AUSTRALIAN SUSTAINABLE BUILT ENVIRONMENT COUNCIL

LOW CARBON, HIGH PERFORMANCE

How buildings can make a major contribution to Australia’s emissions and productivity goals

APPENDICES

May 2016

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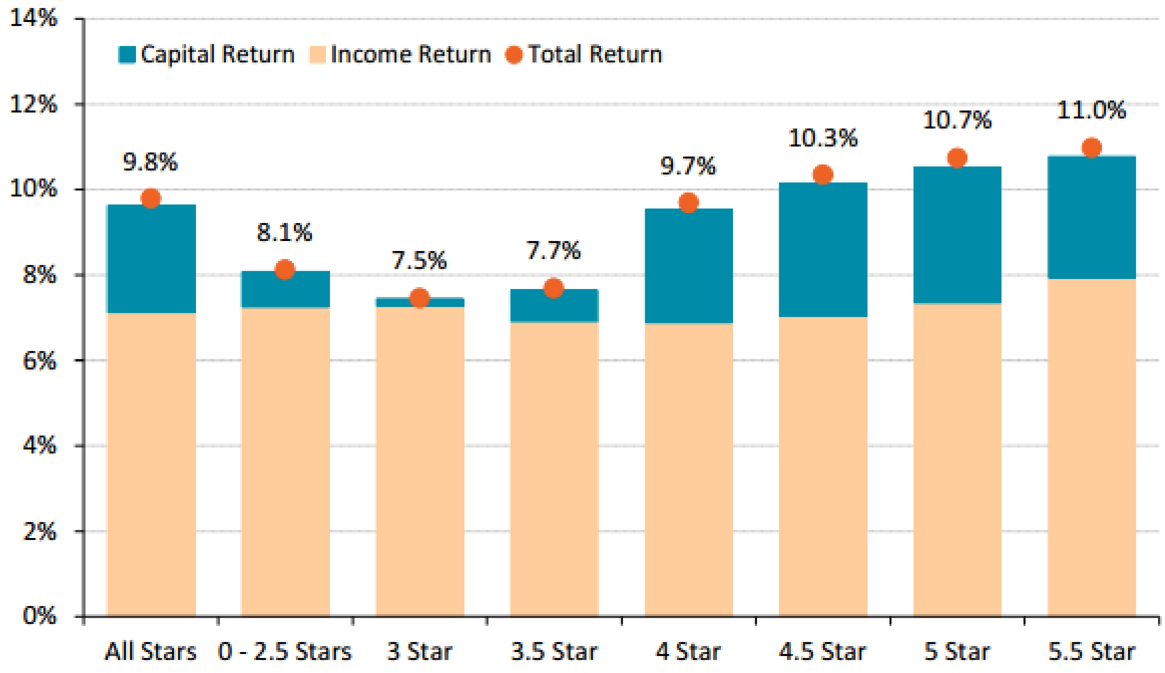
Results of the 2013 Property Council/IPD Australia Green Property Index show that green office buildings have continued to outperform the broader office market across a range of financial indicators. Green Star rated offices on average delivered a 7 per cent higher basic rent than the broader office market, net operating income was almost 19 per cent higher and capital expenditure was over 29 per cent lower. The market vacancy rate for Green Star rated offices was lower at 3 per cent compared to 6 per cent for the broader office market.[1] Figure 1 below shows how annualised total returns for High NABERS Energy rated offices are higher than Low NABERS Energy rated offices. Building Better Returns, a Study of the Financial Performance of Green Office Buildings in Australia, showed higher rated NABERS buildings have much higher value premiums. A 5 star NABERS energy rating delivers a 9 per cent premium in value while a 3-4.5 star rating delivers a 2-3 per cent premium.[2]

Figure 1 - NABERS Office energy market returns



Sources: IPD, NABERS.

[1] The Property Council/IPD, 2013
[2] The Australian Property Institute, 2011

International evidence - Increases in asset value and returns for building owners

Similar evidence has been collected overseas showing a positive impact on asset values for higher energy performing buildings. For example, US research has found that the inclusion of green design features when selling a house can increase closing prices by 2 per cent and energy efficiency features can increase resale values by roughly 6 per cent.[3] There is evidence from California that claims Energy Labels increase the sale price of a home by 9 per cent.[4] A report from the Netherlands claims that homes with better environmental ratings sell ten days quicker and attract a 1–3 per cent improvement on sale price.[5]

Figure 2 - Green labelled home sell at higher prices

Reduced running and maintenance costs for households and businesses

Improved energy efficiency can reduce the running and maintenance costs of households and businesses. Lighting retrofits to replace existing bulbs with LEDs can reduce energy spend as LEDs use almost 80 per cent less energy than halogen globes and 25 per cent less than CFLs. Prices of LED lights have dropped almost 90 per cent in the past decade while light output has increased fivefold.[6] Manufacturers typically estimate a bulb's lifespan based on three hours of use per day, by that measurement, an LED bulb will last for at least a decade while a halogen light bulb may work only a year before burning out.[7] Energy efficiency retrofits at Jones Bay Wharf in Sydney resulted in annual energy savings over $150,000 plus an additional $20,000 in reduced maintenance costs annually.[8] The Tumut

[3] Rocky Mountain Institute, 2016
[4] Kok & Quigley, 2012
[5] Smorenburg, 2015
[6] ClimateWorks, 2015
[7] Calem, 2013
[8] NSW OEH, undated

Shire Council in NSW completed extensive retrofits on their council building that resulted in a 66 per cent reduction in annual energy costs, equating to over $116,000. An additional $80,000 in annual savings was realised due to reduced maintenance costs and increased tenancy.[9]

