



**DRAFT REPORT**

# Independent review of the Commercial Building Disclosure Program

*Prepared for  
The Department of the Environment and Energy  
September 2019*

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## *Glossary*

ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AIHE	Australian Institute of Hotel Engineers
BEEC	Building Energy Efficiency Certificate
BEED	Building Energy Efficiency Disclosure
CBA	Cost Benefit Analysis
CBD	Commercial Building Disclosure
CIE	Centre for International Economics
CLF	Conservation load factor
COAG	Council of Australian Governments
DEE	Department of the Environment and Energy
EA	Ecotourism Australia
ETS	Emissions Trading Scheme
GDP	Gross Domestic Product
GHG	Greenhouse gas
GLAR	Gross Lettable Area Retail
GRESB	Global Real Estate Sustainability Benchmark
HVAC	Heating, ventilation and cooling
IEQ	Indoor environmental quality
IT	Information Technology
IWG	Interagency Working Group
KPA	Key performance areas
LRMC	Long-run marginal cost

NABERS	National Australian Built Environment Rating System
NCC	National Construction Code
NEPP	National Energy Productivity Plan
NFEE	National Framework on Energy Efficiency
NGERS	National Greenhouse and Energy Reporting Scheme
NLA	Net Lettable Area
NLPD	Nominal Lighting Power Density
NPI	National Pollutant Inventory
NSEE	National Strategy on Energy Efficiency
PUE	Power usage effectiveness
PWC	PricewaterhouseCoopers
RIS	Regulation Impact Statement
SCA	Shopping Centres Australasia
SCC	Social cost of carbon
SDG	Sustainable Development Goals
TAA	Tourism Accommodation Australia
TLA	Tenancy Lighting Assessment
UNFCCC	United Nations Framework Convention on Climate Change
US	United States

## *Executive summary*

The Commercial Building Disclosure (CBD) Program is a mandatory disclosure program, requiring information on a building's energy performance to be disclosed when larger office spaces are sold or leased.

The Centre for International Economics (CIE) has been engaged to review the CBD Program and its enabling legislation — the *Building Energy Efficiency Disclosure Act 2010* (the BEED Act). The terms of reference for our review are shown in box 4.19. The following sections outline our findings against each of our terms of reference and our recommendations.

### **1 Terms of Reference**

The review will assess and provide recommendations on:

- 1 Whether the CBD Program's objectives are clear, remain relevant and are being met.
- 2 Whether the CBD Program is the most effective, appropriate and least-cost way to achieve energy efficiency outcomes including the benefits and costs imposed on industry.
- 3 The effectiveness of the Program in promoting energy efficiency and emissions abatement, both in its own right and in the context of the current framework of energy efficiency measures.
- 4 The case for expansion of the Program to other high energy-using classes of buildings including shopping centres, data centres, hotels (and apartment accommodation), and office tenancies, including the most appropriate form of disclosure in each sector and cost benefit analyses of the preferred options.
- 5 The impact of changes made in response to the previous review, including lowering the mandatory disclosure threshold for commercial office buildings from 2000 square metres to 1000 square metres and the extension of the Tenancy Lighting Assessment to five years.
- 6 Whether operational elements of the Program are delivering the best outcomes for stakeholders and the Program's objectives, including the merits of the Tenancy Lighting Assessment and whether it should be continued or improved, and the merits of requiring periodic ratings instead of ratings triggered by property being offered for sale or lease.
- 7 Any legislative or regulatory changes required to improve the existing Program.

### *Objectives of the CBD program*

- **The objectives of the CBD are currently not clear, although the CBD Program has achieved all of the objectives stated in various documents.**
- **The objectives of the CBD Program should be aligned with the National Energy Productivity Plan.**

The objectives of the CBD Program are variously stated as to:

- promote the disclosure of information about the energy efficiency of buildings (as stated in the Act)
- improve the energy efficiency of office buildings and to ensure prospective buyers and tenants are informed (as stated in the RIS for the BEED Act and on the CBD Program website), and
- facilitate a significant reduction in energy consumption and greenhouse gas emissions (as stated in the RIS for the recent changes to the CBD Program).<sup>1</sup>

The CBD Program has achieved all of the above objectives.

The relevance of the CBS program's objectives should reflect the overarching plan, the National Energy Productivity Plan (NEPP). The NEPP argues that the benefits of improved energy efficiency (or energy productivity) are to:

- boost competitiveness and growth;
- help businesses manage their energy costs
- reduce GHG emissions.

Given the lack of clear objectives for the program currently, the CBD program should develop objectives aligned to the NEPP, such as the objective below.

The objective of the CBD program is to facilitate improvement to the energy efficiency of commercial buildings on the basis that improved energy efficiency can:

- reduce energy bills and overall costs for building owners and/or tenants
- reduce GHG emissions.

### *Effectiveness of the CBD Program*

- **The CBD Program has been effective in promoting energy efficiency and emissions abatement.**
- **Under the CBD Program, building owners/managers make their own decisions on energy efficiency improvements. As such, there is a lower risk of building owners being forced to make energy efficiency improvements that are not cost-effective, compared with programs where higher levels of energy efficiency are mandated.**

Average energy use for offices (base building) has declined over time from over 550 MJ/m<sup>2</sup> in 2010-11 to 400 MJ/m<sup>2</sup> in 2018-19. The CBD Program has made a

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<sup>1</sup> ACIL Allen Consulting, *Improving the energy efficiency performance of small office buildings*, Regulation Impact Statement for Consultation, March 2016, p. 6.

significant contribution towards this improvement, primarily through encouraging building owners/managers to make operational changes and end of life capital upgrades (very few stakeholders have indicated that they would undertake major capex solely for improving their energy efficiency). We estimate that the CBD Program has:

- reduced energy consumption by a cumulative 3 PJ to date
- saved over \$82.6 million in energy bills to date, and
- reduced GHG emissions by around 600 000 tonnes CO<sub>2-e</sub> to date (equivalent to the GHG emissions of more than 40 000 household for a year).

After accounting for all the costs and benefits of achieving these energy savings, and including impacts from changes already made to buildings and that will occur over the next ten years, the net benefits of the program are estimated to be \$86 million in net present value terms (table 2). This includes:

- benefits to building owners/tenants, because savings in energy bills outweigh the costs of the improvements made
- community benefits from reduced GHG emissions.

## 2 CBD Program – cost-benefit analysis

Total Impacts	
\$ million	
<b>Private benefits/costs</b>	
Electricity savings	90
Gas savings	49
Upgrade costs	- 68
Compliance costs - NABERS ratings	- 29
Compliance costs - TLAs	- 8
<b>Net private benefits/costs</b>	<b>34</b>
<b>Other benefits/costs</b>	
GHG emissions	65
Government costs	- 12
<b>Total net benefit/cost</b>	<b>87</b>

Note: Costs and benefits are presented in present value terms over the period from where the CBD Program commenced in 2010-11 to 2018-19. As the energy efficiency upgrades made over this period will continue to deliver benefits into the future, energy saving benefits have been extended for an additional ten years.

Source: CIE estimates (see chapter for further details).

These benefits are expected to increase over time. Under a 'business as usual' scenario, we estimate that the net benefits of the CBD Program will increase to \$217.2 million by 2030.

The CBD Program has achieved these gains because poorly performing offices have substantially lifted their performance, and because of demand from tenants including government tenants for high NABERS energy rated buildings. More specifically, the program has:

- highlighted poor performance for building owners, which has pushed them to make changes
- assisted corporate social responsibility objectives around reducing energy use and environmental footprint, thereby allowing tenants to choose more efficient buildings.

The CBD Program has achieved these gains through relatively light touch regulation — the mandatory provision of information. There is no regulatory requirement for building owners/managers to improve energy efficiency. Rather, the CBD Program works by encouraging building owners/managers to make their own decision to improve energy efficiency (the outcome) by overcoming some of the market and behavioural failures that may be barriers to improved energy efficiency. Because building owners/managers make their own decision on what energy efficient improvements to undertake, there is a lower risk of regulatory failures — such as where the costs of an energy efficient improvement outweigh the energy saving benefits for some or all buildings.

### *Impact of previous changes to the program*

- **As the recent changes to the CBD Program in response to a previous review commenced only around two years ago, they have had limited impact to date.**
- **However, we expect that these changes will deliver modest net benefits over time.**

Following the previous review of the CBD Program, the following changes were made to the CBD Program effective from 1 July 2017:

- the threshold was reduced from 2000 m<sup>2</sup> to 1000 m<sup>2</sup>
- the requirement for a TLA was reduced from every year to every five years.

As these changes were made only around 2 years ago, the additional buildings covered by the CBD Program have had limited opportunity to improve their energy performance.

However, under a ‘business as usual’ scenario, we estimate that the changes made in 2017 would deliver a net benefit to the community of around \$4.17 million in net present value terms (using a discount rate of 7 per cent) by 2030.

### *Potential changes to the CBD Program*

- **The CBD Program should be expanded to:**
  - hotels (subject to a review of the NABERS tool)
  - office tenancies (subject to the development of a low-cost system that would integrate mandatory tenancy ratings with existing base building requirements).
- **At the present time, the CBD Program should not be expanded to:**
  - shopping centres
  - data centres.
- **There is a strong conceptual case for mandatory NABERS ratings for apartment buildings. However, strata-titled buildings (such as most apartment buildings)**

**cannot be regulated by the Commonwealth under the Corporations Act and cannot therefore be covered by the CBD Program. Apartment buildings have not therefore been considered in detail.**

Table 3 summarises some key metrics for the four expansion sectors, with further discussion below.

### 3 Quantitative assessment of expansion sectors

	Number of buildings covered	Amount of space covered	Additional energy covered	Estimated net benefits
	No.	No.	PJ/year	\$m, pv
Office tenancies	3000	20 million m <sup>2</sup>	8	61
Shopping centres	427	16 million m <sup>2</sup>	3	-17
Hotels	640	86 000 rooms	6	26
Data centres <sup>a</sup>	252	n.a.	6	n.a.

<sup>a</sup> Includes only colocation data centres. There is no information on private data centres available.

Note: The estimated net cost for shopping centres reflects the compliance costs associated with the scheme only. The energy covered for shopping centres is only for shopping centres not rated in 2018.

Source: The CIE.

#### *Offices*

The existing CBD program is focused on the base building energy use, which excludes the energy use from tenants (such as lighting and computing).

We find that if compliance costs can be minimised through co-assessments and a requirement for ratings every second year (rather than every year), expanding mandatory disclosure requirements to office tenancies could deliver a net benefit to the community. We estimate that these benefits could be around \$61 million in net present value terms (using a discount rate of 7 per cent) over ten years.

However, this finding is contingent on a streamlined system being established. This would require:

- aligning the requirement for an office tenancy rating to the base building rating (this would necessitate a shift to periodic ratings where buildings are required to obtain a rating every year or every second year, rather than on sale or lease).
- building owners/managers (or the assessor acting on their behalf) having direct access to tenant metering data to complete the rating through the co-assess tool. In some states, we understand this would require some legislative changes.

If such a system cannot be developed, expanding mandatory disclosure requirements to office tenancies is likely to impose a significant net cost on the community.

#### *Shopping centres*

We do not recommend expanding mandatory disclosure requirements to shopping centres. We estimate that mandatory disclosure could impose a net cost of around \$17 million in net present value terms (using a discount rate of 7 per cent) over ten years.

Shopping centres have improved their energy efficiency, over the time period and set of centres for which this can be measured. These changes have occurred for shopping centres that undertake annual NABERS energy ratings, for those that occasionally use NABERS energy ratings and, where information is available, for those that do not use NABERS energy ratings.

A large share of shopping centres (almost half of the centres above 15 000 m<sup>2</sup>) use NABERS energy ratings voluntarily. NABERS energy has proven to be a useful tool for these businesses to monitor, compare and communicate the changes in their energy performance. Others monitor their energy consumption and environmental performance using other tools.

Our draft finding is that NABERS energy ratings continue to be promoted as a voluntary tool for shopping centres.

- Mandatory disclosure could be beneficial if shopping centre owners or operators are unaware of their comparative energy performance. The evidence does not support this for the majority of shopping centres. Whether or not they are using and disclosing NABERS energy ratings, shopping centres are monitoring and improving their energy efficiency.
- Mandatory disclosure could be beneficial if there was demand from tenants in shopping centres. Tenant groups have indicated that they receive information on costs, including energy costs. Energy efficiency disclosure of the shopping centre is not information that they would use.
- Mandatory disclosure could be beneficial if there was demand from customers going to shopping centres. Consultations have not supported the view that customers would make use of comparative energy efficiency information.

If there are specific concerns about smaller shopping centre owners not being aware of their energy performance, then these owners could be targeted through programs for energy audits and NABERS energy ratings, building on NABERS recent expansion of the tool into smaller shopping centres.

## ***Hotels***

We find that if the NABERS Energy tool for hotels is reviewed to ensure that the industry has confidence that it provides fair assessments across hotels, expanding mandatory disclosure could deliver a net benefit to the community of \$26 million in net present value terms (using a discount rate of 7 per cent) over ten years.

Hotel (accommodation) energy performance data is less widely available than for other sectors. While many hotels have adopted sustainability tools to communicate their sustainability actions to customers, these do not often provide energy efficiency information on an individual hotel or even aggregate company basis. Uptake of NABERS energy in hotels has been very low and falling<sup>2</sup> — it appears that hotels adopted NABERS energy ratings because of an expectation that this would become

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<sup>2</sup> There are unofficial hotel ratings, which are not certified by NABERS, and it appears that there are much higher number of these than official ratings.



mandatory, but have not found enough value from the tool to continue rating in the absence of mandatory disclosure. There is also a widespread view across the industry that NABERS energy does not provide a good benchmark for hotels.

The evidence that is available for hotels indicates that they are generally improving their energy performance. This evidence base includes hotels rated using NABERS energy and public reporting by hotels in relation to sustainability. However, the sample sizes for this are small and may not represent what is happening to hotels in general. Consultations with hotel engineers, including members of the Australian Institute of Hotel Engineers, suggests that they do face pressure to reduce energy and to reduce energy costs, such as through targeted reductions year-on-year.

Evidence from energy efficiency advisers, which is based on similar or larger samples to the data available, suggests that hotels are less advanced in considering how to reduce their energy use than other commercial building sectors. This is gradually changing because of increasing energy prices. Based on NABERS energy use data, a zero star NABERS energy rated star hotel will have a cost of \$6000 per room per year, compared to a 3 star energy rated hotel of less than \$2000 per room.<sup>3</sup>

Our draft findings for hotels are that:

- NABERS energy does not currently have sufficient support from the industry to be mandated now. It should be reviewed and if necessary redone if it were to be made mandatory. Industry has indicated a willingness to provide data for this to occur
- There is no other energy efficiency tool that could be disclosed instead of NABERS energy — we consider that a mandatory disclosure arrangement would have to use a single tool to be useful, and it would not be advisable to make a tool mandatory that was not controlled by an Australian government
- A mandatory disclosure program for hotels would drive energy efficiency improvements because it would be used in procurement by government and larger corporates (these sectors are likely to be sufficiently important to drive energy efficiency improvements in many hotels)
- The hotel industry considers procurement related to a NABERS energy rating to be a risk, in that they will be required to invest in expensive upgrades to improve their energy performance
  - this will vary considerably across hotels, with hotel consultations indicating particular risk for older hotels to be able to achieve cost effective energy efficiency improvements
  - current payback periods indicated by hotel groups for energy efficiency upgrades are low (4-5 years), which suggests that many hotels will find energy efficiency upgrades that can pay for themselves over a 10-year period
- Mandatory disclosure of energy performance for hotels would have a net benefit of \$26 million. This particularly reflects benefits from reduced GHG emissions. Hotels achieve only a small return themselves through lower energy bills, which just offsets

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<sup>3</sup> This uses a weighted average price across Australian states and territories for 2018 of 9.79 cents per kwh of electricity and 2.34 cents per MJ for gas.

the compliance costs of a mandatory disclosure scheme and costs of energy efficiency upgrades.

### ***Data centres***

There is currently insufficient evidence to support the expansion of the CBD Program to cover data centres.

- Data centres are harder to define than other types of commercial buildings and the market is constantly evolving.
- For colocation data centres, the available (albeit limited) evidence suggests that mandatory disclosure is unlikely to drive significant improvements in energy efficiency for existing data centres.
  - Energy is a much more significant proportion of costs than for other commercial buildings and colocation data centres must closely manage energy costs to compete effectively in the market. As such, there is much less likely to be poorly performing colocation data centres (the benefits of mandatory disclosure for office buildings was driven to a significant extent by large improvements in buildings that were performing poorly when they entered the NABERS system).
  - There is little evidence of a systematic improvement in energy performance over time among the small number of data centres that voluntarily rate.
  - There are significant barriers to improving the energy efficiency of existing data centres through end of life replacement of cooling systems.
- Less is known about the performance of private data centres. Some stakeholders suggested that many of these data centres perform poorly (particularly government-owned data centres).

### ***Recommendations***

- 1 The CBD Program continues for office buildings.
- 2 The impact the CBD Program is having in offices can be increased, through funding programs aimed at low-NABERS energy star-rated buildings. Some offices have not improved their performance and remain at low levels of energy efficiency. A Commonwealth funding program that is delivered by councils could be targeted at these buildings.
- 3 The CBD Program should be extended to office tenancies, replacing the current TLA requirements.
  - a) This recommendation is subject to developing a system that minimises compliance costs through the use of the NABERS Co-assess tool (which we understand may require legislative changes in some states). This would necessitate moving to a periodic rating system and we recommend that a BEEC be required every two years (rather than on sale and lease).
  - b) Disclosure of tenancy ratings using the co-assess tool could be trialled in a state where existing legislation would allow this to occur.

- c) If the CBD Program is not extended to office tenancies, there is no compelling case to change current disclosure requirements for base buildings.
- 4 Disclosure of energy performance should not be mandated for shopping centres
- 5 Mandatory disclosure of energy performance should be expanded to hotels, subject to satisfactory completion of the following steps:
  - a) The benchmarks in the NABERS energy tool for hotels should be reviewed to ensure they provide fair comparison across hotels. This should involve industry representation (as is standard NABERS practice) and would be expected to take around one year. If issues are found with the benchmarks, these should be re-issued. This should be complemented with NABERS engagement with the hotel industry to build trust in the outcomes of the tool. NABERS could also consider what could be done to reduce potential confusion with quality star for hotels.
  - b) Following this, a period of two years should be allowed for undisclosed ratings to be done by hotels prior to mandatory disclosure being put in place.
  - c) Mandatory disclosure should apply firstly to hotels with more than 100 rooms. This would cover approximately 600 hotels covering ~86 000 rooms. Subject to the review below, this could then be reduced (such as by expanding to all hotels with more than 50 rooms). This does not apply to motels and resorts, which are not rated by NABERS. It is not clear if the ABS defined 'Private hotels' would be covered – this is hotels without a public bar. Our expectation is that these are not appropriately benchmarked in NABERS as they were not part of the sample for initial benchmarking
  - d) Hotel ratings should be required every two years. Disclosure should be in the hotel foyer and on the hotel's website
  - e) The Australian Government should consider funding support for obtaining the first NABERS energy ratings. The costs of obtaining the first rating would amount to ~\$4 million
  - f) Four years after mandatory disclosure is put in place, its impact on hotel energy efficiency should be reviewed.
- 6 The CBD Program should not be expanded to data centres at the present time.
  - a) Nevertheless, the Commonwealth and state governments should commit to obtaining NABERS ratings on their own data centres. This process should be used to gather information on: the practical challenges associated with rating existing data centres; identifying whether the process of obtaining a NABERS rating identifies any cost-effective options for improving the energy efficiency of existing data centres; and the cost of improving the energy efficiency of existing data centres.
  - b) Based on these findings, the government could re-consider expanding mandatory disclosure requirements to data centres.
- 7 Disclosure of energy performance for apartment buildings should be investigated in detail, following agreement from states and territories to undertake such an investigation.

- 8 State and territory government should agree to a detailed examination of mandatory disclosure of NABERS ratings for apartment buildings, including consideration of an appropriate legal framework.
- 9 As recovering the costs incurred by DEE in administering CBD Program (including compliance and enforcement costs) through user charges would be consistent with the Australian Government Cost Recovery Guidelines, DEE should develop a compliant cost recovery framework.

### *Feedback on our draft recommendations*

We welcome feedback on all our draft recommendations and findings, particularly from those who would be users of information, such as building owners and operators, tenants and customers, and their representative groups. Feedback can be provided:

- in person at stakeholder forums to be held:
  - in Melbourne on 22 October 2019; and
  - in Sydney on 28 and 29 October 2019
- by contacting Phil Manners or Hayden Fisher on 02 9250 0800, [pmanners@TheCIE.com.au](mailto:pmanners@TheCIE.com.au) / [hfisher@TheCIE.com.au](mailto:hfisher@TheCIE.com.au)
- through written submission to the above email addresses.

# 1 Background and introduction

## Policy context

Energy efficiency can be a low-cost approach to reducing greenhouse gas (GHG) emissions and meeting Australia's targets under the Paris Climate Agreement (see box 1.1). In some cases, energy efficiency improvements can provide a 'win-win' outcome by providing net private benefits (i.e. bill savings that exceed implementation costs) to energy users, as well as reducing GHG emissions.

### 1.1 The Paris Climate Agreement

The Paris Climate Agreement has been ratified by 168 of 197 Parties to the United Nations Framework Convention on Climate Change (UNFCCC), including Australia.<sup>4</sup> It aims to limit global warming to less than 2 degrees Celsius and pursue efforts to limit the rise to 1.5 degrees Celsius.

The Paris Agreement requires all Parties to put forward their best efforts through 'nationally determined contributions'. Australia has committed to implementing an economy-wide target to reduce greenhouse gas emissions by 26 to 28 per cent below the 2005 level by 2030.<sup>5</sup>

The potential benefits of improving energy efficiency is reflected in various policy papers and plans including the following.

- The Commonwealth Government's *Energy White Paper* — this was released in April 2015, and sets out an energy policy framework for Australia. Increasing energy productivity to promote growth was one of the White Paper's three key themes.
- The National Energy Productivity Plan (NEPP) — as an integral part of the *Energy White Paper*, the Council of Australian Governments (COAG) Energy Council has developed the *National Energy Productivity Plan 2015 – 2030*, released in December 2015. The Work Plan for NEPP developed 34 measures to achieve a target of improving Australia's energy productivity by 40 per cent between 2015 and 2030 to:
  - boost competitiveness and growth
  - help families and businesses manage energy costs

<sup>4</sup> United Nations Framework Convention on Climate Change website, [http://unfccc.int/paris\\_agreement/items/9485.php](http://unfccc.int/paris_agreement/items/9485.php), accessed 19 October 2017.

<sup>5</sup> Department of the Environment and Energy website, <http://www.environment.gov.au/climate-change/publications/factsheet-australias-2030-climate-change-target>, accessed 8 November 2017.

- reduce greenhouse gas emissions.<sup>6</sup>

### *Overview of the CBD Program*

The Commercial Building Disclosure (CBD) Program requires information on the energy efficiency of a building to be made publicly available. This means that it can be accessed to inform commercial decisions by prospective tenants and purchasers of a property. It applies to commercial office space where more than 1000 m<sup>2</sup> is offered for lease or sale simultaneously, except:

- new buildings where a certificate of occupancy (or equivalent) has either not yet been issued or was issued less than two years earlier
- buildings that have completed a major refurbishment for which a certificate of occupancy (or equivalent) was issued less than two years earlier
- strata-titled buildings
- mixed use buildings where total office space comprises less than 75 per cent by net lettable area
- spaces used for police or security operations; or where a rating cannot be assigned and an exemption has been granted.

### *How the CBD Program works*

The Commercial Building Disclosure (CBD) Program is a key national-level policy to encourage energy efficiency improvements in existing buildings.

- Under the CBD Program, all office space greater than 1000 m<sup>2</sup> must obtain a Building Energy Efficiency Certificate (BEEC) upon sale or lease.
- A BEEC includes:
  - a NABERS star rating that provides information on energy use, GHG emissions and a benchmark of how energy use compares to similar buildings in similar climatic locations
  - the lighting efficiency of the tenanted area through a Tenancy Lighting Assessment (TLA). This provides a measure of the energy required to light each of the areas of a building.
- The NABERS rating must be disclosed in all advertising material.

A BEEC is prepared by a CBD-accredited assessor. There are currently 176 accredited assessors around Australia. In larger jurisdictions there are many assessors. However, in smaller jurisdictions such as Northern Territory and Tasmania there are only 1-2 accredited assessors. There are currently 437 accredited NABERS assessors, who can prepare a NABERS rating (which forms part of the BEEC).

An overview of the CBD Program and its evolution over time is shown in chart 1.3. Effectively, the CBD Program focuses on overcoming information asymmetries, where sellers/lessors do not disclose a building's energy performance to potential

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<sup>6</sup> COAG Energy Council 2015, *National Energy Productivity Plan 2015-2030: Boosting Competitiveness, managing costs and reducing emissions*, December 2015, p. 5.

buyers/lessees. A number of significant changes were made to the CBD Program following a previous review in 2015 by ACIL Allen Consulting.<sup>7</sup>

The CBD Program was intended as a complement to mandatory minimum standards set out in the National Construction Code (NCC). Whereas the NCC applies only to new buildings (and buildings undergoing major refurbishment), the CBD Program aims to encourage improved energy performance of existing buildings.

### *Coverage of the CBD Program*

Buildings that have been subject to mandatory disclosure cover 20 million square metres of floor space, and 11 PJ of energy use per year as of 2016-17 (table 1.2). This is equivalent to ~one-third of estimated energy use from stand-alone offices, 7 per cent of estimated non-residential building energy use (which includes education, public buildings, hospitals, retail and hotels) and 0.6 per cent of Australia's electricity and gas consumption. The program does not cover the energy use of offices outside of the base building (in most cases), does not cover very small buildings (less than 1000 m<sup>2</sup>) and has a range of other exemptions.

## 1.2 Energy use in commercial buildings

	Area	Energy use	Share of Australia's electricity and gas consumption
	Million m <sup>2</sup>	PJ/year	Per cent
Australia energy consumption <sup>a</sup>	Na	6 146	Na
Australia's electricity and gas consumption <sup>a</sup>	Na	1 887	100.0
Commercial services electricity & gas consumption <sup>a</sup>	Na	294	15.6
Non-residential building energy use <sup>b</sup>	157	159	8.4
Stand-alone offices <sup>b</sup>	43	37	2.0
Buildings rated under CBD Program <sup>c</sup>	20	11	0.6

<sup>a</sup> 2016/17 from Australian Energy Update 2018, Department of the Environment and Energy. Electricity and gas consumption excludes gas consumed in producing electricity; <sup>b</sup> Estimate for 2016/17 from pitt&sherry 2012, *Baseline energy consumption and greenhouse gas emissions in commercial buildings in Australia*; <sup>c</sup> Sum of annual energy use from latest BEEC for each building. Note that the timing of this measure is different for each building and for most buildings only includes base building energy.

