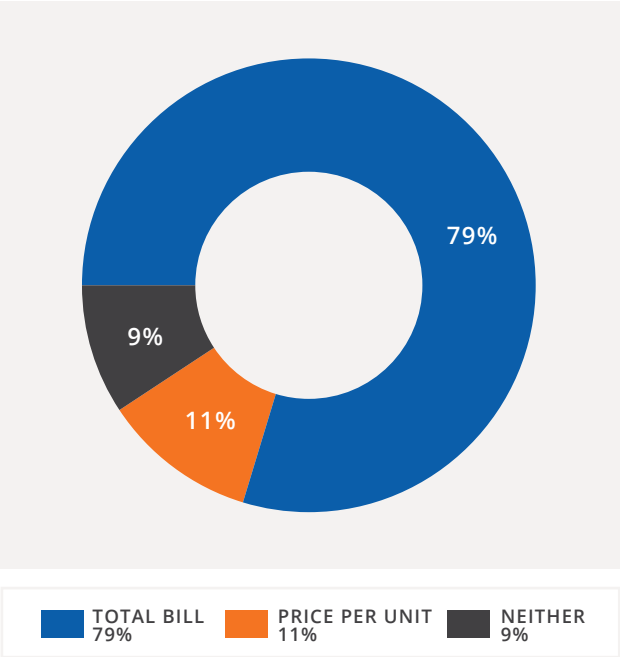
2.1 California dreaming

In the 1970s California experienced two energy crises. Along with the well-known oil crisis, California was also threatened by an electricity crisis. Demand for electricity was growing rapidly. While several nuclear generators had been built or were under construction, long lead times and delays caused by community concerns meant that energy demand was rising far faster than generation could be built.

In 1975, the newly elected Californian Governor, Jerry Brown, had a chance meeting with a renowned physicist, Dr Art Rosenfeld. Dr Rosenfeld explained that California could create as much capacity as two nuclear generators just by improving the energy efficiency of new fridges. As a result, California rapidly introduced minimum energy efficiency standards for refrigerators and freezers, and then other appliances and buildings.

Once California learned that energy efficiency was the cheapest and cleanest way to meet its energy needs, it never turned back. California integrated energy management into its energy markets and continues to ramp up its efforts on energy efficiency. As a result, California's per capita demand for energy stayed flat while the economy boomed. Californians' relatively good energy efficiency means that, despite paying quite high costs per unit of energy, Californians' energy bills are significantly lower than average for the United States.

Figure 2.3 Australians response to the questions "Do you care more about your total energy bill or the cost per unit of energy?"



Source: Australian Council of Social Services, Energy Efficiency Council and Property Council of Australia 2018, *Energy Bills and Energy Efficiency - Survey of Community Views,* Energy Efficiency Council, Melbourne.

This highlights a critical point. Consumers care far more about their total energy bill than the cost per unit of energy (Figure 2.3). Energy bills are affected by the price of a unit of energy, but are also strongly affected by fixed charges and the amount of energy that people use. In Australia, an efficient household can easily save 30 per cent on its energy bill compared to an average household. What's more, efficient households and businesses can lower everyone's energy bills by providing reliable capacity to the energy system at far lower cost than generation.

Australian policy makers have focused almost exclusively on the cost per unit of energy and, as a result, they have paid far too little attention to energy management. This has contributed to Australia's skyrocketing energy bills. California learnt this lesson 40 years ago – it's time we caught up.

2.2 How does energy management provide capacity?

To understand how energy management can provide capacity it's useful to go back to basics. Homes and businesses don't directly consume electricity, gas and oil; they convert them into energy services, such as warm showers, cool homes, transport and computing. The cheapest way to deliver the services that households and businesses need is a balanced mix of investment in:

- **Supply-side** measures, such as generation, storage and networks; and
- **Demand-side** measures, such as energy efficiency and demand response.

For example, the cheapest way to keep an off-grid home cool in summer is investment in both supply (e.g. a generator and batteries) and demand-side measures (e.g. insulation and an efficient air conditioner). If a homeowner buys a cheap, very inefficient air-conditioner they will need to spend much more on generation and batteries. Likewise, if they buy a generator that is too small, they will need to spend much more on a very advanced cooling system. This illustrates that the best way to meet the demand for a cool home is a balance of supply- and demand-side measures.

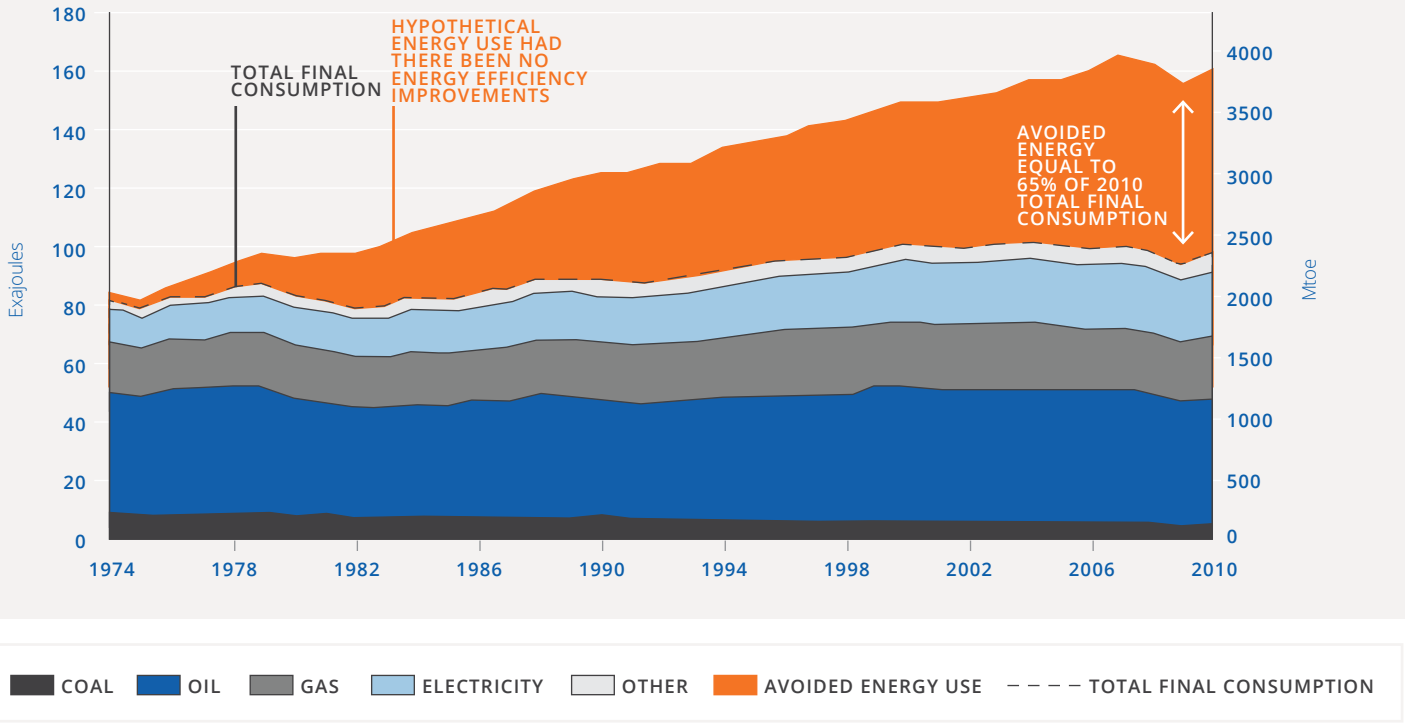
At a grid level, supply- and demand-side measures can both provide capacity. For example, minimum standards for fridges and freezers provide 'baseload' capacity by reducing Australia's electricity demand by over 360 MW, 24 hours a day, 365 days a year.[23] This capacity is virtually 100 per cent reliable and displaces the need for a small coal-fired generator. Energy management can also provide rapidly dispatchable 'peaking' capacity. Australian industry could provide at least 3.1 gigawatts of demand response, more than twice the maximum output of the former Hazelwood generator.[24]

In many other countries, energy management is a formal part of their energy markets, providing more than ten per cent of their capacity. However, energy management provides far more capacity than this – we just don't notice it. Improvements in the energy efficiency in millions of appliances, buildings, businesses and vehicles are often hidden. However, these energy efficiency improvements add up and collectively eliminate the need for huge amounts of energy supply.

In fact, energy management is the largest form of capacity in the global energy market. The IEA estimates that, between 1974 and 2010, energy efficiency improvements in Australia and ten other countries provided more capacity than any other fuel source, including electricity, coal and oil.[25] Accordingly, the IEA now calls energy efficiency the world's 'first fuel'.

More recently, between 2000 and 2017, energy efficiency improvements in the world's major economies reduced final energy consumption by 37 exajoules of energy – enough to meet both Japan's and India's energy needs.[26] Remarkably, these results have been delivered in a context where most countries have made relatively piecemeal efforts to improve their energy efficiency. Countries that have made more concerted effort, such as China, Japan and Germany, have made even greater gains.

Figure 2.4 Total avoided energy use from energy efficiency in 11 countries



Source: International Energy Agency 2013, *Energy Efficiency Market Report 2013*, IEA, Paris.

TFC stands for 'total final consumption'. "Other" includes biofuels plus heat from geothermal, solar, co-generation and district heating.

23 Department of Energy and Environment 2018, *The Independent Review of the GEMS Act 2012 Draft Report*, Commonwealth of Australia, Canberra.

24 ClimateWorks Australia 2014, *Industrial Demand Side Response Potential*, ClimateWorks Australia, Melbourne.

25 The IEA analysed energy use in 11 countries that had sufficient quality and quantity of data. The countries were Australia, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States.

26 International Energy Agency 2018, *Energy Efficiency 2018*, IEA, Paris.

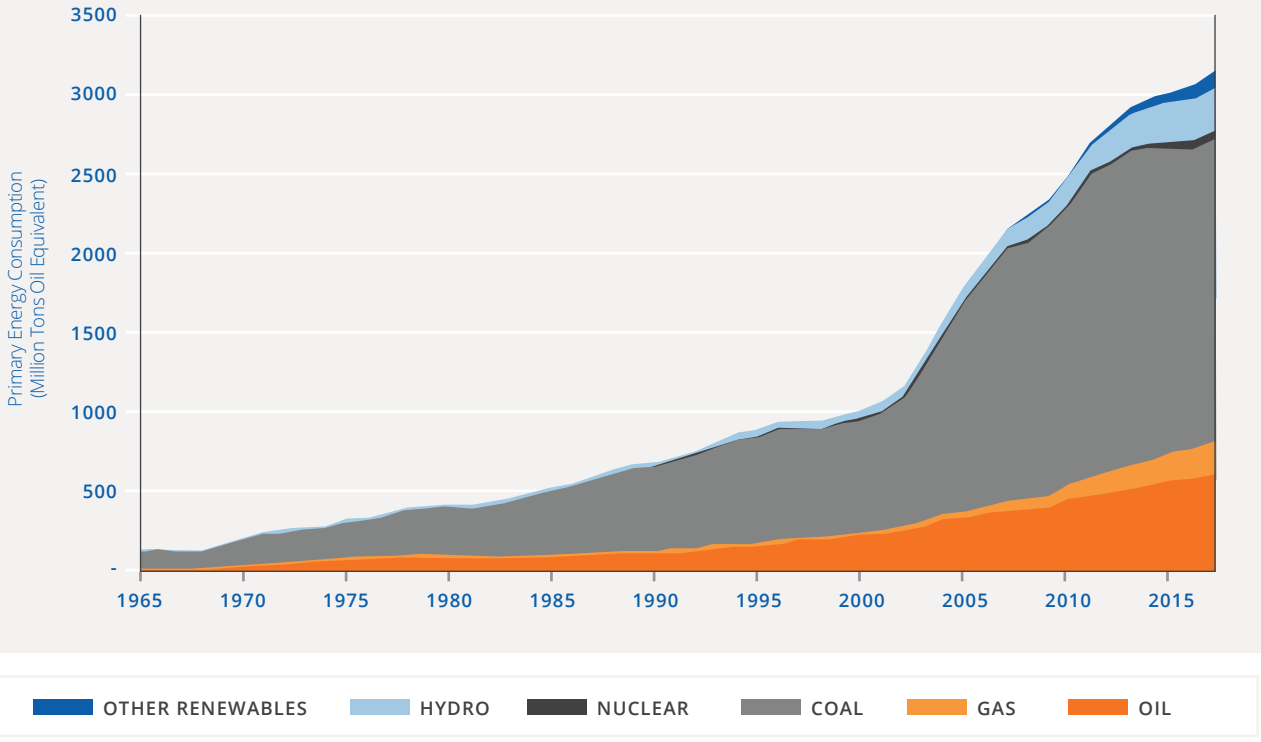
2.3 China

China's economy boomed over the last three decades, resulting in skyrocketing demand for energy. In the early 2000s China embarked on a huge program to build generation, but this still wasn't rapid enough to meet China's growing demand for energy. In response, Chinese institutions decided to complement investments in generation with trials to create capacity through energy management.

Several Chinese provinces set up energy efficiency programs that were extremely successful, not only delivering capacity, but also boosting the productivity and competitiveness of Chinese enterprises. In 2005, the Chinese Government made improving energy management a major national priority and rolled out a series of major programs, with a particular focus on industry.

China's efforts on energy efficiency have delivered extraordinary results: China reduced its energy intensity by 33.8 per cent between 2006 and 2015.[27] Energy efficiency improvements since 2000 reduced China's primary consumption by 10 exajoules in 2017, about 12 per cent of its final energy consumption.[28] **In other words, in 2017 China saved more than twice as much energy as Australia consumed.**[29] Energy efficiency has cut Chinese households' energy bills by around 20 per cent, and improvements in energy productivity in 2017 alone increased its GDP by AU$1.3 billion.[30, 31]

Figure 2.5 Chinese primary energy consumption, 1965-2017



Source: Energy consumption compiled from: BP 2018, *BP Statistical Review of World Energy 2018*, BP, London.

Consumption displaced by improvements in energy efficiency between 2006-17 based on IEA 2018, *Energy Efficiency 2018*, IEA, Paris.

