Dr Alan Finkel AO
Chair of the Ministerial Reference Panel
Technology Investment Roadmap
Submitted to http://consult.industry.gov.au/

21 June 2020

Re. Energy Efficiency Council Submission to the Technology Investment Roadmap

Dear Dr Finkel

Thank you for the opportunity to provide a submission on the *Technology Investment Roadmap Discussion Paper* (the Discussion Paper).

Energy management is critical to Australia's future and must form a central part of the Technology Investment Roadmap. Energy management is:

- **The single largest source of global abatement**. The International Energy Agency (IEA) estimates that over 40 per cent of abatement to 2040 in the energy sector will come from energy efficiency.[1] Energy management delivers direct decarbonisation and facilitates the rapid adoption and integration of renewable energy, buying us time to address the difficult-to-abate sectors; and
- **The single largest form of capacity in energy markets**. Energy management represents an enormous economic opportunity both locally and globally - AU$364 billion was invested globally in energy management in 2019, and the IEA forecasts that that this figure double for the world to meet its climate goals.[2]
- **A major opportunity for economic recovery.** Upgrading Australia's energy efficiency would create 120,000 jobs in energy management, boost GDP and cut households' and businesses' energy bill by $7 billion per annum.[3]

While many energy management technologies are already cost-effective, deploying them will depend on emerging technologies, such as digitalisation in building management and industry (sometimes termed 'Industry 4.0'). The IEA estimates that digitalisation could reduce the global building sector's energy demand by 10 per cent by 2040 and increase demand response capacity from 40 GW today to 450 GW in 2040.[4] Many of these advances in digitisation will also be essential for the effective integration of energy supply and storage, including solar PV, batteries and hydrogen.

Accordingly, the International Renewable Energy Agency (IRENA) states that the boundaries in energy management are blurred between 'mature' and 'emerging' technologies. Innovations in technology, business models and market design will be essential to address the non-price barriers to mature and emerging technologies.

[1] IEA 2019 *World Energy Outlook*, IEA, Paris.

[2] International Energy Agency 2019, *World Energy Investment 2019*, IEA, Paris.

[3] Edis, T. 2019 Energy efficiency employement in Australia, Green Energy Markets, Melbourne.

[4] International Energy Agency 2019, Energy Efficiency Market Report 2018, IEA, Paris

Therefore, the Technology Roadmap needs to set out an integrated strategy to drive scalability through *both* the development and the deployment of energy management technologies. A strategy that simply focuses on technology development will fail to mobilise investment in either new or existing technologies. Conversely, a strategy that simply focusses on the deployment of existing technologies will fail to develop the innovations are needed to fully realise the benefits of energy management.

We recommend that the technology roadmap sets out a strategy to:

- Invest in innovation and demonstration of emerging energy management technologies, focusing on digitisation; and
- Implement key policies that have been adopted overseas that address non-price barriers to new and existing technologies. These policies are set out in the First Fuel report and the Building Efficiency for Jobs and Growth report, and include:
    - Energy market reforms;
    - An energy efficiency rating system for new and existing homes; and
    - Directing stimulus funding towards energy efficiency upgrades in public housing, government buildings and businesses.

Australia has demonstrated strategic advantages in a number of emerging technology fields, including building optimisation and grid integration. Capitalising on these advantages will deliver huge benefits, with the building services industry worth over $1 trillion a year. However, Australia must move quickly to seize these strategic advantages. We recommend that the Technology Roadmap set stretch goals to:

- Reduce the energy intensity of Australia's buildings by 30 per cent by 2030
- Double Australia's energy productivity by 2030.

The Energy Efficiency Council looks forward to working closely with you as the Technology Roadmap is developed. Should you require any information on the matters set out in this submission please contact me on 0414 065 556 or via rob.murray-leach@eec.org.au.