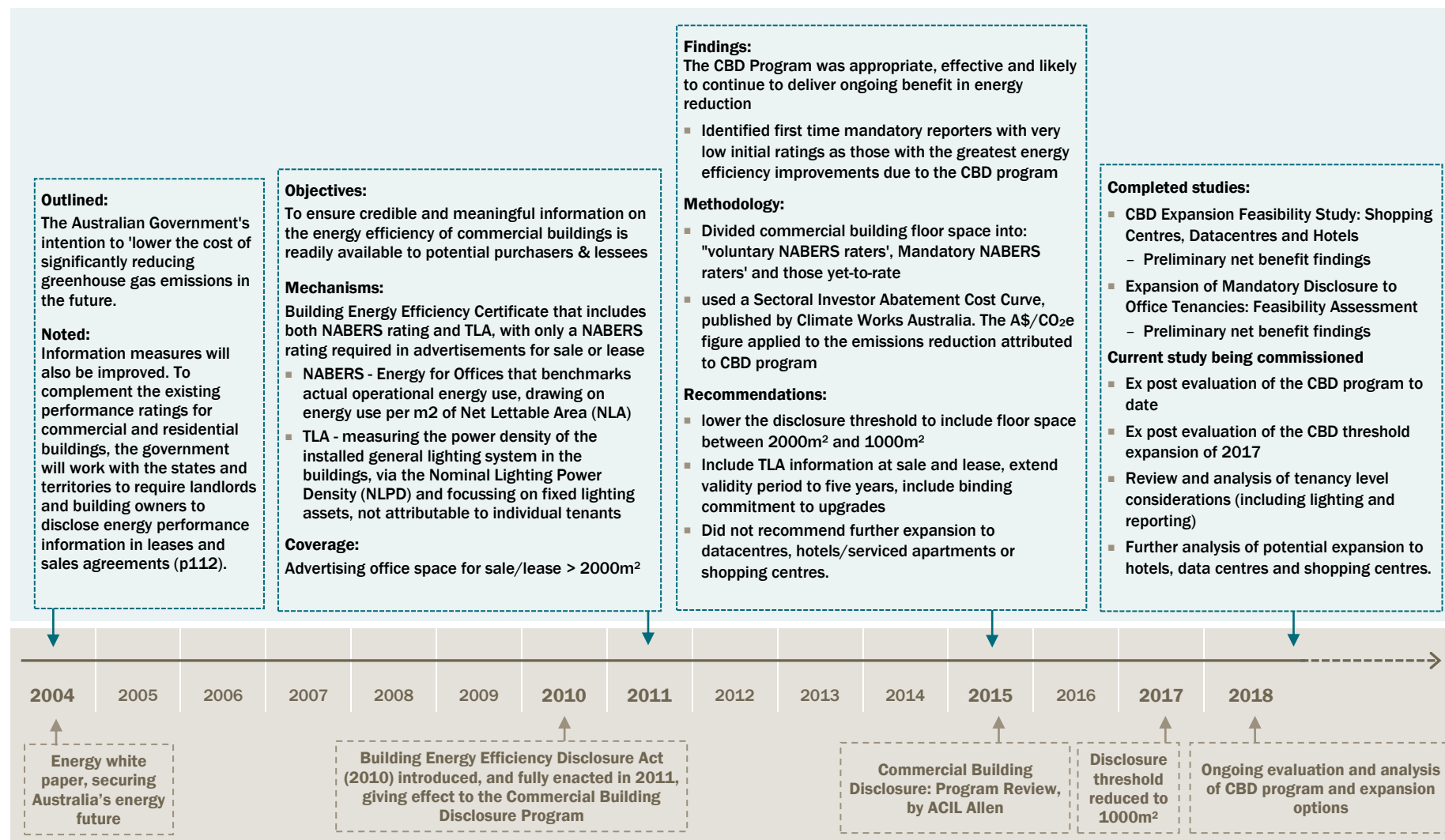
Note: Commercial services includes ANZSIC divisions: Wholesale Trade (F); Retail Trade (G); Accommodation and Food Services (H); Information Media and Telecommunications (J); Financial and Insurance Services (K); Rental, Hiring and Real Estate Services (L); Professional, Scientific and Technical Services (M); Administrative and Support Services (N); Public Administration and Safety (O); Education and Training (P); Health Care and Social Assistance (Q); Arts and Recreation Services (R); and Other Services (S).

Source: CIE analysis of CBD dataset; Australian Energy Update 2018, Department of the Environment and Energy.

<sup>7</sup> ACIL Allen Consulting 2015, *Commercial Building Disclosure: Program review*, prepared for Department of Industry and Science, <https://prod-cbd.energy.slicedtech.com.au/sites/prod.cbd/files/CBD%20program%20review%20final%20report.pdf>.



### 1.3 The evolution of the CBD Program

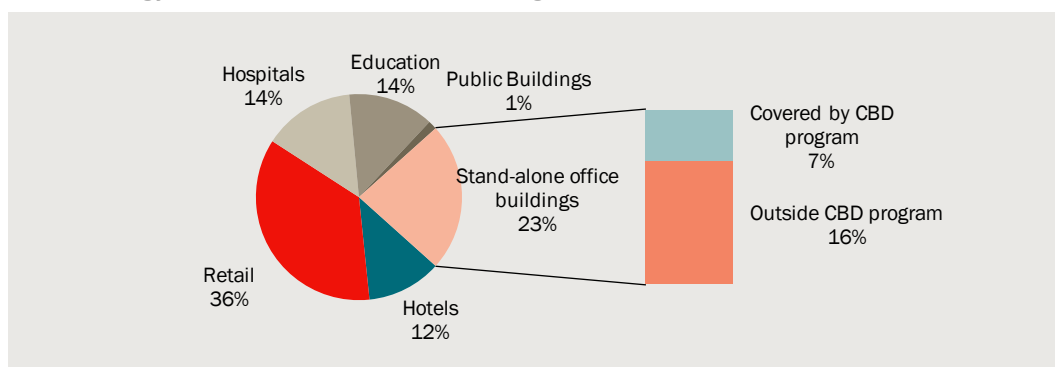


Source: CIE.



The CBD Program covers only a small part of non-residential building use, given that it largely focuses on the base building energy use of larger office buildings. Using past forecasts of non-residential building use by sector, and energy use covered by the CBD Program, the comparisons of different building types is shown in chart 1.4.

#### 1.4 Energy use of non-residential buildings



Note: pitt&sherry estimates are for 2017.

Data source: pitt&sherry 2012, *Baseline energy consumption and greenhouse gas emissions in commercial buildings in Australia*; CIE analysis of CBD dataset.

Possible expansions to the Program do not cover the full amount of energy in other sectors. Expanding mandatory disclosure to shopping centres would add about 3PJ of energy for space that is not currently rated, compared to the existing 11PJ of energy rated under the CBD Program. Expanding mandatory disclosure to hotels above 100 rooms would add about 6PJ of energy.

#### 1.5 Energy use in commercial buildings

	Area	Energy use	Share of Australia's electricity and gas consumption
	Million m <sup>2</sup>	PJ/year	Per cent
Buildings rated under CBD Program <sup>a</sup>	20	11	0.6
Shopping centres rated under NABERS <sup>b</sup>	8	3	0.2
Shopping centres that could be rated using NABERS but are not currently <sup>c</sup>	8	3	0.2
Hotels that could be rated under NABERS with more than 100 rooms <sup>d</sup>	na	6	0.3
Data centres that could be rated under NABERS	na	6+	0.3+
Tenancies that could be rated under NABERS	20	8	0.4
<b>Total</b>	<b>na</b>	<b>37+</b>	<b>2.0+</b>

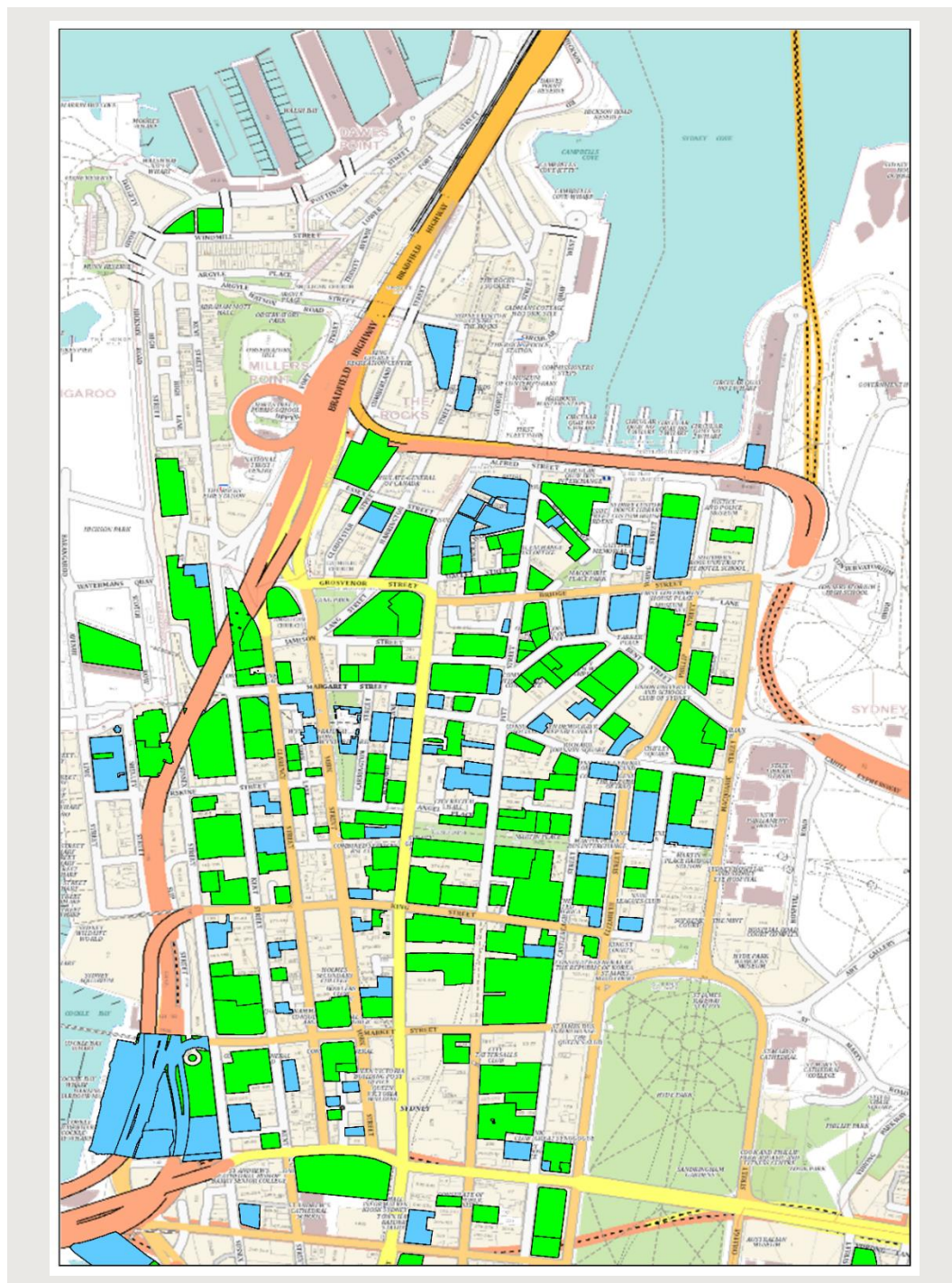
<sup>a</sup> Sum of annual energy use from latest BEEC for each building. Note that the timing of this measure is different for each building and for most buildings only includes base building energy. <sup>b</sup> For shopping centres rated in 2018. <sup>c</sup> Based on dataset of all shopping centres over 15 000m<sup>2</sup>. <sup>d</sup> For hotels only, not motels, private hotels, guesthouses and serviced apartments. CIE estimate using NABERS energy intensity data and ABS data on room numbers.

Source: CIE analysis of CBD dataset, NABERS datasets and other as set out above.

The NABERS scheme has fairly wide coverage in central business district areas, particularly in Sydney, largely reflecting buildings under the CBD Program as well. In

charts 1.6 and 1.7, we show the NABERS and CBD coverage in the central business districts of Sydney and Melbourne (respectively) where green indicates CBD rated buildings and blue indicates other NABERS rated buildings.

### 1.6 NABERS and CBD coverage – Sydney central business district

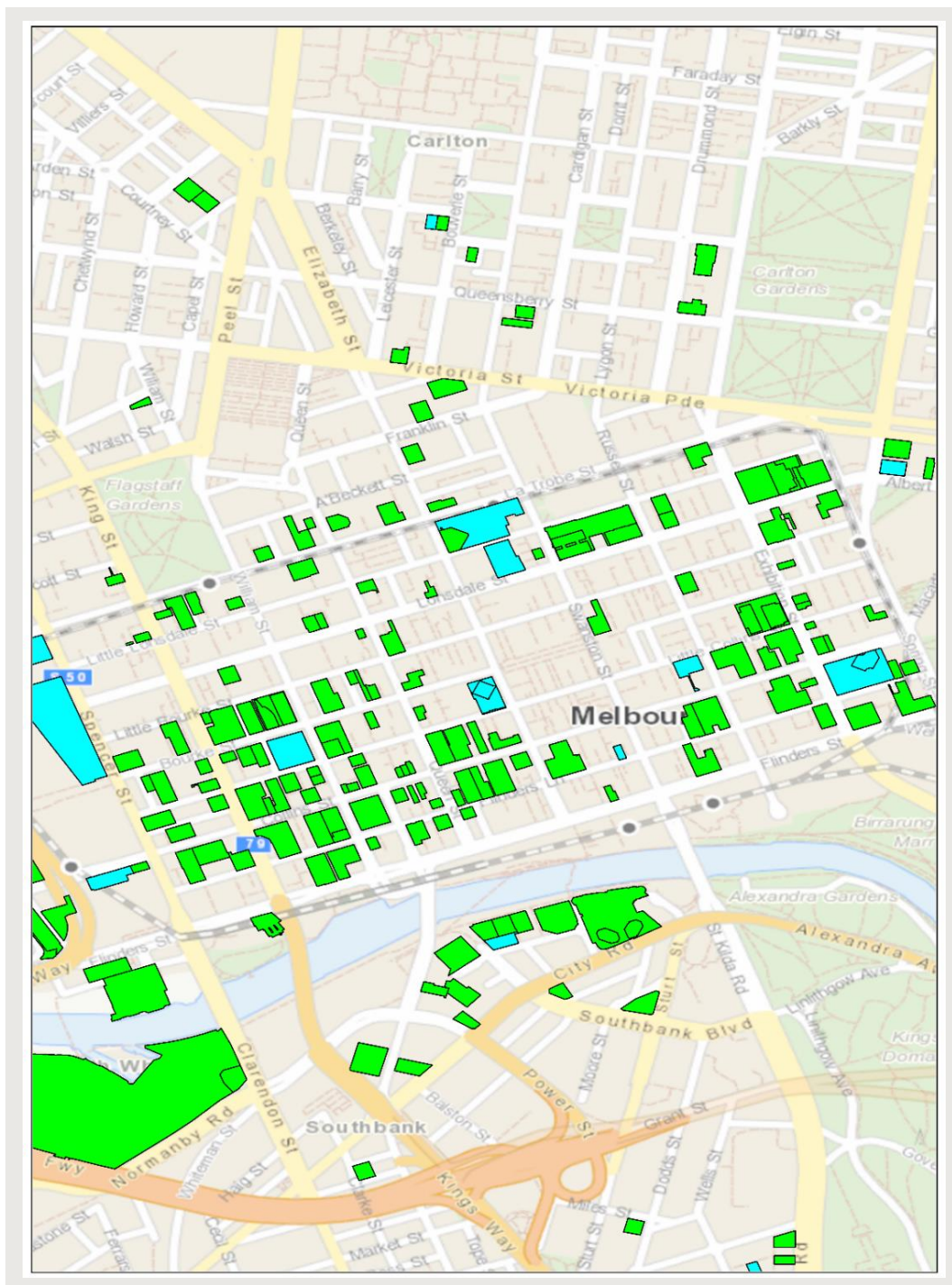


Note: Green is buildings rated under the CBD Program and blue is buildings rated under NABERS but that were not required to be rated under the CBD Program.

Data source: The CIE.



## 1.7 NABERS and CBD coverage – Melbourne central business district



Note: Green is buildings rated under the CBD Program and blue is buildings rated under NABERS but that were not required to be rated under the CBD Program.

Data source: The CIE.

## *Review of the CBD Program*

The CBD Program was previously reviewed in 2015, with the review focusing mostly on whether the benefits of the existing program outweighed the costs. The 2015 review found that the CBD Program:<sup>8</sup>

- is appropriate, complements related government policies and programs
- has been effective in inducing positive behaviour change in relation to commercial building energy efficiency
- is the principal program for driving energy efficiency improvements in the office sector.

The report made a number of recommendations, including that the Program should:<sup>9</sup>

- continue
- remain focused on office buildings
- be expanded to include smaller office spaces
- continue to harness opportunities for further process and administrative efficiency improvements
- utilise opportunities to accelerate awareness and appreciation of Tenant Lighting Assessment by clients.

Measure 9 of the NEPP work plan focuses on expanding commercial building ratings and disclosure. Although the 2015 review did not recommend that the CBD Program be expanded to other buildings, subsequent feasibility studies have looked at expanding the CBD Program to cover: office tenancies, shopping centres, hotels and data centres. This is a key focus of current review (the terms of reference are shown in box 1.8).

### **1.8 Terms of Reference**

The review will assess and provide recommendations on:

- 1 Whether the CBD Program's objectives are clear, remain relevant and are being met.
- 2 Whether the CBD Program is the most effective, appropriate and least-cost way to achieve energy efficiency outcomes including the benefits and costs imposed on industry.
- 3 The effectiveness of the Program in promoting energy efficiency and emissions abatement, both in its own right and in the context of the current framework of energy efficiency measures.
- 4 The case for expansion of the Program to other high energy-using classes of buildings including shopping centres, data centres, hotels (and apartment

<sup>8</sup> ACIL Allen Consulting, 2015, *Commercial Building Disclosure Program Review*, Final Report, for Department of Industry and Science, pp i-iv.

<sup>9</sup> ACIL Allen Consulting, 2015, *Commercial Building Disclosure Program Review*, Final Report, for Department of Industry and Science, pp iv-vi.

accommodation), and office tenancies, including the most appropriate form of disclosure in each sector and cost benefit analyses of the preferred options.

- 5 The impact of changes made in response to the previous review, including lowering the mandatory disclosure threshold for commercial office buildings from 2000 m<sup>2</sup> to 1000 m<sup>2</sup> and the extension of the Tenancy Lighting Assessment to five years.
- 6 Whether operational elements of the Program are delivering the best outcomes for stakeholders and the Program's objectives, including the merits of the Tenancy Lighting Assessment and whether it should be continued or improved, and the merits of requiring periodic ratings instead of ratings triggered by property being offered for sale or lease.
- 7 Any legislative or regulatory changes required to improve the existing Program.

### ***This report***

This preliminary draft report presents our preliminary views based on our analysis and the information we have gathered so far. The remainder of the report is structured as follows.

- Chapter 2 sets out the rationale for mandatory disclosure
- Chapter 3 reviews the objectives of the CBD Program
- Chapter 4 presents our analysis of the impacts the CBD Program, including the impacts of the recent changes
- Chapter 5 estimates the costs and benefits of the CBD Program to date
- Chapter 6 presents our analysis and draft findings on offices
- Chapter 7 presents our analysis and draft findings on shopping centres
- Chapter 8 presents our analysis and draft findings on hotels
- Chapter 9 presents our analysis and draft findings on data centres
- Chapter 10 discusses some other issues, including the potential for cost recovery and mandatory disclosure for apartment buildings.

## 2 *Rationale for mandatory disclosure*

### *The rationale for government energy efficiency policies*

The rationale for government policies to encourage energy efficiency is based on the proposition that industry would not make socially optimal energy efficiency decisions in commercial buildings without government intervention. That is, there are energy efficiency opportunities where the benefits to the community (including public benefits) outweigh the associated costs that would not be taken up in the absence of regulation. This is often referred to as the ‘energy efficiency gap’.<sup>10</sup>

One view is that the energy efficiency gap is caused mainly by a range of market failures and behavioural anomalies.

### *Market failures relating to energy pricing*

A key market failure is that the full cost of consuming energy is not fully reflected in energy prices. There are unpriced ‘negative externalities’ (i.e. costs imposed on the broader community, rather than energy users) associated with energy consumption, which means that energy users do not take these costs into account in their decisions on whether to invest in energy efficiency. Various studies have identified these externalities as including:

- greenhouse gas emissions — as greenhouse gas emissions contribute to climate change, the costs are borne by the whole (global) community (see box 2.1 for a discussion on the global context)
- health and other costs associated with other air pollutants emitted by some energy sources, and
- externalities associated with peak demand — network capacity and therefore infrastructure costs are driven by peak demand; however, costs relating to peak demand may not be fully reflected in energy prices, which will tend to be more averaged. This also means that energy prices can overstate the cost outside of peak periods.

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<sup>10</sup> See for example: Productivity Commission, *The Private Cost Effectiveness of Improving Energy Efficiency*, Productivity Commission Inquiry Report No. 36, 31 August 2005.

## 2.1 Global context

Climate change caused by human activity is a global problem, requiring a global solution. Greenhouse gases in the atmosphere contribute to warming across the globe, regardless of where the emissions occur. In that sense, greenhouse gas abatement has the characteristics of a global public good. Specifically, greenhouse gas abatement is:

- non-excludable — individual countries cannot be excluded from receiving the benefits of limiting climate change; and
- non-rival — one country receiving benefits from limiting climate change does not prevent other countries from receiving the same benefits.

These characteristics mean that there is little incentive for each country individually to reduce greenhouse gas emissions to a level that will limit climate change. The costs associated with reducing greenhouse gas emissions are incurred domestically, while the benefits are spread across the globe. Each country therefore has an incentive to free-ride off the efforts of others.

International Agreements are therefore a crucial mechanism for achieving global action. The Paris Climate Agreement has been ratified by 168 of 197 Parties to the United Nations Framework Convention on Climate Change (UNFCCC).<sup>11</sup> It aims to limit global warming to less than 2 degrees Celsius and pursue efforts to limit the rise to 1.5 degrees Celsius.

### *Other market failures and behavioural anomalies*

Notwithstanding the market failures associated with energy pricing, it is often argued that policy measures to improve energy efficiency deliver ‘win-win’ outcomes in the sense that they deliver reduced greenhouse gas emissions, as well as private benefits through bill savings that outweigh any associated costs.<sup>12</sup> This implies there are energy efficiency opportunities that are privately cost effective (for example, replacing incandescent lights with LED lights, or installing motion sensor lights) that nevertheless fail to be adopted. This is often referred to as the ‘energy efficiency paradox’.<sup>13</sup>

Frequently cited market failures and behavioural anomalies/failures that contribute to the energy efficiency paradox in relation to commercial buildings, include the following:

- Information failures, including:
  - a lack of information available to consumers/tenants;

<sup>11</sup> United Nations Framework Convention on Climate Change website, [http://unfccc.int/paris\\_agreement/items/9485.php](http://unfccc.int/paris_agreement/items/9485.php), accessed 19 October 2017.

<sup>12</sup> See for example COAG Energy Council 2015, *National Energy Productivity Plan 2015-2030: Boosting Competitiveness, managing costs and reducing emissions*, December 2015, p. 6.

<sup>13</sup> Gerarden, T.D., Newell, R.G. and Stavins, R.N. 2015, *Assessing the Energy Efficiency Gap*, Duke University Energy Initiative and Harvard Environmental Economics Program, January 2015, p. 1.



- information asymmetries where the seller/landlord may have information on the energy efficiency of a building, but the buyer/tenant does not.
- Split incentives/principal-agent problem — this arises where the party making energy efficiency investment decisions is not responsible for paying the energy bills and can arise where the incentives affecting the builders making decisions that affect future buyers are not aligned to end-occupant/end-owner.
  - This split incentive problem typically occurs between building owner (i.e. the landlord) who bears the cost of any investment in energy efficiency and tenant who pays the energy bills. Note that operational improvements to energy efficiency are less likely to suffer from this problem. Where a tenant has a gross lease arrangement then there is also not a split incentive problem.
  - Split incentives may also occur between a building contractor and its owner and occupier. A building contractor makes many energy-related decisions, and given these energy efficient alternatives usually increase the cost of construction, the contractor has incentives to avoid these measures, especially if the measures are not immediately obvious to the owner or prospective buyers. This effect may be further exacerbated through the use of sub-contractors, who have no incentive to make long term energy efficiency recommendations to the owner/occupier.
  - Another type of split incentive could occur within large organisations, where separate parts of the organisation are responsible for capital budgets and paying energy bills.
- Behavioural anomalies/failures — some studies suggest that behavioural anomalies contribute to under-investment in energy efficiency. Here the problem is not the availability of information, rather the available information may not be acted on due to:
  - misinformed consumers — this includes issues such as:
    - ... inattention — some building owner/developer may fail to consider the benefits of future energy savings;
    - ... lack of sufficient expertise; and/or
    - ... the salience of energy costs — for many businesses, energy costs are a relatively small component of total costs and therefore may receive little consideration from owners/developers during the building design phase.
  - systematic behavioural biases — in the face of the sheer complexity of understanding energy efficiency options, some owners/developers may make sub-optimal decisions due to:
    - ... bounded rationality — cognitive limitations may mean that owners/developers have difficulty weighing up the energy saving benefits against cost and other factors such as design attributes;
    - ... sunken cost fallacy — where owners/developers maintain the status quo because of their previous investment decisions; and/or
    - ... heuristic decision making — heuristics are mental short-cuts, which some owners/developers may rely on to make decisions (examples include: repeating entrenched practices or building to the minimum standards specified in the NCC).