27 Voita, T. 2018, *The Power of China's Energy Efficiency Policies*, IFRI Centre for Energy, Paris.

28 International Energy Agency 2018, *Energy Efficiency 2018*, IEA, Paris p. 145.

29 Department of the Environment and Energy 2018, *Australian Energy Update 2018*, Commonwealth of Australia, Canberra.

30 International Energy Agency 2017, *Energy Efficiency 2017*, IEA, Paris.

31 International Energy Agency 2018, *Energy Efficiency 2018*, IEA, Paris.

2.4 Japan

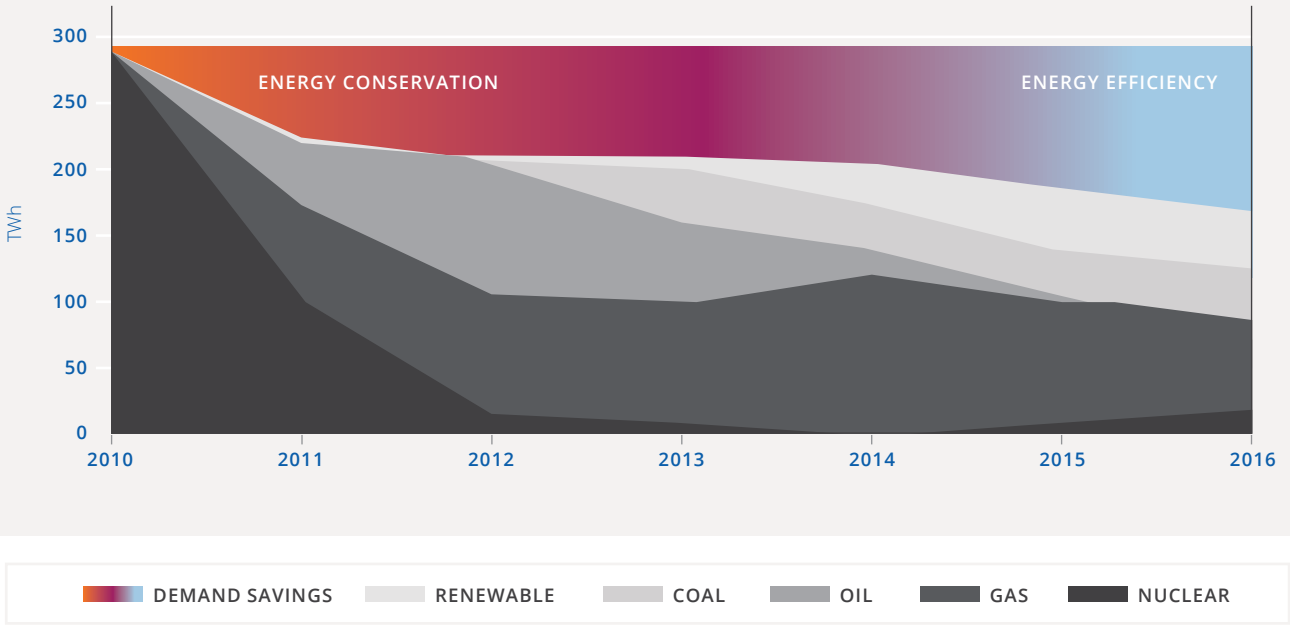
Japan has had a strong focus on improving energy efficiency since the oil crisis in the 1970s. As a result, by 2010 Japan's energy intensity was around 20 per cent lower than the global average.[32] However, Japanese efforts to manage energy use were redoubled following the tsunami on 11 March 2011, which lead to the immediate loss of electrical output from the Fukushima Daiichi Nuclear Power Plant, and subsequent closure of another 48 nuclear reactors. Between 2011 and 2012 Japan lost the output of generators that had provided 30 per cent of its electrical capacity in 2010.

The Japanese Government and energy utilities rolled out a series of urgent supply-side measures, such as increased output from fossil-fuel generation. However, they also ran a major *Setsuden* – saving electricity – campaign that encouraged households to voluntarily reduce their energy demand and set businesses targets to reduce their energy use. As an emergency measure, the campaign was hugely successful, reducing peak electricity demand in the Tokyo region by 19 per cent.[33] However, the *Setsuden* campaign wasn't intended as a long-term measure, as it included actions that reduced comfort and productivity.

Emergency energy conservation measures were wound back after September 2011, and gradually replaced with programs that improved energy productivity and reduced peak demand. In addition to ramping up support for businesses to find energy savings, Japanese institutions provided incentives for companies to reduce demand during peak periods, accelerated the roll-out of smart meters, and commenced an energy market reform program that included market liberalisation and auctions for demand response capacity.

Between 2011 and 2016 improved energy management delivered more new capacity to Japan than any form of generation, playing a central role in the replacement of Japan's nuclear fleet. Over that period, improved energy management delivered 39 per cent of the capacity added to Japan's electricity market, while gas delivered 30 per cent, renewables 13 per cent, coal 12 per cent, and reactivated nuclear 6 per cent. Japan demonstrates that even a highly energy efficient economy can still have substantial potential for improvements in energy management.

Figure 2.6 Replacement of nuclear electricity generation in Japan



Source: International Energy Agency 2017, *Energy Efficiency 2017*, IEA, Paris.

32 World Bank Source 2019, *Sustainable Energy for All database*. Accessed 31 May 2019 from: https://data.worldbank.org/indicator/eg.egy.prim.pp.kd

33 Reduction for the Tokyo Electric Power Company (TEPCO) region. Bloomberg New Energy Finance 2014, *Japan's Approach to Demand-Side Management*, Bloomberg New Energy Finance, New York.

2.5 Germany

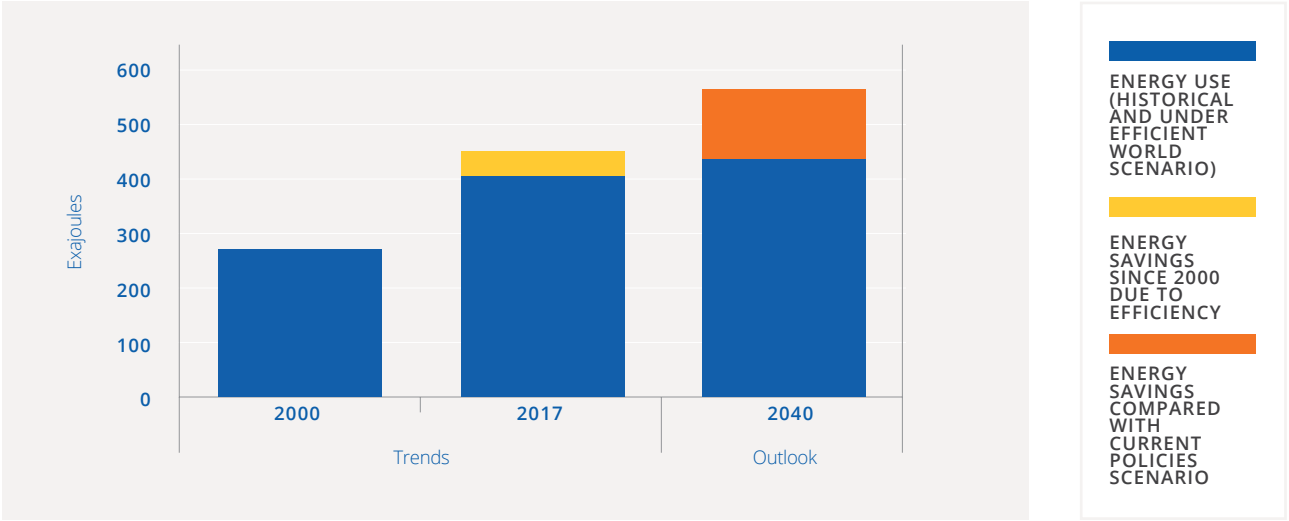
Germany is rapidly moving to a 100 per cent renewable energy system through a strategy called the *Energiewende* – energy transition. The shift to zero-carbon generation has increased, rather than reduced, Germany's focus on energy management. 'Energy efficiency first' (see section 4) is a central principle of the *Energiewende*, because energy management not only drives faster reductions in greenhouse gas emissions, but also ensures that the shift to renewable generation is reliable, affordable and has public support.[34]

Germany's increased focus on energy management builds on its already significant efforts over the last two decades. Energy efficiency improvements since 2000 reduced German households' energy consumption by 27 per cent in 2016, saving 1,000 petajoules of energy and reducing bills by AU$64 billion that year alone. Germany also views its efforts on energy management as part of its economic development strategy. There are already 400,000 people employed in energy efficiency in Germany, and the sector is expected to grow rapidly over the coming decade.[35]

2.6 Raising global ambition

Global improvements in energy management have already delivered phenomenal results. The IEA estimates that global energy use in 2017 would have been 12 per cent higher without improvements in energy efficiency that took place between 2000 and 2017.[36] However, most countries have barely started to tap the potential for energy management. The IEA estimates that global energy use in 2040 could be 22 per cent lower than business-as-usual if countries introduce ambitious energy efficiency policies – the 'efficient world scenario'.[37]

Figure 2.7 Global energy use – historical and projected



Source: International Energy Agency 2018, *Energy Efficiency 2018,* Analysis and Outlook to 2040, IEA, Paris.

34 Professor Peter Hennicke, personal communication.

35 German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 2018, *Climate Action in Figures 2018*, BMU, Berlin.

36 International Energy Agency 2018, *Energy Efficiency 2018, Analysis and Outlook to 2040*, IEA, Paris.

37 Ibid.

If the world took serious action on energy efficiency it would deliver:

- Over 40 per cent of the greenhouse gas reductions required from the energy sector by 2040, for the world to be in line with the Paris Agreement;
- AU$770 billion reduction in households' energy bills (home and car); and
- Considerable economic opportunities: global investment in energy management would reach AU$832 billion a year between 2017 and 2025, rising to AU$1.9 trillion a year between 2026 and 2040. On average, investments in energy efficiency measures will pay back $3 for every $1 invested.[38]

The case studies in this section show that genuinely ambitious action on energy management delivers real results. The success of these world leaders' efforts has only increased their ambition on energy management. Other countries are following their lead and ramping up their ambition. The Group of Seven countries – Canada, France, Germany, Italy, Japan, the United Kingdom and the United States – collectively account for just under half of global GDP. In 2016 the energy ministers from these countries plus the European Union met in Japan to discuss collaboration on energy, and agreed to a broad strategy for energy security and economic growth, which stated:

> *We affirm that improving energy efficiency is key to decarbonisation of our economies, enhancing energy security and fostering economic growth and should be regarded as the 'first fuel'.*[39]

Recommendations

Over the last two decades Australia has made far less effort to improve energy management than other major economies. As a result, Australians pay higher energy bills than they need to, and our health, emissions and productivity have suffered. Improving our energy management will be essential to ensure that the transition to clean energy is fast, reliable, affordable, and popular. Recent studies also show that an ambitious energy efficiency strategy would deliver economic growth and create at least 120,000 job-years of employment.[40]

Australian governments and institutions should:

1. **Make the dramatic improvement of energy management a national and jurisdictional priority.** Australia should not just aim to catch up with other developed countries, but learn from world leaders to become a global leader in this field; and
2. **Place energy management at the centre of their strategies for energy, emissions reduction and economic growth.** Energy management and energy supply should be integrated to deliver affordable, sustainable and reliable energy.

38 International Energy Agency 2018, *Energy Efficiency 2018, Analysis and Outlook to 2040*, IEA, Paris.

39 G7/G8 2016, *G7 Kitakyushu Energy Ministerial Meeting, Kitakyushu Initiative on Energy Security for Global Growth, Joint Statement*, Ministry of Economy, Trade and Industry of Japan, Tokyo.

40 Green Energy Markets 2018, *Energy Efficiency Employment in Australia*, Green Energy Markets, Melbourne.

3 Ambition and targets

In 2015 the Australian Government set a target to improve energy productivity by 40 per cent between 2015 and 2030.[41] The Government's decision to set a target was a major step forward for Australian energy policy. However, the target is significantly lower than Australia's potential for cost-effective energy efficiency improvement. Australia's buildings, vehicles and industrial facilities are relatively inefficient compared to those in other developed economies, giving us a larger scope than other countries to rapidly improve our energy efficiency.

While Australia's energy productivity target is relatively modest, we are not on track to meet it. The increase in Australia's gas exports, and the associated increase in energy used to liquefy gas, has contributed to Australia falling behind its target. However, the main reason that Australia has fallen behind its target is that governments have not introduced the policies that are necessary to improve Australia's energy productivity.

China

China has placed a major focus on improving energy productivity, particularly to reduce urban air pollution, improve energy security and drive economic growth.

China sets its energy efficiency targets in its Five-Year Plans – the country's primary policy strategies. Chinese officials face immense pressure to ensure that targets in the Five-Year Plans are met. China's 11th Five-Year Plan set a target to reduce the country's energy intensity by 20 per cent between 2006 and 2010.[42] China's 12th Five-Year Plan built on this target, with a goal reduce the country's energy intensity by a further 16 per cent between 2011 and 2015. China exceeded the goals that it set in both 2005 and 2010, reducing its energy intensity by a total of 33.8 per cent between 2006 and 2015.[43, 44]

China's 13th Five-Year Plan not only set a target to reduce energy intensity by a further 15 per cent between 2016 and 2020, it also set a national energy use cap of 3,500 million tonnes of oil equivalent (Mtoe). This shift signals that China will use improvements in energy efficiency to meet much of the increase in demand for energy services that is being driven by economic growth and increased affluence.

China's remarkable improvement in energy efficiency has underpinned much of the global growth in energy efficient goods and services, and will continue to do so.

European Union

The European Union (EU) has dramatically improved its energy efficiency over the past three decades and is aiming for further gains. The EU's ambitions on energy efficiency are partly driven by its goal to reduce its greenhouse gas emissions by 40 per cent below 1990 levels by 2030, but also driven job creation, economic growth and energy security. European leaders believe that reducing the EU's fuel imports, particularly gas from Russia, is critical to the region's economic and political stability.

The EU's 2012 *Energy Efficiency Directive* set a non-binding goal to reduce Europe's energy consumption to 1,474 Mtoe of primary energy in 2020.[45] If the EU achieves this goal, primary energy consumption in the EU in 2020 will be 13.4 per cent below 2005 levels, and 20 per cent below projected business-as-usual levels.[46] Taking account of economic growth, this is roughly equivalent to a 25 per cent increase in energy productivity over eight years, which is a faster rate

41 Energy productivity is defined as GDP generated per unit of primary energy used.

42 Energy intensity is the inverse of energy productivity, and is measured in energy used per unit of GDP generated.

43 Voita, T. 2018, *The Power of China's Energy Efficiency Policies*, IFRI Centre for Energy, Paris.

44 Dai Y. et al. 2017, *Energy Efficiency Investment in China, 2006 – 2020*, Energy Foundation China, China Energy Efficiency Investment and Assessment Committee of China Energy Research Society, China Energy Efficiency and Investment Consultancy Service Center, Beijing, May, p. 23.

45 European Council 2012, *Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU, and repealing Directives 2004/8/EC and 2006/32/EC,* European Council, Brussels.

46 European Environment Agency 2017, *Trends and projections in Europe 2017 – Tracking progress towards Europe's climate and energy targets*, Publications Office of the European Union, Luxembourg.

of energy productivity improvement than Australia is aiming for.[47]

The *Energy Efficiency Directive* requires every state that is a member of the EU to set an aspirational energy efficiency target and implement a number of policies. States' targets vary with their circumstances. While countries like Estonia, that have rapidly developing economies, have set targets that allow for an overall increase in energy consumption, the United Kingdom has committed to reduce its primary energy consumption by 19.4 per cent by 2020. The sum of states' targets puts the EU on track to reduce its primary energy consumption in 2020 by 16.9 per cent below is baseline.

In 2018, EU institutions formally agreed to set a binding target for the EU to reduce energy demand by 32.5 per cent below business-as-usual projections by 2030. As the EU leaves its member states considerable discretion on how they comply with the *Energy Efficiency Directive*, we will briefly examine Germany's targets.

Germany

Germany is a global leader in energy efficiency and has played a key role driving up the EU's ambition on efficiency. Germany's advocacy for the principle of energy efficiency first in the EU is particularly important, and is discussed more in section 4.

The *Energy Efficiency Directive* requires Germany to submit its plans to improve its energy efficiency to the EU. Germany's National Action Plan on Energy Efficiency (NAPE) has a far higher ambition than many other countries in the EU. Germany aims to reduce its primary energy consumption by 20 per cent by 2020, and by 50 per cent by 2050 (below 2008 baselines).[48] The NAPE also sets out the policies that Germany will use to achieve its targets, including actions to address the energy efficiency of energy supply, manufacturing, buildings and appliances.

California

California has been a global leader in energy efficiency since the 1970s. While California's interest in energy efficiency was originally driven by its potential to provide low-cost energy capacity, its ambitions have been lifted in order to reduce urban air pollution, reduce greenhouse gas emissions and create jobs. There are currently an estimated 310,433 jobs in energy efficiency in California, making the state the leading employer in energy efficiency in the US.[49]

In 2008 the California Public Utilities Commission adopted a Long-Term Energy Efficiency Strategic Plan for 2009-2020.[50] Unlike many other strategies, this plan focused on sectoral goals, rather than an overall target. These goals included:

- All new residential construction in California will be zero net energy by 2020, and all new commercial construction will be zero net energy by 2030;
- Heating, ventilation and air conditioning will be transformed to ensure that its energy performance is optimal for California's climate; and
- All eligible low-income customers will be given the opportunity to participate in low-income energy efficiency programs by 2020.