Yours sincerely

Rob Murray-Leach

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energy efficiency
COUNCIL

Energy Efficiency Council submission to the Technology Investment Roadmap

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1. Importance of Energy Management

Energy management is critical to the energy future of Australia and the world. The way that we use energy is just as critical as the way that we generate it:

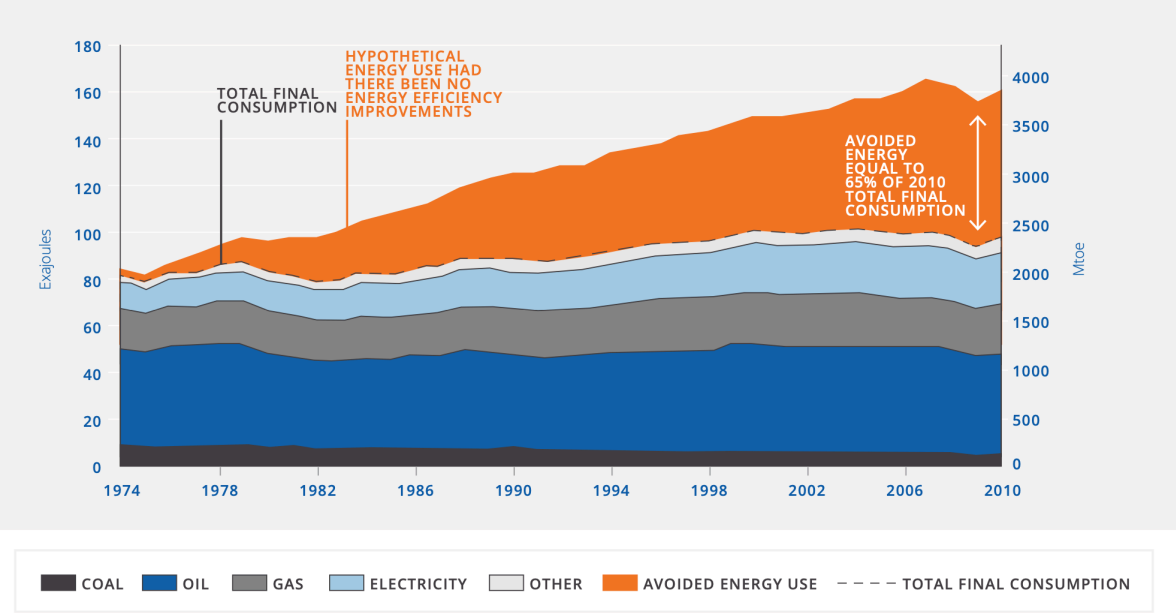
1.1 Energy management is the world's largest energy resource

Saving a unit of energy creates capacity in energy markets. For example, energy efficiency standards for fridges and freezers act like 'baseload' capacity by reducing Australia's electricity demand by 360 MW, 24 hours a day, 365 days a year.[5]

The International Energy Agency (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 (Figure 1).[6] Accordingly, the IEA now calls energy efficiency the world's 'first fuel'.

The scale of energy efficiency as a resource means that it is a huge economic opportunity – globally AU$364 billion was invested in energy management in 2019.[7]