Figure 3 - Tumut Shire Council building

Health and productivity improvements for commercial building occupants

Retrofits that increase energy efficiency and improve amenities can result in improved worker productivity and reduction in illness and work related stresses. Research shows improved indoor air quality and ventilation can lead to productivity increases of up to 11 per cent[10], while thermal discomfort has been linked to a possible 10 per cent reduction in performance.[11] Studies have also shown there is a relationship between increased access to daylight and reduced sick leave. For example, a retrofit of LendLease's Sydney office saw improvements such as 100 per cent fresh air supply for the whole office and naturally ventilated sunrooms. LendLease found over half of occupants identified themselves as being more productive while 84 per cent felt more comfortable. Other benefits included having the building fully leased within the first six months and annual energy savings of $157, 000.[12] A Retrofit of 500 Collins Street, Melbourne, by the Kador Group found a reported 44 per cent reduction in the monthly average cost of sick leave from one tenant. A survey by the second tenant found a 39 per cent reduction in average sick leave days per month, 26 per cent reduction in incidences of fatigue and 20 per cent reduction in poor concentration.[13] Staff costs typically account for about 90 per cent of business operating costs so even small improvements in employee health or productivity can have a significant financial implication for employers.[14]

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[9] McGowan, 2014
[10] Loftness, Hartkopf & Gurtekin, 2003
[11] World Green Building Council, 2014
[12] DoEWR, 2007, p39
[13] 1200 Buildings, undated, p6
[14] World Green Building Council, 2014, p3

Measuring health and productivity

With excellence in energy and water efficiency no longer a point of difference, the newly improved NABERS IE tool is a world first at measuring and benchmarking the indoor environment performance of offices and will help the Australian property sector continue to lead the world in sustainability.

JLL, ISPT, Brookfield (and more) have all been successfully using NABERS IE to demonstrate their indoor environment quality. ISPT alone has 23 rated properties. Outcomes measured as part of NABERS IE include acoustics, lighting, ventilation and office layout. Measurement is based on a combination of data and sensor gathering, alongside a qualitative assessment of occupant satisfaction[15].

The standard aligns with green buildings as requirements for clean air and good light are key to better workspaces. A PricewaterhouseCoopers report in 2014 for BeyondBlue found that for every dollar spent on successfully implementing an appropriate action, there is an average benefit of $2.30 to be gained by the organisation[16].

Reduced fuel poverty for low income households

Research shows that implementing energy efficiency retrofits can improve a building's resistance to the elements and reduce fuel poverty[17] for low income households.[18] For example, raising a home from a 2 to 5 star energy rating can result in a 54 per cent reduction in energy required for space heating and cooling in Victorian homes. This equates to a 32 per cent total energy saving, or up to $600 in annual household savings.[19] Modelling used for this report shows the average 2015 home spent $2,400 on electricity and gas, therefore a $600 savings equates to a 25 per cent bill reduction. Low income houses may have lower appliance use which would mean this is a higher savings in percentage terms.

A range of Commonwealth, state/territory and retailer programs are available across Australia to target energy efficiency advice, retrofits and assistance to people on low incomes. The Hume City Council's Hume Heatwave Help Program is a practical, grass roots response to improve the heatwave resilience of vulnerable residents. The program has resulted in 100 low-income homes home being retrofitted for improved energy efficiency. Installation items are outlined in figure 4, below.[20] A pre retrofit and then a post-summer survey was conducted to gather information from participating clients about the effectiveness of the products and program, results included: 93 per cent of participants were either 'very satisfied' or 'satisfied' with the project; 64 per cent of participants felt that they were better able to manage during heatwaves; 86 per cent of participants perceived their home to be much cooler than outside during heatwaves following the project, compared with 54 per cent in the pre project survey; 75 per cent of respondents rated their comfort level as 'very

[15] NABERS, undated

[16] PWC, 2014

[17] Households in fuel poverty have energy costs which are excessive compared to overall household income. The broader impacts of fuel poverty include inadequate thermal comfort, increased morbidity and mortality, and poor educational outcomes - IEA, 2011, p6

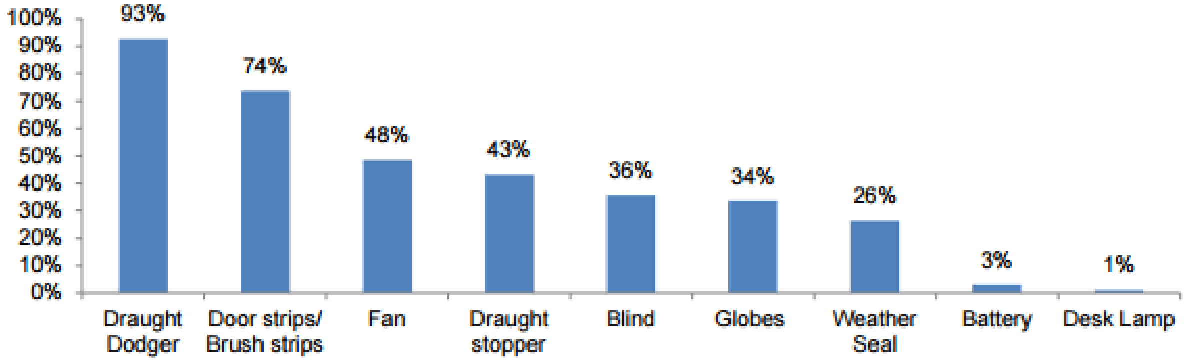
[18] IEA, 2011, p7

[19] ACOSS, 2013 p4

[20] Hume City Council, 2015 a

comfortable' or 'comfortable', following the project compared with 44 per cent before it; 66 per cent of participants slept comfortably at night during heatwaves compared to 38 per cent before it.[21] Overseas, many countries have recognised these benefits and have implemented low- income energy- efficiency policy. In the US, over six million homes have been retrofitted over three decades to better suit the climate[22] and in the UK, the Warm Front and Energy Assistance program have provided insulation and heating systems to over two million vulnerable households since 2001.[23]