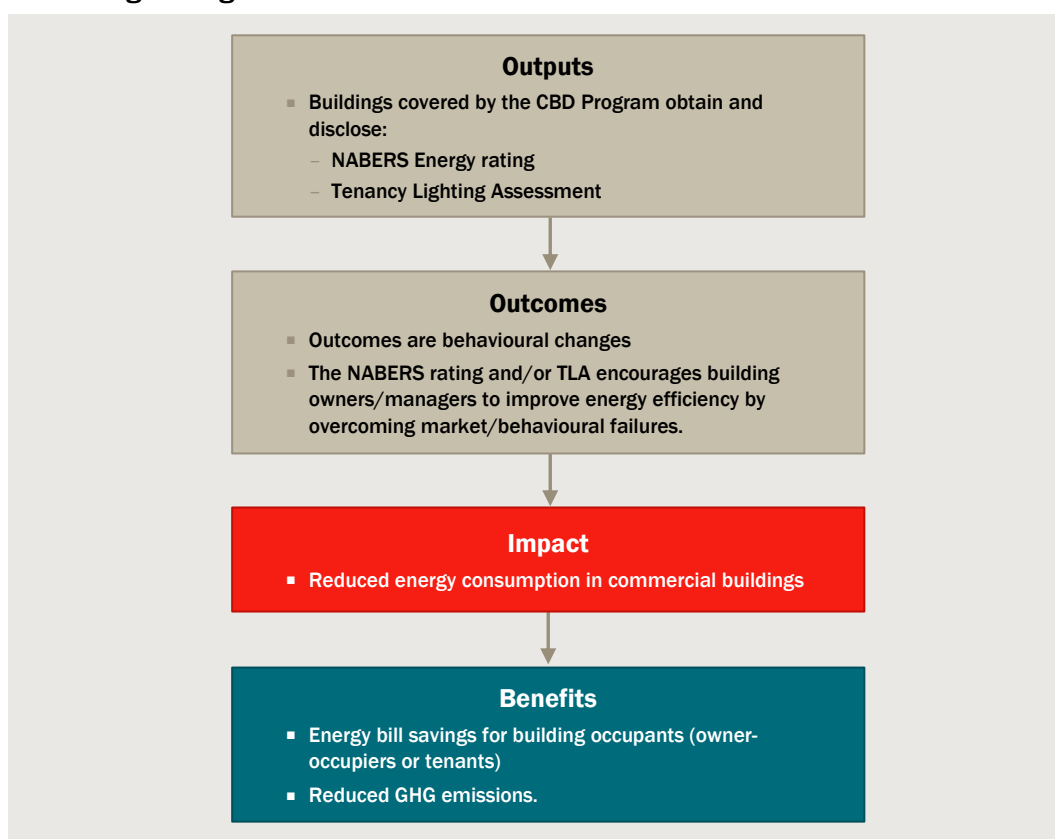


## *The rationale for mandatory disclosure*

### *Program logic*

A program logic framework — of which there are numerous variations — is often used in program evaluation to help clarify how a program delivers benefits to the community through understanding the causal links through the chain. A program logic for the CBD Program is set out in chart 2.2.

### 2.2 Program logic



Data source: The CIE.

Under the CBD Program, the only explicit regulatory requirement imposed on buildings covered by the program is the need to obtain and disclose a NABERS Energy rating and a TLA (the output).

There is no regulatory requirement for building owners/managers to improve energy efficiency. Rather, the CBD Program works by encouraging building owners/managers to make their own decision to improve energy efficiency (the outcome) by overcoming some of the market failures and behavioural anomalies outlined above.

As building owners/managers make their own decision on what energy efficient improvements to implement, there is lower risk of regulatory failures — such as where the costs of an energy efficient improvement outweigh the energy saving benefits for some or all buildings — compared to more prescriptive approaches, such as mandatory

minimum standards (i.e. building owners/managers are unlikely to implement energy efficiency measures that are not cost effective). Mandatory disclosure can therefore be considered a relatively 'light touch' approach to regulation.

### ***How does mandatory disclosure drive behavioural change?***

The market and behavioural failures that mandatory disclosure could potentially overcome include:

- Information asymmetries — where buyers or tenants have better information, they can make more informed decisions.
- Split incentives — making information available to tenants can also reduce the split incentives problem.
  - Where information is available the market can adjust, so that lower energy bills are reflected in rents (i.e. tenants should be willing to pay higher rents for office space in a building with lower energy bills). Where improved energy efficiency is reflected in rents, landlords have an incentive to improve. Note that the information most relevant to split incentives is the cost of energy and other outgoings, rather than an energy efficiency rating.
  - Even with information, split incentives will also arise due to the length of leases; once lease rates are agreed, there is little incentive for the landlord to improve energy efficiency through capital expenditure. Where operational expenditure can be recovered from tenants, there is less of an incentive problem.
- Behavioural failures — the requirement to obtain a NABERS rating can overcome a range of behavioural failures by alerting building owners/managers to the fact they are performing poorly in terms of energy efficiency compared to similar buildings (lack of knowledge). Although building owners/managers receive their energy bill, they may not be aware that the bill is higher than it need be (i.e. higher than other similar buildings) in the absence of benchmarked information.

### 3 *Review of objectives*

#### *Objectives of the CBD Program*

To review the objectives of the CBD Program (as required by the Terms of Reference), it is important to understand both the specific objectives of the CBD Program and the broader objectives of the overarching policy frameworks, of which the CBD Program is one part.

#### *Broader policy objectives*

The CBD Program was initially implemented under the National Strategy on Energy Efficiency (NSEE), which commenced in 2009. The NSEE refers to objectives as follows:

“The Strategy [...] is designed to **substantially improve minimum standards for energy efficiency** and accelerate the introduction of new technologies through improving regulatory processes and addressing the barriers to the uptake of new energy-efficient products and technologies.

The Strategy aims to encourage and support innovation in energy efficient technologies and approaches. It incorporates and builds on measures already agreed by COAG and the Ministerial Council on Energy through the National Framework on Energy Efficiency (NFEE).”<sup>14</sup>

The NSEE therefore focused on improving energy efficiency, but did not elaborate on the underlying motivation.

The NSEE was superseded by the NEPP in 2015. The NEPP introduced an explicit energy productivity target (a 40 per cent improvement by 2030), where energy productivity is defined as: economic output (as measured by gross domestic product in millions of dollars) divided by petajoules (PJ) of primary energy (a measure of the total energy supplied within the economy).<sup>15</sup>

The NEPP argues that energy productivity should be improved to:

- boost competitiveness and growth
- help families and business manage their energy costs

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<sup>14</sup> Australian Government, available at:  
[http://www.energyrating.gov.au/sites/new.energyrating/files/documents/Energy\\_efficiency\\_measures\\_table\\_0.pdf](http://www.energyrating.gov.au/sites/new.energyrating/files/documents/Energy_efficiency_measures_table_0.pdf)

<sup>15</sup> COAG Energy Council, *National Energy Productivity Plan 2015-2030: Boosting competitiveness, managing costs and reducing emissions*, December 2015, p. 9.

- reduce greenhouse gas emissions.<sup>16</sup>

### *Specific CBD Program objectives*

In general, the specific objectives of the CBD Program are not clearly defined. The *Building Energy Efficiency Disclosure Act 2010* itself states it is: “an Act to promote the disclosure of information about the energy efficiency of buildings and for related purposes”.

The Regulation Impact Statement (RIS) for the *Building Energy Efficiency Disclosure Bill 2010* stated that the objectives of government should be to:

“...improve the **energy efficiency** of commercial office buildings in Australia by addressing current market failures.”<sup>17</sup>

Split incentives were explicitly identified as a barrier to buyers and tenants using energy efficiency performance in property decisions and therefore reducing incentives for owners to invest in energy efficiency.

This focus on improving energy efficiency is consistent with the CBD Program website, which states:

“The aim is to **improve the energy efficiency** of Australia's large office buildings and to ensure prospective buyers and tenants are informed.”<sup>18</sup>

On the other hand, a more recent RIS for the *Building Energy Efficiency Disclosure Amendment Act 2015* (which was the amendment that reduced the threshold for disclosure was reduced from 2000 m<sup>2</sup> to 1000 m<sup>2</sup>) stated that the objective of government action was to:

“...facilitate a significant reduction in **energy consumption and greenhouse gas emissions** by smaller office buildings in Australia.”<sup>19</sup>

### *Review of objectives*

It is important that the objectives of any policy or program are stated clearly. The objectives of the CBD Program are variously stated as to:

- promote the disclosure of information about the energy efficiency of buildings (as stated in the Act)

<sup>16</sup> COAG Energy Council, *National Energy Productivity Plan 2015-2030: Boosting competitiveness, managing costs and reducing emissions*, December 2015, p. 5.

<sup>17</sup> The Parliament of the Commonwealth of Australia 2010, *Building Energy Efficiency Disclosure Bill 2010*, Revised explanatory memorandum, p. 17, [https://parlinfo.aph.gov.au/parlInfo/download/legislation/ems/r4324\\_ems\\_bcf8cec6-4957-4ab2-9166-1e0fd6a836d4/upload\\_pdf/buildingrem.pdf;fileType=application%2Fpdf](https://parlinfo.aph.gov.au/parlInfo/download/legislation/ems/r4324_ems_bcf8cec6-4957-4ab2-9166-1e0fd6a836d4/upload_pdf/buildingrem.pdf;fileType=application%2Fpdf).

<sup>18</sup> Department of Environment and Energy web site, <http://cbd.gov.au/overview-of-the-program/what-is-cbd>.

<sup>19</sup> ACIL Allen Consulting 2016, *Improving the energy efficiency performance of small office buildings, Regulation Impact Statement*, p. 6.

- improve the energy efficiency of office buildings and to ensure prospective buyers and tenants are informed (as stated in the RIS for the BEED Act and on the CBD Program website), and
- facilitate a significant reduction in energy consumption and greenhouse gas emissions (as stated in the RIS for the recent changes to the CBD Program).<sup>20</sup>

One way to interpret the difference in these stated objectives is they focus on different stages of the program logic framework (see above).

- The disclosure of information is the output of the CBD Program.
- Improvements to the energy efficiency of office buildings are the outcomes of the CBD Program.
- Reduced GHG emissions are one of the benefits of the CBD Program.

As noted above, the NEPP argues that the benefits of improved energy efficiency (or energy productivity) are to:

- boost competitiveness and growth;
- help businesses manage their energy costs
- reduce GHG emissions.

The first two imply reducing energy bills is a key underlying objective (i.e. in addition to climate change mitigation through reduced GHG emissions). Improved energy efficiency can help to reduce energy bills both:

- directly (i.e. the direct bill savings associated with reduced energy consumption); and
- indirectly (i.e. reduced demand at peak times could reduce or delay new investment in network infrastructure, which are ultimately passed through to all consumers).

To some extent program design choices depend on the underlying objectives. Although improving energy efficiency (or energy productivity), reducing energy bills and reducing greenhouse gas emissions are largely compatible objectives, they are not always aligned. In some cases, there may be trade-offs between bill savings and GHG emissions. For example, offsetting GHG emissions through GreenPower offsets would reduce GHG emissions, but increase energy bills.

Stakeholders on the Reference Group had mixed views on the most appropriate objectives for the CBD Program.

- Most argued that improving energy efficiency was the preferred objective on the basis that improving energy efficiency could both:
  - reduce energy costs
  - reduce GHG emissions.
- However, some stakeholders felt that the priority should be on reducing GHG emissions.

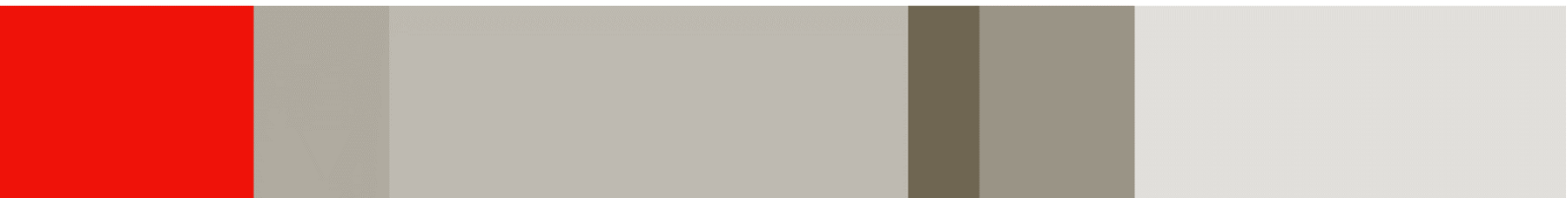
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<sup>20</sup> ACIL Allen Consulting, *Improving the energy efficiency performance of small office buildings*, Regulation Impact Statement for Consultation, March 2016, p. 6.

- In summary, facilitating improvement to the energy efficiency of office buildings is a broadly appropriate objective of the CBD Program on the basis that improved energy efficiency can:
  - reduce GHG emissions
  - reduce energy bills for building owners and/or tenants.
- This objective is consistent with National Energy Productivity Plan of which, the CBD Program forms one part.

## **PART I**

### Review of existing CBD Program







## 4 *Impacts of the CBD Program*

### *Market overview*

The office market is diverse.

- The ownership structure of office buildings varies, depending on the segment of the market.
  - At the higher end of the market (largely high-rise office buildings in central business district locations), ownership is dominated by large property groups.
  - The ownership of mid-tier office buildings (and below) is more diverse and fragmented.
- Office tenants are similarly diverse, ranging from government to large multi-national companies that may occupy multiple buildings to small suburban single person businesses.
- Leasing is prevalent.
  - In most cases tenants are metered separately and billed directly for the tenancy energy consumed (tenancy energy consumption generally includes lighting, IT equipment and other plug-in equipment).
  - The arrangements for base building energy costs can vary.
    - ... Leases are most commonly net leases, where base building energy costs (which generally includes: HVAC, lifts, common area lighting) is passed onto tenants.
    - ... Under a gross lease, energy costs are included in the lease price.

### *Evidence of market and behavioural failures*

The key market failure that the CBD Program has been designed to address is the split incentives problem (i.e. the landlord/tenant problem) that arises as a result of information asymmetries.

- As noted above, split incentives were identified as a key barrier to improved energy efficiency in the RIS for the *Building Energy Efficiency Disclosure Act 2010*.<sup>21</sup>

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<sup>21</sup> The Parliament of the Commonwealth of Australia 2010, Building Energy Efficiency Disclosure Bill 2010, Revised explanatory memorandum, p. 17,  
[https://parlinfo.aph.gov.au/parlInfo/download/legislation/ems/r4324\\_ems\\_bcf8cec6-4957-4ab2-9166-1e0fd6a836d4/upload\\_pdf/buildingrem.pdf;fileType=application%2Fpdf](https://parlinfo.aph.gov.au/parlInfo/download/legislation/ems/r4324_ems_bcf8cec6-4957-4ab2-9166-1e0fd6a836d4/upload_pdf/buildingrem.pdf;fileType=application%2Fpdf).

- The CBD Program website also states that an aim of the CBD Program is: “...to ensure prospective buyers and tenants are informed”<sup>22</sup> implying an information asymmetry problem in the absence of mandatory disclosure.

There is little evidence to suggest an information asymmetry problem in relation to energy bills that is best addressed by a NABERS rating.

- Where base building energy costs are directly passed onto tenants (i.e. a net lease), expected outgoings are typically provided to tenants at the time of choosing office space, allowing tenants to choose the tenancy that offers the preferred mix between lease rates and outgoings (as well as a range of other characteristics). Although benchmarked information (through a NABERS star rating) may be of some value to tenants, estimated outgoings is likely to be of more use for tenants to weigh up energy costs against lease rates and other factors, such as location and amenities (limitations of the NABERS rating as a measure of bill savings are discussed further below).
- Where tenants are on a ‘gross lease’ arrangement, base building energy costs are included in the lease. The amount paid by tenants is fully transparent and no split incentive arises because the landlord would receive the benefits of any improvements in energy efficiency.

The CBD Program is addressing a range of behavioural failures, including a combination of:

- lack of awareness of poor performance — some building owners and managers may be unaware that their building is performing poorly (relative to other similar buildings)
- insalience of energy costs – in general, energy costs are a relatively small share of total costs for many office-based businesses
- lack of expertise in relation to improving energy performance.

On the other hand, there may be a split incentives problem caused by an information asymmetry in relation to lighting. Lighting is provided by the landlord, but the associated energy bill is generally paid for directly by the tenant (i.e. lighting is generally tenant energy consumption, rather than base building). Information on energy cost for this lighting is not likely to be available for a tenant at the time of choosing office space.

- An information asymmetry could arise where the tenant is not aware of the relative efficiency of the lighting in an office space.
- This creates a split incentive whereby the landlord would bear the cost of a lighting upgrade, while the tenant would receive the benefits. In principle, providing information on the relative efficiency of lighting could allow rents to adjust accordingly (i.e. result in higher rents for more energy efficiency lighting) and overcome the split incentives problem.

The TLA component of the BEEC is designed to overcome the information asymmetry/split incentives problem in relation to lighting.

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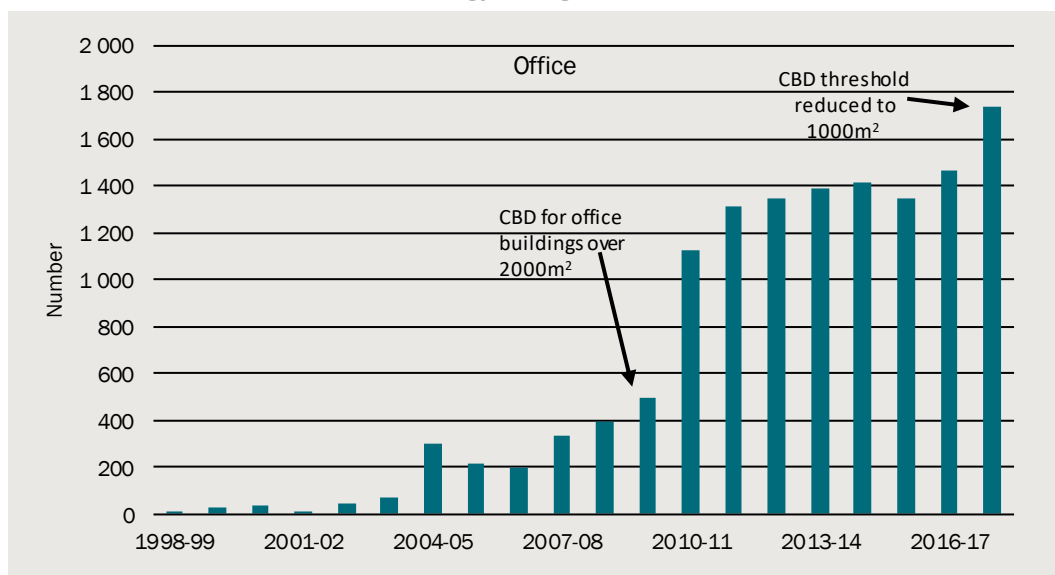
<sup>22</sup> Department of Environment and Energy web site, <http://cbd.gov.au/overview-of-the-program/what-is-cbd>.

### *Impact on the number of NABERS ratings*

The impact of the CBD Program on the number of NABERS Office Energy ratings is shown in chart 4.1.

- Although on a gradual upward trajectory from 2001-02 to the implementation of the CBD Program, the number of NABERS Office Energy ratings increased from around 500 to around 1400 after the implementation of the CBD Program.
- Following a stabilisation of the number of ratings after the implementation of the CBD Program, there was a further significant increase (18.6 per cent) when the threshold triggering a rating was reduced to 1000 m<sup>2</sup>.

#### **4.1 Number of NABERS Office Energy ratings over time**



Data source: NABERS Annual Report.

Another way to look at the impact of the CBD Program is in the number of new NABERS Office Energy ratings (including base building and whole building ratings). (chart 4.2).

- The impact of the CBD Program can be seen in a sharp increase in the number of new ratings is evident in 2010-11.
- The number of new ratings subsequently declined, but stayed above previous levels as the CBD Program was phased in and (for some buildings) a delay in the requirement for a BEEC (and therefore a NABERS rating) being triggered.
- A second (albeit smaller) spike in the number of buildings entering the NABERS system for the first time was recorded in 2017-18 reflecting the reduction in the threshold from 2000 m<sup>2</sup> to 1000 m<sup>2</sup>.

## 4.2 Number of new NABERS Office Energy ratings



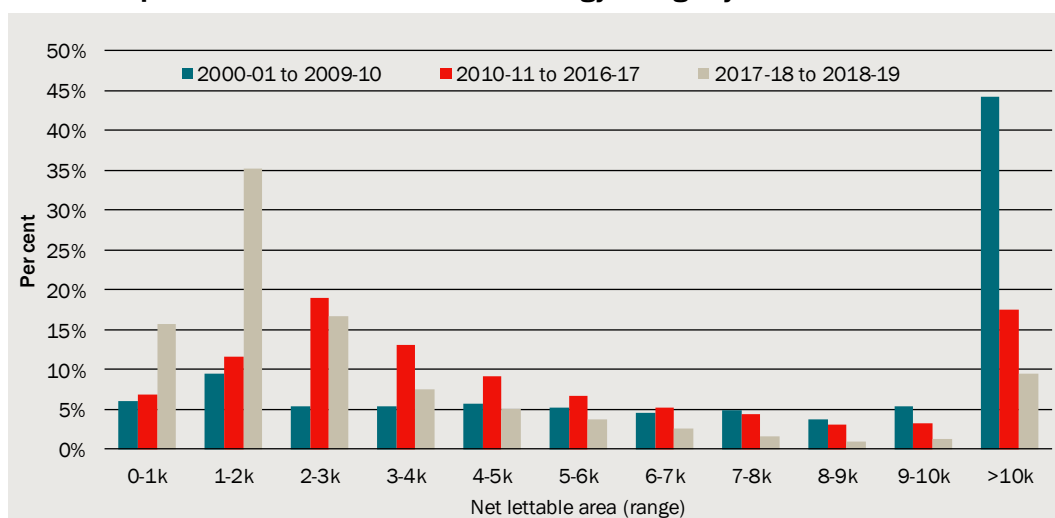
Note: Includes base building and new building ratings.

Data source: NABERS database.

The impact of the CBD Program can also be seen in the size composition of buildings entering the NABERS system for the first time (chart 4.3).

- Prior to the introduction of the CBD Program, the buildings that were voluntarily rating were mostly larger buildings (particularly those with a net lettable area above 10 000 m<sup>2</sup>).
- It is not straightforward to identify the impact of the recent changes to the CBD Program as the requirement to obtain a BEEC is triggered by a tenancy, while the NABERS and CBD datasets refer to the NLA of the building. Nevertheless, the change in the threshold has skewed the composition of buildings entering the NABERS system for the first time towards buildings less than 2000 m<sup>2</sup>.

## 4.3 Composition of new NABERS Office Energy ratings by net lettable area

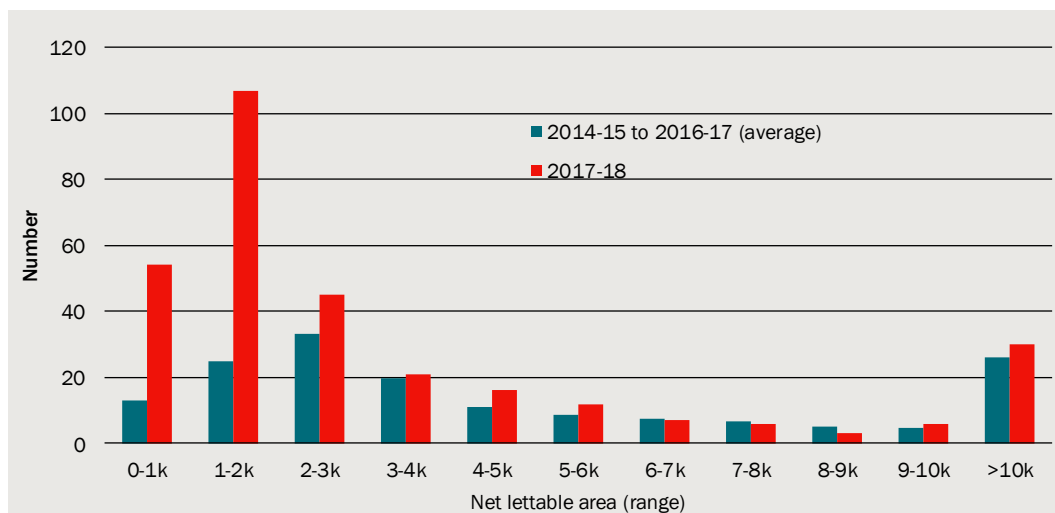


Note: Includes base building and whole building ratings.

Data source: NABERS database.

Focusing more closely on the impact of the recent change, the increase in the number of new NABERS ratings is mostly due to more small buildings (i.e. NLA less than 2000 m<sup>2</sup>) entering the NABERS system (chart 4.7).

#### 4.4 Number of new NABERS ratings



Data source: NABERS dataset.

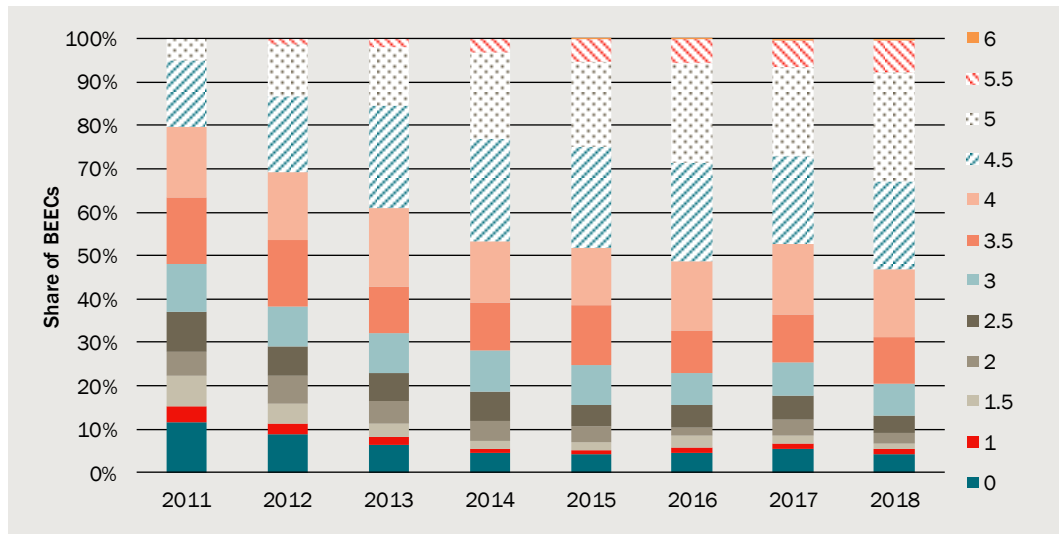
### *Impact on energy performance*

The CBD Program makes public its data on the ratings and energy use achieved by buildings each time they obtain a Building Energy Efficiency Certificate (BEEC). This data shows substantial improvements in building performance over time.

- Since 2011, the share of buildings covered by the program achieving higher ratings has increased substantially (chart 4.5).
- The average star rating achieved across BEECs has increased by almost one star from 2011 to 2018, and energy use per m<sup>2</sup> of floor space has fallen substantially (chart 4.6).

The changes in building energy use and star ratings will not be solely attributable to the CBD Program. Other factors such as changing electricity prices, Government requirements for higher star buildings, higher employment to workspace ratios, corporate sustainability objectives and other government programs will also have changed the energy efficiency of buildings.