Figure 1. Total avoided energy use from energy efficiency in 11 countries



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

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

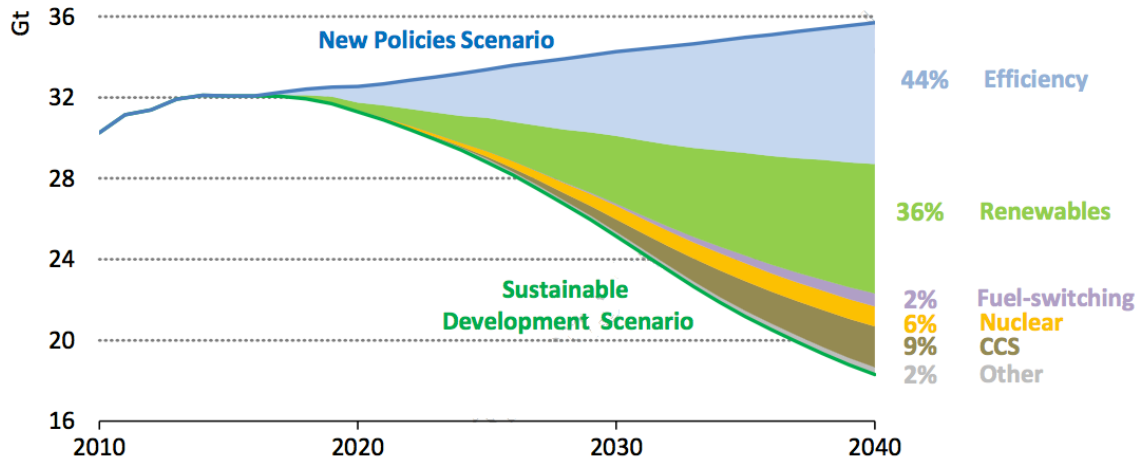
[6] International Energy Agency 2013, *Energy Efficiency Market Report 2013*, IEA, Paris. The IEA analysed energy use in 11 countries that had sufficient quality and quantity of data. The countries were Australia, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States.

[7] International Energy Agency 2020, *World Energy Investment 2020*, IEA, Paris.

1.2 Energy management is the largest source of greenhouse gas abatement

Improvements in energy efficiency were responsible for 75 per cent of the stabilisation of emissions from the global energy system between 2014 and 2016. In contrast, renewables and fuel-switching together delivered less than 25 per cent of emissions stabilisiation in this period. Going forward, the IEA estimates that additional action on energy efficiency will deliver 44 per cent of the world's abatement to 2040 (Figure 2).

Figure 2. Global CO2 emissions reduction in the New Policies and Sustainable Development Scenarios



Source: IEA 2019 *World Energy Outlook*, IEA, Paris.

Australia will eventually have zero-emission electricity and fuels. However, cumulative emissions over 10-20 years will have far more impact on climate change than emissions at a particular point in time. Energy management will allow us to reduce emissions faster and more affordably, as it not only directly reduces emissions, but also helps us to more rapidly integrate zero-emission forms of energy into the grid (e.g. demand response helps support variable output renewables).

In summary, investment in energy management delivers rapid reduction in emissions in the electricity sector, which buys us time to develop cost-effective technologies to deliver abatement in the difficult-to-abate sectors.

1.3 Goals of the Technology Investment Roadmap

Energy management delivers against all four proposed goals of the Roadmap:

- **Improving energy affordability**

  Energy efficiency improvements have reduced households' energy bills in most countries by 10 to 30 per cent. In Germany, energy efficiency improvements since 2000 saves the average household AU$790 each year off the energy bills for their home and car.[8]

- **Maintaining security and reliability of energy supply**

  Energy management provides capacity that helps to maintain grid security and reliability. Based on international experience, demand response could provide 20 per cent of the National Electricity Market (NEM) capacity, and it already provides 15 per cent of frequency control ancillary services (FCAS) in the NEM.

- **Helping Australia and other countries reduce their emissions**

  As noted above, energy management has been, and will be, the most significant source of greenhouse gas abatement this century.

- **Seeking employment and growth opportunities**

  Energy management is extremely jobs-rich. There are already an estimated 59,000 full time equivalent jobs in energy management, and properly deploying energy management in Australia would create over 120,000 jobs.[9] Recent work by McKinsey found that every $10 million invested by governments would deliver 27 jobs in fossil fuels, 75 jobs in renewable energy and 77 jobs in energy efficiency.[10]

[8] International Energy Agency 2017, *Energy Efficiency Market Report 2017*, IEA, Paris

[9] Edis, T. 2019 Energy efficiency employment in Australia, Green Energy Markets, Melbourne.