Figure 4 - Installation items in Hume Heatwave Help Program participant's homes



Health benefits for households

Energy efficiency upgrades of the building envelope can minimise temperature fluctuations, noise, drafts, mould and mildew. This can lead to improved physical and mental health related to symptoms of respiratory and cardiovascular conditions, rheumatism, arthritis and allergies, reduced chronic stress and depression. The improvements are particularly realised among vulnerable groups such as children, the elderly and those with pre-existing illnesses.[24] Research has found living in cold and damp homes can have significant effects on occupants mental health. A study into occupant experiences of living in homes with poor energy efficiency found 55 per cent of occupants identified themselves as 'miserable' while 34 per cent felt 'anxious or depressed'.[25] Another study found incidence of anxiety or depression were halved after energy-efficiency measures were undertaken in previously poorly insulated homes.[26]

Increased productivity associated with health improvements

Realised health improvements can generate downstream social and economic impacts, including avoided costs for the public budget and increased productivity. For example, addressing indoor air quality at the same time as energy efficiency could (in a high energy efficiency scenario), save the European Union's economy as much as EUR 190 billion

[21] Hume City Council, 2015 b
[22] US DOE, 2011
[23] Green & Gilbertson, 2008
[24] IEA, 2011 p116
[25] Anderson, Finney & White, 2010, p37
[26] Green & Gilbertson, 2008, p14

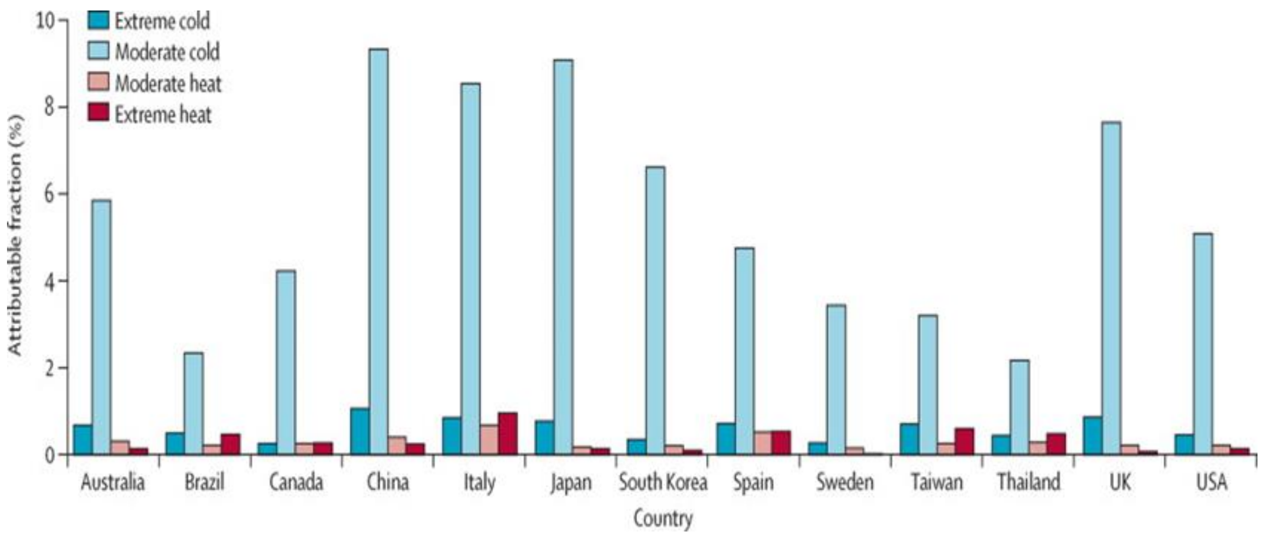
annually. Financial benefits are reflected in improved quality of life, avoided hospitalisation and pharmaceutical costs, as well as the cost savings from fewer days absent from work or school.[27] Cost-effectiveness analysis of well executed energy efficiency programs show that the programs generate cost savings for the public health sector that outweigh the initial expenditure on the energy efficiency intervention.[28]

Improved resilience for building occupants

Built environment improvements deliver value to society over the long term by improving climate resilience for current and future building occupants. A 2015 study published in The Lancet shows 6.5 per cent of deaths in Australia are attributed to cold weather, and 0.5 per cent from hot weather. Most deaths are a result of cardiovascular and respiratory disease and for every death there are also many more hospital admissions for effects such as strokes and heart attacks. Many Australian homes are not built to ensure adequate comfort levels to its occupants.[29] Similar results have occurred internationally, one study found that across 13 countries the total fraction of deaths caused by both heat and cold was 7·71 per cent, with the cold accounting for 7.29 per cent of this, see figure 5, below.[30] Approximately 40 per cent of Australian household energy is used for heating and cooling to achieve thermal comfort. This rate could be cut to almost zero in new housing through climate responsive design.[31] Building climate responsive homes as well as upgrading existing homes, particularly to address insulation, can reduce household and system costs and reduce the risk of illness or even death. For example, up to 35 per cent of the energy used to heat or cool homes can leak out of a home without insulation resulting in higher operating costs.[32] Reductions in heating and cooling loads can also reduce peak demand, insulation retrofits in New Zealand have been shown to decrease average household peak electricity consumption by 18 per cent during winter months.[33]

[27] IEA, 2011, p22
[28] IEA, 2011, p83
[29] Barnett, 2015
[30] Gasparrini et al, 2015
[31] Reardon, 2013
[32] ACOSS, 2013, p2
[33] Grimes et al, 2012, p4

Figure 5 - mortality attributable to moderate and extreme hot and cold temperature by country



Public benefits

Economic growth and job creation from energy efficiency in Australia

A number of studies have drawn a link between improved energy efficiency and economic growth and job opportunities. Research by Davis Langdon (now AECOM) found that retrofitting Australia's ageing office stock could create direct employment for more than 10,000 people in the construction industry, with a flow on effect of creating 27,000 new jobs across the broader economy.[34] In 2009, the Australian Council of Trade Unions and the Australian Conservation Foundation found if Australia immediately introduced policies to grow the domestic market for energy efficiency it could capture 5 per cent of the global market, potentially creating 75,000 jobs in energy efficiency by 2030.[35] Overseas, other major economies are recognising the economic benefits of investing in energy efficiency. The US aims to double energy productivity by 2030 through the implementation of a range of diverse energy efficiency policy solutions. Modelling for the plan suggests that $166 billion (year 2010 dollars) in energy productivity investments each year could yield a net annual savings of over $327 billion nationwide in 2030 and yield a net employment increase of almost 1.3 million jobs in that year.[36] In the EU, for every EUR 1 million invested in energy efficiency measures the potential for job creation ranges from 8 to 27 jobs.[37]