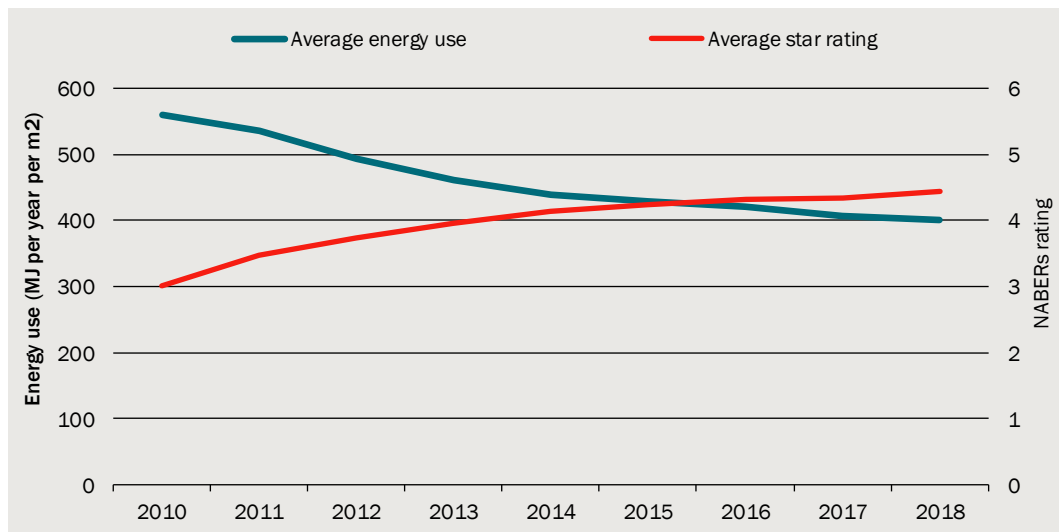
#### 4.5 Share of BEECs achieving different star ratings



Note: For base buildings only.

Data source: CBD dataset, CIE analysis.

#### 4.6 Average energy use and average star rating



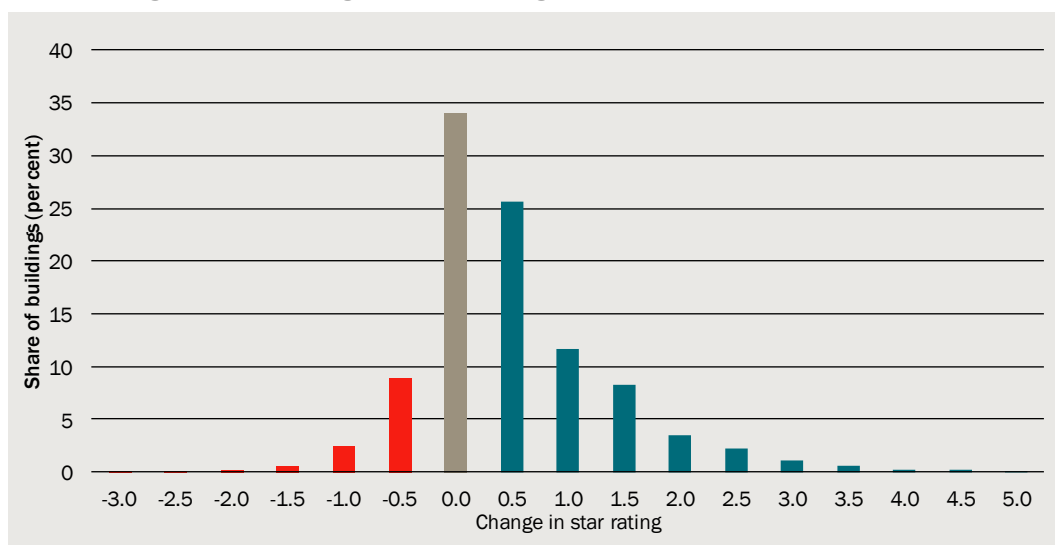
Note: For base buildings only. Averages are floor area weighted averages.

Data source: CBD dataset, CIE analysis.

The pattern of impacts across buildings is quite variable. About one-third of buildings have the same star rating as they had initially with the program. A further quarter have improved their star rating by 0.5 stars, and about the same amount have improved their rating by one star or more. About 12 per cent of buildings have a lower star rating than when they were first rated under the CBD Program. Note that some buildings have only rated twice, while others have rated up to 11 times.

The same pattern is observed for energy use per square metre, with a large number of buildings have similar or marginally lower energy use, a smaller number having made very large reductions in energy use, and a smaller number again increasing their energy use.

#### 4.7 Changes in star rating across buildings



Note: This is for base buildings only. It excludes ratings where the area rated is less than 80 per cent of the maximum area rated. The change is from the first rating under the CBD Program to the last rating under the CBD Program.

Data source: The CIE; CBD dataset.

The change in energy star rating and energy intensity since the CBD Program has been in operation for buildings with different initial energy ratings is shown in table 4.8. Buildings with low initial ratings have had larger reductions in energy use, despite often only being rated twice within the CBD Program period.

#### 4.8 Changes for buildings based on initial star rating

First star rating	Number of buildings	Average number of ratings	Change in star rating	Change in energy intensity
	No.	No.	Stars	MJ/m <sup>2</sup>
0	41	2.1	1.6	-176
1	22	2.0	1.6	-184
1.5	40	2.7	1.4	-203
2	64	2.6	0.9	-123
2.5	89	3.1	0.7	-120
3	100	3.4	0.8	-90
3.5	143	3.5	0.5	-68
4	175	3.7	0.2	-36
4.5	183	3.7	0.2	-32
5	151	3.4	0.0	-17
>5	42	3.5	-0.1	-15

Note: This is for base buildings only. It excludes ratings where the area rated is less than 80 per cent of the maximum area rated. The change is from the first rating under the CBD Program to the last rating under the CBD Program.

Data source: The CIE; CBD dataset.

To more accurately estimate the impacts of obtaining successive BEECs, we have undertaken statistical modelling of the impacts, based on data from the CBD dataset, NABERS dataset, CityScope dataset and other data collated by the CIE. The overall findings are shown below, with Appendix C setting out the analysis in greater detail.

The statistical analysis shows that typically, each additional NABERS rating generates an improvement in the star rating achieved **~0.2 stars**, and a reduction in energy use of **~20 MJ/m<sup>2</sup>**.<sup>23</sup> This impact persists over time and becomes cumulatively larger as more ratings are undertaken. However, the impact of each successive rating is smaller — by the fifth rating the reduction in energy use is estimated at **~14 MJ/m<sup>2</sup>**.

The impact also depends on the building characteristics. The stand-out characteristic driving changes in star ratings is the initial rating of the building — a building rated 2 stars will have improved its star rating over the CBD Program period by 0.8 stars less than a building rated 0 stars, other things equal. For example, the 0 star building might improve by 1.6 stars, while the 2 star building improves by 0.8 stars, other things equal.

An overview of all the drivers of impact of the program and the direction of impact is shown in chart 4.9.

- Buildings have improved more rapidly if they had poor initial energy efficiency, have had more ratings, are larger and of a higher grade. Buildings with higher initial energy efficiency, fewer ratings, are smaller or of a lower grade have improved less rapidly.
- Factors that have not had an individual impact on the change in energy performance are the age of the building, the owner being part of GRESB (which is also an indicator of the professionalism of the building) or the state where the building is located.
- Whether the building had been rated prior to the CBD Program potentially has an impact, with building rated prior to CBD voluntarily having a marginally smaller improvement in energy performance, under some empirical specifications.

Note that individual buildings have a range of a characteristics and some factors may have impacts on the changes in energy performance that offset other factors over time. For example, a B grade building with a low initial star rating could have:

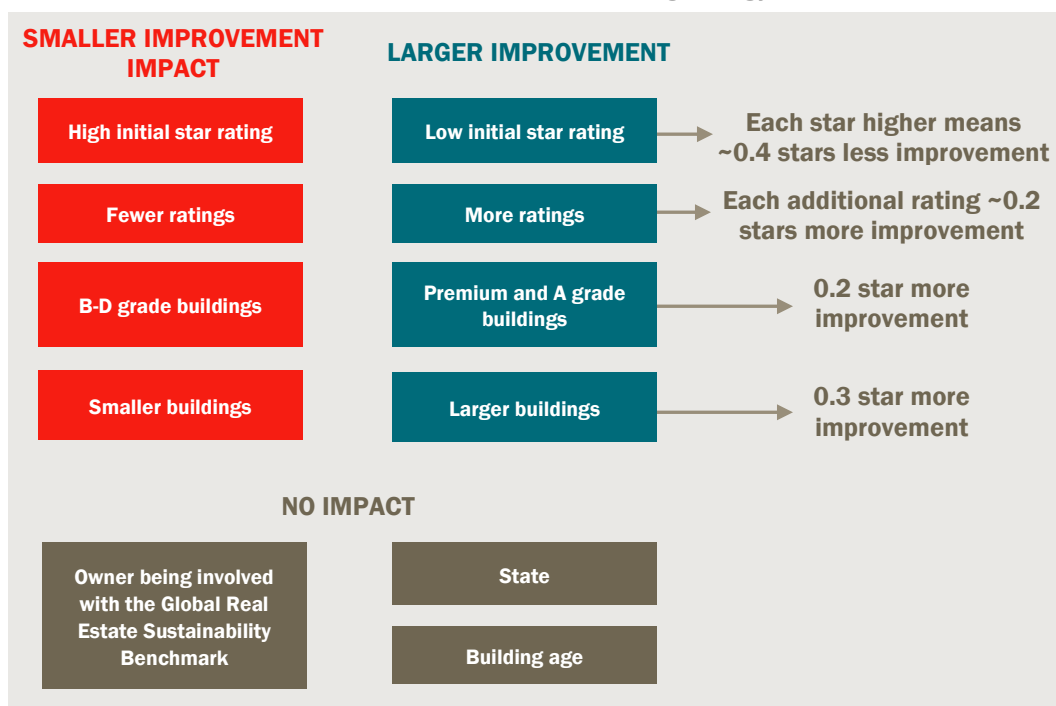
- a larger improvement than average because of its initial poor performance (i.e. the statistical analysis showed that buildings that initially performed poorly tended to make larger improvements over time)
- a smaller improvement than average, because it is a lower grade building (i.e. the statistical analysis showed that lower grade buildings tend to improve at a slower rate, compared to higher grade buildings).

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<sup>23</sup> Note that average energy use per square metre is ~480 MJ per year.



## 4.9 Factors that impact on improvements in building energy performance



Data source: The CIE.

To put the change in energy performance into perspective, for a very small building (2000 m<sup>2</sup>), the energy savings from each additional BEEC is \$1300 per year, or slightly more than \$12 000 over 15 years (present value). The GHG emissions saved for this building are 9 tonnes for one year of 81 tonnes over 15 years (present value). The impacts are larger for larger building sizes, as the base energy use is higher.

## 4.10 Illustrative energy cost and GHG emissions reductions

Size of office building	2000 m <sup>2</sup>	10 000 m <sup>2</sup>	20 000 m <sup>2</sup>	40 000 m <sup>2</sup>
	\$/building	\$/building	\$/building	\$/building
<b>Energy saving</b>				
One year	-1,333	-6,667	-13,333	-26,667
Present value over 15 years	-12,144	-60,719	-121,439	-242,878
	Tonnes/building	Tonnes/building	Tonnes/building	Tonnes/building
<b>GHG emissions savings</b>				
One year	-9	-44	-89	-178
Present value over 15 years	-81	-405	-810	-1619

Note: This uses an energy cost of 12 cents per kwh. For the present value calculations, the discount rate used is 7 per cent (real). The emissions factor used is 0.8 tonnes of CO<sub>2</sub>e per MWh. The cost benefit analysis will adjust these figures to be specific for electricity and gas, and for each jurisdiction.

Source: The CIE.

### *Can the observed improvements be attributed to the CBD Program?*

A key issue is whether the changes that have occurred are due to the CBD Program.

- **Overall the evidence suggests that approximately half of the improvement in energy performance identified in the CBD and NABERS datasets (see above) can be attributed to the CBD Program.**

There is a pattern of evidence (outlined in the previous chapter) that suggests the CBD Program has contributed to the observed improvements in energy efficiency.

- Buildings entering the NABERS system tend to be less energy efficient than those already rating and that buildings with more ratings have achieved greater performance improvements.
- Those achieving the worst performance have improved the most, indicative of the rating providing information.

That said, there is also substantial evidence that the CBD Program is only a component of the changes in energy use achieved by office buildings.

- A small sample of strata-titled buildings that are not covered by the CBD Program also achieved substantial reductions in energy use (see table 4.11).
- Other statistical tests also suggest that only a component of the change observed is due to the CBD Program.
- A substantial share of the buildings were rating voluntarily prior to the CBD Program. Arguably, the energy savings and costs of obtaining NABERS ratings and making energy efficiency improvements would therefore have occurred (for at least some buildings) anyway, and are not driven by the CBD Program itself<sup>24</sup>
- Other factors have changed that could influence commercial building energy use. These include National Construction Code Changes and changes in energy prices.
  - National Construction Code Changes impact primarily on new buildings. We are tracking individual buildings over time and hence exclude these impacts.<sup>25</sup>
  - There has been widespread commentary about rising energy prices over the period, which could be a driver of improvements in energy performance
    - ... our analysis of prices suggests that prices have increased in real terms particularly for gas. Prices of electricity have increased in most jurisdictions but not everywhere. Prices in NSW, for example, have fallen for larger commercial customers because of changes to tariff structures
    - ... we have looked at models incorporating prices changes to see if this changes the impact of additional NABERS ratings, and it does not. This makes sense given that despite falling real prices over some years, NSW has had similar energy efficiency improvements as other states

<sup>24</sup> It could be argued that impacts are larger because all buildings are rated. This will be partly testable by looking at the rate of change of NABERS ratings prior to CBD and after, although other changes will also have occurred.

<sup>25</sup> Note that we have cleaned the data to remove ratings where the building size is 20 per cent less than the maximum rated size, which could be because of building refurbishment, vacancies or incorrect data.

- New equipment is typically more energy efficient than older equipment, leading to improvements at end of life replacement.
- It is also possible that building energy performance for those buildings not voluntarily using NABERS would have declined rather than improved over time. For example, trends to have more people in each building increase the energy use per m<sup>2</sup>, other things equal.<sup>26</sup>

#### 4.11 Changes in energy use from NABERS and counterfactual

	CBD	Strata titled
	Per cent	Per cent
Reduced by 40% or more	10	18
Reduced by 30-40%	9	5
Reduced by 20-30%	14	9
Reduced by 10-20%	15	9
Reduced by 0-10%	21	32
Increased by 0-10%	12	14
Increased by more than 10%	19	14

Source: The CIE; AusGrid.

We have undertaken a number of tests around the degree to which the CBD Program has contributed to the improvements in energy efficiency.

- It is possible that the impact of more NABERS ratings is just picking up a change over time. That is, buildings that have been rating more have been in the NABERS system for longer, and ratings effect is just a time trend. To test for this we included the number of years between the first and last rating as an additional variable. This substantially reduces (by 60 per cent) the estimated impact of each additional NABERS rating (and therefore the CBD Program). However, the impact of additional NABERS ratings remains statistically significant.
- Secondly, if the CBD Program was having an impact, then buildings that come into the scheme later should have lower star ratings and higher energy use per square metre, after accounting for other factors. This is because obtaining a NABERS energy rating is making an impact on buildings in the scheme, but not for those not in the scheme. To test for this we have regressed the last rating or energy use against how many ratings a building has previously had and other factors. This includes buildings that have only had one rating.
  - using this approach, we find a significant impact of NABERS in terms of a building that has had more ratings has a higher rating (0.07 stars per rating) and a lower energy use (10 MJ/m<sup>2</sup> per rating)
  - this is smaller than the impact measured for more NABERS energy ratings, but still statistically significant and material.

<sup>26</sup> City of Sydney Floor Space and Employment Survey, <https://www.cityofsydney.nsw.gov.au/learn/research-and-statistics/surveying-our-community/floor-space-and-employment-survey/village-overview-summary/cbd-and-harbour>.

- Thirdly, we have obtained data from an electricity distributor on commercial buildings that do not have a NABERS rating. In particular, this is the base building electricity use for strata titled commercial buildings. This provides a counterfactual against which the improvements in buildings that have a NABERS rating can be compared.
  - data has been obtained for 22 strata titled commercial buildings. This only covers electricity use not gas use and is a relatively small sample
  - the pattern of changes for the strata titled buildings indicates these buildings are also typically reducing their energy use, measured from 2011/12 to 2017/18. In fact, more of the strata titled buildings have had large reductions in energy use than buildings covered by the CBD Program
  - this comparison is not over the same time period. The CBD sample is from their first to last rating, while the strata titled buildings are over a set time period. If we adjust for this, by considering a building rated five times under the CBD Program, it has achieved a reduction in energy use of 70 MJ/m<sup>2</sup>.
    - ... trying to adjust for time periods, a building that had rated 5 times with NABERS would have reduced energy use by 70 MJ/m<sup>2</sup> or 14 per cent.
    - ... in comparison, the strata titled buildings have reduced energy use by 46 MJ/m<sup>2</sup> or 13 per cent
  - this suggests that the CBD Program is responsible for only a component of the impact. The sample is small however, and restricted to electricity use only and a single capital city (Sydney). It is not easy to identify what the initial level of performance of the strata titled buildings is, which also impacts on the counterfactual.

### ***What factors contributed to improved energy performance?***

The changes across different building types and the consultation we have had with building owners and others has indicated a range of reasons as to why the CBD Program has had an impact on base building energy use.

- 1 It has provided information for building owners/managers that has made them realise that they are not operating their building efficiently. This makes sense in that the larger changes are for buildings that performed poorly. It is incrementally harder to improve energy efficiency for better performing buildings.
- 2 There is demand for higher rated office buildings from tenants, particularly governments and larger corporates. Most governments have requirements for the base building NABERS rating to be above a particular level. (Australian, NSW, ACT, SA and WA of 4.5 stars, QLD 4.5 stars for new builds and Victoria 4 stars).
- 3 It has provided a more transparent mechanism for building owners to hold building managers accountable. Declines in NABERS ratings are seen as a leading indicator of poor building management.
- 4 Disclosure of ratings has introduced a competitive dynamic/shame dynamic, that pushes companies to improve their performance.

- 5 You manage what you measure. Being forced to measure energy performance has meant that it is now managed.
- 6 Ratings are included in Property Council of Australia office building gradings, which encourages better energy performance to achieve be a premium grade or A grade building.
- 7 There are a range of investors that require information on corporate social responsibility. This has been noted in many consultations. Note that the analysis has not found a difference in energy improvements for buildings with owners involved in GRESB versus others, which is a partial indicator of investor interest in corporate social responsibility.

The combination of these different factors mean that many owners of commercial buildings see a higher NABERS rating as contributing to higher profit and higher value of their buildings. This is not true for all commercial building owners of course.

The actual changes made to buildings to improve energy performance have been fairly consistently stated by building owners as operational changes and end of life capital changes. Very few stakeholders have indicated that they would undertake major capex solely for improving their energy efficiency.

### ***Energy efficient improvements and the associated costs***

There are a wide range of changes that can be made to an office building to improve the NABERS Energy rating, many of which are likely to be privately cost-effective (i.e. the energy bill savings over time outweigh the cost of implementation). Key findings from stakeholder consultations are as follows.

- Although there are some overarching corporate social responsibility objectives driving investment in energy efficiency, these investments must also deliver a financial return, particularly where senior management or Board approval is required.
- The criteria to proceed with energy efficiency investments appear to vary across owners. For example, some property groups use a 'return on investment' criteria, while others use a payback period. Some reported using a required rate of return (or hurdle rate) of around 12 per cent or a payback period of around 10 years. That said, some property groups appear to have lower criteria, particularly where there has been a high-level commitment to reach particular targets across the portfolio.
- Given the need for a financial return on energy efficiency upgrades, building owners/managers tend to focus on low-cost operational changes and end-of-life equipment upgrades. Examples of strategies to improve the NABERS Energy rating and evidence of the associated costs are shown below.
- The incremental cost of achieving each additional improvement in the NABERS star rating increases as the star rating increases (i.e. the cost of moving from zero to 1 stars is likely to be much lower than the cost of moving from 5 to 6 stars). This reflects the following.
  - Building owners are likely to implement the strategies that deliver the highest pay-off first (such as, low cost operational changes). Several stakeholders reported

significant gains in poorly performing buildings from measures as simple as turning off the HVAC system when the building is unoccupied.

- As the star rating increases and the strategies with the highest pay-offs have been implemented, owners must implement increasingly costly measures to drive further improvements in the NABERS rating.

Some evidence of cost-effective strategies to improve the NABERS Energy rating of an office building are provided below.

The office building case study identifies a range of options to improve the NABERS Energy rating in a 3.5 star office building with around 53 000 m<sup>2</sup> of floor space (table 4.12).

- There are several relatively low-cost that focus on excluding some energy consumption from the NABERS base building rating strategies (i.e. NABERS Energy exclusions and retail are lighting exclusions), but do not necessarily save energy.
- Based on the case study estimates, upgrading the BMS controls and hardware can have significant, while in itself the upgrades save relatively little energy. However, in some cases BMS upgrades are a necessary condition for achieving some other low-cost energy efficiency strategies.

#### 4.12 Energy efficiency opportunities – office building case study

	Annual electricity savings	Annual gas savings	Annual financial saving	Annual emissions reduction	Capital cost	Payback
	kWh	MJ	\$	kgCO <sub>2-e</sub>	\$	Years
NABERS Energy exclusions	98 000	0	0	132 000	8 000	n.a.
BMS and controls hardware upgrade	12 000	0	1 200	16 000	630 000	n.a.
Retail area lighting exclusion	3 000	0	0	4 000	3 000	n.a.
Lift lobby and toilet lighting luminaire upgrade	180 000	0	13 000	241 000	0	0.0
Cooling tower control strategy	67 000	0	6 100	89 000	4 100	0.7
Lighting controls upgrade and recommissioning	155 000	0	11 000	208 000	22 000	3.0
Tenant condenser water plant	130 000	0	9 000	175 000	41 000	4.6
Toilet lighting control upgrade	85 000	0	5 800	114 000	41 000	7.1
Internal air-handling control strategy	255 000	0	26 000	341 000	200 000	7.7
Dual duct AHU upgrade and control strategy	134 000	152 000	13 000	188 000	114 000	8.8
Other air-handling plant control strategies	31 000	0	2 500	41 000	30 000	12.0
L1 Office stair lighting upgrade	16 500	0	1 300	22 000	16 000	12.3
L41 air-handling control strategy	21 000	0	2 100	28 000	31 000	14.8
Perimeter air-handling control strategy	215 000	791 000	29 000	335 000	465 000	16.0
Chilled water plant upgrade and control strategy	720 000	0	66 000	965 000	1 100 000	16.7
Plant room lighting upgrade	8 500	0	700	11 000	20 000	28.6

	Annual electricity savings	Annual gas savings	Annual financial saving	Annual emissions reduction	Capital cost	Payback
	kWh	MJ	\$	kgCO <sub>2-e</sub>	\$	Years
Heating hot water plant upgrade and control strategy	18 000	530 000	6 600	55 000	308 000	46.7
Lift motor and drive upgrade	440 000	0	42 000	86 000	6 500 000	155.0

Source: Energy Action.

One major property group also provided aggregated information from more than 500 individual energy efficiency projects across the group's portfolio. Average implementation costs, annual energy (and water) cost savings and payback periods for different types of projects are shown in table 4.13.

#### 4.13 Average costs and benefits of various energy efficiency strategies

	Average implementation cost	Average annual energy cost savings	Payback period
	\$	\$	Years
Metering and Analytics	32 702	9 887	3.3
Commissioning	52 979	15 034	3.5
Car Park Ventilation	58 200	10 858	5.4
Lighting	59 729	8 373	7.1
Hot Water	76 271	10 022	7.6
General Power	9 500	1 130	8.4
Controls	486 969	31 238	15.6
HVAC	326 237	18 605	17.5
Façade	302 136	13 127	23.0
Lifts	3 289 800	19 667	167.3

Source: Information provided by a major property group.

Not all of the measures identified above would be considered privately 'cost-effective' (i.e. meet the building owners' criteria). Nevertheless, the information presented above is evidence of a range of cost-effective energy efficiency opportunities, even for buildings with average energy performance or above.

### *Aggregate impacts*

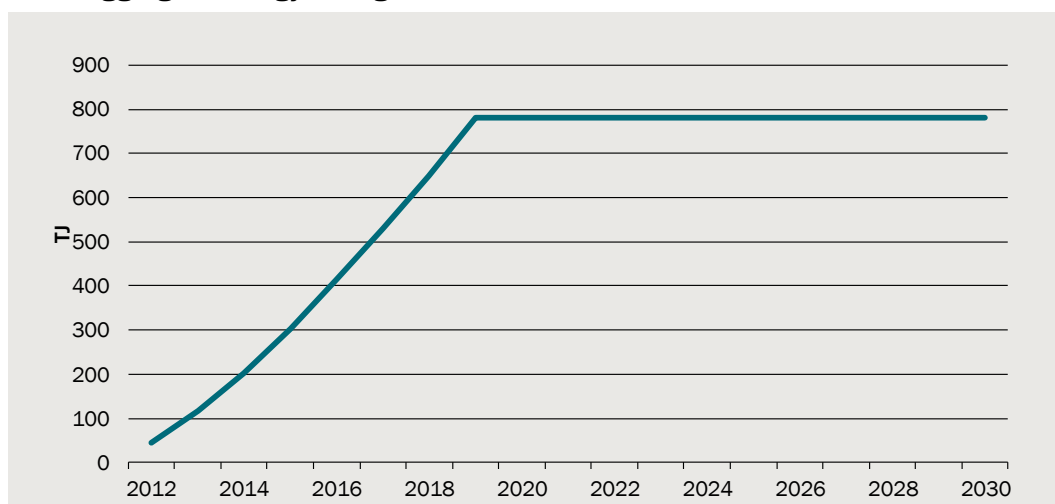
- Based on the above analysis, we estimate that to date, the CBD Program has:
  - reduced energy consumption by around 3 PJ
  - reduced GHG emissions by around 152.6 Kt CO<sub>2-e</sub>
- Even with no further energy efficiency upgrades, the upgrades made to date will continue to deliver energy savings into the future. We estimate that by 2029-30:
  - energy savings will reach 11.6 PJ

- GHG emission savings will reach around 2.2 Mt CO<sub>2</sub>-e.

### *Aggregate energy savings*

Estimated aggregate energy savings are shown in chart 4.14. Aggregate energy savings increased rapidly as the number of buildings participating in the CBD Program has increased and each building covered by the program makes ongoing improvements, which accumulate over time. We estimate that aggregate energy savings in 2018-19 reached around 800 TJ. Even if there are no further energy efficiency improvements made (unlikely), we would expect the improvements made to date will continue to deliver benefits into the future.