[10] McKinsey and Company 2020 *How A Post Pandemic Stimulus can both create jobs and help the climate*. Available online at: https://www.mckinsey.com/business-functions/sustainability/our-insights/how-a-post-pandemic-stimulus-can-both-create-jobs-and-help-the-climate#

2. Energy management technologies

Energy management includes energy efficiency (getting more output from each unit of energy) and adjusting when we use energy. Some important energy management technologies identified in the roadmap include;

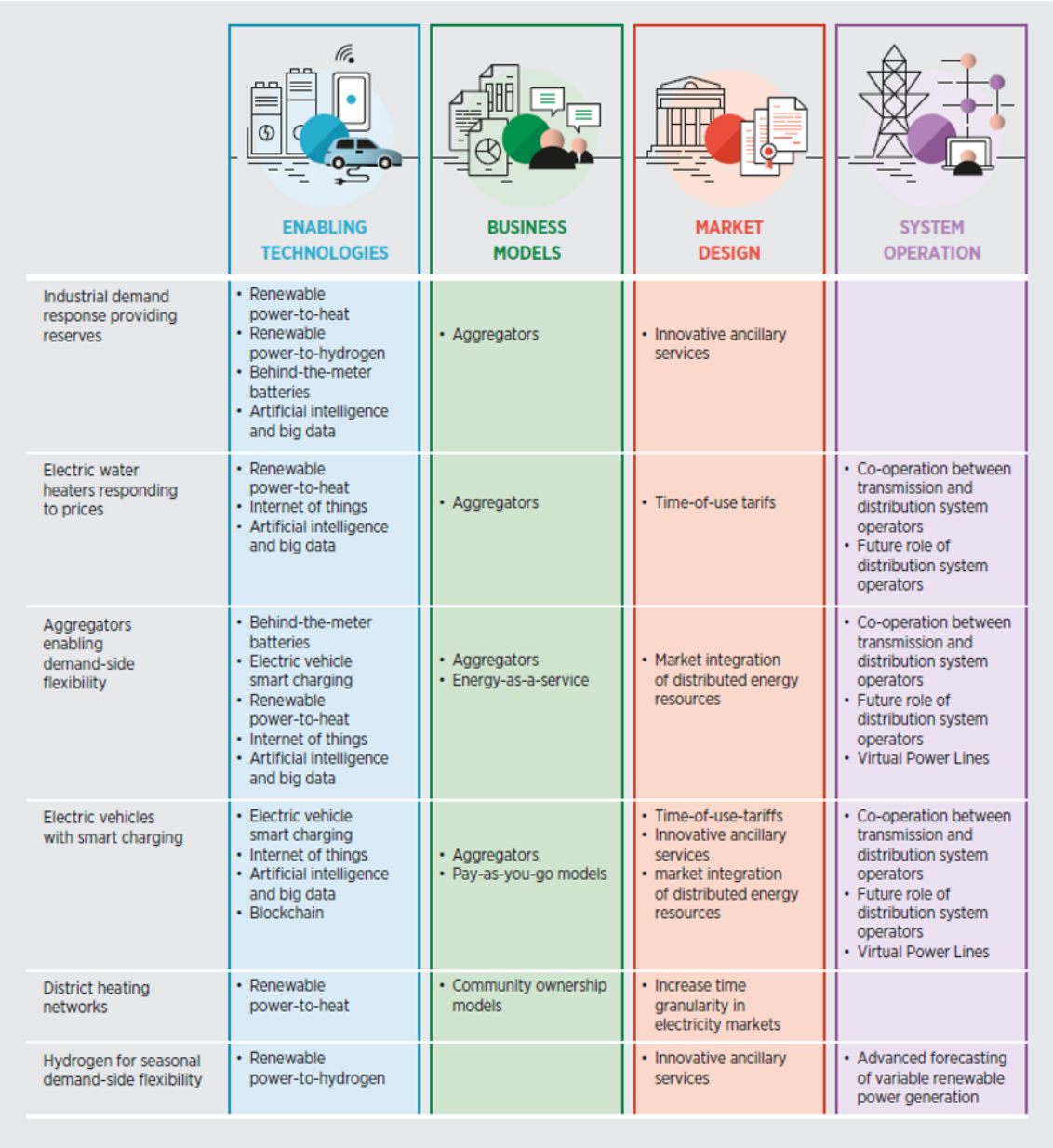
- LEDs for lighting;
- Heat pumps for heating air and water;
- Efficient appliances;
- Advanced building paints, glazing and materials; and
- Metering, digitalisation and control software and systems that can optimise buildings, manufacturing and energy grids.