[34] Davis Langdon, 2009
[35] Energy Efficiency Council, 2010
[36] Alliance to Save Energy, 2013, p12
[37] IEA, 2011, p21

Economic growth and job creation from renewable energy in Australia

At the end of 2013, 21,000 people were employed in the renewable energy industry in Australia[38]. This number doesn't include the substantial flow-on employment for contractors, suppliers, accommodation providers and restaurants in the vicinity of large-scale renewable energy projects. Clean energy investments particularly create jobs in regional Australia, where the best renewable energy resources are located. With supporting policy in place almost 34,000 new jobs could be created in Australia by 2030. States and regions with the best clean energy resources and the strongest policy settings will attract investors.[39] Globally, doubling the share of renewables in the energy mix by 2030 would increase global GDP by up to 1.1 per cent, improve welfare by up to 3.7 per cent and support over 24 million jobs in the sector.[40]

Recent modelling by Beyond Zero Emissions in conjunction with Melbourne University found that Australia could create $370 billion of green energy jobs with current technology. When adding smart homes and buildings as well as low-carbon land use, high speed rail and electric vehicle options, the green jobs could reach $1 trillion dollars in value.[41] Beyond Zero Emissions' Zero Carbon Australia Buildings Plan found all residential and commercial buildings in Australia could be converted to generate as much energy as they consumed, creating $270 billion of green jobs in the construction industry. Delivering the Plan results in approximately 500,000 job hours over ten years, on a yearly, full-time equivalent basis this is 50,000 positions.[42]

Economic growth and job creation from battery storage in Australia

Battery storage presents job opportunities within Australia. Battery developer RedFlow is based in Brisbane, Queensland and their flow battery energy storage system was developed at the University of Queensland. RedFlow's products provide renewable energy storage, on and off-grid remote power, telecommunications, smart grids and peak demand management. The company employs nearly 50 staff across its offices in Australia, the US and Europe. While research and development is done locally in Brisbane, manufacturing of the flow batteries is outsourced to a facility in North America.[43] In California, an early leader in battery storage technology, more than 4,500 people are currently employed in the battery storage sector. Businesses range from startups to large-scale companies like SolarCity and Tesla.[44] The Victorian Government acknowledges the potential for jobs in this industry, particularly in manufacturing, sales and energy management services. Victoria's Renewable Energy Roadmap identifies reducing barriers to distributed generation (like solar PV) and energy storage as one of four priority areas to drive renewable energy in the state. The Victorian

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[38] Clean Energy Council, 2013, p22
[39] Climate Institute, 2011
[40] IRENA, 2016
[41] Vorrath, 2015
[42] Zero Carbon Australia, 2013
[43] Climate Council, 2015, p8
[44] AEE Institute, 2014

Government has also allocated $20 million dollars to a New Energy Jobs Fund with a specific focus on renewable energy storage technologies.[45]

Improvements in Australia's national energy productivity

Energy productivity[46] improvements, in particular through implementation of profitable energy efficiency opportunities, can help reduce expenditure on energy or ensure that for every dollar spent on energy there is a greater economic return.[47] Australia's NEPP outlines a framework and initial measures to reach the Commonwealth target of a 40 per cent improvement in energy productivity by 2030.[48] Improvements in the efficiency of energy consumption contributes significantly to achieving this. ClimateWorks 2015 report *Australia's energy productivity potential* identified that Australia could nearly double energy productivity by 2030, with improvements in the efficiency of energy consumption contributing more than 60 per cent to this.[49] For example, the installation of an efficient boiler could allow a household to produce the same volume of heating with much less energy input, while improving the building itself (insulation of the walls, sealing cracks and gaps etc.) would further reduce the energy inputs required to maintain the building temperature and comfort level.[50] Investment in energy efficiency markets is growing rapidly, in 2012 investment was estimated to be approximately USD 310-360 billion.[51] As such, the International Energy Agency has identified energy efficiency as the 'first fuel' as efficiency investments and policies are substantially reducing energy demand, by such an extent that in 2010 avoided energy use by IEA member countries[52] was larger than demand met by any other supply-side resource, including oil, gas, coal and electricity.[53]

Energy system benefits

Investment in energy efficiency delivers financial savings that offset the additional capital cost of efficient equipment, and, by reducing overall energy demand, it reduces the need to develop new energy supply assets such as power plants and oil fields.[54]

Distributed energy could assist in reducing peak demand and associated costs of peak generation and transmission infrastructure. For example, home battery systems can allow a household to store electricity from the grid when prices are lowest during off-peak periods

[45] Victorian Government, 2015, p22

[46] Energy productivity is a measure of the amount of productive output or value derived from each unit of energy consumed. Productive output or value is usually measured at a national level in terms of GDP- ClimateWorks, 2015, p7

[47] ClimateWorks, 2015, p23

[48] COAG, 2015, p12

[49] ClimateWorks, 2015, p15

[50] ClimateWorks, 2015, p13

[51] IEA, 2014, p16

[52] Australia, Austria, Belgium, Canada, Czech Republic, Denmark,Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States - IEA, 2014, p16

[53] IEA, 2014, p16

[54] ClimateWorks, 2015, p28

and then rely on their battery for power (rather than the grid) during the most expensive peak time. This can also benefit the household by minimising overall electricity costs. Ergon Energy estimates battery storage deployed at the grid level could avoid costs associated with building and upgrading the network, potentially reducing costs by 35 per cent. Battery costs have fallen by 14 per cent on average each year between 2007 and 2014 and capacity is expected to grow 50-fold in less than a decade. Solar PV modules have dropped in price 75 per cent in the past five years. These factors will promote increased uptake of renewable energy. By 2018, going off-grid by installing battery storage could be cost-competitive with staying connected as the price of battery storage falls and grid electricity remains expensive.[55]. Globally, the market for solar PV panels and battery storage is expected to grow tenfold in less than five years – from 90 MW in 2014 to 900 MW in 2018.[56]