#### **4.14 Aggregate energy savings**

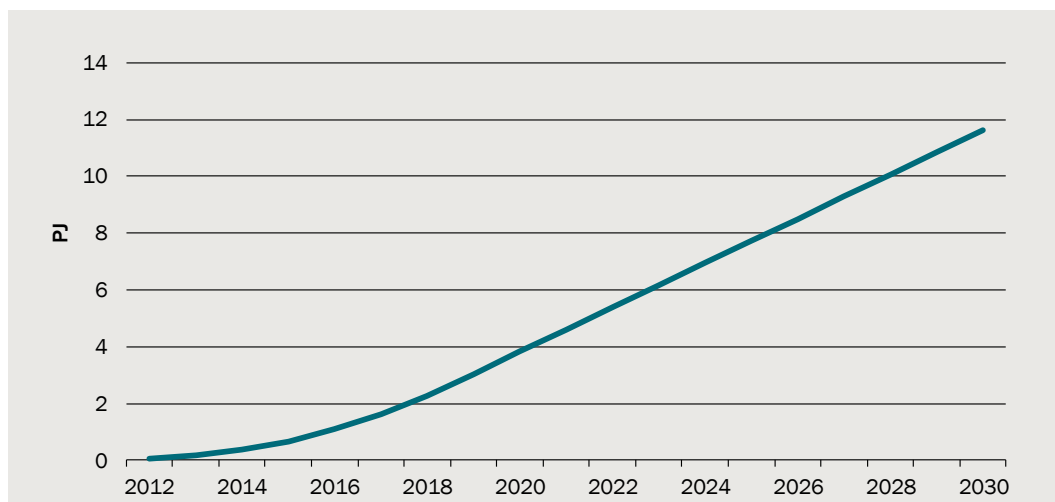


Data source: CIE estimates.

Cumulative energy savings are shown in chart 4.15. We estimate that cumulative energy savings to 2018-19 are around 3.0 PJ. Even with no further energy efficiency improvements, ongoing energy savings from the improvements made to date mean that cumulative energy savings will reach around 11.6 PJ by 2029-30.



#### 4.15 Cumulative energy savings

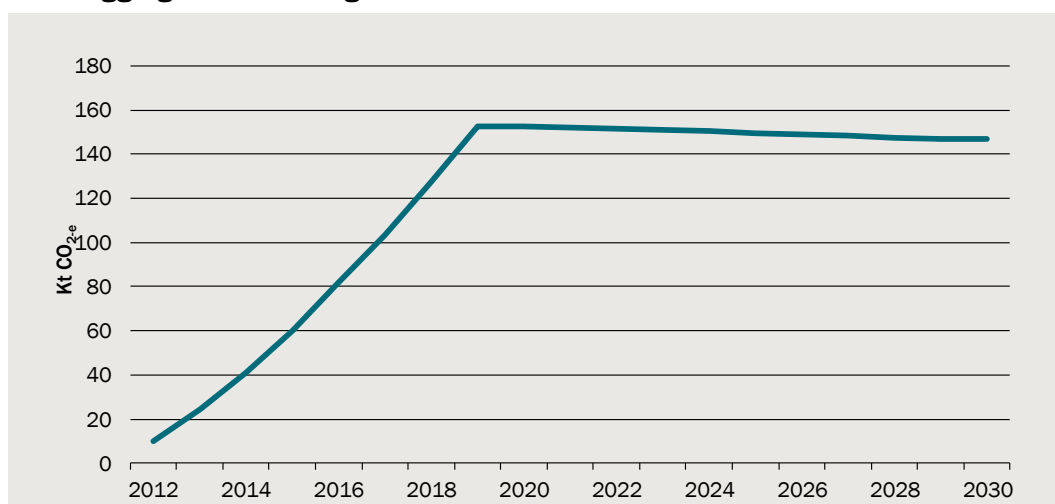


Data source: CIE estimates.

#### *Aggregate greenhouse gas savings*

Aggregate GHG savings follow a similar pattern, with a rapid increase as both the number of buildings covered by the CBD Program and the savings made by each building (on average) increasing over time (chart 4.16). We estimate that in 2018-19, aggregate GHG savings were around 152.6 Kt CO<sub>2-e</sub>. This is expected to decrease gradually over time as the GHG intensity of electricity generation is expected to decline gradually over time.

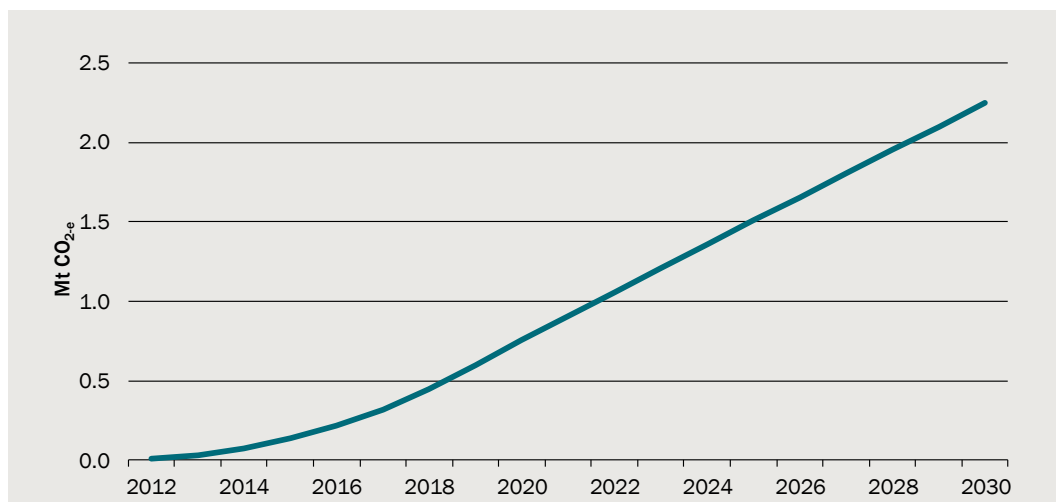
#### 4.16 Aggregate GHG savings



Data source: CIE estimates.

We estimate that cumulative GHG savings reached around 600.4 Kt CO<sub>2-e</sub> in 2018-19 (chart 4.17). Even with no further energy efficiency improvements, we estimate that the benefits of the improvements made to date will increase to around 2.2 Mt CO<sub>2-e</sub> by 2030.

#### 4.17 Cumulative GHG savings



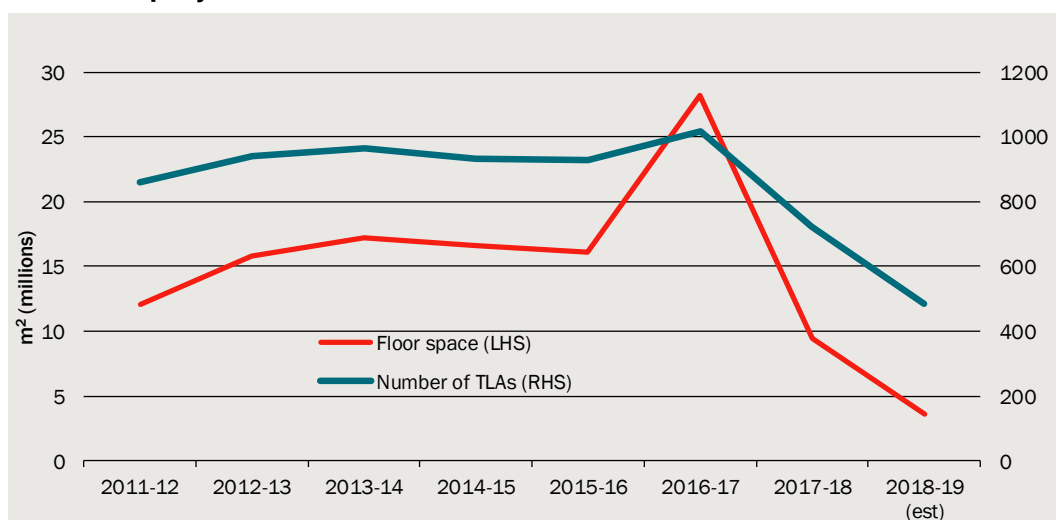
Data source: CIE estimates.

### *Tenancy lighting performance*

In addition to a NABERS rating, the CBD Program also requires a Tenancy Lighting Assessment (TLA). As part of the recent changes (from 1 July 2017), the TLAs are required every five years (rather than every year).

This change has reduced the number of TLAs per year significantly (chart 4.18). Prior to the change, the number of TLAs per year had been broadly steady at around 900 to 1000 per year; however, this fell to 723 in 2017-18. Based on data over the July to December 2018 period (which we double to provide an annual estimate), it appears that the number of TLAs will have fallen even further in 2018-19.

#### 4.18 TLAs per year



Note: The estimated number of TLAs in 2018-19 is based on the TLAs over the July 2018 to December 2018 period, which we doubled to provide an annual estimate.

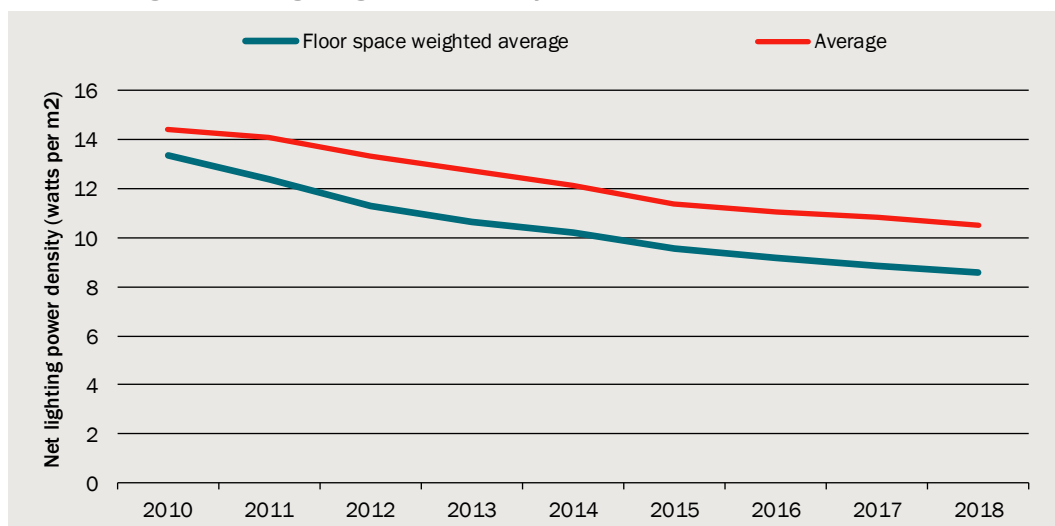
Data source: CBD dataset.

Very few stakeholders have considered the TLA to have had an impact on tenant energy use, or to be a useful mechanism for improving energy efficiency. This is despite that, from a first principles perspective, the TLA is closely related to the issue of split incentives, on which the original CBD Program was premised (i.e. the building owner would generally bear the cost of lighting refits, while the tenant would receive the benefits through lower energy bill). Stakeholders noted that:

- tenants rarely look at the TLA (unlike the NABERS rating)
- most tenants have little understanding of what NLPD means and how it would affect their energy bills.

In terms of changes over time, net lighting power density has fallen rapidly across the buildings covered by the CBD Program (chart 4.19).

#### 4.19 Changes in net lighting power density



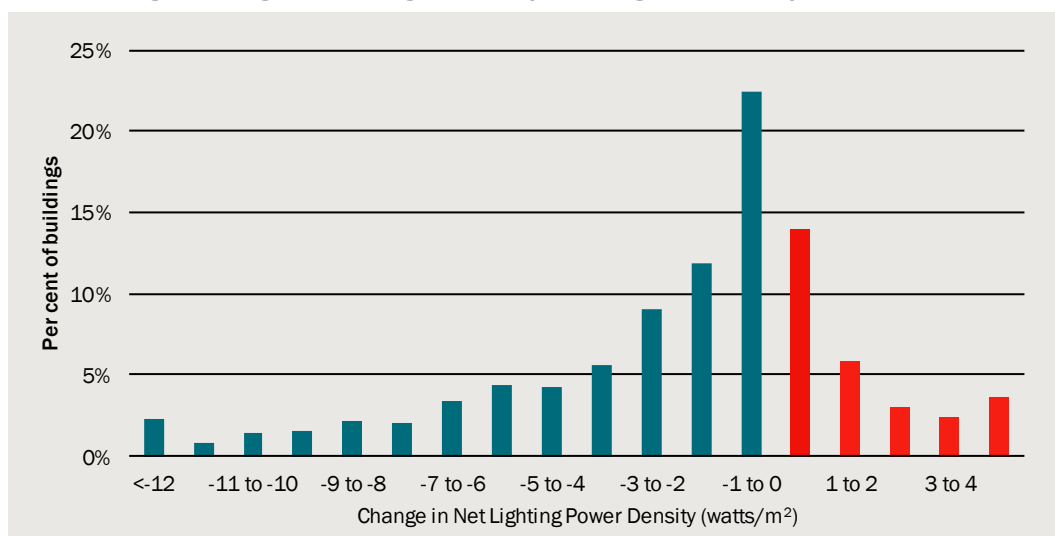
Data source: CBD Dataset; CIE analysis.

We have also sought to track the NLPD of an individual space over time, to see how it has changed.<sup>27</sup> The most TLAs that any functional space has had across the sample is 7. The average is only 1.5 ratings. Functional spaces that have more ratings do tend to be those that have improved their net power lighting density. However, the model explains less than 1 per cent of the variation in net power lighting density for functional spaces, and therefore cannot be viewed as reliable.

Another way to look at changes over time is at the building level. We compare the weighted average NLPD across all functional spaces in a building for all buildings with more than one TLA (chart 4.20). The weighted average NLPD improved in about 71 per cent of buildings and increased in the remaining 29 per cent.

<sup>27</sup> Note that the unique identified for functional spaces appears to have changed over time. We have matched the name of the functional space, building identified and level.

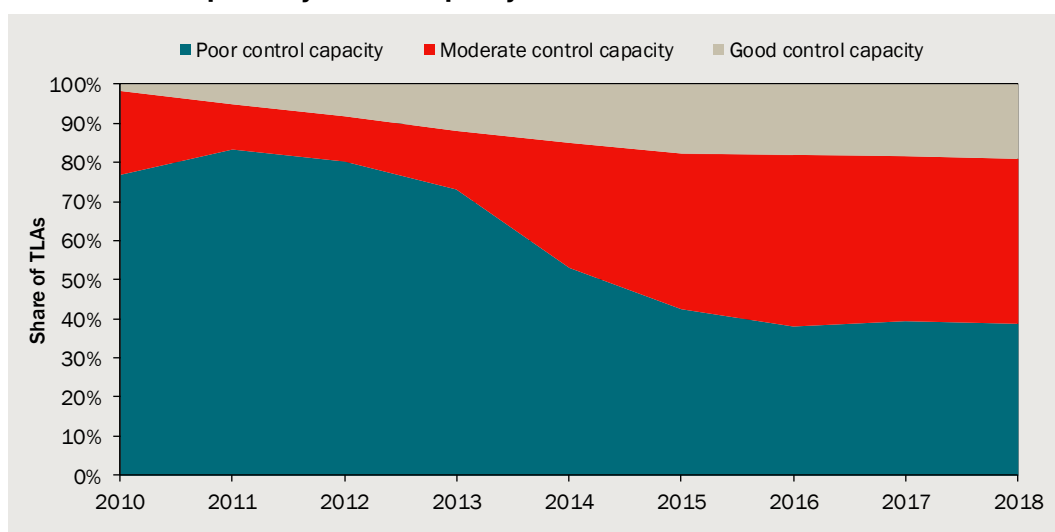
#### 4.20 Change in weighted average NLPD by building – frequency distribution



Data source: CBD database.

The level of control has also improved over time, in terms of lights switching off when not needed (chart 4.21).

#### 4.21 Share of spaces by control capacity



Data source: CBD dataset; CIE analysis.

Most stakeholders consulted considered that the changes in lighting performance have reflected the adoption of LEDs and have not been attributable to the CBD Program.

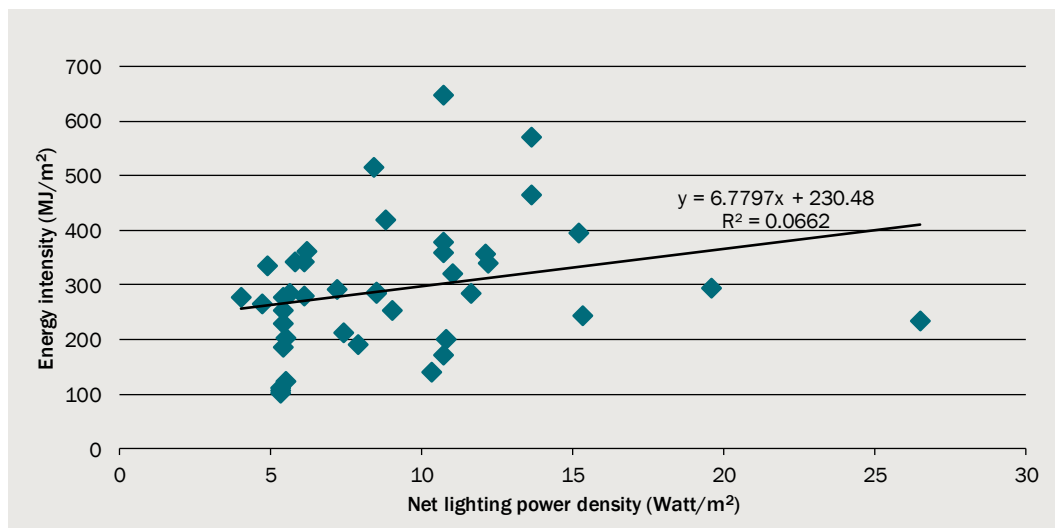
Furthermore, the impacts of reducing NLPD on actual energy consumption and improved lighting control is not clear from the data available. Unlike a NABERS rating, the TLA is not based on actual performance.

To link NLPD to a measure of actual energy performance, we have matched the NLPD for functional spaces (from the CBD database) with the tenant energy intensity (from the NABERS database for those tenants that have an office tenancy rating). Note that the measure of tenant energy intensity would include energy consumption unrelated to

lighting, such as plug-in equipment (for example, computers) and in some cases tenant server rooms and data centres.

Nevertheless, based on this relatively small sample the relationship between NLPD and tenant energy intensity is relatively weak (chart 4.22). This suggests that the TLA is unlikely to be a good indicator of tenant energy bills.

#### 4.22 Relationship between net lighting power density and energy intensity



Note: The measure of tenant energy intensity would include energy consumption unrelated to lighting, such as plug-in equipment (for example, computers) and in some cases tenant server rooms and data centres.

Data source: CBD database, NABERS database, The CIE.

## 5 Cost-benefit analysis of existing program

### Key findings

Cost-benefit analysis (CBA) is a framework for systematically weighing up the costs and benefits of government policies and programs discussed in the previous chapter. This provides insights as to whether the CBD Program is a cost-effective approach to achieve energy efficiency outcomes (as required by the Terms of Reference).

### Net benefits to date

We estimate that the CBD Program has delivered net benefits of around \$86.09 million in net present value terms based on all energy efficiency upgrades made since the program commenced to 2018-19 (table 5.1) (see appendix A for CBA results by state). As the energy efficiency upgrades made to date would be expected to continue to deliver energy savings (relative to the baseline) even with not further upgrades, energy saving benefits have been extended over an additional ten-year period.

#### 5.1 CBD Program to 2018-19 – cost-benefit analysis

	Original program design	2017 changes	Total impacts
	\$ million	\$ million	\$ million
<b>Private benefits/costs</b>			
Electricity savings	89.74	0.15	89.89
Gas savings	49.04	0.06	49.11
Upgrade costs	- 68.07	- 0.09	- 68.16
Compliance costs - NABERS ratings	- 27.54	- 1.67	- 29.22
Compliance costs - TLAs	- 8.19	0.52	- 7.67
<b>Net private benefits/costs</b>	<b>34.98</b>	<b>- 1.03</b>	<b>33.95</b>
<b>Other benefits/costs</b>			
GHG emissions	64.48	0.10	64.58
Government costs	- 11.91	0.00	- 11.91
<b>Total net benefit/cost</b>	<b>87.54</b>	<b>- 0.93</b>	<b>86.62</b>

Note: Costs and benefits are presented in present value terms over the period from where the CBD Program commenced in 2010-11 to 2018-19. As the energy efficiency upgrades made over this period will continue to deliver benefits into the future, energy saving benefits have been extended for an additional ten years.

Source: CIE estimates.

The changes to the CBD Program implemented from 1 July 2017 (including reducing the threshold from 2000 m<sup>2</sup> to 1000 m<sup>2</sup> and reducing the requirement for a TLA from every year to every five years) are estimated to have had minimal impact to date.

- The CBA results suggest these changes have resulted in a small net cost, with the compliance costs imposed on the additional buildings covered by the CBD Program estimated to outweigh the net benefits of the energy efficiency improvements made to date.
- However, this result is not reflective of the longer-term impacts of these changes (see below).
  - As these changes have been in place for only around 2 years, most buildings that have entered the NABERS system as a result of these changes have had limited opportunity to make energy efficiency improvements.
    - ... Those buildings that obtained their first NABERS rating during 2017-18 have had only 1 year to make energy efficiency improvements.
    - ... Those buildings that obtained their first NABERS rating during 2018-19 have effectively had no opportunity to make energy efficiency improvements.
  - Furthermore, the evidence suggests that once buildings enter the NABERS system, most improve performance progressively over time; the benefits of these improvements are cumulative.

The overall net benefits are somewhat higher than estimated by ACIL Allen Consulting in the previous review of the CBD Program; under ACIL Allen's 'realistic case', the net benefits were estimated at around \$44 million in net present value terms (around \$47 million in 2019 dollar terms).<sup>28</sup> However, due to different time periods (ACIL Allen's estimate covered only the period to 2014) and different methodological approaches, these estimates are not directly comparable.

### ***'Business as usual' to 2030***

We also estimated the costs and benefits assuming 'business as usual' out to 2029-30 (table 5.2). As above, energy saving benefits are extended out an extra ten years, reflecting the fact that energy efficiency upgrades made during the period would be expected to deliver ongoing benefits. These estimates are based on ongoing improvements in buildings that have already entered the NABERS system. As we would expect some additional buildings to enter the NABERS system in the future (such as new buildings), these estimates are likely to understate the costs and benefits.

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<sup>28</sup> Acil Allen Consulting, *Commercial Building Disclosure Program: Program Review*, Final Report, Report to Department of Industry and Science, p. 56.



## 5.2 CBD Program ‘business as usual’ to 2030 – cost-benefit analysis

	Original program design	2017 changes	Total impacts
	\$ million	\$ million	\$ million
<b>Private benefits/costs</b>			
Electricity savings	187.85	1.94	189.79
Gas savings	112.02	0.85	112.87
Upgrade costs	- 164.39	- 1.37	- 165.76
Compliance costs - NABERS ratings	- 47.15	- 1.67	- 48.82
Compliance costs - TLAs	- 8.19	2.99	- 5.20
<b>Net private benefits/costs</b>	<b>80.13</b>	<b>2.74</b>	<b>82.88</b>
<b>Other benefits/costs</b>			
GHG emissions	153.88	1.43	155.30
Government costs	- 20.98	0.00	- 20.98
<b>Total net benefit/cost</b>	<b>213.03</b>	<b>4.17</b>	<b>217.20</b>

Note: Costs and benefits are presented in present value terms over the period from where the CBD Program commenced in 2010-11 to 2029-30. As the energy efficiency upgrades made over this period will continue to deliver benefits into the future, energy saving benefits have been extended for an additional ten years.

Source: CIE estimates.

In general, the net benefits of the CBD Program are expected to increase substantially over time under the business as usual scenario. The changes made in 2017 are estimated to have a relatively modest impact relative to the estimated net benefits of the CBD Program in total.

### *The impacts of the CBD Program*

The key impacts of the CBD Program are:

- the benefits of reduced energy consumption
- the costs of the associated energy efficiency upgrades
- the cost of compliance (this is mainly the costs associated with obtaining a BEEC (including the cost of obtaining NABERS ratings and TLAs)
- the costs incurred by the Australian Government in administering the CBD Program.

### *Measuring the benefits of the CBD Program*

The analysis in chapter 4 showed that buildings covered by the CBD Program have significantly reduced energy consumption and that this can partly (but not fully) be attributed to the CBD Program.

A discussion of the benefits of reducing energy consumption and the approach used to quantify them (where relevant) are outlined below.

### *What are the benefits of improved energy efficiency?*

Various publications refer to the ‘multiple benefits’ of energy efficiency, including both energy benefits and non-energy benefits.<sup>29</sup> These benefits and our approach to valuing them (where relevant) are discussed below.

#### *Resource costs reductions*

A key benefit from improved energy efficiency is avoided resource costs associated with reduced energy consumption. There are broadly two approaches to measuring the avoided resource costs associated with reduced energy consumption through improved energy efficiency (see appendix A for further details).<sup>30</sup>

- The capacity and energy approach — this approach breaks down energy costs into its components and estimates the impact on the broader energy system.
  - For electricity, this includes the avoided costs of generation (such as avoided fuel costs) and the avoided (or delayed) cost of augmenting the transmission and distribution networks (network capacity is driven by peak demand).
  - For natural gas, this includes the avoided cost of extracting and processing natural gas, as well as the cost of transporting the gas.
- The retail price approach — under this approach, reduced energy consumption is valued based on retail prices.

We value energy savings based on retail prices (see appendix B for further details). Discussions with the Australian Energy Market Operator suggest that network charges generally exceed the long-run marginal cost of supply. This implies that the retail price method would generally place a higher value on the resource cost savings than the so-called ‘capacity and energy’ approach.

#### *Greenhouse gas emissions reductions*

Reducing consumption of energy generated through burning fossil fuels through improved energy efficiency will reduce greenhouse gas (GHG) emissions that contribute to climate change. These benefits are valued using the social cost of carbon (SCC) approach. We used the ‘medium’ series published by the United States (US) Government’s Interagency Working Group (IWG) on Social Cost of Greenhouse Gases (see appendix B for further details).

<sup>29</sup> See for example: International Energy Agency, 2014, *Capturing the Multiple Benefits of Energy Efficiency*, Paris; and United States Environment Protection Agency, 2018, *Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy: A Guide for State and Local Governments*, Washington.

<sup>30</sup> See Lazar, Jim and Ken Colborn 2013, *Recognizing the Full Value of Energy Efficiency (What’s Under the Feel-Good Frosting of the World’s Most Valuable Layer Cake of Benefits)*, September 2013, available at <http://www.raponline.org/wp-content/uploads/2016/05/rap-lazarcolburn-layercakepaper-2013-sept-9.pdf>.

### *Health benefits from reduced air pollution*

Energy generated from fossil fuels emit a range of pollutants, some of which can be damaging to human health. Reducing the consumption of energy that involves burning of fossil fuels (particularly coal-fired electricity generation) can therefore have some health benefits.

These health benefits depend on a range of factors, including emissions of the relevant pollutants, how those pollutants are dispersed and population density in the relevant areas (see appendix B for further details).