At a superficial level, energy management technologies can be broken into three groups:

- Mature technologies that are already being deployed. Some technologies are widespread (e.g. LED lightbulbs) while some are deployed well below their economic potential due to various barriers;
- Technologies that have yet to be commercialised or widely taken up, such as heat pumps for low-temperature water in industrial sites, which largely need to be demonstrated; and
- Emerging technologies that require support for research and development.

However, there is significant overlap between these groups, as research, development and deployment is often required to lower the cost and improve the dispatch of mature technologies, and much of the value emerging technologies (e.g. digitisation) is in the optimisation and dispatch of mature technologies. The overlapping nature of innovations in technology, business models, market design and system optimisation are shown in Figure 3.

Figure 3 Mapping different demand-side flexibility examples with innovations



	ENABLING TECHNOLOGIES	BUSINESS MODELS	MARKET DESIGN	SYSTEM OPERATION
Industrial demand response providing reserves	• Renewable power-to-heat • Renewable power-to-hydrogen • Behind-the-meter batteries • Artificial intelligence and big data	• Aggregators	• Innovative ancillary services	
Electric water heaters responding to prices	• Renewable power-to-heat • Internet of things • Artificial intelligence and big data	• Aggregators	• Time-of-use tarifs	• Co-operation between transmission and distribution system operators • Future role of distribution system operators
Aggregators enabling demand-side flexibility	• Behind-the-meter batteries • Electric vehicle smart charging • Renewable power-to-heat • Internet of things • Artificial intelligence and big data	• Aggregators • Energy-as-a-service	• Market integration of distributed energy resources	• Co-operation between transmission and distribution system operators • Future role of distribution system operators • Virtual Power Lines
Electric vehicles with smart charging	• Electric vehicle smart charging • Internet of things • Artificial intelligence and big data • Blockchain	• Aggregators • Pay-as-you-go models	• Time-of-use-tariffs • Innovative ancillary services • market integration of distributed energy resources	• Co-operation between transmission and distribution system operators • Future role of distribution system operators • Virtual Power Lines
District heating networks	• Renewable power-to-heat	• Community ownership models	• Increase time granularity in electricity markets	
Hydrogen for seasonal demand-side flexibility	• Renewable power-to-hydrogen		• Innovative ancillary services	• Advanced forecasting of variable renewable power generation

Source: IRENA 2019 *Innovation Landscape Report*, IRENA, Abu Dhabi

2.1 Emerging Technologies

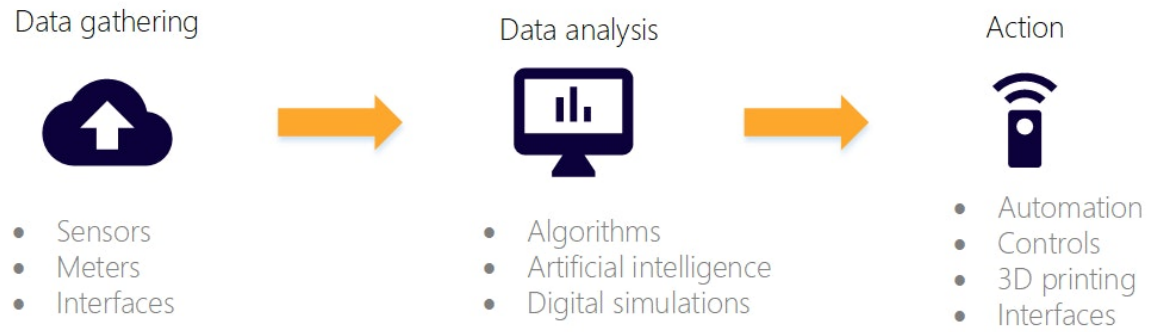
Digitalisation and related services are a huge opportunity both as:

- energy saving opportunities in themselves; and
- enabling other existing clean energy and energy management technologies.