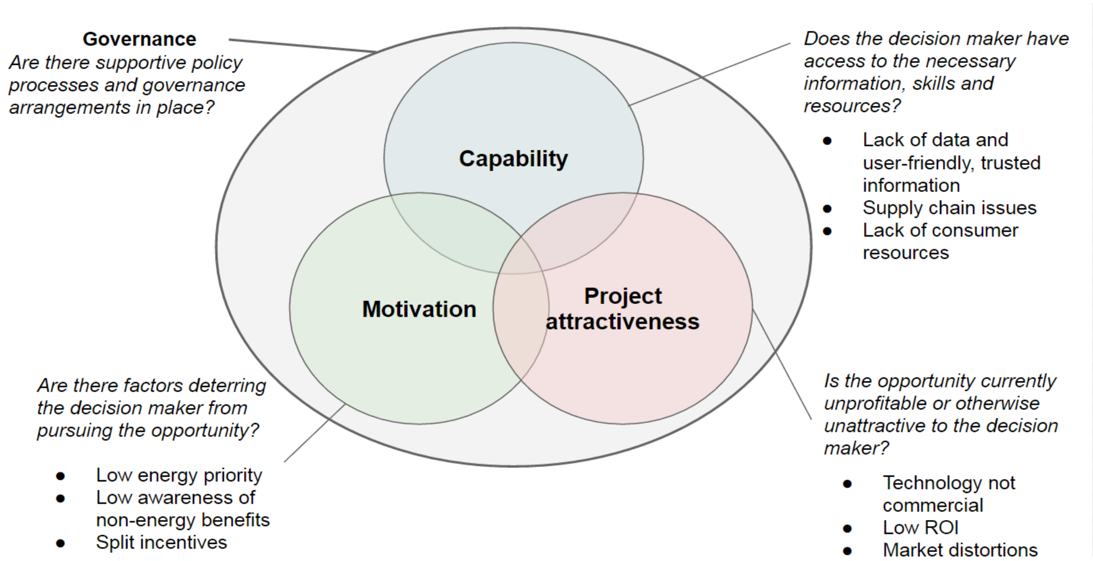
[55] Climate Council, 2015
[56] Clean Energy Council, 2015

APPENDIX 2. DETAILED DESCRIPTION OF BARRIERS AND IMPEDIMENTS

For many years energy efficiency has been recognised as the lowest-cost opportunity to reduce emissions, and a crucial component of any corporate, city, state or national emissions reduction strategy. However, both energy efficiency and distributed energy opportunities are impeded by a range of complex and interrelated impediments, and the majority of the opportunity is not expected to be captured without resolution of these issues.

Energy efficiency and distributed energy opportunities are blocked by multiple inter-related impediments, for which there is no 'silver bullet' solution. Following an extensive literature review and consultation with industry experts, this report has identified four broad categories of factors inhibiting building energy efficiency from various decision makers' perspectives (occupants, owners, the building industry as well as policy makers). These are shown in Figure 6 and described below.

Figure 6. Framework for Impediments to Energy Efficiency



Three types of impediments affect decision makers for energy efficiency opportunities in buildings (usually the building owner or tenant):

- **Capability:** The decision maker may lack (or lack access to) appropriate data and information, skills, services and products, or capital or finance, which can undermine their ability to identify or implement energy efficiency opportunities.

- **Attractiveness:** While most energy efficiency opportunities offer a financial return, some technologies (e.g. high efficiency heat pumps) may not yet be commercially attractive compared to less efficient alternatives (e.g. gas heaters). Alternatively, the financial return may exist but be less attractive than the return offered by other investments available to the decision maker. This can be amplified by market distortions such as discounted energy pricing.

- **Motivation:** Internal and external factors can have a strong influence on the motivation for a decision maker to consider implementing energy efficiency projects, regardless of financial attractiveness and capability. These include the fact that for many households and businesses, energy represents a low share of total expenditure and is therefore a low priority, or a lack of awareness of the non-energy benefits of energy efficiency, or 'split incentives' between tenants and landlords.

A further issue relates to overarching **policy processes and governance** for energy policy and regulation. A lack of good processes and governance can lead to unresolved regulatory barriers, regulatory uncertainty which can stifle investment, uncoordinated policy measures by different governments and agencies leading to suboptimal outcomes, duplicative consumer information and confusion amongst businesses and the community about the path forward. A specific issue affecting energy efficiency policy relates to the undervaluation of the benefits of energy efficiency in regulatory assessment processes.

These categories can be broken down into a range of more specific interrelated impediments that prevent decision makers from investing time, effort and resources into improving the energy efficiency of buildings. These are described in more detail in Table 1.

Table 1. Detailed overview of impediments

Category	Sub-category	Impediment
Project Attractiveness	Technology not commercial	Some opportunities not yet commercially feasible
	Low ROI	Some energy efficiency project offer a low return-on-investment and high transaction costs
	Market distortions reduce project attractiveness	Energy market does not recognise or reward value of energy efficiency
		Discounted energy pricing for large consumers can disincentivise energy efficiency
		Energy market reforms towards more fixed pricing could undermine energy efficiency
Capability	Lack of consumer resources	Particularly for low income households and small businesses, a lack of capability to investigate and implement energy efficiency opportunities and a lack of resources to meet upfront costs or source finance
	Lack of energy data and user-friendly and trusted information	Limited collection of and access to energy consumption data and lack of clear and engaging information provided in the right form and at the right time to enable consumers and investors to compare between low and high performing buildings and appliances
	Supply chain issues	Low minimum standards, and poor compliance and enforcement
		Lack of education and training in identification and implementation of energy efficiency opportunities
		Lack of valuation techniques that appropriately value energy performance and features in asset value
		Ancillary services (finance providers, lawyers and accountants) are not experienced in landing energy efficiency
		Perception that building more efficient buildings is too costly
		View that energy efficiency is not part of their job
		Limited availability of high efficiency equipment and appliances at reasonable cost
		Extreme fragmentation buildings ownership
		Disconnection between different stages of the design and construction process
Motivation	Energy priority	Energy is a low share of total household and business costs
		Priority on other building characteristics for owners, purchasers and occupants
	Low awareness of non-energy benefits	Low awareness of potential benefits beyond energy savings
	Split incentives	Split incentives prevent efficient allocation of costs and benefits between building owners and occupants
Governance		Complex governance and limited policy co-ordination resulting in regultaroy uncertainty and inconcistencies across jurisdictions
		Lack of valuation of full benefits in regulatory assessment processes