47 European Environment Agency 2017, *Primary and Final Energy Consumption and targets*, European Environment Agency, Copenhagen. Accessed 31 May 2019 from: https://www.eea.europa.eu/data-and-maps/daviz/primary-and-final-energy-consumption#tab-dashboard-01

48 Federal Office for Economic Affairs and Export Control and Federal Office for Energy Efficiency 2017, N*ational Energy Efficiency Action Plan 2017 for the Federal Republic of Germany,* Federal Ministry for Economic Affairs and Energy, Berlin.

49 E2 2018, *Clean Jobs California*, E2, Washington DC, available online from: https://www.e2.org/wp-content/uploads/2018/09/E2-Clean-Jobs-California-2018.pdf.

50 California Public Utilities Commission 2008, *California Long-Term Energy Efficiency Strategic Plan,* California Public Utilities Commission, San Francisco.

In 2015 California also set an ambitious overall goal under its *Clean Energy and Pollution Reduction Act (SB 350)*. The Act required California to "to double statewide energy efficiency savings and electricity and natural gas end uses by 2030."[51] This complex metric required the California Energy Commission to estimate the expected impact of the state's energy efficiency programs between 2015 and 2030, and then double these cumulative savings and convert them into annual energy saving targets.[52]

Recommendations

The examples from China, the EU, Germany and California demonstrate that leading global economies are setting ambitious targets to improve their energy efficiency in order to develop reliable energy capacity, jobs and economic growth, while reducing urban air pollution and greenhouse gas emissions.

The Australian Government should:

3. **Raise the ambition of its 2030 energy productivity target and complement it with sub-targets for specific sectors, such as buildings.**
4. **Consider setting a target for primary energy consumption in 2030, noting that this will require some flexibility.**

Australian states and territories should:

5. **Complement national targets with their own targets.**

Most critically, all governments should:

6. **Put mechanisms in place, including allocating funding and improving governance, to ensure that new or existing targets are met.**

51 California Energy Commission 2019, *Clean energy & pollution reduction act SB 350 overview*, State of California, Sacramento CA, available online from: https://www.energy.ca.gov/sb350/.

52 Energy savings were measured in gigawatt hours for electricity and therms for gas.

4 Energy market reforms

The cheapest way to meet Australia's energy needs (e.g. warm showers, comfortable homes and a thriving manufacturing sector) is a balanced mix of investment in **supply-side** measures, such as generation, storage and networks, and **demand-side** measures, such as energy efficiency and demand response.

Generation is an essential part of any electricity system, but our bills will be far lower if we also manage demand. For example, it's normally far cheaper to incentivise manufacturers to voluntarily reduce demand for a few hours a year than to build generators that only operate during extreme heat waves. Demand-side capacity is also incredibly reliable – for example, while a generator might fail, capacity created by replacing inefficient lights with light-emitting diodes (LED) simply can't be lost. Managing demand could deliver significant reduction in energy costs; around 25 per cent of retail electricity costs come from peaks that last for less than 40 hours a year.[53]

Improving the flexibility of demand will become increasingly important as the level of renewable generation increases in the system. Even a slightly better match between when energy is generated and consumed will dramatically reduce the amount of generation and storage required in the system. Managing demand is also vital when the future shape of our system is uncertain, as it is a far more flexible way of providing capacity than large investments in supply that may become redundant.

The balance of investment in supply- and demand-side measures is affected by electricity market design. Governments do not have a choice about whether to regulate electricity markets – the question is how they regulate them. In addition to needing regulations around electrical safety and system stability, electricity markets are based around monopoly networks that manage the poles and wires, and wholesale spot-prices and dispatch decisions are made by a central buyer based on a set of rules and assumptions.

The current rules and regulations of Australia's east coast National Electricity Market (NEM) have resulted in overinvestment in supply-side capacity and under-investment in demand-side capacity. This contributed to the average residential electricity bill increasing by 35 per cent between 2007-08 and 2017-18.[54]

The most succinct explanation of the problem was set out in 2002 in the COAG Energy Market Review led by Warwick Parer AM. The Parer Review states:

> *"The Panel found that there is a relatively low demand side involvement in the NEM because:*
>
> - *The NEM systems are supply side focused;*
> - *The demand side cannot gain the full value of what it brings to the market; and*
> - *Residential consumers do not face price signals."* [55]

In the 17 years since the Parer Review, numerous other reviews have confirmed the existence of these distortions, but energy market institutions and successive governments have failed to properly resolve them. We need urgent action to address the supply side biases in our energy markets. Recent developments in technology, consumer preferences, and global politics are driving a new wave of investment in energy supply and demand-side measures. If we get the balance wrong in this new wave of investment it will waste billions of dollars and reduce Australia's productivity.

This section looks at two international approaches to supply-side bias, namely:

- Using the energy efficiency first principle to address supply-side biases; and
- Establishing markets for demand-side services.

The section specifically focuses on how these approaches could be applied to the NEM, although the elements are applicable to other electricity and gas markets.

53 Fraser, R 2010, 'Demand side management', paper presented at the Australian Institute of Energy symposium, *NSW's Electricity Future 2020 (and beyond): What will it look like and how do we get there?*, 24 May, Sydney.

54 Australian Competition and Consumer Commission (ACCC) 2018, *Restoring electricity affordability and Australia's competitive advantage. Retail Electricity Pricing Inquiry – Final Report,* ACCC, Canberra.

55 Parer, W. 2002, *COAG Energy Market Review – Towards a Truly National and Efficient Energy Market*, Commonwealth of Australia, Canberra, p. 174.

4.1 Energy efficiency first

Electricity markets around the world have traditionally focused on building energy supply; demand has been seen as something that merely needs to be forecast accurately, rather than something that can be influenced. However, digitisation is giving us increased opportunities to manage demand in ways that dramatically cut costs.

In order to tackle this supply-side bias, many overseas governments have adopted explicit principles to invest in the most cost-effective mix of supply- and demand-side measures. This approach has been called 'least-cost planning' or 'integrated resource planning', particularly in vertically-integrated energy markets where a single organisation is responsible for investment in both generation and networks.

More recently, jurisdictions have started to adopt the principle of energy efficiency first. This principle has the same goal as least-cost-planning, but recognises and attempts to address the many biases against demand-side investment that lie outside monopoly utilities. The energy efficiency first principle doesn't mean that decision-makers should favour demand-side investments over supply-side solutions. Rather, it tries to ensure that decision-makers consider both demand- and supply-side options.

In practice, energy efficiency first means that decision-makers should consider demand-side measures before they finalise policies, plan or investments. In other words, *first* refers more to *sequencing* rather than *preferencing*. The Regulatory Assistance Project, an independent advisory body of former utility regulators and policymakers, recommends action at multiple levels in order to implement the energy efficiency first principle.[56] These levels could include:

- **Governance:**
  Key institutions need to have the remit to consider both demand- and supply-side measures. For example, the Californian Energy Commission is able to consider matters as diverse as building standards and energy market rules when it determines the most affordable way to meet Californians' energy needs.
- **Strategy and policy:**
  Energy market design and climate change policies should consider both energy supply and demand. For example, for a building owner in the UK to claim the full feed-in tariff for solar PV, the building that the solar PV is installed on must have an energy efficiency rating of 'D' or above.[57]
- **System planning and investment:**
  Electricity system planners, regulators and transmission and distribution companies need to consider whether demand-side options could help meet communities' energy needs before they plan, approve or invest in supply-side infrastructure.

The energy efficiency first principle isn't just about ensuring that demand-side options are considered, it's also about ensuring that demand- and supply-side measures are properly integrated.

The failure of key Australian institutions to take a properly integrated approach to supply and demand resulted in over-investment in electricity infrastructure in the period 2008-2013. Electricity networks built infrastructure based on their projections for electricity consumption and substantially over-estimated the increase in peak demand. The networks' projections were wrong partly because they failed to consider the impact of policies such as appliance standards, despite these impacts being modelled and freely available. This mistake resulted in billions of dollars of unnecessary expenditure.

The following section looks at the approaches used to address supply-side biases in energy markets in the United States (US) and the European Union (EU).

United States

Utilities in 38 states in the US are required to undertake integrated resource planning or similar processes.[58] integrated resource planning involves forecasting future demand for energy, identifying potential supply- and demand-side options, and determining the mix of measures that will meet consumer demands at lowest cost. As utilities' profits traditionally increased with the amount of energy that they sold, many states also undertook reforms to

56 Bayer, E. 2018, *Energy Efficiency First: A Key Principle for Energy Union Governance,* Regulatory Assistance Project, Brussels.

57 Rosenow, J., Bayer, R., Rososinska, B., Genard, Q. & Toporek, M. 2016, *Efficiency First: From Principle to Practice - Real World Examples from Across Europe*, Energy Union Choices, Brussels.

58 Wilson, R. & Biewald, B. 2013, *Best Practices in Electrical Utility Integrated Resource Planning*, Regulatory Assistance Project, Brussels.

address utilities supply-side bias, including decoupling utility profits from the volume of energy that they sell and requiring utilities to meet minimum targets for peak demand management and energy efficiency improvements (see section 5).[59]

Integrated resource planning has delivered significant savings to consumers. For example, Consolidated Edison, a utility in New York, avoided an estimated $1 billion in capital expenditure through its energy efficiency programs.[60] However, the focus of integrated resource planning on monopoly utilities means that, on its own, it would be insufficient in Australia's liberalised energy markets.[61] As such, the energy efficiency first approach is more appropriate to ensure that our markets deliver the most cost-effective mix of investment in supply- and demand-side measures.

European Union

The highly decentralised nature of regulation and decision-making in the EU means that the European Commission typically focuses on creating frameworks and encouraging national, regional and local governments to develop strategies, legislation and policies that are consistent with these frameworks. In 2015 the European Commission released a strategy to integrate and improve Europe's energy markets, which included "prioritising action on energy efficiency" as one of its five core principles.[62] States within the EU are expected to prioritise energy efficiency in their National Energy and Climate Plans (NECPs).

Germany demonstrates how the energy efficiency first principle has been adopted at a national level. While the German Government only formally adopted the principle in 2018 as part of an agreement between various political parties, the principle has been shaping Germany's energy policy for at least three years.[63] The principle is a major element of Germany's *Climate Action Plan 2050* and its F*ourth National Energy Efficiency Action Plan*.

Recommendations

COAG Energy Council and all Australian governments and institutions should:

7. **Adopt the energy efficiency first principle and undertake a review to determine what actions are required to implement the principle.** Ensuring that decision-makers and markets make the most cost-effective mix of investment in supply- and demand-side measures will require a range of changes, including energy market reforms and governance changes, to ensure that new and existing bodies can consider both supply- and demand-side approaches to meeting Australian's energy needs.

4.2 Markets for demand-side services

Households and businesses can significantly reduce their energy bills by reducing their energy use and shifting demand away from peak periods. However, customers can also help the energy system through better energy management, by providing:

- **Frequency Control Ancillary Services (FCAS):** the grid needs to operate at a frequency very close to 50 hertz. If there is a rapid change in supply or demand it can change the frequency, threatening grid stability. If customers respond to incentives and voluntarily change their demand, it can bring the frequency back to around 50 Hertz, stabilising the grid.
- **Reduced network costs:** if consumers reduce their energy demand at certain times and locations it reduces the need for expenditure on network infrastructure, reducing energy bills for all consumers.
- **Emergency capacity:** when parts of the network go off-line, or generators have low

59 American Council for an Energy Efficient Economy (ACEEE) 2010, *State Energy Efficiency Resource Standard Activity,* ACEEE, Washington DC.

60 Bayer, E. 2018, *Energy Efficiency First: A Key Principle for Energy Union Governance*, Regulatory Assistance Project, Brussels.

61 Dunstan, C. 2018, *In the Balance – Electricity, Sustainability and Least Cost Competition, Institute for Sustainable Futures,* University of Technology Sydney, Sydney.

62 European Commission 2015, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank - A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, (COM/2015/080 final)*, European Commission, Brussels.

63 Lopez, E., Schlomann, B., Reuter, M. & Eichhammer W. 2018, *Energy Efficiency Trends and Policies in Germany – An Analysis Based on the ODYSSEE and MURE Database*s, Fraunhofer Institute, Karlsruhe.

output during periods of heavy demand (e.g. heat waves), it can result in insufficient energy supply. If customers such as businesses reduce their non-essential energy use during these periods, it can improve system stability and reduce the need for involuntary load-shedding.

- **Reduced wholesale electricity prices:** reducing energy consumption, particularly during periods of peak demand, can reduce wholesale electricity prices for all consumers.

The Australian Energy Market Commission (AEMC) has conservatively estimated that reducing peak demand alone could deliver benefits valued at between $4.3 billion and $11.8 billion over ten years.[64]

However, consumers are not properly incentivised to provide these services. For example, most consumers pay relatively flat electricity tariffs that don't properly encourage them to reduce demand during periods of very high wholesale prices. This led the Parer Review to conclude that "the demand side cannot gain the full value of what it brings to the market".[65] However, little action was taken to address this problem until 2012, when the AEMC released its *Power of Choice* Review.

In 2015 the AEMC passed a rule change that allowed demand response and batteries to provide FCAS. As a result, demand response now provides a significant proportion of FCAS, contributing to a rapid drop in the price for FCAS. The impact of this rule change demonstrates the power of price-signals and open markets for delivering a step-change in energy management and lower bills for consumers.

In the last four years the AEMC and the Australian Energy Regulator made a number of reforms that provide the monopolies that manage electricity networks with a more balanced set of incentives for demand-side and supply-side investments, such as the *Demand Management Incentive Scheme*. These reforms should start to have an impact on bills in the coming years, although further changes will likely be required, such as requiring networks to undertake minimum levels of demand management.

The Australian Energy Market Operator (AEMO) and the Australian Renewable Energy Agency are currently conducting a trial that significantly expanded the use of demand response for emergency capacity.

This trial will have a lower benefit-cost ratio than a well-established demand response program, but has already demonstrated that demand response can provide emergency capacity at significantly lower cost than the construction of emergency generators. There is currently work underway to enhance the use of demand-side resources for emergency capacity, including the Energy Security Board's (ESB) development of a Retailer Reliability Obligation.

However, the most urgent reform that is required is the development of a system to provide an incentive for consumers and aggregators to adjust demand in response to prices in the wholesale electricity market. If consumers are incentivised and supported to adjust their demand in response to wholesale electricity prices it will significantly increase the stability and affordability of the electricity system and reduce the volume of emergency capacity that is required to stabilise the electricity market.

In 2012 the AEMC identified the need for a 'wholesale demand response mechanism' in the *Power of Choice* Review. However, in 2015, implementation of the mechanism was stalled, partly due to a perceived excess of dispatchable capacity that no longer exists. With the increase in intermittent generation and closure of a number of coal-fired generators in 2017 and 2018, the need for a wholesale demand response mechanism has now become urgent. The AEMC is currently considering three Rule Changes that propose various options for implementing a demand response mechanism, with a draft decision likely in mid-2019.

This section looks at how two US energy markets approach demand management.

Pennsylvania New Jersey Maryland (PJM) energy market

PJM refers to both a regional energy market and the organisation that oversees this market. The PJM market extends over 13 states in the northeast and midwest US, servicing around 65 million people with over four times the peak load of the NEM.