Energy saving digital technologies include:

- Automation of devices and repetitive tasks in order to overcome behavioural barriers and reduce transaction costs. For example, systems that optimise building operation can automatically pre-cool buildings in order to dispatch demand response to match supply and demand;
- Industry 4.0, the use of machine-to-machine communication and Internet of Things (IoT) to improve automation, self-monitoring and optimisation; and
- Using machine learning to identify energy saving options in buildings.

Figure 4 Elements of digitisation



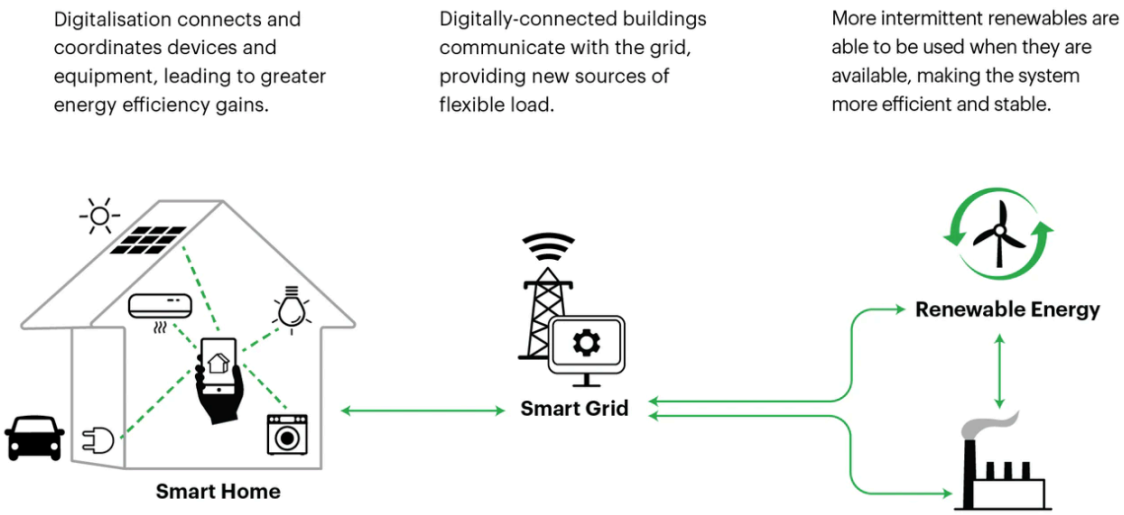
Source: International Energy Agency 2019 *Energy efficiency and digitalisation,* IEA, Paris.

Digital technologies present huge abatement and economic opportunities. Large meta-reviews have shown that around 15-30 per cent of energy use in buildings is wasted due to improperly controlled equipment. The IEA estimates that digitalisation could reduce the global building sector's energy demand by 10 per cent by 2040.

However, digitalisation has benefits well beyond energy efficiency, including the integration of all supply-side and demand-side technologies (Figure 5). As a result, the IEA estiamtes that digitalisation could increase demand response capacity from 40 GW today to 450 GW in 2040.[11]

[11] International Energy Agency 2019, Energy Efficiency Market Report 2018, IEA, Paris

Figure 5. The role of digitalisation in energy optimisation



Source: International Energy Agency 2019 *Energy efficiency and digitalisation,* IEA, Paris.