Estimates of the health costs associated with a number of coal-fired generators are provided in appendix B. However, it is difficult to link the reduction in energy consumption from specific buildings to particular generators. These benefits have therefore not been valued. That said, these benefits are estimated to be relatively small compared to the other benefits that have been included in the CBA.

### *Increased rental income and building values*

Numerous studies — including Australian studies — have shown that more energy efficient buildings achieve higher rental income (either through higher lease rates or occupancy rates) and sale prices.<sup>31</sup> This was also a key benefit raised by stakeholders during consultations.

Higher rental income and building value would reflect higher demand for tenants for higher rated buildings (relative to lower rated buildings). Tenants would be willing to pay more for higher rated buildings due a combination of factors including:

- lower energy bills (included in outgoings)
- a preference for ‘greener buildings’ to meet corporate social responsibility objectives
- a perception that higher-rated buildings are of superior quality (in terms of building management or other characteristics).

The benefits of lower energy bills are already included in the CBA, so to the extent that higher rental incomes reflects reduced energy bills, also including increased rental incomes and building values would involve double-counting these benefits. Similarly, the benefits of reducing GHG emissions have also been included above.

### *Broader economic impacts*

Some studies refer to a range of broader economic impacts, including industry productivity improvements and the flow-on economic impacts of increased investment in energy efficiency and reduced energy consumption.

Many investments in energy efficiency (or energy productivity) would be reflected in ‘multi-factor productivity’ (a measure of output per unit of combined economic inputs), a measure closely associated with economic wellbeing (although this is not necessarily the

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<sup>31</sup> See for example, Newell, G. MacFarlane, J. and Kok, N. *Building Better Returns: A Study of the Financial Performance of Green Office Buildings in Australia*, September 2011.

case as most energy efficiency improvements also involve an increase in capital inputs). However, these productivity benefits are not additional to the energy saving benefits estimated above. As such, including productivity benefits in addition to reduced energy costs would involve double-counting these benefits.

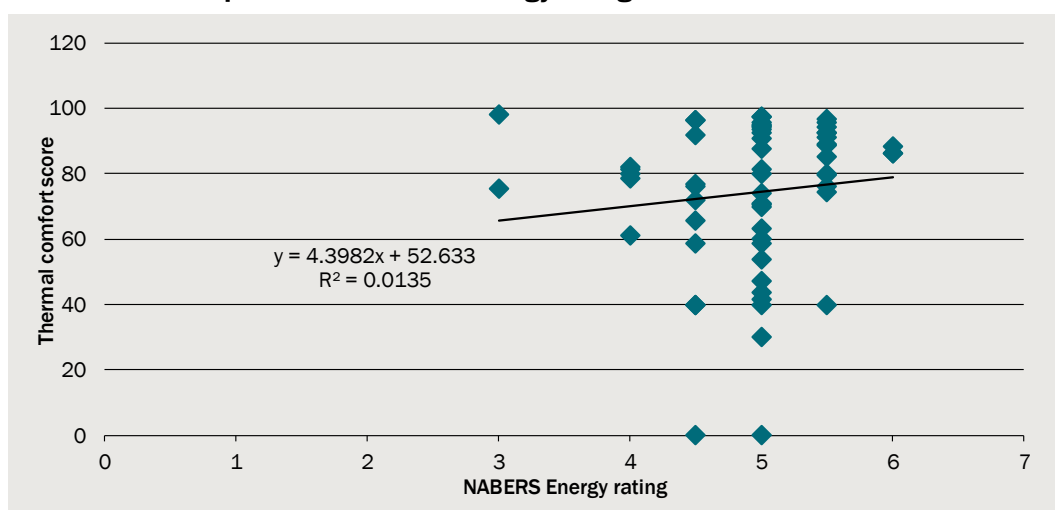
### *Health and productivity benefits*

Several publications also refer to the health and productivity benefits associated with 'green buildings'.<sup>32</sup> There is some evidence to suggest that indoor environmental quality (IEQ) in office building has a measurable impact on worker productivity through both fewer sick days, as well as improved performance.

The previous review of the CBD Program found that even under conservative assumptions, the productivity benefits of the CBD Program are expected to be significant and would be more than double the energy saving benefits. That said, these benefits were reported separately from the main CBA results, with ACIL-Allen Consulting noting a lack of sufficient and robust data estimating the productivity benefits of green buildings and the high degree of uncertainty in the estimates.<sup>33</sup>

Any health and productivity benefits would be in addition to the energy benefits estimated above. However, an analysis of buildings in the NABERS database with both a NABERS Energy rating and a NABERS Indoor Environment Quality (IEQ) rating (a relatively small sample of 61 observations) suggest that the relationship between the NABERS Energy rating and the thermal comfort score (the component of IEQ that is most likely to be associated with energy efficiency) is not statistically significant (chart 5.3).

### **5.3 Relationship between NABERS energy rating and thermal comfort score**



Data source: CIE based on NABERS database.

<sup>32</sup> For a discussion of these studies, see: ACIL-Allen Consulting, Commercial Building Disclosure: Program Review, Report to the Department of Industry and Science, March 2015, p. 56.

<sup>33</sup> ACIL-Allen Consulting, Commercial Building Disclosure: Program Review, Report to the Department of Industry and Science, March 2015, pp. 56-57.

One caveat here is that there are no buildings with a NABERS Energy rating of less than 3 stars in the dataset. There is some evidence to suggest that for low-rated buildings, improvements in the NABERS Energy star rating is associated with increased thermal comfort.

Furthermore, the NABERS IEQ tool has two thermal comfort methodologies. One of these methodologies is only available to buildings with annual tracking and storing of temperature data. The thermal comfort score may be artificially low for buildings that do not store their annual temperature data. This may partly explain the weak relationship between the NABERS Energy rating and the thermal comfort score.

- **As there is no statistical evidence to show a link between energy efficiency and thermal comfort, we have not included the benefits any health and productivity improvements associated with IEQ in the CBA.**

### *Approach to modelling the benefits*

The impact of the CBD Program on energy performance are discussed in detail in chapter 4. Our modelling approach reflects the following key observations from our analysis of the data and stakeholder consultations.

- Buildings in the NABERS system tend to reduce energy intensity (and improve the NABERS Energy star rating) consistently over time (rather than make larger periodic improvements).
- Buildings that enter the NABERS system with lower star ratings tend to make larger improvements than buildings that enter the NABERS system with higher star ratings.
- Although there are not significant differences in performance improvements across states, the benefits of reducing energy consumption will vary due to differences in energy prices, as well as the GHG-intensity of the energy consumed (particularly electricity).

### *Attribution to the CBD Program*

As some buildings were rating voluntarily prior to the implementations of the CBD Program, any improvements in these buildings cannot be attributed to the CBD Program. The CBD Program:

- was announced in November 2009
- the legislation received assent in June 2010
- the legislation commenced in November 2010, but was not implemented in full until November 2011.

Chart 4.2 (in the previous chapter) shows that the most significant increase in the number of new NABERS ratings occurred in 2010-11, although there was also a smaller increase in 2009-10, the year in which the CBD Program was announced.

- **We assume that all buildings that entered the NABERS system from 1 July 2010 is attributable to the CBD Program.**

The total floor space of buildings entering the NABERS system for the first time (including both base building and whole building ratings) since 2010-11 by state/territory and star rating is shown in appendix D.

#### *Estimated changes in energy intensity over time*

The average base building energy intensity of buildings entering the NABERS system for the first time by state/territory and star rating is shown in appendix D.

Based on the statistical modelling, the assumptions on the incremental change in energy intensity for each building entering the NABERS system after 2010-11 are shown in table 5.4. Note that these reductions in energy intensity are cumulative over time.

Improvements in energy efficiency under the baseline scenario (i.e. without mandatory disclosure) are less clear as we have only limited data. On balance, the analysis in chapter 4 suggests that the average improvement made by those buildings outside the NABERS system may be around half that observed under the CBD Program. Under the baseline scenario, we therefore assume half the improvement shown in table 5.4.

#### **5.4 Incremental change in energy intensity and NABERS star rating**

Initial star rating	Incremental change in energy intensity		Incremental change in NABERS rating	
	Under CBD Program	Baseline	Under CBD Program	Baseline
	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	Stars	Stars
0.0	-48.24	-24.12	0.42	0.21
0.5	-48.24	-24.12	0.42	0.21
1.0	-47.95	-23.97	0.40	0.20
1.5	-47.95	-23.97	0.40	0.20
2.0	-42.51	-21.25	0.23	0.11
2.5	-42.51	-21.25	0.23	0.11
3.0	-17.86	-8.93	0.18	0.09
3.5	-17.86	-8.93	0.18	0.09
4.0	-11.14	-5.57	0.13	0.07
4.5	-11.14	-5.57	0.13	0.07
5.0	-17.50	-8.75	0.16	0.08
5.5	-17.50	-8.75	0.16	0.08
6.0	0.00	0.00	0.00	0.00

Source: CIE estimates.

As these results are based on each NABERS rating (rather than years since the first NABERS rating) and not every building obtains a rating every year, we scale the annual improvement by the average number of ratings each year for the relevant buildings. In particular, weighted by floor space, the average number of ratings per year is 0.78.

### *Estimating energy savings*

Energy savings in each year are estimated by multiplying the change in energy intensity (relative to baseline) (in MJ per m<sup>2</sup>) by the floor area of the buildings that entered the NABERS system in the relevant year (see above).

Total energy savings are then allocated between electricity and gas, based on the average share of savings in each state (comparing first and last NABERS ratings) (table 5.5).

### **5.5 Share of total energy saved**

	Electricity share	Gas share
	Per cent	Per cent
NSW	59	41
Victoria	67	33
Queensland	68	32
Western Australia	81	19
South Australia	58	42
Tasmania	n.a.	n.a.
ACT	41	59
Northern Territory	63	37

Source: NABERS database.

As noted above:

- the avoided resource costs associated with these energy savings are valued using the retail price in the relevant state (see appendix B)
- the avoided GHG emissions are:
  - estimated by applying the estimated GHG-intensity of each energy source (electricity or gas) in the relevant state
  - valued using the SCC approach (see appendix B for further details).

### *Measuring the costs of the CBD Program*

The costs associated with the CBD Program include:

- the (mandatory) cost of complying with the CBD Program requirements
- the cost of (voluntary) energy efficiency upgrades
- government administration costs.

### *Compliance costs*

The estimated cost of complying with the requirements of the CBD Program are shown in table 5.6. These costs include the following.

- Based on our survey of assessors, the average cost of obtaining a NABERS rating is estimated at around \$3300.
- NABERS administration fees are around \$1100 per rating.



- Internal costs include the cost of gathering the relevant information, as well as costs associated with arranging assessors to complete the assessment. These costs were estimated at around \$1000 per assessment based on a small number of responses to our survey of building owners/managers.
- The cost of completing a TLA and applying for a BEEC is also based on our survey of assessors.

## 5.6 Estimated compliance costs

Cost per rating	
	\$
<b>Cost of NABERS rating</b>	
Consulting fees – NABERS rating	3 300
NABERS certification fees	1 100
Internal costs	1 000
<b>Total</b>	<b>5 400</b>
<b>Other costs</b>	
Consulting fees – TLA assessment	1 460
BEEC	160

Source: CIE surveys.

The number of NABERS ratings (base building and whole building) completed by buildings that entered the NABERS system after 2010-11 are shown in table 5.7.

## 5.7 Number of NABERS Energy ratings

	2011	2012	2013	2014	2015	2016	2017	2018	2019
	No.	No.	No.	No.	No.	No.	No.	No.	No.
NSW	209	223	260	277	283	232	248	316	212
Victoria	118	165	162	199	191	172	193	232	162
Queensland	107	129	148	128	145	170	174	239	158
Western Australia	49	62	54	87	77	96	119	169	126
South Australia	17	30	39	37	37	52	42	71	42
Tasmania	7	16	14	14	19	17	19	21	12
ACT	27	38	49	47	43	51	68	69	56
Northern Territory	11	11	13	11	10	12	17	22	14
<b>Total</b>	<b>545</b>	<b>674</b>	<b>739</b>	<b>800</b>	<b>805</b>	<b>802</b>	<b>880</b>	<b>1139</b>	<b>782</b>

Note: Includes both base building and whole building ratings.

Source: NABERS database, CIE.

## *The cost of energy efficiency upgrades*

As noted above, the cost of energy efficiency upgrades can vary significantly, depending on building-specific characteristics and the energy efficiency measures chosen. The

specific measures that each building has taken to improve energy efficiency and the timing of these upgrades is not known.

To estimate the costs of energy efficiency upgrades, we have gathered information on upgrade costs and the associated energy savings for both planned and completed energy efficiency upgrades to 31 office buildings, including information from:

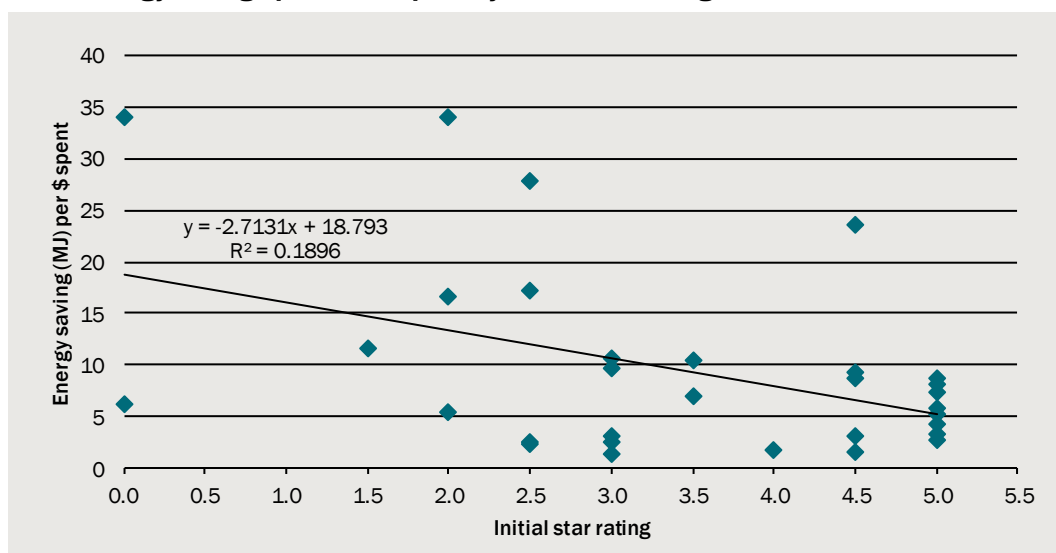
- the Victorian Government's Energy Efficient Office Buildings program run by Sustainability Victoria; and
- a range of proposed upgrades from a major property group (these upgrades are well advanced in the planning process and have identified a number of specific measures for each building).

The sample therefore contains:

- buildings in the low and mid-tier sector (the Energy Efficient Office Buildings Program (EEOB) focused specifically on the mid-tier sector) and premium and A grade sector
- buildings located in NSW, Victoria, Queensland and the ACT and therefore covers a range of climate zones (although the sample is skewed towards buildings located in Victoria, given that the EEOB program focused on Victorian buildings only).

Although the costs and energy savings achieved varied significantly across buildings, there is a statistically significant (at the 95 per cent level of significance) negative relationship between the building's initial NABERS rating and the energy savings achieved for each dollar invested (although the relationship is relatively weak) (chart 5.8).

## 5.8 Energy savings per dollar spent by initial star rating



Data source: Sustainability Victoria and data gathered from a major property group.

Although this relationship is based on a small sample and is relatively weak it forms the basis of our cost estimates in the CBA on the basis that:

- the estimates are based on actual costs (rather than modelled costs)

- this approach produces broadly plausible estimates (see below for the implied payback periods)
- the finding aligns with anecdotal evidence that the cost of achieving each additional star rating increases as the star rating increases.

This relationship implies that the annual cost of an energy efficiency upgrade for each building can be estimated as follows:

$$C = \frac{E}{18.793 - 2.7131 \cdot star}$$

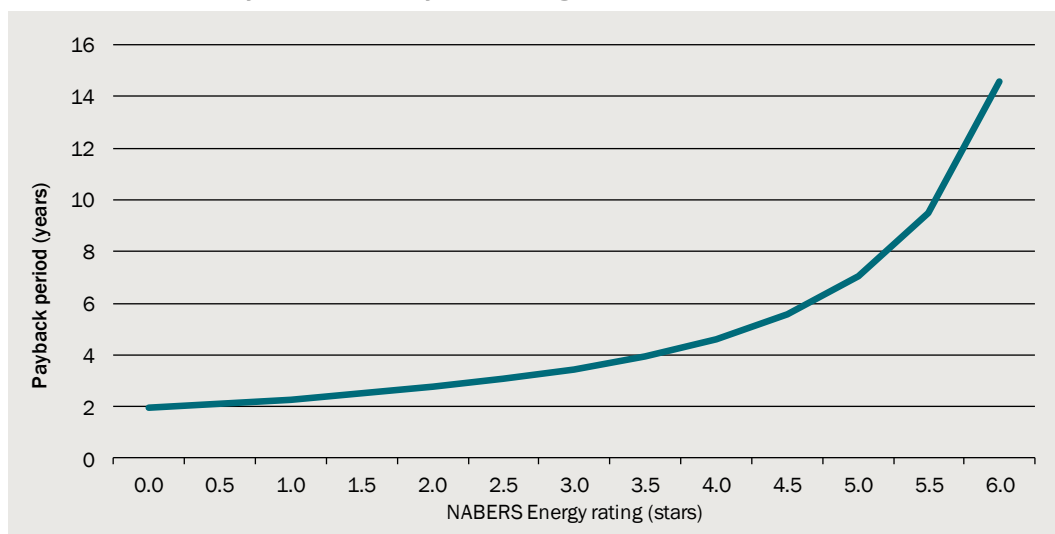
Where:  $C$  is the annual cost (in dollars);  $E$  is the energy saved during the year (in MJ); and  $star$  is the NABERS star rating at the start of the period.

As the NABERS star rating improves over time, this relationship suggests that it becomes increasingly costly to achieve the same reduction in energy consumption. The assumption on the incremental change in NABERS star rating over time are shown in table 5.4 (above).

Based on a simple average of estimated 2019 energy prices across states (and national average mix of energy savings), the payback period for energy efficiency upgrades at each star rating implied by the relationship estimated above are shown in chart 5.9.

- Payback periods for energy efficiency upgrades for on highly inefficient buildings (i.e. 0 to 1 stars) are generally around 2 years.
- This increase to around 4 years for 3 to 3.5 star buildings.
- For buildings that are already relatively efficient (more than around 5 stars), payback periods are broadly around the 'hurdle rate', suggesting many building owners may be indifferent as to whether to pursue further energy efficiency improvements for these buildings.

### 5.9 Estimated payback period by star rating



Data source: Sustainability Victoria and data gathered from a major property groups (see chart 5.8).

### Government costs

As there are currently no cost recovery arrangements in place, the Australian Government incurs costs administering the CBD Program. Based on estimates provided by DEE, annual operating costs (including operations and compliance costs) are estimated at around \$1.7 million (table 5.10).

#### 5.10 Annual operating costs

	Annual costs
	\$ million
Staff costs - operations	592 784
Staff costs - compliance	370 228
ICT support services	422 982
CRM System and server hosting costs	228 956
Website hosting costs	22 370
Geocoding address validation services	21 000
Assessor training and exams	20 000
Assessor conference (biennial) <sup>a</sup>	25 000
<b>Total operating costs</b>	<b>1 703 320</b>

<sup>a</sup> DEE estimates that the cost of each conference is around \$50 000 every two years. We therefore assume an average annual cost of \$25 000 per year.

Source: Department of the Environment and Energy.

In addition, DEE advised that it has/will incur capital costs relating to:

- minor IT capital upgrades (in 2017-18 and 2018-19); and
- a major redevelopment of the IT system.

These costs have been annualised by amortising them over a five-year period (using a discount rate of 7 per cent) and included from the year from which they were incurred (table 5.11).

#### 5.11 Summary of capital costs

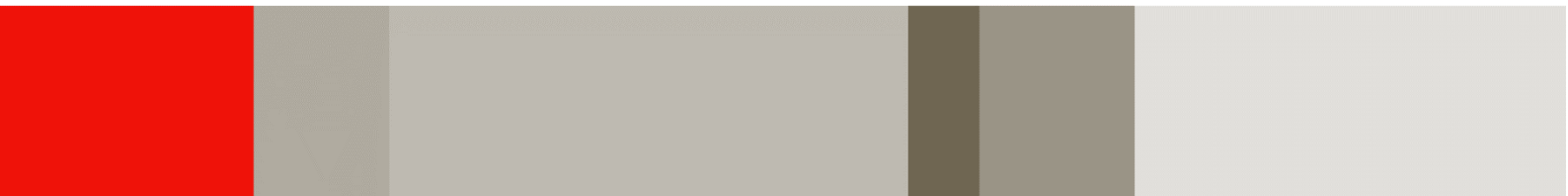
	Capital cost	Annual amortisation costs <sup>a</sup>
	\$	\$
Minor IT capital upgrades (2017/18)	91 000	22 194
Minor IT capital upgrades (2018/19)	50 000	12 195
Redevelopment of IT system	1 400 000	341 447
<b>Total</b>	<b>1 541 000</b>	<b>375 836</b>

<sup>a</sup> Amortised over 5 years, using a discount rate of 7 per cent.

Source: CIE based on information provided by DEE.

## PART II

### Potential changes to the CBD program





## 6 Offices

### *Key findings and draft recommendations*

The CBA results suggest that if compliance costs can be minimised through co-assessments and a requirement for ratings every second year (rather than every year), expanding mandatory disclosure requirements to office tenancies could deliver a net benefit to the community.

However, this finding is contingent on a streamlined system being established. This would require:

- aligning the requirement for an office tenancy rating to the base building rating (this would necessitate a shift to periodic ratings where buildings are required to obtain a rating every year or every second year, rather than on sale or lease).
- building owners/managers (or the assessor acting on their behalf) having direct access to tenant metering data to complete the rating through the co-assess tool. In some states, we understand this would require some legislative changes.

If such a system cannot be developed, expanding mandatory disclosure requirements to office tenancies is likely to impose a significant net cost on the community.

- **We recommend that:**
  - disclosure of tenancy ratings using the co-assess tool could be trialled in a state where existing legislation would allow this to occur
  - if the implementation challenges can be overcome, the CBD Program should be expanded to cover office tenancies, replacing the current TLA requirements.
- **If the CBD Program is not extended to office tenancies, there is no compelling case to change current disclosure requirements for base buildings.**

### *Design options for a mandatory disclosure scheme*

The design elements of a mandatory disclosure program for a particular type of building include:

- the thresholds that apply
- the trigger for mandatory disclosure (i.e. what triggers the need for a BEEC)
- what information is disclosed
- how the information is disclosed
- the administrative arrangements.

The options for each of these design elements are outlined in table 6.1.

## 6.1 Design options

Design elements	Options
Thresholds	<ul style="list-style-type: none"> <li>■ No specific limitations on what threshold should apply.</li> <li>■ Threshold could apply to (depending on choice of trigger for a BEEC): <ul style="list-style-type: none"> <li>– Space being sold/leased</li> <li>– Whole building size</li> </ul> </li> </ul>
Trigger for disclosure	<ul style="list-style-type: none"> <li>■ Sale/lease</li> <li>■ Periodic trigger (i.e. every year or every two years)</li> </ul>
Information disclosed	<ul style="list-style-type: none"> <li>■ NABERS Energy without greenpower</li> <li>■ NABERS Energy with greenpower</li> <li>■ TLA</li> <li>■ Estimated energy bill</li> <li>■ Energy consumption per m<sup>2</sup></li> <li>■ Energy cost per m<sup>2</sup></li> </ul>
Disclosure arrangements	<ul style="list-style-type: none"> <li>■ All advertising material</li> <li>■ Leases</li> <li>■ Building foyer</li> <li>■ Annual report</li> <li>■ No external disclosure</li> </ul>
Other administrative arrangements	<ul style="list-style-type: none"> <li>■ Cost recovery arrangements</li> <li>■ Compliance and enforcement</li> <li>■ Time periods over which a rating is valid</li> </ul>

Source: The CIE.

### *Mandatory disclosure for office tenancies*

As required by the Terms of Reference, a key consideration in reviewing the CBD Program arrangements for office buildings is whether to expand mandatory disclosure requirements to office tenancies.

### *Voluntary uptake of the NABERS office tenancy tool*

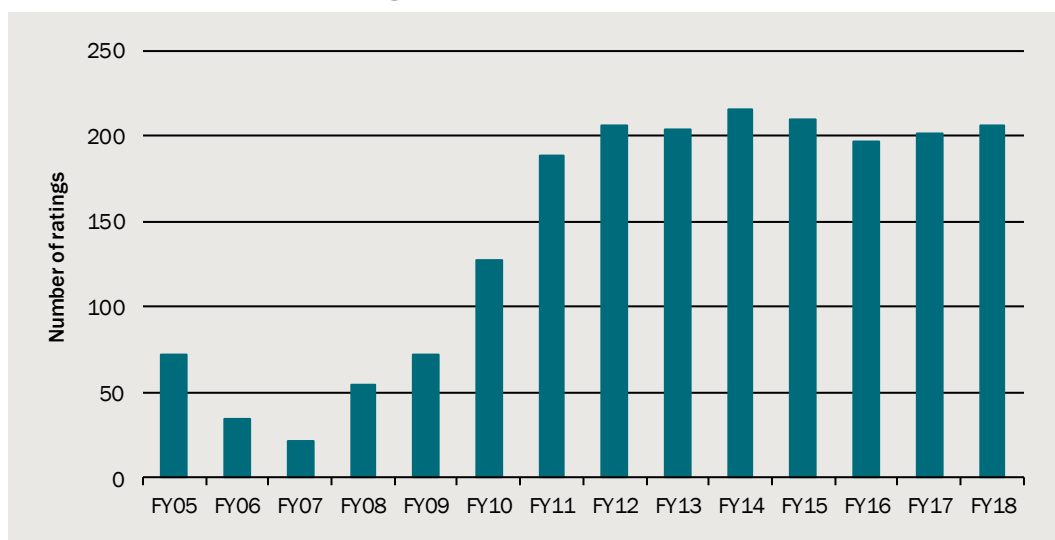
Based on NABERS data, there were around 200 current office tenancy ratings as at 30 June 2018. This has been broadly steady for several years (chart 6.2).

NABERS estimates that of the buildings that have been rated so far, there may be around 35 400 office tenancies<sup>34</sup>. This would suggest that the current level of voluntary disclosure is quite low for office tenancies.

<sup>34</sup> NABERS Annual report, 2017-18, p. 16.



## 6.2 Number of NABERS ratings over time



Data source: The CIE, CBD dataset

### *Market and behavioural failures*

Office tenants on net leases have access to their energy bills and would therefore be aware of the private financial costs associated with their energy usage. It is possible, however, that energy bills (and the resulting greenhouse gas emissions) are higher than they need to be, due to the following market and behavioural failures.