Detailed description of impediments

Project attractiveness
Most energy efficiency opportunities deliver a financial return over the life of the project or asset. However, in some instances, the attractiveness of an energy efficiency project or investment can be affected by:

- **Commercial viability of technologies**. While all of the energy efficiency opportunities modelled in this report deliver a positive return on investment, it is important to note that there are a range of **emerging technologies** (see section 4.6 for a description of some of the key technologies) and approaches that are not yet financially attractive, and have therefore yet to become widely deployed in Australia. Some of these technologies could unlock substantial new opportunities for cost-effective energy efficiency once commercialised.

- **Low return-on-investment (ROI).** While most energy efficiency measures deliver a financial return, some projects offer a low return-on-investment compared to the returns available from other potential projects. In many cases, projects may not meet internal hurdle rates for return-on-investment.

- **Market distortions** which reduce the cost-effectiveness of the project. In many cases, discounted energy pricing is provided to large energy consumers by retailers looking to lock-in energy supply contracts, and this reduces the value of any energy savings achieved through energy efficiency. In the residential sector and for small commercial buildings, there is often no reward provided for the lower impact that energy efficient buildings place on the electricity network - for example, lower energy prices.

  This may in part be resolved through the ongoing process of energy market reform, which includes a move towards more 'cost reflective' pricing[57], in part through a higher proportion of 'capacity charges' calculated on the basis of a customer's peak demand for electricity. Energy efficiency measures have the potential to reduce a customer's peak demand, therefore 'capacity charges' could potentially improve the business case for some energy efficiency projects. However, there is also the risk that this process could lead to a higher proportion of 'fixed charges' for electricity customers, namely a fixed daily charge imposed regardless of the customer's actual consumption, which could act as a strong disincentive for energy efficiency measures.

[57] ENA, 2015, p.15

Capability
Some consumers do not have the capacity to identify and implement energy efficiency opportunities regardless of how attractive the latter are or how motivated they are to do so. This can result from:

- **Lack of consumer resources,** particularly for low-income households and small businesses. Rising housing costs have increased the rental burden of rent on low-income households, who are already less equipped to meet the upfront costs of efficient appliances or renovation[58]. Small businesses can also struggle to meet the upfront costs of renovation, and may lack the time or capability to engage with complex and scattered information on energy efficiency opportunities. This is particularly the case in the small retail sector which is highly fragmented across many small stores.[59]

- **Lack of energy data collection and access, and user-friendly, trusted information** about buildings' energy performance and about the benefits of energy efficient buildings.

  Access to useable real-time energy consumption data can help enable consumers to make informed decisions about potential energy efficiency investments, but can be limited in a number of ways. The data may not be collected at all, where 'smart meters' or 'interval meters' are not installed. Where data is collected, it may not be easily accessible at low cost to consumers[60]. Or, a simple, streamlined process for consumers to grant access to third parties may not be provided, limiting the extent to which innovative services can be developed and offered, particularly to households or smaller-scale non-residential consumers.

  Beyond the data itself, there is often a lack of useable information such as appliance energy performance labels, or more often energy performance ratings for buildings, to enable purchasers to differentiate between high performing and poor performing assets. In some cases energy labels or rating schemes do not exist. More often, for the majority of building types, energy ratings are not used due to the cost or lack of consumer demand, or not disclosed to prospective purchasers.[61] There are also suggestions that existing energy rating schemes could be more engaging, particularly for homes. The lack of this consumer information has a flow-on effect to developers and asset owners, who may be less willing to develop efficient buildings or retrofit existing buildings if consumer-friendly information to demonstrate higher performance is non-existent or ineffective.

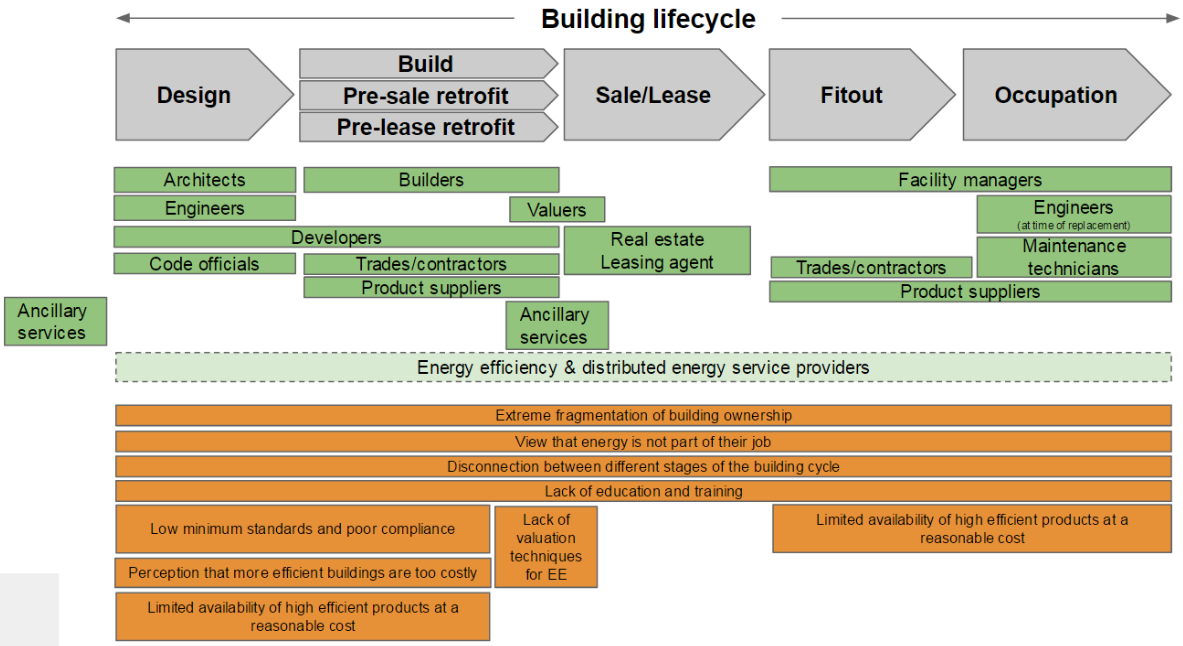
  A lack of useable information can not only affect consumer decision making, but also