2.2 Australia's Strategic Advantage

Australia has a number of strategic advantages in energy digitalisation, including:

- **Building optimisation:** Australia's sophisticated commercial property sector, in combination with the Commercial Building Disclosure program, means that Australia has become a world leader in commercial building optimisation. The Australia has led the global GRESB sustainable real estate sector ratings for the last 8 successive years. As a result, a number of the world's leading optimisation software and service providers are based in Australia and exporting to the world. Australia also leads the IEA's 'Data-Driven Smart Buildings' work, which oversees a research consortium of over 45 organisations and 17 countries; and
- **Grid integration:** our spread-out grid with high localised penetrations of distributed resources means that we need to solve issues that other grids won't face for five or more years. This gives local system developers an opportunity to develop and trial technologies before other countries.

The 'Digital Innovation: Australia's $315B opportunity', 2018 report, found that "data-driven urban management" was one of the top 8 strategic priority areas (valued at $5-$10 billion over this decade) for Australia in the digital space

There is an opportunity now to take advantage of these strategic advantages. If Australia can capitalise on its lead in these areas it will become the global leader in grid and building optimisation.

The EEC strongly supports the proposed broadening of ARENA and CEFC's terms of reference to ensure that they can fund both the development, deployment and dispatch of energy management technologies. Additional funding to both bodies and organisations like CSIRO to ensure that they can fulfil these terms of reference. Given the substantial overlap between the development of new technologies and dispatch of existing technologies, it will be critical to enable the CSIRO, ARENA and the CEFC to collaborate on 'end-to-end' strategies for the development and dispatch of energy management.

2.3 Mature Technologies

Technologies that improve energy efficiency are constantly evolving and being adopted. Australia has adopted many mature energy efficiency technologies, such as LED lamps, but has much lower take up of a range of other mature technologies than other countries. 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.[12]

The following three points illustrate both the barriers and solutions to the deployment of mature technologies in Australia

- **Distortions in energy market rules:** As you know, the Independent Review into the Future Security of the National Energy Market (NEM) noted a flaw in the NEM's design which meant that many energy users were not rewarded if they reduced their demand during peak periods. Accordingly, the Review recommended a Rule Change to introduce a Demand Response Mechanism, which has just been signed off by the Australian Energy Market Commission.
- **Information barriers:** Commercial building owners, managers and tenants used to find it extremely hard to assess the energy efficiency of a building and accurately compare it to other buildings. Governments worked with industry to introduce the NABERS Energy rating tool and the Commercial Building Disclosure (CBD) program, which required buildings to disclose their energy efficiency ratings when they were sold or leased. This lead to voluntary action by building owners, resulting in the emissions per m^2 of buildings falling by over 40 per cent over the last eight years.[13]
- **Transaction costs**: The cost associated with identifying energy savings can be a major impediment to implementing even highly cost-effective technology solutions. Several Australian companies have developed software that can monitor homes and commercial buildings and rapidly identify energy savings opportunities, including using machine-learning to identify the signatures of various pieces of equipment through their energy use alone. As a result, new technology developments can help with the deployment of very mature solutions.

Key policies to deploy existing technologies are set out in the Energy Efficiency Council's report *The World's First Fuel* and the property sector's joint statement *Building efficiency for jobs and growth*, and include:

- Further energy market reform to value and dispatch energy management;
- A national program to rate the energy efficiency of homes when they are sold;
- Upgrading the efficiency of government buildings and public housing; and
- A $500 billion stimulus programs to drive energy management in buildings and $500 million to drive investment in energy management in industry.

However, further development of digitalisation will also be critical to the deployment of cost-effective energy efficiency technologies.

[12] 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.

[13] NABERS National Administrator 2019, *NABERS Annual Report 2018/19*, NABERS National Administrator, Sydney.

2.4 Technologies that need demonstration and cost-reductions

Finally, there are a number of technologies that need to be demonstrated before they will be adopted, and several technologies that need to move from 'low-volume with high-prices' to 'high volume low price'. One key opportunity is the adoption of air- and ground-source heat pumps for thermal comfort and water heating in homes and businesses. The costs and efficiencies of these technologies have improved dramatically in the last decade, and overseas sales are ramping up rapidly. Demonstration and deployment programs are critical in Australia's industrial sectors and acceleration programs are required in the residential and commercial markets, especially for water heating.