Energy markets use a variety of mechanisms to balance cost and reliability. The NEM is an 'energy-only' market, which only pays generators for the

64 Australian Energy Market Commission 2012, *Power of Choice – Final Report*, AEMC, Sydney.

65 Parer, W. 2002, *COAG Energy Market Review – Towards a Truly National and Efficient Energy Market*, Commonwealth of Australia, Canberra.

amount of energy that they dispatch into the market. In order to provide an incentive for companies to build generators that aren't used very often, wholesale prices are allowed to reach extremely high levels relative to the marginal cost of generation. However, in practice most energy-only markets involve a number of design compromises, including a cap on the price of electricity.

The PJM has both an energy market, which pays for electricity, and a forward capacity market, which pays generators and demand response providers to be available for dispatch during periods when demand exceeds normal supply. Energy users in a capacity market have to pay additional charges for capacity, but generally pay much lower wholesale energy prices.

While there are pros and cons to having a capacity market, it is undeniable that allowing demand response to provide capacity in the PJM has dramatically reduced consumers' bills. Demand response and, increasingly, energy efficiency can provide capacity in both energy-only and capacity markets. For the market, and for customers as a whole, it is much cheaper to pay for energy users who wish to do so to reduce demand for a handful of hours each year than build a generator that sits idle for more than 8,000 hours each year. Unsurprisingly, this means that demand response providers are able to offer capacity at much lower prices than generators.

The inclusion of low-cost bids from demand-side resources in the PJM's 2017/18 capacity auction reduced consumers' bills by $9.3 billion in that year alone.[66] The level of demand management in the PJM was also one of several factors enabling the system operator to cancel the multi-billion-dollar Potomac-Appalachian Transmission Highline.[67]

Texas

The Electricity Reliability Council of Texas (ERCOT) oversees a regional energy market servicing around 25 million people. The ERCOT market is an energy-only market, similar to the NEM. However, following a series of events where major generator outages nearly caused system blacks, ERCOT set up an Emergency Response Service (ERS) program. Under this program, energy consumers are paid if they are prepared to reduce their demand in an emergency. Consumers have only been called to dispatch three times during major weather events, but on these occasions the ERS has helped to avoid major involuntary load-shedding events.

Recommendations

COAG Energy Council and all Australian governments and institutions should:

8. **Develop a number of markets for energy services, including:**
    - **A wholesale demand response mechanism** that allows customers and demand response providers to sell demand-response capacity into the wholesale electricity market on an equal basis with generation; and
    - **Markets for emergency capacity.**
9. **Commission a review to determine whether to establish regional competitive markets for network capacity,** so that network infrastructure and demand management can compete on a level playing field. This would both increase competition and reduce the need for expenditure on the electricity network.

66 Monitoring Analytics 2014, *The 2017/2018 RPM Base Residual Auction: Sensitivity Analyses,* The Independent Market Monitor for PJM, Eagleville PA.

67 Hlecdik, R. & Faruqui, A. 2015, *Valuing Demand Response: International Best Practices, Case Studies and Applications*, Brattle Group, Cambridge MA.

5 Energy efficiency schemes

Many countries have introduced requirements for energy utilities to help homes and businesses save energy. These programs are called energy efficiency schemes (EES), energy efficiency resource standards or energy efficiency obligations.

EES are used to correct distortions in energy markets and lower energy bills. Electricity and gas network companies are monopolies that bring together large numbers of energy consumers to enable large-scale investment in energy supply. Energy networks are valuable but, without equivalent support for aggregating demand management, they distort investment towards energy supply and away from managing demand.

Many governments have recognised the need to reduce this distortion by establishing EES to drive large-scale investment in energy efficiency. There are currently over 50 EES in operation around the world, including:

- Four in Australia: the NSW Energy Saving Scheme, Victorian Energy Upgrades program, South Australian Retailer Energy Efficiency Scheme and ACT Energy Efficiency Improvement Scheme;
- 27 in the United States (US);
- 15 in Europe; and
- Schemes in Canada, China, Brazil, Uruguay, Korea, and South Africa. [68, 69, 70]

Globally, EES have proved highly effective at reducing both consumers' energy bills and the cost of energy supply. EES generally drive two dollars in private sector investment for every dollar of public or utility expenditure, and save energy at under 4 cents per kWh, substantially less than the cost of building new energy supply.[71, 72, 73] This section looks at key lessons from the European Union (EU), the US and India.

European Union

The EU's *Energy Efficiency Directive* Article 7 requires member states to ensure that energy utilities achieve annual energy savings equivalent to 1.5 per cent of total energy use in the base period of 2010-12. The *Directive* gives states the flexibility to achieve this through introducing an EES or alternative measures. There are currently 15 EES in Europe.

The first lesson from Europe is that EES can deliver major energy savings, and that ambition can rise over time as new opportunities are identified and implemented. While several countries have EES with targets that are lower than required by the *Energy Efficiency Directive*, some EES are far more ambitious than required by the Directive. Denmark has one of the oldest schemes and also has the highest target – equivalent to reducing energy use by three per cent of total demand per annum. As a result, EES are, overall, expected to deliver 34 per cent of the EU's target to cut energy use by 20 per cent by 2020.[74]

A second lesson from Europe is that governments play a key role in determining the outcomes of EES. While market forces determine the precise mix of measures that an EES drives, the variations in the designs of EES in the EU mean that they drive quite different outcomes. Government decisions affect which activities EES will support (e.g. lighting and heating upgrades) and which sectors they support (e.g. households and businesses). Most EES allow savings in both households and businesses as this lowers the cost of delivery by providing more options.[75]

68 International Energy Agency 2017, *Market-based Instruments for Energy Efficiency – Policy Choice and Design*, IEA, Paris

69 International Energy Agency 2018, *Energy Efficiency 2018*, IEA, Paris.

70 Fawcett, T., Rosenow, J. & Bertoldi, P. 2019, 'Energy efficiency obligation schemes: their future in the EU', *Energy Efficiency*, vol. 12, pp. 57-71.

71 Hoffman, I., Rybka, G., Leventis, G., Goldman, C.A., Schwartz, L., Billingsley, M., & Schiller, S. 2015, *The total cost of saving electricity through utility customer-funded energy efficiency programs: Estimates at the national, state, sector and program level*, Lawrence Berkeley National Laboratory, Berkeley.

72 Nadel, S., Cowart, R., Crossley, D. & Rosenow, J. 2017, *"Energy saving obligations across three continents: contrasting approaches and results," Proceedings of the 2017 ECEEE Summer Study*, ECEEE, Stockholm.

73 International Energy Agency 2017, *Market-based Instruments for Energy Efficiency – Policy Choice and Design*, IEA, Paris.

74 Nadel, S., Cowart, R., Crossley, D. & Rosenow, J. 2017, *"Energy saving obligations across three continents: contrasting approaches and results," Proceedings of the 2017 ECEEE Summer Study*, ECEEE, Stockholm.

75 International Energy Agency 2017, *Market-based Instruments for Energy Efficiency – Policy Choice and Design*, IEA, Paris

Governments, intentionally or unintentionally, also determine the administrative cost and incentives for various activities. For example, the Italian EES started out focusing on 'deemed' energy efficiency activities, such as lighting upgrades. In 2006-10, deemed savings accounted for well over 75 per cent of annual energy savings delivered by the Italian ESS. In 2010 the Italian Government adjusted the scheme to provide more support for industrial energy saving projects, leading to measured and verified industrial projects accounting for over 64 per cent of savings in 2011-15.[76] The rules of the Italian EES have recently been tightened, which will likely adjust the mix of energy efficiency projects in the Italian EES.

United States

There are 27 EES across the US. As in Europe, these schemes vary in their design and ambition. While some states have quite modest targets, the majority of EES in the US aim to save about 0.5 to two per cent of total energy use per annum. However, Rhode Island and Massachusetts set much more ambitious targets equivalent to annually saving energy equivalent to 2.6 per cent and 2.9 per cent per cent of retail energy sales in 2016.[77]

One key lesson from the US is that states that introduced EES more recently benefitted from the experience and industry development driven by states that introduced EES earlier on. EES tend to become more cost-effective over time, as regulators become more experienced and businesses and supply-chains develop. However, newer schemes can normally take advantage of low-cost energy-saving opportunities that are already saturated in more established schemes and their cost effectiveness has normally been relatively high from the start.

A second lesson from the US is that EES in different states can be substantially harmonised without being formally merged. Regulators in the US have made efforts to harmonise the details of EES both within and between states. Harmonisation between states has largely occurred through regulators sharing experiences and adopting similar regulatory requirements. Harmonisation within states has also been important as many US states contain multiple utilities that are regional monopolies. Regulators often require utilities to offer almost identical energy efficiency services to customers in order to provide consistency and economies of scale.

The details of US EES have also been harmonised at both intra- and inter-state levels through the involvement of non-profit organisations like the Wisconsin Energy Conservation Corporation (WECC), the Energy Trust of Oregon and the Vermont Energy Investment Corporation. Using WECC as an example, the organization was formed in 1980 to run a range of energy efficiency programs in Wisconsin. Over time, governments, cities and utilities in other US states hired WECC to design and implement their energy efficiency programs. WECC has recently merged with another non-profit to form Slipstream, and, as a result of administering multiple EES:

- Slipstream has developed a high level of expertise that improves EES implementation;
- Economies of scale lowered the cost of EES administration; and
- Slipstream has contributed to the harmonisation of key details of several EES in the US, further lowering costs for scheme administrators, energy efficiency providers and customers.

Australian jurisdictions should look for opportunities to administratively harmonise their schemes where possible. Potentially, a single state, federal or other body may be able to undertake much of the administrative tasks, such as product registration, on behalf of all the EES in Australia.

India

In 2010 the Indian Government set up Energy Efficiency Services Ltd (EESL) to deliver large-scale energy efficiency programs. EESL's largest program is called UJALA, an apronym for the Hindi word for 'light'. UJALA aims to roll out 770 million LED lamps to homes and businesses. EESL partners with utilities and uses on-bill financing, so that customers pay 20 per cent of the cost of LEDs upfront, and 80 per cent through instalments on their electricity bill.

76 Stede, J. 2016, "Bridging the industrial energy efficiency gap: Assessing the evidence from the Italian white certificate scheme", *DIW Discussion Papers 1565*, Deutsches Institut für Wirtschaftsforschung, Berlin.

77 American Council for an Energy Efficient Economy (ACEEE) 2018, *State Scorecard 2018*, ACEEE, Washington DC.

While EESL does not operate like an EES, it demonstrates the key principles of an effective EES, including:

- Using energy markets to overcome barriers to facilitate investment and engage and aggregate consumers; and
- Using large-scale procurement to drive down costs and transform markets.

To date, UJALA has sold over 320 million LED lamps, helping to make India the second largest LED market in the world.[78] UJALA delivers an average of a 15 per cent reduction in participating households' energy bills, saving Indian households over AU$3 billion a year. UJALA also saves enough energy to reduce peak demand by 8,300 MW – providing more than three times the capacity of Australia's largest coal-fired generator at less than half the cost per MWh.[79]

The scale of UJALA has been critical to its success. The size of the program created economies of scale that led to improvements in LED manufacturing and distribution that helped lowered the cost of an LED lamp by 80 per cent between 2014 and 2018. Even if UJALA was terminated tomorrow, the cost of LEDs in India will remain far lower than they were before 2014, delivering ongoing benefits to India's citizens.

When a program permanently alters a market for a product it's called 'market transformation'. EESL has now started to apply this approach to transform the markets for a range of other technologies, including street lighting, water pumps, residential fans and air conditioning. Australian EES have also transformed markets for particular products and services, such as LEDs and compact fluorescent lamps (CFL). These changes have lowered Australian's energy bills and enabled Australia to introduce the world's first minimum energy standards for light bulbs.

However, Australian governments rarely consider the ongoing benefits of market transformation when they design and evaluate EES. If governments more explicitly tried to use EES to drive market transformation it will magnify their impact, delivering far greater benefits to homes and businesses.

Recommendations

The governments of Queensland, Western Australia, Tasmania and the Northern Territory should:

10. **Introduce energy efficiency schemes (EES) with ambitious targets** as soon as possible to lower consumers' energy bills. Experience in the EU and the US strongly suggests that Queensland, Western Australia, Tasmania and the Northern Territory will not only have large, untapped opportunities for low-cost energy efficiency, but can also build off the experience and industry development of the existing Australian schemes.

Australian states and territories should:

11. **Consider harmonising some or all of the administration of their EES** to improve program design and administration, and reduce costs of delivering energy efficiency upgrades. Based on the experience in the US, harmonisation could be facilitated by engaging a single government, non-profit or private organisation to carry out administrative duties such as product registration, and potentially some aspects of program design.
12. **Explicitly aim to use EES to transform markets for particular energy efficient products and services.** Based on experience from India and Europe, in practice this means:
    - Identifying particular technologies that are ripe for market transformation;
    - Planning in advance to phase down support as markets transform; and
    - Raising minimum standards for products once markets have transformed.

78 Ministry of Power 2019, *National UJALA Dashboard,* Ministry of Power, New Delhi, accessed on 21 January 2019, available online from: http://ujala.gov.in/.

79 Ibid.

6 Minimum standards for appliances

Mandatory minimum standards for the energy efficiency of appliances provide critical protection for consumers, because households are generally unable to assess and compare the energy efficiency of products, let alone easily calculate the minimum level of energy efficiency that they should accept. As a result, more than 80 countries, including our key trading partners, set minimum energy efficiency standards for appliances.[80] This includes the US, Europe, Japan, China, India and Indonesia.

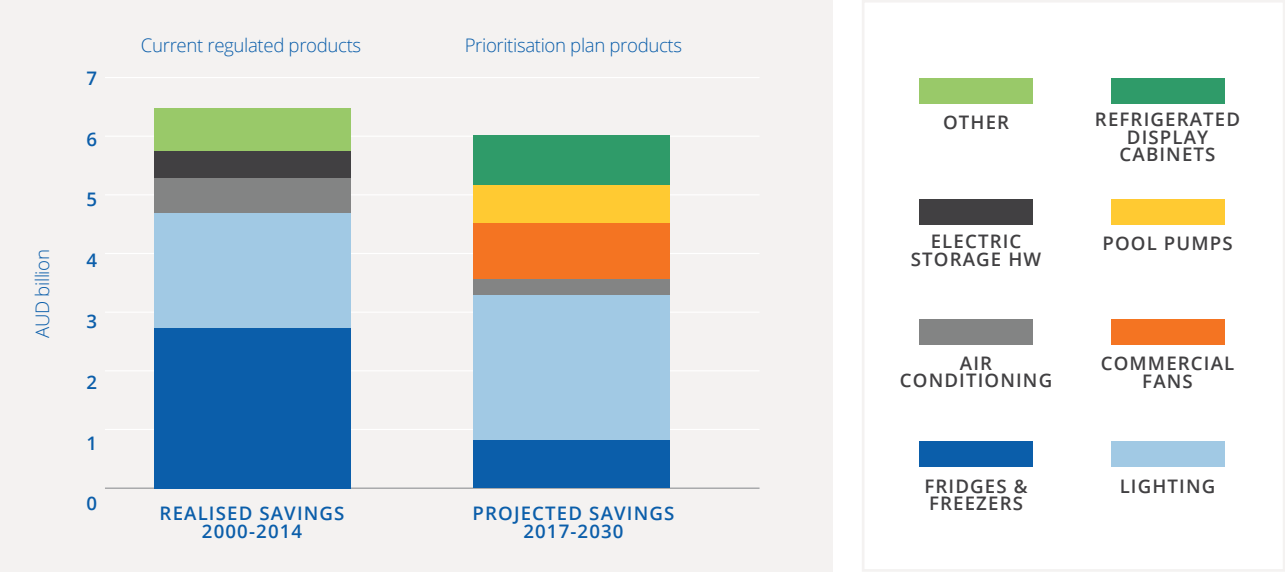
Australian governments collectively set minimum standards for a number of important appliances including fridges, televisions, air conditioners and electric motors through the Greenhouse and Energy Minimum Standards (GEMS) program. The GEMS program saves the average household between $140 and $220 each year on their electricity bill, which is about 10 to 15 per cent of the average annual bill.[81] Between 2000 and 2020 the current GEMS regulations will deliver between $9.4 and $18.8 billion in net benefits to consumers.