[58] Australian Council on Social Services, 2013
[59] ClimateWorks Australia, 2011, *Low Carbon Growth Plan for Australia - Retail Sector Summary Report*, p.13
[60] Pitt & Sherry, 2014
[61] Pitt & Sherry, 2014

- inhibit the upscaling of finance, as investors do not have the means to cost-effectively evaluate the impact of their investment[62].

- **Supply chain issues,** ranging across the building construction, renovation and maintenance industry, the equipment and appliances supply chain, real-estate and property valuers, but also ancillary services (finance-providers, accountants and lawyers), as described in **Figure 7.**

Figure 7 - Description of Building supply chain and associated barriers



Outside of the market leaders, most buildings are built to **low minimum standards**. The last upgrade of the National Construction Code's minimum energy performance requirements dates back to 2010, and lags well behind best practice, with the average Green Star rated office consuming almost half the energy of a building built to minimum standards.[63] Many energy performance standards for equipment and appliances may also lag behind best practice. In addition, there is increasing evidence that **compliance** with energy performance standards during construction in particular is poor[64], partly as a result of poor workmanship and the substitution of poor quality and cheaper products. The issue of compliance with energy efficiency requirements can in part be attributed to a lack of verification that buildings meet standards, which encourages a sign-off culture[65], but also to a variety of other factors.

[62] UNEP Finance Initiative, 2014
[63] ClimateWorks Australia, 2013,*Tracking Progress towards a low carbon economy- Buildings, p.17*
[64] Government of South Australia (2015) *National Energy Efficient Building Project*
[65] Pitt & Sherry, 2014

There are suggestions that many professionals throughout the design and construction supply chain do not have the **education and training** to be able to identify and implement energy efficiency measures, and do not regard this as a part of their job. This affects not only construction practices but also decisions made about replacement of energy intensive equipment at end-of-life (e.g. HVAC, water heaters) - often old inefficient equipment is replaced with equally inefficient new equipment, missing a crucial opportunity to upgrade at minimal marginal cost. Another area where skills are lacking is valuation, where there is currently a lack of methodologies that appropriately value energy performance and features in asset value. Finally, ancillary services (finance providers, accountants, lawyers) which can be trusted advisers to building owners or tenants often lack experience with energy efficiency projects and either advise against investment or, in the case of finance providers, may place onerous conditions on finance for energy efficiency projects because they are inexperienced in valuing these projects[66].

A related issue is the perception that more efficient buildings are too costly to construct,[67] a perception that evidence suggests may be inaccurate. For example, CSIRO showed that building a 5-star house costs between $5,000 and $7,000 less than a lower-rated house[68]. That said, experts have noted that in some cases there is limited availability of high efficiency equipment - particularly commercial equipment - at reasonable cost in Australia, due to the small size of the market combined with requirements to meet unique Australian standards and tests that impose a capital barrier to imports.

Another element that affects the uptake of energy efficiency measures is the **extreme fragmentation of building ownership.** This fragmentation creates high transaction costs and makes it difficult for the supply chain to develop viable business and delivery models for energy efficiency. Fragmentation is very high in commercial buildings, particularly in the retail sector[69], as well as in the mid-tier office sector. The latter is fragmented by extremely varied types of ownership but also by a lack of networks able to unify the segment[70]. Investors, owners and end-users in these fragmented sectors are isolated and often relatively small, which increases the burden of transaction costs associated with gathering the necessary information and assistance for them as well.

Fragmentation and disconnection within the building supply chain is another impediment to the implementation of energy efficiency. The **disconnection between different stages of the design and construction process** often results in a lack of communication between designers, builders, and operators. This lack of communication can lead to a loss of efficiency in the construction and operation

[66] UNEP, 2014
[67] Master Builders Association, 2010
[68] CSIRO, 2013
[69] ClimateWorks Australia, 2011, *Low Carbon Growth Plan for Australia - Retail Sector Summary Report*, p.3
[70] Green Building Council of Australia, 2015

stages, for example by the use, during the construction phase, of less efficient products than intended by the designer, or by an inefficient operation of the building due to a lack of understanding of its original design.

Motivation

Even if a project is fundamentally attractive in financial terms and the decision maker has access to all the information and skills required to implement it, in many cases the decision maker remains unmotivated to act. This can result from:

- **Low energy priority,** as energy is usually a very low share of total household and business costs. This is particularly the case for large energy consumers who benefit from discounted energy pricing provided by retailers, as illustrated by surveys showing that corporate senior executives remain mostly unaware of their annual energy costs.[71] In many cases, energy bills represent 3 per cent to 5 per cent of annual spending, and it is often unclear who is in charge of managing them.

  This low priority given to energy costs also results from of a focus on **competing priorities**. Most new-home buyers focus primarily on comfort, price, location as well as running costs, leaving energy efficient and sustainable features at the bottom of their lists when considering purchasing an asset.[72] This explains the relatively low demand for efficient housing despite of the higher resale value of low carbon homes.[73] Likewise, most business decision makers are focused on growth of their core business, which takes precedence over managing energy costs.