- Split incentives and information asymmetries in relation to lighting — split incentive arise in relation to lighting because the landlord is responsible for the providing the lighting, while the tenants pays for the associated energy consumption (under net leases). The landlord would therefore bear the cost of a lighting upgrade, while the tenant would receive the benefit. In principle, the landlord would have an incentive to install more energy efficient lighting (where cost-effective) if they are able to recover the costs from tenants (such as through higher rents). However, there may be some underlying barriers, which prevent this from occurring.
  - Leasing arrangements may make it difficult for the landlord to increase rents to recover the cost of a lighting upgrade mid-lease (or the cost of negotiating with tenants may be too high). We note that some leases do require periodic lighting upgrades although landlords typically conduct these between leases.
  - Information asymmetries when the lease is entered into – this occurs where the tenant does not have information on the efficiency of the lighting when they enter into the lease. This means that the relative efficiency of lighting may not be reflected in rents. The TLA is designed to address this information asymmetry. Whilst the TLA may affect landlord behaviour (by conducting upgrades between leases), most stakeholders argued that the TLA is rarely looked at by the tenant. Furthermore, the TLA provide technical information on the efficiency of the lighting and the controls; however, it will not always be clear to tenants how those efficiency measures translate into energy costs.

- Lack of information and bounded rationality — while tenants on a net lease would have full knowledge of their energy costs, they may make sub-optimal decisions for several reasons including the following.
  - Tenants are unaware how their energy consumption compares to other similar office tenants.
  - Tenant energy costs may be a relatively small share of overall business costs and therefore receive little attention (i.e. insalience of energy costs).
  - Tenants may not understand the consequences of their decisions that affect energy consumption and therefore not understand how to reduce energy consumption.

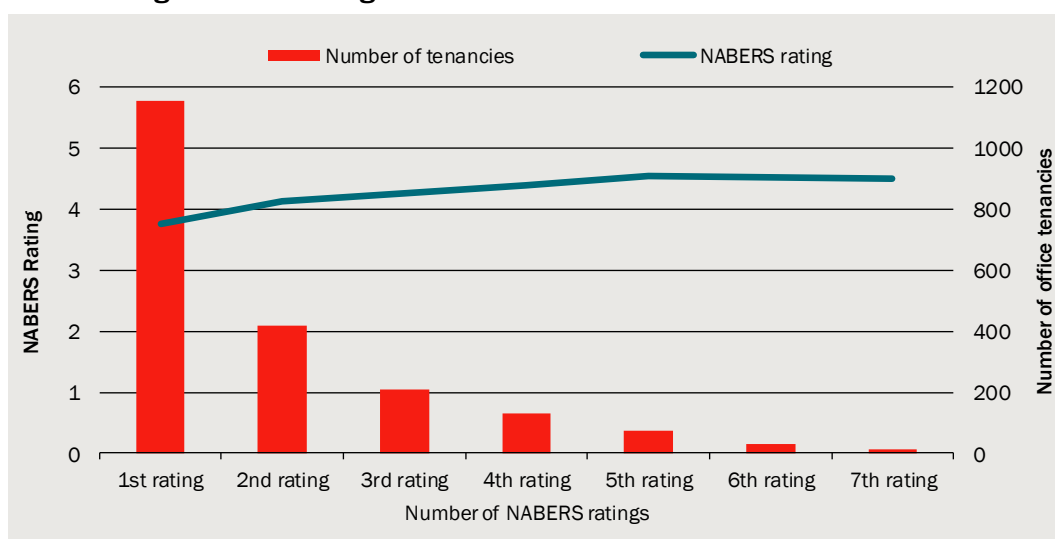
### *Would mandatory disclosure drive behavioural change?*

Mandatory disclosure would generally only be effective if it overcomes a market or behavioural failure. For office tenancies, a mandatory NABERS rating could help overcome the information barriers associated with reducing energy consumption and greenhouse emissions. Mandatory disclosure would serve to set a benchmark that tenants can measure themselves against. Poor performers may be incentivised (due to realising that lower costs are possible) to improve their overall energy efficiency.

This of course, hinges on overall materiality of the energy savings. The private benefits of reduced energy consumption need to outweigh any costs associated with enacting a behavioural change. If energy costs are a small proportion of overall tenants' costs, then they may lack the incentive to reduce energy consumption.

For those tenants that have rated voluntarily, the average NABERS rating for office tenancies rated multiple times has improved; however, the number of tenants that acquire additional ratings after the first rating falls significantly (chart 6.3).

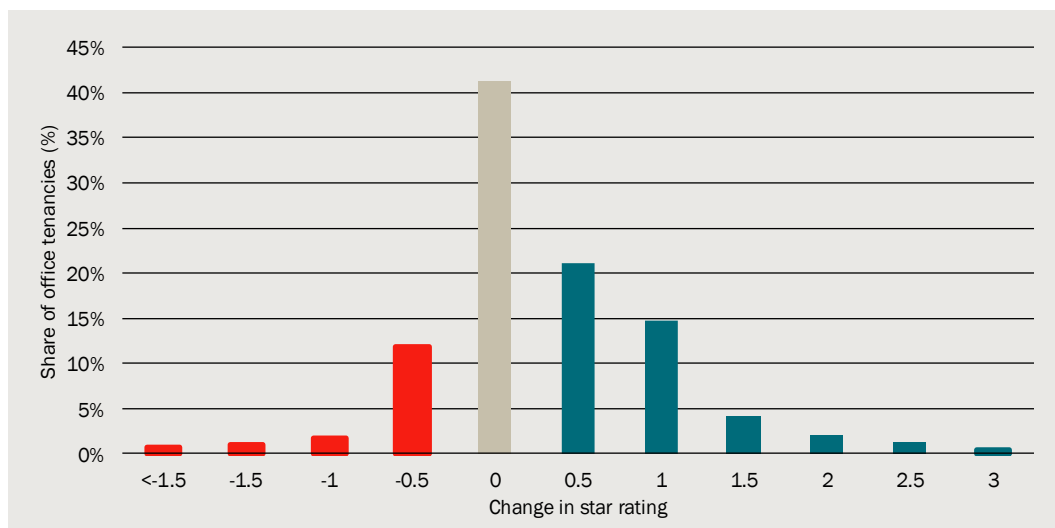
### **6.3 Average NABERS rating over time**



Data source: The CIE, CBD dataset

Nevertheless, around 40 per cent of office tenancies that have rated multiple times had no change in rating, while those that improved mainly saw increases in their rating by 0.5 to 1 star (chart 6.4).

#### 6.4 Comparing first NABERS rating to last rating



Data source: The CIE, CBD dataset

In terms of energy intensity, tenancies with more than 1 voluntary NABERS Office Tenancy rating improved by around 23.5 MJ per m<sup>2</sup> or around 6.5 Kwh per m<sup>2</sup> on average. Note that (unlike the NABERS star rating), this measure would not take into account any changes in the number of people per m<sup>2</sup> accommodated in the office space.

We also compare the change in energy intensity of tenants with a voluntary NABERS rating with:

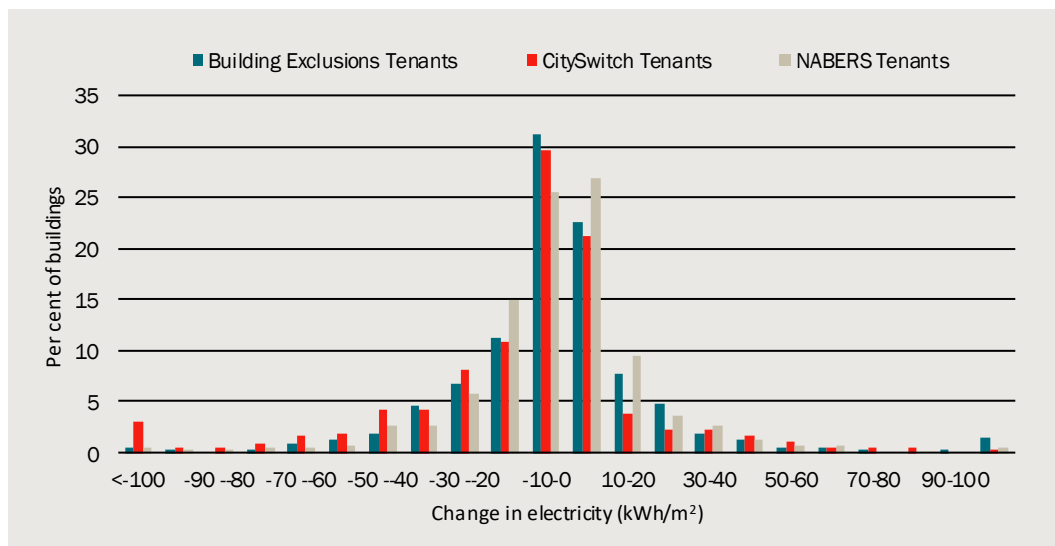
- data from participants in the CitySwitch program (provided by the City of Sydney).
- exclusions from base building ratings — in some states, metering arrangements mean that base building ratings are estimated based on the energy consumption of the whole building, less any energy consumption excluded from the base building rating (this could include energy consumed by tenants and any retail areas of the building). These ‘exclusions’ are reported to NABERS. This data may provide some indication of trends in the energy consumption of tenants that do not voluntarily obtain NABERS office tenancy ratings.

A frequency distribution of the change in energy intensity (between the first and last rating) across the 3 datasets is shown in chart 6.5.

- Participants in the CitySwitch Program made more progress in reducing energy intensity (compared to tenants with a voluntary NABERS ratings), having reduced energy intensity by around 98 Kwh per m<sup>2</sup> on average.
- The exclusions data suggests an average increase in energy intensity. However, this dataset is highly variable and as it includes some energy consumption unrelated to office tenants (such as retail). As such, we have little confidence in this finding. That said, it is plausible that the energy intensity of office tenants has increased if average number of employees per m<sup>2</sup> has increased over time. This would increase a tenant’s

energy intensity (although this would be accounted for in the NABERS tenancy star rating).

## 6.5 Change in energy consumption



Data source: NABERS database, City Switch data.

- In summary, the available (albeit limited) evidence suggests that mandatory disclosure for office tenants could encourage some modest reductions in energy intensity.

## Review of the CBD Program for offices

In this section we review the key design features of the CBD Program as it applies to office buildings. As discussed above, a key issue considered is the expansion of mandatory disclosure requirements to office tenancies. As there are likely to be significant advantages in aligning any mandatory disclosure requirements for office tenancies with the requirements for base buildings, our review has been undertaken in this context.

Other considerations include the alignment of the design features with the recommended objectives of the CBD Program and the market and behavioural failures that prevail in the office market.

### Trigger for a BEEC

The options for the trigger for a BEEC include:

- sale and lease — currently, the requirement to obtain a BEEC is triggered when an office space greater than 1000 m<sup>2</sup> is offered for sale or lease.
- periodic ratings — the main alternative to sale and lease is a periodic trigger where a BEEC must be obtained periodically (such as annually or biennially).

If mandatory disclosure requirements are to be extended to office tenancies, a periodic trigger is preferable to the current sale and lease trigger (note that current sale and lease disclosure requirements could still be maintained – see below).

- A sale and lease trigger makes little sense for office tenancies.
  - A rating would be of little use to an incoming tenant as it would reflect the previous occupant’s energy usage.
  - A rating would also be of little use to the outgoing tenant as they are vacating the office space and therefore could not use the rating to improve their performance.
  - A periodic trigger would allow existing tenants can track their performance over time.
- As there are likely to be significant advantages in aligning the tenancy and base building requirements, extending mandatory disclosure to office tenancies is likely to also mean moving to a periodic trigger for base buildings. A periodic trigger for base buildings would also align better with the market/behavioural failure that mandatory disclosure is addressing.
  - Requiring a BEEC when office space is offered for sale and lease is a logical trigger where the main market failure that information disclosure is seeking to address is an information asymmetry problem in relation to energy costs. However, there is little evidence of an information asymmetry problem in relation to tenant energy bills, as expected outgoings are revealed to prospective tenants (see above).
  - Rather, the main behavioural failure that the requirement to obtain a NABERS rating is a lack of awareness of poor performance for some building owners/managers. A periodic trigger is better aligned with this behavioural failure.
  - Furthermore, given that a NABERS rating (but not necessarily the TLA) relates to the building, rather than the tenanted area, it makes more sense for the trigger to relate to the total floor space (i.e. total net lettable area), rather than the area being leased at any given time.

The current trigger also means that some office buildings with significant total floor area can avoid obtaining a BEEC (not necessarily deliberately), where the space leased at any one time is less than 1000 m<sup>2</sup>. That said, our analysis of the Sydney and Melbourne central business districts suggest that the CBD Program and/or voluntary NABERS ratings provides good coverage of buildings, with few buildings with a significant size not having a rating. Where larger buildings are not rated, this seems to be largely because they are strata titled and therefore outside the scope of the CBD Program.

There were generally mixed views from stakeholders on the appropriate timeframe for a periodic trigger.

- Some stakeholders suggested an annual NABERS rating would be necessary to drive energy improvements.
  - On the downside, this would impose higher regulatory costs on some buildings.
    - ... We estimate that buildings that have obtained a NABERS rating, average around 0.6 ratings per year (implying 6 ratings across a ten-year timeframe).
    - ... Weighted by floor space, the average is around 0.74 ratings per year.

- ... This reflects the fact that many larger office buildings obtain a NABERS rating every year to ensure that a current BEEC is available when office space within the building becomes vacant. Other buildings obtain a NABERS rating only when required. There may be some increase in cost for these buildings.
- Furthermore, changes in NABERS ratings from one year to the next are generally relatively small, but can change significantly over longer periods.
- Less frequent NABERS ratings could significantly reduce the regulatory burden. However, NABERS ratings less frequently than every second year may not drive the intended behavioural change.

We consider it plausible that a requirement to obtain a rating every second year could still drive improvements in energy efficiency (note that this is not much less than the current average). On the other hand, it seems less likely that a rating every 3 years or less would drive behavioural change.

### *Information disclosed*

The information currently disclosed on a BEEC includes:

- a NABERS Energy rating (without GreenPower):
  - base building rating (where possible); or
  - a whole building rating (where a base building rating is not possible)
- a Tenancy Lighting Assessment.

We also consider the most appropriate metric to be disclosed in relation to office tenancies.

### *NABERS Energy rating*

In reviewing the information that is disclosed through the CBD Program, the focus is on whether a NABERS Energy rating is an appropriate metric (or the most appropriate metric) that is disclosed. In considering these questions it is important to understand how the NABERS Energy rating is constructed (see box 6.6). However, reviewing the NABERS methodology *per se* is not within the scope of this review.

#### **6.6 NABERS Energy ratings**

A NABERS Energy rating compares the greenhouse gas emissions associated with the energy consumed in a building against a benchmark that represents the performance of similar buildings in the same location.<sup>35</sup>

A building's greenhouse gas emissions is assessed based on actual energy consumption (reflected in energy bills) over a 12 month period. A greenhouse gas emissions factor is then applied based on the energy mix in the relevant location.

To ensure the building's performance is comparable with other buildings, some adjustments are made to account for some building and use characteristics that have been shown to systematically affect energy performance, specifically:

- the climate where the building operates
- floor space (large buildings tend to be relatively more energy efficient than small buildings)
- hours of operation.

Based on the comparison between the building's actual (adjusted) performance and the NABERS benchmark (based on an initial sample of buildings when the relevant tool was developed) a star rating is awarded, with the star rating interpreted as follows:

- 1 star — poor
- 2 stars — below average

<sup>35</sup> NABERS website, <https://www.nabers.gov.au/ratings/spaces-we-rate/office-buildings>, accessed 8 May 2019.

- 3 stars — average
- 4 stars — good
- 5 stars — excellent
- 6 stars — market leading.<sup>36</sup>

Feedback from stakeholders suggested NABERS ratings and the associated systems are trusted and well respected across the industry. Even if an appropriate commercial tool were available, mandating the use of a privately-owned tool could create some issues, including the following.

- The owner of a privately-owned scheme could potentially make changes to the rating approach/methodology that do not align with the government's regulatory objectives.
- Mandating a privately-owned scheme could potentially allow the owner to charge prices well-above the cost of running the scheme.

We therefore consider it appropriate for the government to retain some control over the information to be disclosed and the prices.

Nevertheless, we make the following observations about the relevance of a NABERS Energy rating in the context the CBD Program objectives and the market and behavioural failures that the CBD Program seeks to address.

The first observation is that the most appropriate metric depends on the CBD Program objectives.

- If the primary objective is to improve energy efficiency (or reduce energy consumption), the metric disclosed under the CBD Program should be based on energy consumption.
- By contrast, if the primary objective is to reduce greenhouse gas emissions, a metric based on greenhouse gas emissions should be disclosed. This also implies that actions to offset greenhouse gas emissions (such as purchasing GreenPower) should be included in such a metric.<sup>37</sup>
- The primary objective could be less prescriptive and focus, for example, on the availability of information. This light touch approach would allow the market to decide how best to comply.<sup>38</sup> This approach would require a meaningful link between the metric (such as the availability of information) and desirable outcomes (reduction in energy use/less greenhouse gas emissions).

In this regard, we note that the NABERS Energy rating uses greenhouse gas emissions to convert electricity and gas consumption to a common metric. Alternatively, energy

<sup>36</sup> NABERS website, <https://www.nabers.gov.au/about/what-nabers/how-it-works-rating-and-certification>, accessed 9 May 2019.

<sup>37</sup> We note that some stakeholders are concerned that the with greenpower measures is limited and does not properly incorporate their purchase of renewable energy as currently structured.

<sup>38</sup> This is consistent with PMC's principles-based regulation. See PMC (2014), *The Australian Government Guide to Regulation*, p 28.



consumption (or energy bills) could be the common metric. In theory, a measure based on energy consumption would better align with:

- the stated objectives of the CBD Program (to improve energy efficiency)
- the NEPP targets (which is expressed in terms of the ratio of gross domestic product (GDP) per unit of primary energy).

That said, the only practical difference between a measure based on greenhouse gas emissions and energy consumption is the weighting between energy sources (i.e. electricity and gas) and there is no compelling reason to change from the status quo.

A second observation is that no single metric is the most relevant measure for all uses (and all users). Table 6.7 summarises the most relevant information for different stakeholders with different priorities.

## 6.7 Information most relevant to different stakeholders

Stakeholder	Primary focus	Relevant information
Tenant	Energy bills	Estimated outgoings (as already disclosed)
Tenant	Greenhouse gas emissions (to meet corporate social responsibility objectives)	Greenhouse gas emissions (Kg CO <sub>2</sub> -e) per m <sup>2</sup> (including GreenPower)
Buyer	Energy efficiency	A measure of energy efficiency benchmarked against similar buildings (i.e. NABERS Energy for offices)
Building owner/manager	Energy efficiency	A measure of energy efficiency benchmarked against similar buildings (i.e. NABERS Energy for offices)
Commonwealth Government	Greenhouse gas emissions (to track progress in the sector)	Greenhouse gas emissions (Kg CO <sub>2</sub> -e) per m <sup>2</sup> (including GreenPower)

Source: CIE.

- For a tenant whose primary focus is on energy bills, the most relevant information is an estimate of future energy bills (as is already disclosed).
  - Direct information on estimated energy bills allows a tenant to weigh up energy bills against rents and other factors and choose the office space that best meets their needs.
  - By contrast, the NABERS Energy rating is designed to benchmark the energy efficiency of the building to other similar buildings. While benchmarking a building's energy efficiency against similar buildings is useful information for other stakeholders, it is less useful for tenants, where their primary focus is on energy bills. In particular, the energy intensity of a building (and therefore the energy bills) can vary significantly within a star band (and can overlap with other star bands), even within a given climate zone. As such, the NABERS Energy rating is unlikely to be a good indicator of energy bills.
- As the NABERS Energy rating is based on greenhouse gas emissions, it may be more relevant to tenants primarily concerned with greenhouse gas emissions (such as to

meet corporate social responsibility objectives). That said, the actual greenhouse gas intensity of office space can also vary significantly within a particular star rating, even within a given climate zone. The NABERS star rating will not necessarily be a good indicator of the actual greenhouse gas emissions associated with a particular office space.

- As tenants will generally be looking for office space within a particular location (i.e. office space in different locations are unlikely to be substitutable), the NABERS Energy rating provides a reasonable comparison of the relative GHG performance within that location. As such, the climate adjustment is unlikely to distort decisions to any great extent. Nor would the hours of operation adjustment.
- On the other hand, office space within different sized buildings is likely to be highly substitutable. As such, any adjustment (or non-linear benchmark) based on building size could potentially distort the decision made by a tenant seeking to minimise their carbon footprint. For example, an office space in a smaller building may have a higher NABERS rating but higher emissions compared to an office space in a larger building with a lower NABERS rating. Therefore any adjustment to the rating based on the size of a building could lead some potential tenants to prefer the office space with higher emissions.
- Furthermore, where a tenant's primary concern is greenhouse gas emissions, a measure including GreenPower may be more relevant, as this is the best indicator of greenhouse gas emissions (that said, this rating would generally be available to tenants even if it is not the primary metric disclosed).
- On the other hand, a NABERS Energy rating (without greenpower) is the most relevant metric for building owners/managers (as well as prospective buyers), as the building's energy performance is benchmarked against similar buildings.
- **In summary, no single measure can meet the specific needs of all stakeholders. However, it would be impractical (due to information overload, for example) to disclose multiple measures.**
- **The NABERS Energy (without GreenPower) rating is the most appropriate measure for mandatory disclosure, because:**
  - it best aligns with the CBD Program objective of improving energy efficiency
  - it is the best measure to overcome a lack of knowledge of poor performance, which is likely to be the main mechanism through which the CBD Program encourages improved performance
  - the measure most relevant to tenants primarily concerned about energy bills is already disclosed.

### *Tenancy Lighting Assessment*

Disclosure of the TLA is intended to overcome the split incentive caused by information asymmetry in relation to lighting (as the efficiency of lighting may not be reflected in rents, see above). However, unlike the NABERS rating, the TLA is not based on actual performance. Rather, it is effectively a description of the lighting technology in place. As such, it is not necessarily a good indicator of tenancy energy bills.

In particular, the relationship between lighting power density (as measured by the TLA) and tenancy energy intensity appears to be relatively weak (see chart 4.22 in chapter 4 above), with a correlation coefficient of 0.25 (note that we have only been able to match a small selection of tenancies from NABERS tenancy assessments and CBD data).

Furthermore, a consistent theme from consultations is that (unlike the NABERS rating), the TLA is rarely looked at by tenants or owners. This suggests there is a case to remove the requirement for a TLA, and this would certainly be removed if tenancy ratings were mandatory.

### *Office tenancy rating*

In practice, there is no viable alternative to the NABERS Office tenancy tool for the reasons outlined above. That said, the NABERS tool benchmarks performance against tenancies with similar characteristics and is therefore the measure most likely to encourage behavioural change because it also aligns with the most likely market/behavioural failure that a mandatory disclosure scheme would be seeking to address. As such, the NABERS office tenancy rating is likely to be of practical use to the tenant themselves and mandatory disclosure would overcome a lack of knowledge of poor performance. Furthermore, NABERS also provides a useful mechanism for Government to track greenhouse gas emissions and formulate policy.

### *CBD Program coverage for office tenancies*

#### *CBD Program coverage*

There are broadly 2 ways that the coverage of the CBD Program could be specified in relation to office tenancies.

- The requirement for mandatory disclosure could be specified based on the characteristics of the **tenancy**. The most logical criteria would be the floor space of the tenancy (i.e. NLA).
- Alternatively, the requirement for mandatory disclosure could be specified based on the characteristics of the **building**. This would provide an opportunity to link the requirement for a tenancy rating to the requirement for a base building rating. Specifically, a NABERS rating would be required for all tenancies within a building where the requirement for a BEEC has been triggered. Linking the requirement for a tenancy rating to a base building rating is likely to have significant benefits by simplifying the administrative arrangements and reducing cost, particularly regulatory costs (i.e. the cost of obtaining a NABERS rating could be minimised by co-assessment for tenants when the base building is rated).

### *Legal responsibility*

An important related issue that has emerged through stakeholder consultations is to consider what party would bear the legal responsibility for obtaining a tenancy rating.

- If the requirement for a tenancy rating is specified in terms of the characteristics of the tenancy, it is logical for the tenant to have legal responsibility for obtaining a rating.
- On the other hand, if the requirement for a tenancy rating is specified in terms of the characteristic of the building, there are likely to be significant cost savings if the building owner/manager has responsibility for arranging the NABERS ratings for all tenants. However, we understand that in some states the building owner/manager cannot legally access the tenants' energy bills. Some building owners also reported that some tenants have refused to provide energy bills to facilitate a NABERS tenancy rating. Consequently, it would be inappropriate to impose a legal obligation on the building owner/manager to ensure that tenancy ratings are completed unless legislative changes are made to require: the building owner to go to all reasonable lengths to conduct the rating; and tenants disclose all relevant information.

To take advantage of the potential cost savings associated with preparing all tenancy ratings in conjunction with the base building rating (such as through the co-assess tool), the building owner/manager (or the assessor acting on their behalf) would need to have direct access to the relevant information. The cost of gathering this information could be minimised by giving the building owner/manager (or the assessor acting on their behalf) direct access to meter information, which we understand would require some legislative changes and/or changes to leases.

### *Thresholds*

While any minimum threshold could apply, it would make sense to align the minimum threshold to the current trigger for a BEEC (i.e. mandatory disclosure would apply to all office spaces greater than 1000 m<sup>2</sup>).

If appropriate regulatory arrangements for the assessor to obtain access to tenant energy consumption data to allow co-assessment, the threshold for tenants could also relate to the size of the building, rather than the size of the tenancy.

### *Exclusions*

A tenancy rating is relevant to specific tenant only; the performance of previous tenants has no relevance to the existing tenant. Tenants that have not occupied the relevant office space for a full year at the time of the base building rating would therefore be exempt from a tenancy rating.

## ***Disclosure arrangements and other issues***

### *Disclosure arrangements for base buildings*

Currently the NABERS star rating must be disclosed on all advertising material and in the building foyer. These disclosure arrangements were presumably designed to overcome information asymmetries, although we argue that information asymmetries were not a significant issue in the office market (as tenant decisions are typically driven by estimated outgoings rather than energy efficiency ratings. See chapter 4 of this report).

Nevertheless, several stakeholders argued that disclosure is an important driver of behavioural change, due to the ‘embarrassment factor’ associated with publicly disclosing a very low (i.e. zero or 1 star) rating. That is, it is not the disclosure to tenants that is important, but the disclosure in general.

Under a periodic trigger, existing sale and lease disclosure requirements should continue to apply.