The GEMS program is also arguably Australia's most significant climate change program. The current GEMS regulations will deliver greenhouse gas savings that are equivalent to between nine and 15 per cent of Australia's 2020 emissions reduction target.[82]

Minimum standards for appliances also affect energy security and price. Improvements in the efficiency in homes and heaters in Europe have made it possible for countries like the UK and France to meet their gas security requirements.[83] Conversely, delays in the introduction of appropriate air conditioner standards in Australia contributed to the rapid growth in peak demand in the early 2000s, and the subsequent rise in electricity prices.

Australia's GEMS program has many similarities to overseas programs, but covers far fewer appliances than similar programs in the US, China and Canada, and lacks a number of features that are seen in places like Germany and Japan. The following international case studies focus on key practices in other countries that could be applied to improve Australia's GEMS program.

Figure 6.1 Benefits of the GEMS program and its future priorities



Source: International Energy Agency 2018, *Energy Policies of IEA Countries – Australia 2018 Review*, IEA, Paris, p. 212.

80 International Energy Agency 2018, *Energy Efficiency 2018 Market Report,* IEA, Paris, p. 88.

81 Department of the Environment and Energy 2018, *The Independent Review of the GEMS Act 2012 Draft Report,* Commonwealth of Australia, Canberra, p. 29

82 Ibid, p. 30.

83 International Energy Agency 2017, *Energy Efficiency 2017 Market Report*, IEA, Paris.

Japan

Japan introduced the *Top Runner* program for appliances and vehicles in 1998. Under this program, companies compete to produce the most efficient product in a class, such as a television set or light vehicle. Winning products are labelled *Top Runner*, which helps consumers identify leading appliances and provides marketing benefits to the winning company. The performance of the winning product is then used to set the minimum standard for that class of product at some point in the future, generally in five to ten years' time.

The *Top Runner* program gives companies advanced notice of appliance standards, demonstrates that standards are achievable, ensures that standards are regularly updated, and drives rapid improvement in product efficiency. The energy consumption of:

- Air conditioners in Japan fell 33 per cent between 2001 and 2011;
- Refrigerators by 43 per cent between 2005 and 2010; and
- Television sets by 60 per cent between 2008 and 2012.[84]

This has had a significant impact on energy use, as *Top Runner* includes 31 products and covers around 70 per cent of household energy consumption.

The *Top Runner* program isn't just about saving energy; it also helps to foster innovation which benefits consumers and keeps Japanese manufacturing at the forefront of many fields. The impact of standards on innovation isn't unique to Japan, with recent research finding that appliance standards in the US have significantly increased product quality without increasing product prices.[85]

The *Top Runner* program highlights the benefits of setting clear processes for regularly updating appliance standards, and for complementing minimum standards with top performance ratings and market transformation approaches. The program also highlights that well-designed standards can be a significant benefit to industry. It's also notable that most countries with major appliance and vehicle manufacturing sectors have strong minimum performance standards.

Canada

Canada has made significant efforts to harmonise energy efficiency standards with its trading partners in recent years, particularly the US and Mexico. Rather than watering down standards, international harmonisation has generally resulted in Canadian standards being significantly raised, delivering benefits to both consumers and manufacturers.

In 2016 Canada increased the minimum energy performance standards for 20 products to bring them into line with standards that were already in force, or soon to be in force, in the US. These products include air conditioners, washing machines, refrigerators, chillers and lighting products. Harmonising Canadian standards is estimated to deliver around AUD$1.6 billion of net benefits to Canadians by 2030.[86]

The Canadian experience highlights that Australian manufacturers and consumers would significantly benefit if Australia more actively harmonised its standards with major trading partners like the US, the European Union (EU) and China. This could be done by setting a trigger in the GEMS act to review or automatically update standards when they are raised in the US, EU or China.

European Union and Germany

Individual European countries have had appliance standards in place for many decades. In 2009 the EU adopted the *Ecodesign Directive 2009/125/EC* that sets up a framework for EU-wide appliance standards. This ensures that every member state has minimum standard for appliances, and also harmonises

84 International Energy Agency 2016, *Energy Policies of IEA Countries – Japan 2016 Review*, IEA, Paris, p. 53.

85 Brucal, A & Roberts, M 2017, "Do energy efficiency standards hurt consumers? Evidence from household appliance sales", *Centre for Climate Change Economics and Policy Working Paper No. 300,* London School of Economics, London.

86 Government of Canada 2016, "Energy Efficiency Regulations", *Canada Gazette*, Government of Canada, Ottawa, Part II, Vol. 150, available online from: http://www.gazette.gc.ca/rp-pr/p2/2016/2016-12-28/html/sor-dors311-eng.html.

standards in order to lower costs for industry and consumers.

The *Ecodesign Directive* is framework legislation, with standards for individual product groups set by EU regulatory committees, streamlining the process for introducing new standards. The framework currently covers around 40 energy-related product groups such as fridges, lights, television sets, windows and insulation.

Germany has advocated for the EU to move towards incorporating a *Top Runner* approach for setting standards, but in the meantime has set up a domestic process to increase the market penetration of highly energy efficient appliances. While Germany still uses the EU's appliance standards, it set up a National Top Runner Initiative (NTRI) in 2016. NTRI aims to transform supply chains and product markets by encouraging:

- Manufacturers to build more efficient appliances;
- Retailers to promote and sell more efficient appliances; and
- Consumers to purchase more efficient appliances.

The EU experience highlights both the importance of harmonising standards, and of streamlining the process for setting standards. The German experience builds on this and highlights the potential to formally complement appliance standards with other programs in order to speed up the transition to high-efficiency appliances.

Recommendations

Based on a review of international experience there are significant opportunities to enhance appliance standards in Australia. First, Japan demonstrates that Australia, via the COAG Energy Council, should:

13. **Formalise and streamline the process for introducing new appliance standards and raising standards over time.** Australia's system for setting standards is relatively ad hoc and inefficient. Australian agencies are often required to source local data to create the case for new or raised standards, even if there are already equivalent standards in place among our major trading partners and no reason for those standards to be different in Australia. This increases the cost and time to introduce new standards.

    As a result, Australia has standards in place for only 23 products, significantly fewer than the US, China and Canada. Moreover, our standards have fallen behind best practice for many products. In the past this has resulted in low-quality appliances that can no longer be sold in Europe or North America, such as air conditioners, being dumped into the Australian market. This has negative impacts on both consumers and local manufacturers, who generally produce goods to the highest international standard.

Second, Canada and the EU demonstrate that Australia, via the COAG Energy Council, should:

14. **Harmonise Australian appliance standards with our major trading partners, both in their ambition and details.** Having higher standards benefits consumers, and having harmonised standards reduces the cost of testing, which benefits both consumers and manufacturers. In addition, as Australian manufacturers generally produce goods to meet US and European standards, if our standards fall behind US and European standards it can result in local manufacturers competing with 'dumped' products. As a result, it's important to both consumers and manufacturers to keep Australian standards in line with our global trading partners, especially the US, EU and China.

Part of the process for setting Australian appliance standards should either be a schedule for regular reviews of appliance standards (e.g. every eight years), or the automatic review of an Australia appliance standard if a major trading partner raises its standard significantly above the current Australian standard.

Additionally, Germany demonstrates that all governments should:

15. **Complement appliance standards with processes that help prepare supply-chains to manufacture, distribute and adopt more efficient products.**

Finally, Australia would ideally move beyond harmonising its appliance standards with overseas standards, and proactively advocate for an international approach to setting standards. Consequently, the Australian Government should:

16. **Investigate a global approach to setting appliance standards** as many developing countries still lack appliance standards, and a global approach to standards could deliver substantial reductions in global greenhouse gas emissions.

7 Manufacturing

Australian manufacturers have been hit by extraordinarily rapid rises in energy prices, with electricity prices almost doubling and gas prices more than tripling in recent years.[87] This threatens the competitiveness and even viability of many Australian companies.

We need supply-side reforms to improve the affordability of electricity and gas, but these will take years to have a material impact on prices. In the meantime, experts like the IEA and Australian Industry Group have concluded that improving the energy efficiency of manufacturers will be critical to their competitiveness.[88, 89]

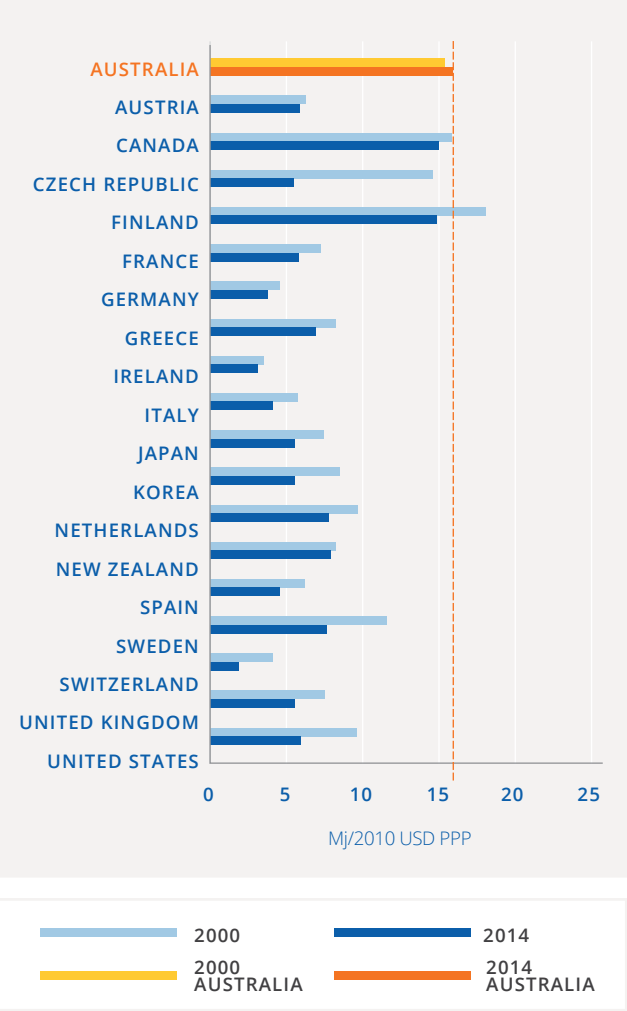
While rising energy prices have created a strong incentive for Australian companies to improve the way that they manage energy, most companies don't have all the capabilities and structures that they need to optimise their energy use. In the past, low energy prices meant that many companies placed limited focus on energy, and a 2012 survey of Australia's largest energy users found that, in over 70 per cent of companies, staff didn't have access to information about energy use in routine operations.[90]

Governments in other major developed and emerging economies have programs to improve their manufacturers' energy productivity, both to improve their competitiveness; and strengthen their electricity systems. This section looks at the major industrial efficiency programs in China, Germany, India, Japan and the US.

In contrast, Australia has major gaps in the support provided for manufacturers to improve their energy productivity. In 2006 the Howard Government introduced the Energy Efficiency Opportunities (EEO) program, which helped companies find over $1 billion in annual energy savings. The EEO program was considered a global leader in light-touch regulation, but was discontinued in 2014 against the advice of an independent review.

The NSW Government has recently launched a dedicated energy management program for manufacturers based in NSW, and the federal government and some state governments currently offer modest grants to help manufacturers improve their energy productivity. However, these programs collectively fall far short of the support that is offered to manufacturers in other countries.

Figure 7.1 Energy Intensity of manufacturing in 19 countries, 2000-2014



Source: International Energy Agency 2017 *Energy Efficiency Indicators 2017 – Highlights*, IEA, Paris.

87 Energy Efficiency Council 2018, *Navigating a dynamic energy landscape: a briefing for Australian businesses*, Energy Efficiency Council, Melbourne.

88 International Energy Agency 2018, *Energy Policies of IEA Countries – Australia 2018 Review*, IEA, Paris.

89 Australian Industry Group 2018, *From Worse to Bad: Eastern Australian Energy Prices*, Australian Industry Group, Melbourne.

90 ACIL-Tasman 2013, *Energy Efficiency Opportunities Program Review, Prepared for the Department of Resources*, Energy and Tourism, Canberra.

As a result, many Australian companies are struggling to respond to some of the fastest increases in energy prices seen in the developed world. A 2017 report by the IEA found that Australia's manufacturing sector is the most energy intensive of the nineteen advanced economies that they studied. Even more startling, we have the only manufacturing sector that became more energy intensive between 2010 and 2014.[91]

The good news is that with the right programs we can rapidly cut our manufacturers' energy bills. The industrial energy intensity of countries that are members of the IEA and other major economies fell by 25 per cent between 2000 and 2017, and leading companies achieved far more.[92]

Helping Australian manufacturers implement the data management, technologies and practices to improve their energy efficiency won't just help them deal with rising energy prices, it will set them up to thrive in the 21st century. Analysis by ClimateWorks Australia found that companies with leading energy productivity practices had much higher overall profitability; companies that adopted best practice could increase their profits by 11 to 69 per cent over five years.[93]

Just as importantly, improving the way that large energy users manage energy will strengthen Australia's energy systems. Improving manufacturers' gas efficiency is the fastest and surest way to improve the demand-supply balance and lower gas prices. Demand response by industrial energy users could provide 3.1 gigawatts of dispatchable capacity, far more than Australia's largest coal-fired generator.[94] This capacity is critical to help our energy system ride through its current challenge.

China

In 2006 China launched the Top 1,000 Enterprises program to improve the energy efficiency of the 1,000 largest enterprises in China. The program required firms to identify and implement energy savings, with an overall aim to save 100 million tons of coal equivalent (Mtce). The program significantly exceeded its target, saving over 4,400 PJ of energy, more than 70 per cent of Australia's annual total primary energy consumption.[95, 96]

In 2011 this program was expanded to become the Top 10,000 Enterprises program, aiming to help around 17,000 firms to save around 250 Mtce of energy. The program requires large energy users to establish energy management systems based on the Chinese standard (GB/T 23331), estimate their energy saving potentials, and report them to governments. Governments then set those enterprises annual energy saving targets and, if they failed to meet their targets, they were required to undergo further energy audits.

The Top 10,000 Enterprises program is designed around the Chinese system of governance and many elements would not be transferrable to Australia. However, it has key features that are common with other overseas programs, including mandates and support for companies to implement energy management systems.

Germany

Germany also encourages companies to use energy management systems and, in some cases, meet targets for energy efficiency improvements. However, the German system is based on financial incentives. Companies can claim relief from the German Renewable Energy Surcharge if they have an energy management system that is compliant with a standard like ISO 50001 – the global standard for energy management systems. Companies in some sectors can also secure a 90 per cent refund of gas and electricity taxes if the entire sector agrees to adopt energy management systems and reduce their energy intensity by at least 1.35 per cent per annum.[97]

The incentive for German companies to implement an energy management system and improve their energy efficiency is significant; by the end of 2017 companies had claimed over $7 billion in relief from surcharges and taxes. Given the very high rate of take-up, these

91 International Energy Agency, 2017, *Energy Efficiency Indicators 2017 – Highlights*, IEA, Paris.

92 International Energy Agency 2018, *Energy Efficiency 2018*, IEA, Paris.

93 ClimateWorks Australia 2016, *Could Boosting Energy Productivity Improve Your Investment Performance? A guide for Investors*, ClimateWorks Australia, Melbourne.