- **Low awareness of non-energy benefits** of energy efficient buildings. Despite increasing evidence that energy efficiency can deliver a range of non-energy benefits - such as improved indoor environment quality, more productive staff, improved comfort and health outcomes - that may be more valuable to building owners or occupants than energy cost savings, most investors, owners and end-users are not aware of these links.

- **Split incentives,** which usually arise in buildings where the owner is in control of the opportunity and is the one required to make the investment to improve energy efficiency, but the tenant in the building is the one who receives most of the benefit of that investment in the form of an improved indoor environment and energy savings. Split incentives in buildings can be resolved if the tenant and landlord are able to reach an agreement to share the costs and benefits of the investment. However, this can involve significant effort (e.g. a lease amendment or separate contract) and can be particularly challenging where there are multiple tenants in a single building, for example in retail shopping centres or in multi-residential apartment buildings. In effect, the split incentive operates as a very strong barrier to energy efficiency in tenanted properties.

[71] FORBES, 2015
[72] Instinct and Reason, 2014
[73] CRC for Low Carbon Living, 2014-2016

Policy processes and governance
The complexity of these issues means supportive institutional frameworks are required, including robust policy processes and governance arrangements. Many industry and expert stakeholders have noted that Australia lacks a cohesive governance framework for energy efficiency. A lack of robust institutional frameworks can contribute to:

- An inability to effectively resolve policy barriers or adapt existing policies to changed circumstances without clear accountability for resolving often very complex and challenging issues
- Inconsistency in policies across different jurisdictions, increasing transaction costs and making it more difficult for
- A lack of public and industry support for and engagement with efforts to improve energy performance

One particular issue that has been raised by a number of stakeholders in the process of writing this report is the **under-valuation of the full potential benefits** of improved energy performance in policy making. Two examples of this are:

- The discount rates applied in regulatory impact assessments, which can severely under-value the economic benefits of measures that incentivise energy efficiency in particular, considering that the full returns are received over a long period of time
- The absence of emissions reduction as an objective of the national electricity market and its regulators, the Australian Energy Market Commission, the Australian Energy Market Operator and the Australian Energy Regulator, which can undermine efforts to resolve regulatory barriers to energy efficiency and distributed energy.

APPENDIX 3. DETAILED MAPPING OF BARRIERS AND IMPEDIMENTS AGAINST POLICY TYPES

			Barriers targeted									
				Motivation			Capability			Project attractiveness		
Policy measures		How the policy overcomes the barriers	Governance	Low energy priority	Low awareness of non-energy benefits	Split incentives & other barriers	Lack of consumer resources	Lack of data & user-friendly, trusted information	Supply chain issues	Technology not commercial	Project not sufficiently attractive	Market structures not aligned
National Plan		**Primary target: Complex governance and limited policy co-ordination** Secondary targets: Can help overcome: - low awareness of non-energy benefits through research and public engagement - improve supply chain issues through improved industry engagement and more regulatory certainty - address high transaction costs by working towards national consistency of policies and overcome market misalignment through national co-ordination with energy market reform processes										
Minimum standards	Buildings Equipment and appliances	**Primary target: Overcomes the very low motivation of those consumers and service providers who are least likely to change voluntarily** Secondary targets: Also helps address: - supply chain issues by requiring a minimum level of improvement - uncommercial technology by accelerating deployment and reducing the cost										
Targeted incentives and programs	Use government market power	**Primary targets: Reducing the cost of implementation and improving supply chain issues by providing sufficient market demand for the development of more mature businesses and economies of scale for new technologies** Secondary target: Helping to overcome low consumer motivation by demonstrating the feasibility and benefits of energy efficiency										
	Incentives for higher performance	**Primary target: Can help to overcome a lack of motivation for most consumers for energy efficiency** Secondary targets: If effective, can help : - improve consumer information and awareness by driving intermediaries to promote the availability of the incentive - accelerate deployment of new technologies that are on the verge of being financially attractive - address market distortions by rewarding value that is not recognised in the market										
	Facilitation of industry leaders	**Primary target: Working with industry leaders and key players to find solutions to common problems and mainstream best practices**										
	Support for least equipped	**Primary target:** **- Addressing the strong limitations on capability for low-income households and small businesses to investigate, make informed choices about and pay for energy efficiency measure**				`						
Provide enabling conditions	Data collection and access	**Primary target: Reducing high transaction costs by making it easier for consumers and third parties to access the data required to develop and deliver energy efficiency projects** Secondary targets: - Enable research for improved policy - Allow the development of better consumer information, - Support the development of more sophisticated business models - Potentially help address split incentives by enabling more accurate calculating and apportioning of costs and benefits				`						
	Actionable information	**Primary targets: Enabling consumers to make informed choices, enabling investors to confidently invest in energy efficiency projects in aggregate, enabling research to be more easily undertaken on the value of energy efficient buildings and enabling investors to ensure buildings meet design standards** Secondary targets: If effective, could help address the low awareness of many consumers by clearly articulating the range of benefits				`						
	Training and education	**Primary target: Addressing gaps in education and training for a very wide range of service providers associated with the built environment, as well as building surveyors and regulators** Secondary targets: Could help improve consumer information and awareness if intermediaries with better training are able to promote the range of benefits to them										
	Research	**Primary target: Provide better information to support improved policy** Secondary targets: Also necessary to address: - a lack of consumer information through research to inform labelling and rating tools - low awareness of non-energy benefits through research to quantify those benefits - high transaction costs and supply chain issues through better research on energy use and energy efficiency costs and benefits - innovation and commercialisation of new technologies through emerging technology research - market distortions by exploring options for energy market reform										
	Support innovation and commercialisation	**Primary target: Reducing the cost of new technologies** Secondary targets: - Supporting the development of new finance mechanisms and business models including models w hich could help reduce transaction costs and address split incentives - Providing valuable information to help understand and promote non-energy benefits										
	Energy market reform	**Primary target: Removing barriers to energy efficiency and distributed energy in the energy market ensuring that the energy market reform process facilitates an optimal mix of energy efficiency, on-site energy and grid decarbonisation**										

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