94 ClimateWorks Australia 2014, *Industrial demand side response potential: Technical potential and factors influencing uptake. Initial findings and discussion paper,* ClimateWorks Australia, Melbourne.

95 International Energy Agency 2017, *Energy Efficiency Market Report 2017*, IEA, Paris

96 Department of the Environment and Energy 2018, *Australian Energy Update 2018*, Commonwealth of Australia, Canberra.

97 International Energy Agency 2018, *Energy Efficiency Market Report 2018*, IEA, Paris, p. 111.

incentives for energy management could be seen as penalties for failing to implement energy management measures.

As a result, Germany has more companies with energy management systems that are certified as compliant with ISO 50001 than any other country (see Figure 7.2). German companies have also substantially improved their energy efficiency. Sectors that have qualified for refunds from the gas and electricity taxes have reduced their energy intensity by around three per cent per annum, substantially higher than the minimum target of 1.35 per cent per annum.

India

India's Perform, Achieve, Trade (PAT) scheme sets targets for large energy using sites to reduce their energy consumption. Each facility is set an individual target based on the benchmark for its sector, which means that less efficient facilities need to reduce their energy consumption more than efficient facilities. Companies that exceed their savings targets can generate certificates, and since 2017, they have been able to sell these certificates to companies that fall short of their targets. This provides an incentive for companies to both meet and exceed their targets.

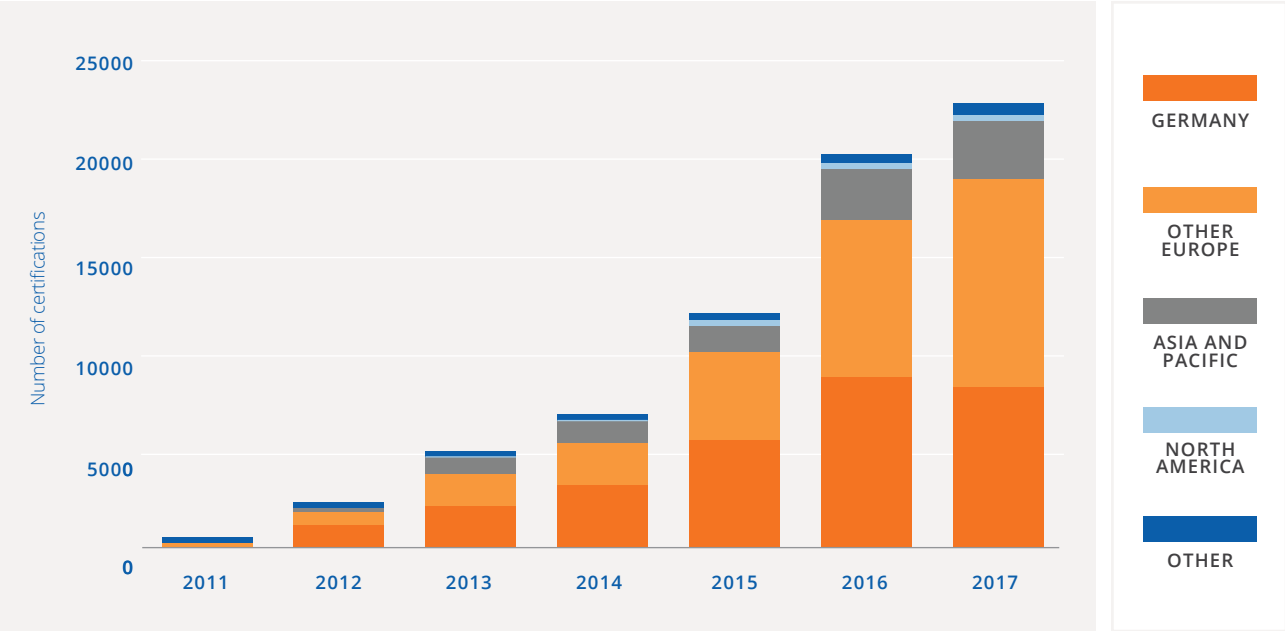
The first cycle of the PAT scheme ran from 2012-15, with targets set for 427 enterprises from eight sectors, including aluminium, cement, and pulp and paper. The scheme reduced energy use across participating facilities by an estimated 5.3 per cent, exceeding the 4.1 per cent target. The second cycle of the PAT scheme, which runs from 2016 to 2019, has been expanded to cover around 621 enterprises and aims to reduce total industrial energy use by four per cent compared to 2009-10 levels.

Japan

Japan introduced the *Energy Conservation Act* (formally titled the *'Act Concerning the Rational Use of Energy'*) in 1979 and it has been updated on multiple occasions. The *Act* requires large energy users to implement measures to help them to manage their energy use, including appointing a qualified energy manager and regularly reporting their energy consumption and energy saving measures to government.

The Government complements these mandates with comprehensive support to help large and small businesses find and implement energy saving opportunities. The Energy Conservation Centre, Japan (ECCJ) provides accreditation and training for energy

Figure 7.2 ISO 50001 certifications 2011-2017



Source: International Energy Agency 2018, *Energy Efficiency Market Report 2018*, IEA, Paris, p. 110.

managers and delivers hundreds of basic energy audits each year.

Since 2009 large energy users have been required to improve their energy intensity by at least one per cent per annum. In the steel, cement, pulp and paper, and chemicals manufacturing sectors companies are also required to meet sector-specific performance benchmarks, which are based on the performance of the top 10 to 20 per cent of companies within that industry sub-sector.[98]

Companies that fail to meet their improvement targets are provided with advice and support. The Japanese Government can take stronger measures if companies still fail to meet their targets, although Japanese experts that we interviewed were unaware of any instances where matters had escalated to this level.

As a result, Japanese manufacturers have been amongst the world's most efficient for many decades. However, Japanese companies placed an even greater focus on energy management following the closure of the Fukushima Daiichi Nuclear Power Plant, and have improved their energy intensity by 1.4 per cent per annum in recent years. This is significantly higher than the minimum target of one per cent per annum.[99] This indicates the extraordinary potential for continuous improvement in energy management.

United Kingdom

Larger energy users in the UK pay a Climate Change Levy (CCL) for each unit of energy that they use. However, energy users can get a substantial discount – 65 to 90 per cent – off their levy if they voluntarily sign a Climate Change Agreement (CCA).

Under a CCA a company – or a whole sector – agrees to a target to reduce its greenhouse gas emissions. Companies need to measure and report their energy use and emissions and, if they meet their target every two years, they are eligible for the reduction in the CCL.

United States

The majority of industrial energy efficiency programs in the US have been run by the states, including utility-led energy efficiency schemes (see section 5). The federal government has largely focused its efforts on capacity building, including the development of ISO 50001, the energy management system that energy users can adopt to help them save energy and strengthen their competitiveness.

However, in 2005 the US Federal Government launched the *Save Energy Now* program in response to volatility in US gas prices. The program offered energy users training, information, tools and support, and high-quality energy audits by a panel of pre-qualified experts.

The *Save Energy Now* program aimed to not just reduce large energy users' gas bills, but actually reduce gas prices by reducing demand for natural gas in a tight market. The Department of Energy conservatively estimated that a 1.3 per cent reduction in US gas demand would alleviate the tightness in the market enough to reduce gas prices by four to ten per cent.[100] This program was wound back as gas supplies increased and prices fell in the US.

98 International Energy Agency 2018, *Energy Efficiency Market Report 2018*, IEA, Paris, p. 105.

99 Ibid, p. 105.

100 Olsen, B 2009, *Save Energy Now*, Webcast presentation delivered by the US Department of Energy, Washington DC.

Recommendations

All Australian governments and institutions should:

17. **Re-establish long-term capacity building mechanisms for industrial energy management.** In February 2018 the IEA recommended that the Australian Government reintroduce an industrial energy efficiency program similar to the EEO program. While there are differences between leading countries' programs for manufacturing efficiency, there are four elements that are common to effective programs:

    - Ensuring that companies have sound **energy management systems**. Countries use a range of systems, and while it may be too onerous for smaller sites to get ISO 50001 accreditation, all manufacturers should be able to implement a basic energy management system;
    - **End-to-end support programs** to help energy users identify and implement energy saving measures;
    - **Funding for the training and accreditation of energy managers;** and
    - **Mechanisms to ensure senior managers focus on energy management.** These include minimum energy saving targets, mandatory energy audits, mandatory energy management systems and incentives.

Given recent, rapid increases in gas and electricity prices are threatening the viability of Australian manufacturers, all Australian governments and institutions should also follow the example of the US and:

18. **Establish a substantial but short-term grants program to help large energy users reduce their exposure to gas prices.**

8 Buildings

Improving the energy efficiency of residential and commercial buildings will deliver huge benefits to Australia. The Australian Sustainable Built Environment Council (ASBEC) estimates that implementing cost-effective building and appliance upgrades could reduce buildings' energy consumption by over 25 per cent by 2030, reducing households' and businesses' energy bills by a cumulative $20 billion over 15 years.[101]

While the building sector uses less energy from all fuels than the industrial sector, it's a heavy electricity user, accounting for 57 per cent of Australia's electricity use.[102] This means that improving the energy efficiency of buildings will have a large impact on both the reliability and affordability of the electricity system. California has long recognised the close relationship between the building and electricity sectors, and the California Energy Commission regularly considers what mix of energy generation and building standards will deliver the lowest costs to consumers.

Buildings' energy efficiency also affects occupants' health and wellbeing. Australia has double the rate of cold-associated deaths as Sweden, and building quality has been implicated as a causal factor.[103] In total over 3,000 Australians are estimated to die each year during periods of hot and cold weather, almost double the number of Australians that die in road accidents.

There is no single policy that can optimise energy management in the building sector, because energy use is affected by a wide variety of factors, including:

- A variety of materials and equipment, including building fabric (e.g. walls) fixed appliances (e.g. hot water systems) and plug-loads (e.g. computers);
- Actions over varying timescales. Some equipment and building features are replaced on a regular basis, others can stay in place for decades; and
- Actions on varying scales, including individuals' behaviour, design decisions, and major societal and market trends.

Therefore, an effective approach to improving the energy efficiency of buildings requires an integrated strategy. The European Union (EU) introduced its first integrated plan in 2002, the *Energy Performance of Buildings Directive*, and has updated the *Directive* several times since then. The *Directive* requires countries to adopt a range of measures, although it gives them flexibility in how they approach them. For example, France's strategy for complying with the *Directive* includes requiring buildings to disclose an energy efficiency rating when they are listed for sale, and requiring all residential buildings to have an energy efficiency rating of 'E' or higher by 2025.

This section doesn't attempt to set out a comprehensive strategy for the built environment. Instead, it highlights three major areas where Australia should learn from other major economies, specifically:

- Strengthening construction codes for new buildings and major retrofits;
- Disclosing the energy efficiency of new and existing buildings; and
- Minimum standards for rental properties.

All of these policies are critical. While construction codes are vital to ensure that new buildings perform to a minimum standard, they only affect existing buildings if they are substantially upgraded or rebuilt. The IEA's recent review of Australia's energy policies explicitly states **"energy efficiency in existing buildings deserves more attention at both national and state levels because of the long lifetime of buildings."**[104] This makes performance disclosure for all buildings and minimum standards for rental properties essential.

101 Australian Sustainable Built Environment Council and ClimateWorks 2016, *Low Carbon High Performance*, ASBEC, Sydney.

102 International Energy Agency 2018, *Energy Policies of IEA Countries – Australia 2018 Review*, IEA, Paris, p. 217.

103 Gasparrini, A et al 2015, 'Mortality risk attributable to high and low ambient temperature: a multicountry observational study', *The Lancet*, vol. 386, no. 1991, pp. 367-375.

104 International Energy Agency 2018, *Energy Policies of IEA Countries – Australia 2018 Review*, IEA, Paris, p. 217.

8.1 Strengthening construction codes

Residential and commercial buildings constructed after 2019 could make up 51 per cent of the building stock by 2050.[105] Construction codes that set out minimum energy efficiency requirements are widely recognised as the cheapest and most effective way to ensure that new buildings are energy efficient and avoid poor design being locked-in for decades.

Construction codes are essential because builders, sub-contractors and some developers face strong incentives to cut corners in the construction phase, while building occupants pay the long-term costs of running a building. As a result, every major developed and emerging economy has minimum standards for the construction and major refit of residential and commercial buildings.

In Australia minimum standards for new buildings and major rebuilds are set out in the National Construction Code (NCC), which is developed by the Australian Building Codes Board on behalf of the Council of Australian Governments (COAG). State and territory governments put legislation in place to apply the NCC within their jurisdictions and manage compliance with the NCC alongside local governments.

Australia's NCC is significantly weaker than other major economies', even taking account for Australia's relatively mild climates.[106] Australian standards for new commercial buildings have just been lifted, but our standards for residential buildings significantly lag those in regions with comparable climates.

However, the most glaring gap between Australia and best practice global policy is the lack of a pathway for increasing the stringency of the NCC over time.[107] Construction codes need to be updated over time with the emergence of new products and services, and a forward trajectory delivers benefits, including:

- Simplifying the process for updating codes for both regulators and industry;
- Providing clarity for industry which helps planning and investment and lowers compliance costs; and
- Encouraging innovation and early adoption, which lowers costs and creates valuable products and services to export into global markets.

Research by ASBEC and ClimateWorks Australia shows a forward pathway for strengthened NCC energy requirements could, between now and 2050, reduce energy bills by up to $29 billion, cut energy network costs by up to $13 billion, and reduce greenhouse gas emissions by a cumulative 78 million tonnes.[108]

ASEBC and ClimateWork's analysis also demonstrates that delaying action will cost Australian families and businesses dearly. A three-year delay in upgrades to building energy performance standards could lead to $2.6 billion in wasted energy expenditure and $720 million of additional electricity network investments, while locking in an additional 22 million tonnes of greenhouse gas emissions to 2050.

There is now global consensus that pathways for new buildings should aim for net zero emissions, noting that some of the reduction in the emissions-intensity of buildings could come from changes to electricity supply. Countries vary in the timeframes they set for this transition, with some already requiring nearly zero emission homes (e.g. Ireland) and others aiming to reach net zero emission homes by 2030 (e.g. Canada).

On 2 February 2019 the COAG Energy Council endorsed the move to a pathway to tighten the NCC in Australia, which was subsequently passed by the Building Ministers Forum to the Australian Building Codes Board for consideration.

Denmark

Denmark is a global leader in setting clear pathways for building standards. Denmark introduced its first energy efficiency standards for new buildings in 1962, and has progressively tightened them over time. In 2008 the Danish Government decided to increase standards to reduce the energy use of a new building by 75 per cent between 2008 and 2020. In order to provide industry with time to adjust to this major tightening of standards, Danish Building Regulations were tightened in three stages, with the total

105 Australian Sustainable Built Environment Council and ClimateWorks Australia 2018, *Built to Perform – An industry led pathway to a zero carbon ready building code,* ClimateWorks, Melbourne.

106 Ma, Y. Miller, W. Saha, S. & Guan, L. 2017, "Comparison of Building Codes in Australia, United States and China for Australian Commercial Building Energy Conservation", *Proceedings of the AIRAH and ABPSA Australasian Building Simulation 2017 Conference*, AIRAH, Melbourne.

107 International Energy Agency 2018, *Energy Policies of IEA Countries – Australia 2018 Review*, IEA, Paris, p. 212.

108 Australian Sustainable Built Environment Council and ClimateWorks Australia 2018, *Built to Perform – An industry led pathway to a zero carbon ready building code,* ClimateWorks, Melbourne.

permitted energy use of new buildings being reduced by 25 per cent in 2010, a further 25 per cent in 2015, and a further 25 per cent in 2020.

European Union

The EU's 2018 *Energy Performance of Buildings Directive* requires member states to ensure that all new buildings are nearly zero-energy buildings by 31 December 2020 – i.e. buildings have very low energy demands, which are met by renewable energy. States are given a broad degree of flexibility in meeting this target. Austria, Germany, Finland, Ireland, the Netherlands and Sweden have already set targets to ensure that new buildings are nearly zero-energy by 2020, and France has set the code for new buildings to be energy positive by 2020.

United States

Building code requirements in the US can vary by state and city, but are generally based on national model codes that are updated every three years. The US Department of Energy has set a goal for all new commercial buildings to be net zero emissions by 2030, and all commercial buildings to be net zero emissions by 2050. Some jurisdictions have also set ambitious targets for residential buildings, with California aiming for all new residential buildings to have net zero electricity by 2020 and Boulder in Colorado aiming for all new buildings to be net zero energy by 2031.

Recommendations

All Australian governments and institutions should:

19. **Commit to a major update to residential building standards in 2022.**

20. **Set a national pathway for tightening the NCC over time,** working with the building industry through ASBEC to set a national pathway for **tightening residential and commercial building standards in 2025 and 2028 to achieve net zero emissions by 2030.**

8.2 Disclosing the energy efficiency of homes

Without expert assistance, most homebuyers and tenants find it very challenging to work out how efficient homes are before they buy or lease them. This reduces the incentive for builders and building owners to invest extra resources in making buildings more efficient. Introducing a scheme to rate the efficiency of homes can unlock the power of the market to improve energy efficiency, as it enables buyers and tenants that are willing to pay more for efficient homes to find those homes.

Schemes that provide information on the energy use or energy efficiency of homes have been implemented in other countries since the 1980s.[109] Global schemes vary from very simple approaches in Alaska and New Zealand, to much more comprehensive programs in Europe, where buyers are provided with energy efficiency ratings and tailored advice on improving the efficiency of a home.

The ACT Government introduced a mandatory energy efficiency rating program for homes in 1999. Several reviews have concluded that it has been highly effective, although exemptions need to be reduced for rental properties.[110] Victoria has started to roll out a voluntary Residential Efficiency Scorecard, and the Low Carbon Living CRC has comprehensively examined how to design a national scheme through its EnergyFit Homes Initiative.[111] However, there is still no national mandatory energy efficiency disclosure scheme for homes, despite COAG agreeing to introduce one in 2009.

The potential benefits of a national mandatory residential disclosure program have been demonstrated in Australia though both the ACT's Energy Efficiency Rating program and the national Commercial Building Disclosure (CBD) program. The CBD program requires building owners to disclose National Australian Built Environment Rating System (NABERS) Energy ratings for offices – over 1000m2 – when they are sold or leased. The program has significantly increased the energy efficiency of Australia's offices, delivering well over $72 million in savings and over $168 million in improved occupant productivity.[112]

109 Clark, M 2015, *The EnergyFit Homes Initiative Working Paper 7: International information Systems for Household Energy Efficiency*, Common Capital, Sydney.

110 Fuerst, F & Warren-Myers, G 2018, 'Does voluntary disclosure create a green lemon problem? Energy-efficiency ratings and house prices', *Energy Economics*, vol. 74, pp. 1–12.

111 Adams H, Clark M, & Potts J 2016, *Enhancing the Market for Energy Efficient Homes: Implementing a national voluntary disclosure system for the energy performance of existing homes*, CRC for Low Carbon Living, Sydney.

112 ACIL Allan 2016, *Commercial Building Disclosure Program Review – Final Report – Report*, prepared for the Department of Industry and Science, Canberra.

New Zealand

Insulation is normally hidden from occupants, and tenants often don't know if their homes have insulation. The Healthy Homes Guarantee Bill 2016 (which is discussed in section 8.3) requires all landlords to disclosure the extent of insulation in their properties to prospective tenants. This basic requirement needs to be understood as part of a more comprehensive insulation program (see section 8.3), but still provides prospective tenants with important information on building quality.

United States

Home energy efficiency disclosure requirements vary across the US. In a number of states, such as Alaska and Hawaii, homeowners are required to disclose information about their energy bill or energy consumption to prospective buyers and tenants.[113]

However, there is now general consensus that, unlike commercial buildings, a dwelling's energy use can vary dramatically depending on the number of occupants and their behaviour. This means that disclosing a residential building's features (e.g. the presence of insulation) is generally more useful for incoming occupants than previous energy use. As a result, jurisdictions such as the City of Portland, Oregon, have followed the European approach and started to introduce programs that rate the features of a home.

European Union and the United Kingdom

Article 7 of the EU's 2002 *Energy Performance of Buildings Directive* requires Member States to ensure that prospective buyers and tenants are provided with Energy Performance Certificates (EPCs) for residential and commercial properties. European countries vary in how they implement Directives, and so this section focuses on EPCs in the UK in more detail.

In 2007 the UK Government introduced a requirement for EPCs to be produced when buildings are built, sold or rented. An EPC in the UK includes an energy efficiency rating for a property and recommendations on how to improve the efficiency of the building.[114] EPCs assess the features of a home, rather than the amount of energy that a home uses. As rating schemes need to make a series of assumptions about how features are likely to affect the energy efficiency of a home, they need to be carefully designed.

EPCs are produced by accredited assessors, who visit homes and put the details of features, such as insulation and fixed appliances into a software program to produce a rating. The system is relatively cost effective, with assessments costing around AU$100 and remaining valid for ten years.

Evaluations have found that homes with higher EPC ratings attract higher sale and leasing prices in many European states. The impacts of EPCs vary between countries depending on what other policies are in operation, the design of the rating tool, levels of compliance, and people's awareness of the benefits of higher EPC ratings for comfort and affordability.[115]

The European experience suggests that while rating systems are not silver bullets, they're important as part of a broad strategy to improve building efficiency. For example, while the EPC program in the UK has had a modest impact, it forms the basis of minimum standards for rental properties. In the Netherlands, a combination of policies resulted in the proportion of homes with poor energy efficiency ratings (E and below) drop from 70 per cent in 2000 to 36 per cent in 2012.[116]

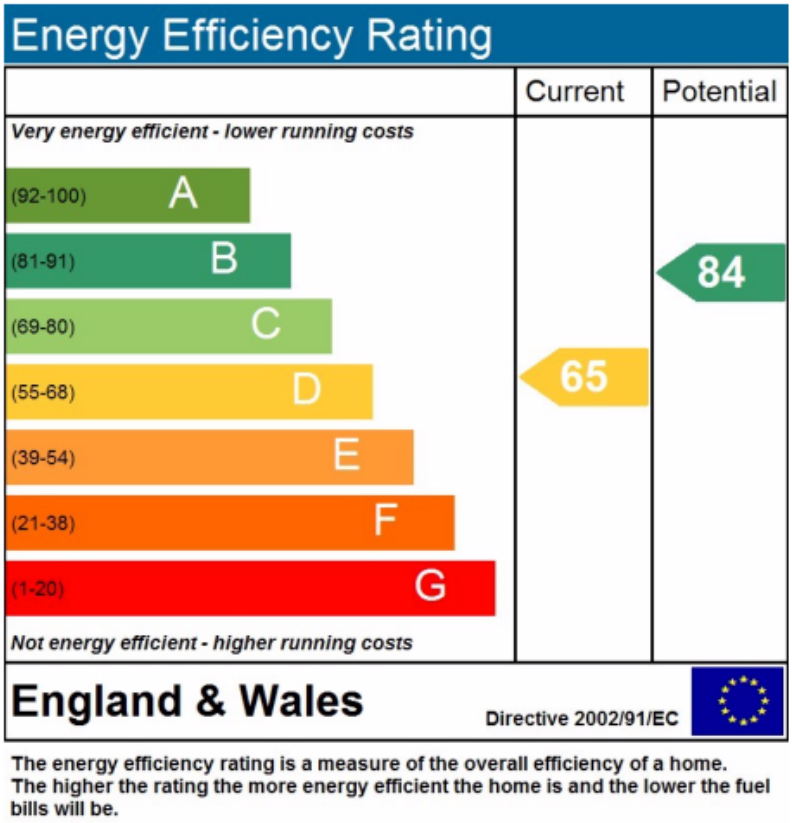
113 Clark, M 2015, *The EnergyFit Homes Initiative Working Paper 7: International information Systems for Household Energy Efficiency*, Common Capital, Sydney.

114 Buildings are rated from 'A' (most efficient) to 'G' (least efficient).

115 Mudgal, S, Lyons, L, Cohen, F, Lyons, R & Fedrigo-Fazio, D 2013, *Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries*, Final report prepared for European Commission, Bio Intelligence Service, Oxford University & Institute for European Environmental Policy, Paris.

116 Gynther, L & Gerdes, J 2014 "Energy performance certificates," *Presentation to the Second meeting of the Project "Monitoring of energy efficiency in the EU"*, ODYSEE-MURE, London.

Figure 8.1 Example of an Energy Efficiency Rating from the UK



Recommendations

There is strong public support for energy efficiency disclosure for homes; a survey in 2018 found that 83 per cent of Australian voters supported this policy, and only six per cent of voters opposed it.[117] COAG should honour its commitment from 2009 and:

21. **Introduce a national program to rate the energy efficiency of residential properties at sale or lease,** and states and territories should collaborate with each other and industry to ensure that the program is well-designed and complemented by a strong compliance and promotion regime. **Governments should set a clear timeframe for introducing the scheme, with ratings intially being voluntary refine the scheme, and then becoming mandatory no later than 2022.**

117 Australian Council of Social Services, Energy Efficiency Council and Property Council of Australia 2018, *Energy Bills and Energy Efficiency - Survey of Community Views*, Energy Efficiency Council, Melbourne.

8.3 Minimum standards for rental homes

Around 31 per cent of Australians live in rented accommodation, and this proportion is steadily increasing.[118] Unfortunately, many rental properties are poorly ventilated, draught-proofed and insulated, which can have serious impacts on tenants' energy bills and health. For example, over 80 per cent of owner-occupied homes have some form of insulation, but that figure falls to less than 40 per cent for private rentals.[119]

While tenants would benefit from lower energy bills and better health outcomes, there are substantial barriers to bringing private homes up to scratch:

- There are limited incentives for landlords to improve the energy efficiency of their properties, especially in tight rental markets;
- Tenants typically aren't allowed to make changes to properties; and
- Leases are typically short and uncertain, significantly reducing the incentive for tenants to invest in upgrades that deliver benefits over many years.

Some state governments have made efforts to upgrade the energy efficiency of public housing, but there has been much less focus on private rental properties. Private landlords rarely respond to voluntary programs that offer support or even generous subsidies to building owners to upgrade their properties.[120]

Introducing minimum standards for the quality of rental properties appears to be the most effective way to ensure that rental properties are fit for habitation. The Victorian and Queensland parliaments recently passed legislation to enable those governments to set minimum standards for rental homes. However, as yet no government in Australia has actually introduced strong energy efficiency standards for rental homes.

There is significant potential to learn from overseas experience, where several governments have introduced minimum standards for rental properties.

City of Boulder, Colorado (United States)

In 2010 the City of Boulder passed a requirement for rental properties to meet minimum energy efficiency requirements. Under the SmartRegs ordinance, properties need to secure 100 points in an energy efficiency assessment to be licensed for rental. As the City of Boulder was a global pioneer, it took a conservative approach and gave landlords until 31 December 2018 to prove that they were compliant with the standards. Landlords were also offered rebates for some types of upgrades.

By 31 December 2018, 97 per cent of the 23,000 rental units in the City of Boulder had been assessed for compliance. Of these, 96 per cent were compliant, including 32 per cent that had been upgraded to meet the standard.[121] The average cost to bring a non-compliant unit up to the standard was US$3,022, which was offset by an average rebate of US$579. In total, bringing Boulder's rental homes up to scratch has cost US$7.2 million in combined private and public investment, and reduced energy bills by US$520,000 a year, proving that minimum standards are both possible and affordable.[122]

New Zealand

In 2017 the New Zealand Parliament passed the *Healthy Homes Guarantee Act*, which requires rental properties to meet minimum standards for heating, insulation, ventilation and drainage. Landlords were given several years to bring their properties up to the standard, with ceiling and underfloor insulation to become compulsory in all rental homes from 1 July 2019. Once the standards become mandatory, landlords that fail to comply with the standards will be liable for penalties of up to NZ$4,000. The New Zealand Government also offered grants to landlords with low-income tenants to help them meet the standards – these grants will cover up to 50 per cent of the cost of installing insulation.

118 Australian Bureau of Statistics 2017, *Census Data Survey, Australia: Summary of Results, 4670.0*, Commonwealth of Australia, Canberra.

119 Australian Bureau of Statistics 2013, *Household Energy Consumption Survey, Australia: Summary of Results, 4670.0*, Commonwealth of Australia, Canberra.

120 Lovering, M 2013, "Can Low-income Tenants Rent an Energy-efficient Home?", *AHURI Evidence Review 040*, Australian Housing and Urban Research Institute, Melbourne.

121 City of Boulder 2018, *SmartRegs Program-to-Date Progress Report*, City of Boulder, Boulder, accessed online 8 Jan 2019, available from: https://www-static.bouldercolorado.gov/docs/SmartRegs_Dashboard__Q3_2018-1-201810091504.pdf?_ga=2.216261782.1245924962.1546909622-1242227485.1546909622.

122 Energy Efficiency and Conservation Authority 2019, *Funding for insulation*, Ministry of Business, Innovation and Employment (MBIE), Wellington, accessed from: https://www.energywise.govt.nz/funding-and-support/funding-for-insulation/.

United Kingdom

The UK Government introduced the *Energy Efficiency (Private Rented Property) (England and Wales) Regulations* in 2015. These Regulations will require all privately rented residential *and* commercial properties to meet minimum energy efficiency standards – an Energy Performance Certificate rating of E or above. It's been estimated that around 20 per cent of private rental properties will need to be upgraded to meet this standard.

Like New Zealand, the British standards are being phased in over time, with properties being required to comply with the standards for:

- All new and renewed leases from April 2018;
- All residential properties with existing tenancies from April 2020; and
- All commercial properties with existing tenants from April 2023.

Recommendations

Australian states and territories should urgently:

22. **Introduce minimum standards for private rental accommodation, focusing on bringing homes up to minimum health, safety and affordability standards.** There is extraordinarily strong public support for minimum rental standards in Australia. In Victoria, a survey found that almost 100 per cent of tenants support mandatory minimum standards, 71 per cent of landlords support standards and just 10 per cent of landlords oppose them.[123]

While minimum standards will likely need to be introduced through state and territory legislation, there would be substantial benefits to national collaboration on this issue. National collaboration could, at the very least, lower the cost of research to support the introduction of appropriate standards and potentially could enable for the alignment of federal incentives with state and territory standards.

Some experts believe that the introduction of minimum standards for rental properties in Australia would automatically provide an incentive for landlords to upgrade their properties, as it means that energy efficiency upgrades would count as tax deductible repairs.[124, 125] Nevertheless, all Australian governments and institutions should:

23. **Consider whether grants may be appropriate to help the landlords of low-income properties meet minimum rental standards.**

The urgent priority should be focusing on minimum standards for residential rental properties, but governments should separately consider minimum standards for commercial rental properties. Australia's Premium and A-grade commercial building properties are now world leaders in energy efficiency and most would substantially exceed any minimum energy efficiency standard. However, lower-grade commercial properties suffer the same problems as residential properties, and are well below the ideal standard from a health and comfort perspective.

The UK is introducing minimum standards for both residential and commercial rental properties; Australian governments and institutions should also:

24. **Consider a minimum standard for rented commercial properties that is phased in over several years.**

123 Wrigley, K & Crawford, R 2015, *Bridging the Gap: Energy Efficiency Improvements for Rental Properties*, The University of Melbourne, Melbourne.

124 Clark, E, Eaton, K & Foster, J 2018, *Mandatory minimum energy efficiency standards for the private rental sector*, Northern Alliance for Greenhouse Action, Brunswick.

125 Wrigley, K & Crawford, R 2017, 'Identifying policy solutions for improving the energy efficiency of rental properties', *Energy Policy*, vol. 108, pp. 369–378.

9 Transport

Transport is households' third greatest expense after housing and groceries.[126] Improving vehicles' fuel-efficiency is one of the greatest opportunities to address Australians' cost of living, with a typical metropolitan household spending over $3,500 on fuel in 2017-18, and a typical regional household almost $3,900.[127] To address fuel costs, Australia must introduce long-overdue fuel-efficiency standards for petrol and diesel vehicles and prepare for the global shift to electric vehicles.

9.1 Fuel-efficiency standards for vehicles

Australia is virtually the only developed country that doesn't protect consumers with fuel-efficiency standards for light vehicles (cars, vans and small trucks). The lack of standards has costs Australians billions of dollars in wasted fuel.

Fuel-efficiency standards for light vehicles were introduced almost 40 years ago in the United States (US), Japan and many European Union (EU) countries, and have subsequently been legislated in most developed economies, and major emerging economies. It is notable that standards are in place in all countries with major automotive industries, including China, Germany and Japan. Many countries have recently, or are in the process of, tightening their fuel-efficiency standards for light vehicles.

While global fuel-efficiency standards for heavy trucks have lagged standards for light vehicles, they are being considered in the EU and were recently introduced in five major economies: Canada, China, India, Japan and the US.[128]

Fuel efficiency standards deliver major savings for consumers. Just the increase in fuel efficiency standards in the EU since 2000 has reduced consumers' fuel bills by over 15 per cent in countries like France. And tighter standards in Japan have cut fuel bills by 35 per cent, saving Japanese consumers a whopping $24 billion in 2016 alone.[129]

United States

The US introduced Corporate Average Fuel Economy (CAFE) standards for light vehicles in 1978. Rather than set a minimum standard for all cars, CAFE standards set a minimum average fuel efficiency for all vehicles sold by a manufacturer in the US, which encourages improvements in efficiency across all models. The CAFE standard approach is generally used by other major economies. There is generally bipartisan support for CAFE standards in the US, and the standards were strengthened by both President George W. Bush and President Barack Obama.

European Union

Many EU countries introduced fuel efficiency standards in the 1970s, and the EU introduced common standards in 1998. Standards have been progressively tightened, and testing regimes for both emissions of local air pollutants and fuel-efficiency have been strengthened, following revelations in 2015 of Volkswagen's non-compliance with local air pollutant standards. In 2018, the European Council agreed to standards for new cars that will reduce carbon dioxide emissions per kilometre by a further 15 per cent by 2025, and 30 per cent by 2030.[130]

Japan

Japan introduced fuel efficiency standards in 1979, and now has the world's most advanced fuel-efficiency standards in the world. These standards sit under its *Top Runner* program (see section 6). The *Top Runner* program has spurred Japan's automotive sector to continuous innovation and, rather than act as a

126 Australian Bureau of Statistics (ABS) 2018, *Household Expenditure Survey, Australia: Summary of Results, 2015-16*. Report 6530.0, ABS, Canberra.

127 Australian Automobile Association (AAA) 2018, *Transport Affordability Index June 201*8, AAA, Canberra.

128 International Energy Agency 2017, *Energy Efficiency Market Report 2018*, IEA, Paris, p. 51.

129 International Energy Agency 2017, *Energy Efficiency Market Report 201*7, IEA, Paris.

130 European Council 2018, *CO2 emission standards for cars and vans: Council agrees its position*, Press Release dated 10 October 2018, European Council, Brussels, available online from: https://www.consilium.europa.eu/en/press/press-releases/2018/10/10/co2-emission-standards-for-cars-and-vans-council-agrees-its-position/.

competitive disadvantage, it has kept Japan at the forefront of the global car industry.

China

China introduced fuel efficiency standards for light vehicles in 2004 and has progressively phased in stronger standards over the past fourteen years for a range of vehicles, including two- and three-wheeled vehicles and heavy vehicles. Unusually, China put in place both CAFE standards, to encourage a reduction in average emissions across each automotive manufactures' suite of vehicles, and minimum weight-based fuel-efficiency standards that every vehicle must meet.[131]

India

India introduced its first fuel-efficiency standards in 2017, but has also made a global first by dramatically raising their standards for local air pollutants (emission standards) directly from the Euro 4 standard to the Euro 6 standard. In 2018, India implemented fuel-efficiency standards for commercial heavy-duty vehicles.

Recommendations

The IEA recommends that Australian governments and institutions should:

25. **Introduce strong fuel-efficiency standards for vehicles.** If Australia introduced CAFE standards for light vehicles that are comparable to European standards, it would save individual drivers $600 to $900 on fuel a year, delivering $27.5 billion in fuel savings and $13.9 billion in net benefits to 2040.[132]

Every further year of delay in introducing fuel-efficiency standards costs Australians tens of millions of dollars. The IEA's 2018 review of Australia's energy policies noted that all the countries from which Australia imports its vehicles have fuel efficiency standards. This means that there are limited barriers and substantial benefits from adopting similar standards to Europe.

9.2 Electric vehicles

Electric vehicles offer significant potential to reduce Australians' energy bills, as they have significantly lower running costs than petrol and diesel vehicles. While electric vehicles have a higher upfront cost than their internal-combustion engine equivalents, the cost is falling rapidly. Due to their low running and maintenance costs, electric vehicles already have lower total costs of ownership in some segments (e.g. buses), and Bloomberg New Energy Finance predicts that electric cars will be cost competitive with conventional cars from around 2022.[133]

Electric vehicle sales have increased rapidly in recent years. In 2018 global sales of electric vehicles were 64 per cent higher than in 2017.[134] While electric vehicles still account for less than two per cent of new vehicle sales in most countries, this is changing rapidly and the figure is much higher in leading countries. In Norway, electric vehicles accounted for over 40 per cent of new car sales in 2018.[135]

Electric vehicle uptake is set to accelerate, driven by improvements in technology, reductions in cost and government policy. Many governments support the uptake of electric vehicles, largely due to the significant potential for electric vehicles to reduce local air pollution and greenhouse gas emissions.[136]

131 Global Fuel Economy Initiative 2015, *The Chinese Automotive Fuel Economy Policy: February 2015 Update*, GFEI, London, available online from: https://www.globalfueleconomy.org/transport/gfei/autotool/case_studies/apacific/china/CHINA%20CASE%20STUDY.pdf.

132 Department of Infrastructure and Regional Development 2016, *Improving the Fuel Efficiency of New Light Vehicles - Regulatory Impact Statement*, Commonwealth of Australia, Canberra. This figure is based on Target A in the Regulatory Impact Statement.

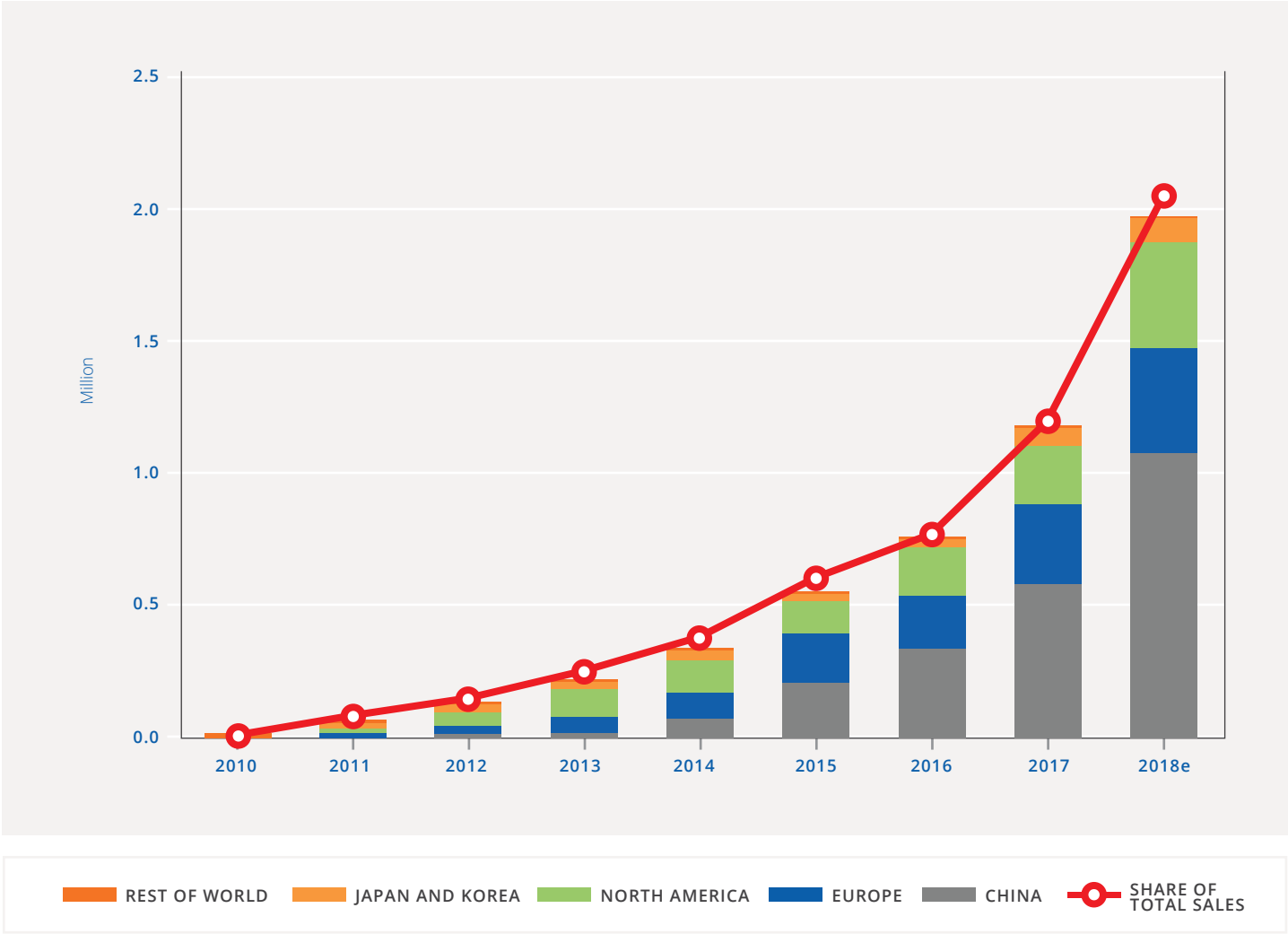
133 Bloomberg New Energy Finance 2019, *Electric Vehicle Outlook*, Bloomberg New Energy Finance, New York.

134 Irle, R 2019, *Global EV Sales for 2018 – Final results*, EV Volumes.com, Trollhättan, accessed 31 May 2019 from http://www.ev-volumes.com/country/total-world-plug-in-vehicle-volumes/.

135 Ibid.

136 Requia, W. et al 2018, "How clean are electric vehicles? Evidence-based review of the effects of electric mobility on atmospheric emissions and health", *Atmospheric Environment*, vol. 185, pp. 64-77.

Figure 9.1 Electric car (passenger light duty vehicle) sales and market share



Source: International Energy Agency 2019, *World Energy Investment 2019*, IEA, Paris.

A number of countries, including China, France, Germany, India, Norway, and the United Kingdom have announced plans to eliminate the sale of petrol or diesel vehicles beyond various dates between 2030 and 2050. This section looks at the policies in place in California and China.

California

California has a long history supporting the development and uptake of electric vehicles, with a particular focus on tackling urban air pollution. In 1990 the Californian Air Resourced Board introduced a Zero-Emission Vehicle (ZEV) program that required major automotive manufacturers to produce a certain amount of zero emission vehicles based on the number of vehicles they sold in California. Under the current program requirements, in 2025 automotive manufacturers will be required to produce electric vehicles equivalent to 22 per cent of their sales in California.[137]

In 2012 the Governor of California set a goal to have 1.5 million ZEV on Californian roads by 2025, which was recently increased to 5 million ZEV by 2030. The Californian Government offered residents up to US$2,500 to encourage them to purchase electric vehicles, which could be combined with the Federal

137 California Air Resources Board, *Zero-emission vehicle program*, available online from https://ww2.arb.ca.gov/index.php/our-work/programs/zero-emission-vehicle-program/about.

Government's tax credit of up to $7,500 for electric vehicles. Electric vehicle drivers are also allowed to use the 'high-occupancy lanes' on Californian roads that are normally reserved for buses and carpool vehicles. By the end of 2018, cumulative sales of electric vehicles in California exceeded 500,000 units.

California is also investing in infrastructure to support the roll out of electric vehicles, recently allowing electricity utilities to spend up to $748 million on electric vehicle charging infrastructure.[138] However, electric vehicles will have far greater impacts on the grid than just the addition of charging points. If California's vehicle fleet is fully electrified it could require 120 terawatt-hours of electricity per annum, almost a 50 per cent increase in the state's electricity demand.[139] Electric vehicles would also shift when and where electricity was required, and provide the grid with mobile energy storage that could reduce the need for expenditure on stationary energy storage.

China

In 2009 the Chinese Government set a goal to make China the leading global manufacturer of 'new energy vehicles' to support economic development and reduce urban air pollution. In addition to investing in a national network of charging stations, the Chinese Government progressively ramped up programs to encourage the manufacture and purchase of electric vehicles.

In 2010 the Chinese Government launched incentives in five cities to subsidise the production of electric vehicles, and in 2013 the Government rolled out a national incentive scheme. In 2017 the Government placed a mandate on automotive manufacturers that 10 per cent of the vehicles that they sold in 2019 would have to be electric vehicles, rising to 12 per cent in 2020.[140] By the end of 2018, cumulative sales of electric vehicles in China exceeded 1 million units.

Recommendations

The global shift to electric vehicles has commenced. Bloomberg New Energy Finance predicts that 33 per cent of the global vehicle fleet will be electric by 2040, and the transition could be faster if overseas governments continue to raise their ambitions in this area.[141] While Australia may or may not want to follow the examples set by California and China, the policies in these and other jurisdictions are causing a rapid shift in global vehicle markets. Australia needs to prepare for this shift in order to make the right investments in electricity and transport infrastructure and avoid stranded assets and higher costs for energy and transport users.

All Australian governments and institutions should:

26. **Collectively develop a national strategy for electric vehicles, with a particular focus on the impact of electric vehicles on the electricity grid.** As part of this strategy, governments should consider whether to encourage some early adoption of electric vehicles to ensure that consumers, businesses, utilities and policy-makers gain experience in managing electric vehicles in advance of what could be a very rapid transformation in the global vehicle market.

138 California Public Utilities Commission 2018 Press Release, available online from: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K467/215467739.PDF.

139 Davidson, F. et al 2018, 'Switching to electric vehicles could save the US billions, but timing is everything', *The Conversation*, available online from: https://theconversation.com/switching-to-electric-vehicles-could-save-the-us-billions-but-timing-is-everything-106227.

140 International Council on Clean Transportation (ICCT) 2018, China's New Energy Vehicles Mandate Policy, ICCT, Beijing, available online from: https://www.theicct.org/sites/default/files/publications/China_NEV_mandate_PolicyUpdate%20_20180525.pdf.

141 Bloomberg New Energy Finance 2018, *Electric Vehicle Outlook*, Bloomberg New Energy Finance, New York.

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