#### *Disclosure arrangements for office tenancies*

Although the energy performance of a tenant has little relevance for other stakeholders (other than the tenants themselves), several stakeholders argued that public disclosure of the NABERS rating helps to drive behavioural change. In particular, some form of public disclosure ensures that key decision-makers in the organisation see the rating and hold those responsible accountable.

Disclosure options identified through consultation include:

- websites — in addition to the NABERS and CBD Program websites, options include disclosing the tenancy NABERS rating on the businesses or the building’s website
- within the building — such as the building foyer (as suggested by many stakeholders)
- annual reports (for those organisations required to prepare one).

Information disclosed on websites is likely to be accessed by those members of the community with a specific interest in comparing NABERS ratings across tenancies. As such, there is likely to be more value in disclosing all NABERS office tenancy ratings in the same place, as is already the case on the NABERS (and the CBD Program) website. There appears to be little additional value in disclosing NABERS tenancy ratings on other websites.

Disclosing the tenancy ratings in the relevant building could potentially act as a reminder to tenants, particularly to the extent that tenancy performance relies on tenant behaviour. That said, disclosing the rating of all tenants in the foyer of a building is likely to be impractical, particularly in larger buildings with many tenants. An alternative would be to disclose the relevant rating at the entrance to each tenanted space, although this requirement is likely to be difficult to enforce.

***Many publicly-listed companies already prepare ‘sustainability reports’, documenting the business’s environmental performance across a range of measures. We see little value in making the disclosure of tenancy ratings in annual reports mandatory. Reform options***

Although the design of a mandatory disclosure scheme for office tenancies need not align with the design features of the existing scheme that applies to base buildings, in practice there are likely to be significant advantages in doing so.

We consider four options as follows.

- Under Options 1A and 1B, the expansion of the CBD Program to cover office tenancies would not be aligned to the mandatory disclosure requirements for base buildings.
  - Under Option 1A a NABERS office tenancy assessment would be required every year.
  - Under Option 1B, A NABERS office tenancy assessment would be required every second year.
- Under Options 2A and 2B, the expansion of the CBD Program to cover office tenancies would be aligned to the requirements of base buildings to minimise compliance costs (through the use of the co-assess tool).
  - Under Option 2A, NABERS base building and office tenancy assessments would be required every year.
  - Under Option 2B, NABERS base building and office tenancy assessments would be required every second year.

Table 6.8 summarises the options that to be considered in the CBA.

## 6.8 Options for expanding the CBD Program to office tenancies

	Option 1A	Option 1B	Option 2A	Option 2B
Aligned to disclosure requirements for base buildings?	No	No	Yes	Yes
Information disclosed	<ul style="list-style-type: none"> <li>■ NABERS tenancy rating</li> <li>■ TLA no longer required</li> </ul>	<ul style="list-style-type: none"> <li>■ NABERS tenancy rating</li> <li>■ TLA no longer required</li> </ul>	<ul style="list-style-type: none"> <li>■ NABERS tenancy rating</li> <li>■ TLA no longer required</li> </ul>	<ul style="list-style-type: none"> <li>■ NABERS tenancy rating</li> <li>■ TLA no longer required</li> </ul>
Trigger for disclosure	<ul style="list-style-type: none"> <li>■ Sale/lease would remain the trigger for base buildings</li> <li>■ Tenancy rating would be required every year</li> </ul>	<ul style="list-style-type: none"> <li>■ Sale/lease would remain the trigger for base buildings</li> <li>■ Tenancy rating would be required every 2 years.</li> </ul>	Base building and tenancy ratings would be required every year.	Base building and tenancy ratings would be required every second year
Coverage	All tenancies greater than 1000 m <sup>2</sup>	All tenancies greater than 1000 m <sup>2</sup>	All tenancies in buildings that require a base building rating	All tenancies in buildings that require a base building rating
Legal responsibility	Tenant	Tenant	Building owner/manager (landlord)	Building owner/manager (landlord)
Disclosure arrangements	<ul style="list-style-type: none"> <li>■ NABERS website</li> <li>■ Prominent position in lift foyer of relevant floor</li> </ul>	<ul style="list-style-type: none"> <li>■ NABERS website</li> <li>■ Prominent position in lift foyer of relevant floor</li> </ul>	<ul style="list-style-type: none"> <li>■ NABERS website</li> <li>■ Prominent position in lift foyer of relevant floor</li> </ul>	<ul style="list-style-type: none"> <li>■ NABERS website</li> <li>■ Prominent position in lift foyer of relevant floor</li> </ul>

Source: CIE.

## Cost-benefit analysis

The costs and benefits of the proposed reform options are assessed against a baseline of maintaining the current arrangements.

The CBA results suggest that if compliance costs can be kept low, expanding the CBD Program to office tenancies could deliver a net benefit (table 6.9).

- Compliance costs are minimised where the expansion of the CBD Program to office tenancies is aligned with base building requirements and ratings are required every 2 years (Option 2B). This option is estimated to deliver a small private benefit to industry and a significant social benefit if greenhouse gas savings are taken into account.
- The other options considered are estimated to deliver net costs to the community. In particular, the net cost of imposing mandatory disclosure requirements on office tenants, without aligning these requirements to disclosure requirements for base buildings (i.e. Option 1A) are estimated to be significant.

### 6.9 Expansion of the CBD Program to office tenancies – cost-benefit analysis

	Option 1A	Option 1B	Option 2A	Option 2B
	\$ million	\$ million	\$ million	\$ million
<b>Private benefits/costs</b>				
Energy benefits	60.27	60.27	86.10	86.10
Upgrade costs	- 46.25	- 46.25	- 66.07	- 66.07
Compliance costs - NABERS Office Tenancy ratings	- 132.06	- 66.03	- 53.83	- 26.91
Compliance costs - NABERS Base/Whole Building ratings	0.00	0.00	- 43.29	10.82
Compliance cost savings - TLA	3.29	3.29	3.29	3.29
<b>Net private benefits/costs</b>	<b>- 158.04</b>	<b>- 37.90</b>	<b>- 73.79</b>	<b>7.23</b>
<b>Other impacts</b>				
Reduced GHG emissions	36.79	36.79	52.55	52.55
Government costs	- 27.81	- 13.91	- 4.82	1.21
<b>Net benefit/cost</b>	<b>- 149.06</b>	<b>- 15.02</b>	<b>- 26.06</b>	<b>60.99</b>

Note: Costs and benefits are expressed in net present value terms based on the impacts over 10 years, using a discount rate of 7 per cent. As the benefits of energy efficiency measures implemented during this period are likely to endure over time, the benefits have been extended by an additional 10 years.

Source: CIE estimates.

Costs and benefits are expressed in net present value terms based on the impacts of the proposed mandatory disclosure options over 10 years, using a discount rate of 7 per cent. However, as the benefits of energy efficiency measures implemented over this period would be expected to endure over time, the benefits have been extended by an additional 10 years. Details on our approach to estimating costs and benefits are outlined below.



### *Office space covered under each option*

As the proposed thresholds for tenancies generally align with the current CBD Program thresholds, most buildings containing tenancies that would be covered by the proposed tenancy disclosure requirements would be included in the CBD Program database. Based on the CBD Program database, we estimate that:

- Around 1620 office buildings could be affected by the proposed disclosure requirements for tenancies.
- We estimate the total net lettable area of these buildings is around 19.5 million m<sup>2</sup>.

The estimated floor space covered by each option are as follows.

- Under Option 1A and 1B, the size threshold is defined in terms of the floor area of the tenancy. As such, not all of the NLA in these buildings would be covered by mandatory disclosure requirements.
  - We assume that 30 per cent of the floor area within these building would not require a NABERS rating based on market data suggesting that around 30 per cent of tenancies (by area) are less than the 1000 m<sup>2</sup> threshold.
  - This implies that around 13.6 million m<sup>2</sup> of office space would be covered by the proposed mandatory disclosure arrangements.
- Under Option 2A and 2B, the size threshold is defined in terms of the building. Therefore, all of the tenancies within the relevant buildings would be covered by the mandatory disclosure requirements.

### *Compliance costs*

The proposed options could change compliance costs in relation to:

- office tenancies
- base buildings

#### *Compliance costs for tenancies*

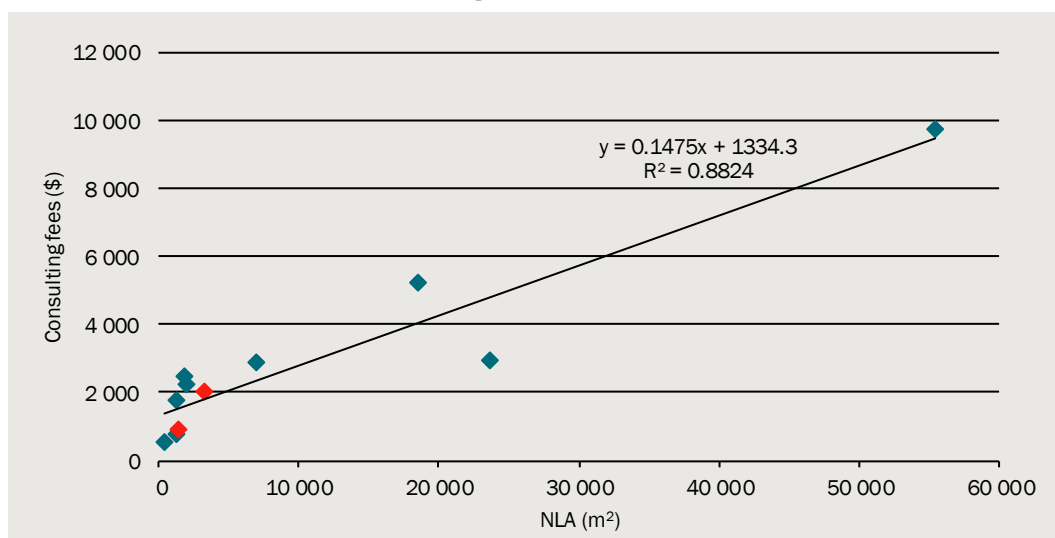
Compliance costs will vary across the 2 options. Compliance costs will include:

- the consulting fees of the NABERS assessor
- NABERS lodgement fees
- the internal administration costs associated with arranging for a NABERS rating and gathering relevant documentation etc.
- any costs associated with the disclosure requirements.

Of the assessors that responded to the CIE's survey, only 13 provided information on the cost of office tenancy assessments, including only 2 that reported using the NABERS Co-assess tool. Based on this (albeit small) sample, there appears to be a relationship between the consulting fees and the NLA of the tenancies covered by the assessment (chart 6.10). There also appears to be a relationship between the consulting fees and the number of functional spaces as the number of functional spaces and NLA are highly correlated.



## 6.10 Relationship between consulting fees and net lettable area



Note: Red dots denote observations using the NABERS Co-assess tool.

Data source: CIE survey of assessors.

This relationship implies a fixed cost of around \$1334 for each rating plus an additional \$147.50 for each additional 1000 m<sup>2</sup> of floor space. Although there are only 2 observations using the co-assess tool, they do not appear to be significant outliers compared to the other observations. That said, presumably use of the co-assess tool would avoid the need to incur the fixed component of the consultation fees multiple times and would therefore reduce costs significantly.

In addition, where tenancies are rated using the co-assess tool, there are likely to be significant savings on NABERS lodgement fees.

- A single tenancy greater than 1000 m<sup>2</sup> incurs a NABERS lodgement fee of \$1108.18.<sup>39</sup>
- A co-assessed building incurs a NABERS lodgement fees of \$2215.45, including the base building and tenancies. As the lodgement fees for a base building rating are \$1108.18, this implies the marginal cost for all of the tenancies covered by the co-assessment would be \$1107.27.

Similarly, there are likely to be significant internal administration cost savings where all tenancies in a building are assessed together. We previously estimated internal administration costs are around \$1000 for each rating. This implies that:

- Under Options 1A and 1B (where each tenant organises their own rating), each tenant would incur a cost of \$1000 for each rating.
- Under Options 2A and 2B (where all tenancies are assessed together), the building owner/manager would incur an internal administration cost of \$1000 for each building (which would presumably be passed onto tenants).

To estimate compliance costs, we also make the following assumptions.

<sup>39</sup> NABERS website, <https://www.nabers.gov.au/pricing>, accessed 8 August 2019.

- Data availability on the number of tenancies or the average floor space per tenancy is limited.
  - The average floor space of tenancies with a voluntary NABERS rating is around 5000 m<sup>2</sup>. However, this is likely to significantly overstate the true average because larger tenancies are more likely to rate voluntarily.
  - To estimate the number of tenancies within each building, we assume an average tenancy of 2500 m<sup>2</sup>.
- As only tenants that have occupied office space for a full year at the time of the base building rating would require a tenancy rating, we assume that 15 per cent of tenants would not require a rating in any given year (based on an assumed turnover rate of 15 per cent).

Based on these assumptions, annual compliance costs for office tenancies are estimated at around:

- \$17.6 million per year under Options 1A (and half this under Option 1B given that a rating is required only once every 2 years)
- \$7.16 million per year under Option 2A (and half this under Option 2B given that a rating is required only once every 2 years).

#### *Compliance costs for base buildings*

In addition to the compliance costs for office tenancies, some options would affect the compliance costs for base buildings. In particular, under Options 2A and 2B, the trigger for a base building rating would change from sale or lease to periodic.

- In 2017-18 there were around 1550 NABERS base building or whole building ratings. This could increase slightly as the effects of reducing the threshold to 1000 m<sup>2</sup> fully flow through. We therefore assume around 1600 NABERS base building and whole building ratings per year under the baseline.
- Based on NABERS data, we estimate that each building in the NABERS systems obtains 0.6 ratings per year on average (i.e. on average, each building obtains a rating in 6 out of 10 years).
  - If this increases to a rating every year under Option 2A, this implies a 67 per cent increase in the number of NABERS rating to around 2667 per year.
  - However, if a rating is required only every 2 years as under Option 2B (i.e. 0.5 per year on average), this implies a decrease in the number of NABERS ratings of around 16.7 per cent to around 1333 per year (although some buildings may choose to rate every year anyway).
- At an average cost of around \$5400 per rating, this implies that base/whole building compliance costs would:
  - increase by around \$8.46 million per year under Option 2A
  - decrease by around 1.69 million per year under Option 2B.

### *TLA cost savings*

As NABERS ratings for office tenancies would replace TLAs, there would also be some compliance cost savings for TLAs.

The CBD database suggests there are typically 900-1000 TLAs every year. However, the number of TLAs has fallen significantly following the recent (from 1 July 2017) change requiring a TLA only every 5 years. We therefore estimate that the number of TLAs would be around 300 per year.

At an estimated cost of around \$1460 for each TLA, this implies a cost saving of around \$438 000 per year under all options.

### *Energy savings*

Unlike office base buildings, there is limited evidence to suggest that the improvement is strongly related to the initial star rating or the number of NABERS ratings.

The CBA is based on the following assumptions.

- Each rated tenancy improves by 23.4 MJ per m<sup>2</sup>, based on the average change achieved by tenants with a voluntary NABERS rating.
- As there is limited reliable information on average changes in tenant energy consumption for those tenants under the baseline scenario (i.e. tenants without a NABERS rating), we assume no change.

Note that we apply the same energy efficiency improvement (for both office tenancies and base buildings) regardless of whether a rating is required annually or biennially (or at current frequencies under sale and lease requirements). It is possible that more frequent ratings could lead to greater improvements in energy efficiency. However, as the number of NABERS ratings and time are closely correlated, it is difficult to determine whether energy efficiency improvements (for base buildings) are driven by more ratings or a time trend.

### *Upgrade costs*

There is limited information available on the changes tenants make to improve energy efficiency and the associated cost.

The shift towards LED lighting is one factor that is likely to have improved the energy efficiency of tenants. As part of this study, the CIE engaged energy efficiency consultant Energy Action to prepare 3 case studies of the energy efficiency opportunities in actual buildings (an office building, a hotel and a shopping centre). Based on the office building case study there were 2 energy efficiency opportunities involving lighting upgrades relevant to tenancies. As with other energy efficiency opportunities, payback periods varied considerably (table 6.11).

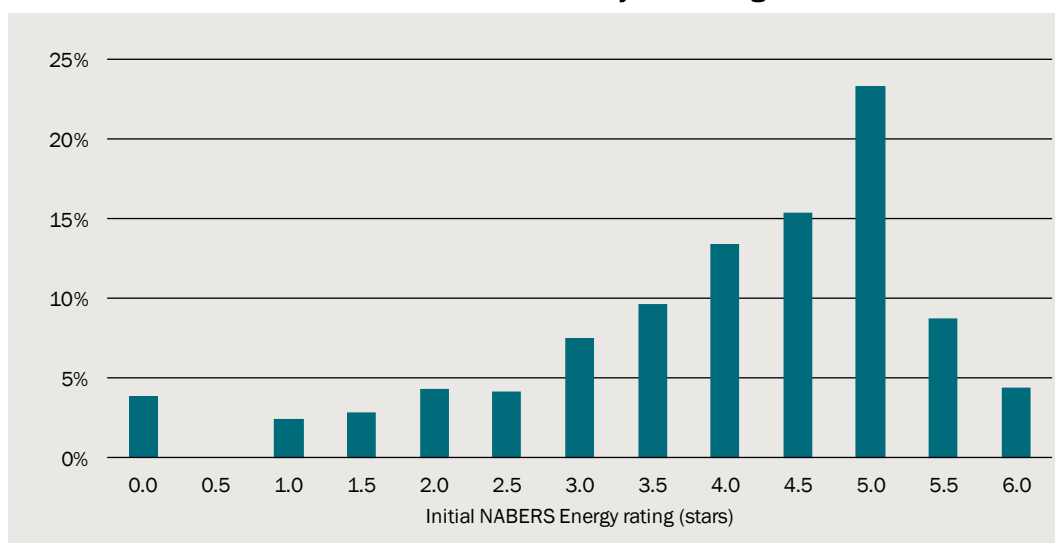
### 6.11 Energy efficiency opportunities – office building case study

	Annual electricity savings	Annual gas savings	Annual financial saving	Annual emissions reduction	Capital cost	Payback
	kWh	MJ	\$	kgCO <sub>2-e</sub>	\$	Years
Lighting controls upgrade and recommissioning	155 000	0	11 000	208 000	22 000	3.0
L1 Office stair lighting upgrade	16 500	0	1 300	22 000	16 000	12.3

Source: Energy Action.

To estimate costs we apply the same cost relationship estimated for office base buildings (see chart 5.8 above). As costs depend on the initial star rating, we assume the same distribution as the initial star ratings for tenancies that have voluntarily obtained a NABERS Tenancy rating (chart 6.12). As there is little incentive for tenants with a poor star rating to disclose this information (by formally lodging the rating with NABERS), this is likely to overstate the star ratings of tenants more generally. This implies that upgrade costs may be overstated (i.e. office tenancies with lower star ratings are likely to be able to take advantage of low/no cost improvements).

### 6.12 Distribution of initial NABERS Office tenancy star ratings



Data source: NABERS database.

### Government costs

The expansion of the CBD Program to office tenancies would also have an impact on the administration costs incurred by the government. Note that if cost recovery were to apply (see chapter 11 for further discussion on cost recovery) these costs would be passed onto industry participants. The estimates presented below are indicative only based on the estimated number of BEECs lodged.

Some of the costs incurred by the government are likely to be unrelated to the number of BEECs lodged (i.e. fixed), while others may vary with the number of BEECs lodged. The main variable costs are likely to be staff costs relating to:

- operations (around \$592 784 per year)
- compliance (around \$370 228 per year).

Under the baseline scenario, we estimate there would be around 1200 BEECs lodged per year (based on historical data).

Under Option 1A and 1B, the number of BEECs relating to base buildings (and whole buildings) would be unchanged. However, we estimate there would be:

- an additional 4612 BEECs relating to office tenancies under Option 1A, implying a 384 per cent increase in the total number of BEECs per year.
- an additional 2306 BEECs per year under Option 1B, implying a 192 per cent increase in the total number of BEECs lodged per year.

Under Options 2A and 2B, there would be a change in the number of BEECs relating to base (and whole) buildings due to the change in the trigger. However, as the office tenancy ratings would be covered under the same BEEC as the base/whole building, there would be no additional BEECs for tenancies. As with NABERS ratings (see above), we estimate:

- the number of BEECs would increase by around 67 per cent (reflecting an increase in the average number of BEECs per year from 0.6 to 1) under Option 2A.
- the number of BEECs would decrease by around 16.7 per cent (reflecting a decrease average number of BEECs per year from 0.6 to 0.5) under Option 2B.

Assuming that operations and compliance costs change in proportion to the change in the number of BEECs, this implies government costs would:

- increase by around \$3.7 million per year under Option 1A
- Increase by around \$1.85 million per year under Option 1B
- increase by around \$642 008 per year under Option 2A
- decrease by around \$160 502 per year under Option 2B.

### *Feedback on draft recommendations*

We welcome stakeholder feedback on our draft recommendations. For office buildings, we would be particularly interested in stakeholder feedback on:

- how office tenants use the information currently provided under the CBD Program (the NABERS base building rating and the TLA) and whether this information is considered useful
- the proposed design of the mandatory disclosure scheme for office tenancies
- the assumption used in the CBA (set out in the report)
- any cost information for office tenancies that have improved their energy efficiency.

## 7 *Shopping centres*

### *Key findings and draft recommendations*

Shopping centres have dramatically improved their energy efficiency, over the time period for which this can be measured, with those using NABERS reducing energy by about 15 per cent from 2013 to 2018. These changes have occurred for shopping centres that undertake annual NABERS energy ratings, for those that occasionally use NABERS energy ratings and based on the information available, for those that do not use NABERS energy ratings.

A large share of shopping centres (almost half of the centres above 15 000 m<sup>2</sup>) use NABERS energy ratings voluntarily. NABERS energy has proven to be a useful tool for these businesses to monitor, compare and communicate the changes in their energy performance. Others monitor their energy consumption and environmental performance using other tools, such as trends over time within each centre and energy use and emissions per square metre.

Our draft view is that NABERS energy ratings continue to be promoted as a voluntary tool for shopping centres.

- Mandatory disclosure could be beneficial if shopping centre owners or operators were unaware of their comparative energy performance. The evidence does not support this for the majority of shopping centres. Whether or not they are using and disclosing NABERS energy ratings, shopping centres are monitoring their performance, and based on the information available those not rated with NABERS have achieved similar improvements in their energy efficiency.
- Mandatory disclosure could be beneficial if there was demand from tenants in shopping centres. Tenant groups have indicated that they receive information on costs, including energy costs, Energy efficiency disclosure of the shopping centre is not information that they would use.
- Mandatory disclosure could be beneficial if there was demand from customers going to shopping centres. Consultations have not supported the view that customers would make use of comparative energy efficiency information.

If there are specific concerns about smaller shopping centre owners not being aware of their energy performance, then these owners could be targeted through programs for energy audits and NABERS energy ratings, building on NABERS recent expansion of the tool into smaller shopping centres.

We have undertaken a cost benefit analysis of expanding mandatory disclosure of NABERS energy ratings to shopping centres above 15 000m<sup>2</sup> of gross lettable area retail. This would impose costs of \$2.4 million per year in getting a NABERS energy rating, as

well as additional administrative costs for shopping centres to put relevant clauses into leases, disclose ratings at the doors of shopping centres and place ratings into advertising.

The benefits will occur for the share of shopping centres that change their behaviour in response to obtaining a NABERS rating. For an expansion to have a net benefit would require a reduction in energy use for shopping centres made to obtain a NABERS energy rating of 3-5 per cent. For the reasons discussed above, we do not consider that this level of impact would be achieved.

## Market overview

### Market structure

Shopping centre owners and operators are typically large professional businesses. Many shopping centre owners and operators are also involved in office buildings.

- IBISWorld notes that the top four players accounted for an estimated 44.5% of Shopping Centre Operators industry revenue in 2016-17 and the major players largely dominate the industry due to the prominence of assets that they manage.<sup>40</sup> The largest operators are Scentre and Vicinity.
- IBISWorld estimates that there are 1800 shopping centres in Australia in 2016/17<sup>41</sup>
- Data available on individual centres indicates there are about 588 shopping centres with more than 10 000 m<sup>2</sup> of Gross Lettable Area Retail (GLAR) and 427 with more than 15 000 m<sup>2</sup> of GLAR. In total, centres with more than 10 000 m<sup>2</sup> of GLAR have ~18 million square metres of GLAR
  - an alternative source suggests less space in total for the shopping centre market, with 17 million square metres of GLAR for centres over 5 000 m<sup>2</sup> and 875 shopping centres in total with GLAR of more than 5000 m<sup>2</sup>
- The size of selected property portfolios is shown in table 7.1. Seven major portfolios account for 10 million square metres of GLAR. Note that this includes centres smaller than 10 000 m<sup>2</sup>. This indicates that even covering only seven major players accounts for over 50 per cent of the shopping centre space. That is, this is a fairly concentrated sector.

### 7.1 Major shopping centre portfolios

Business	Number of shopping centres		GLAR
	No.		m <sup>2</sup>
Scentre	36		3 291 900
Vicinity	80		2 704 615
SCA	77		537 264
GPT	13		940 763

<sup>40</sup> IBISWorld Industry Report OD5255, Shopping Centre Operators in Australia, August 2016.

<sup>41</sup> IBISWorld Industry Report OD5255, Shopping Centre Operators in Australia, August 2016.



Business	Number of shopping centres	GLAR
	No.	m <sup>2</sup>
Mirvac	17	419 262
Stockland	37	1 044 958
AMP	33	1 600 000
<b>Total selected portfolios</b>	<b>293</b>	<b>10 538 762</b>
Centres over 10 000 m <sup>2</sup> – source 1	588	18 137 968
Centres over 5000 m <sup>2</sup> – source 2	875	17 187 167

Source: SCA Annual Report 2018, [https://www.scaproperty.com.au/Resources/pdf/LCM448\\_AR\\_2018\\_Complete%20vFs.pdf](https://www.scaproperty.com.au/Resources/pdf/LCM448_AR_2018_Complete%20vFs.pdf); Mirvac Annual Report 2018, [https://groupir.mirvac.com/icms\\_docs/291482\\_MGR\\_FY18\\_Annual\\_Report.pdf](https://groupir.mirvac.com/icms_docs/291482_MGR_FY18_Annual_Report.pdf); AMP Capital website, <https://www.ampcapital.com/au/en/assets/shopping-centres>; GPT Sustainability data pack 2019, [https://www.gpt.com.au/sites/default/files/document/GPT\\_Environment%20Data%20Pack\\_2019.xlsx](https://www.gpt.com.au/sites/default/files/document/GPT_Environment%20Data%20Pack_2019.xlsx); Vicinity FY2018 Sustainability performance pack, <http://sustainability.vicinity.com.au/media/9601492/vcx-fy18-sustainability-performance-pack-2018.xlsx>; Scentre Group Sustainability Report 2018, [https://www.scentre.com.au/getmedia/e29122fe-784f-42f4-88cc-d3657f5f8a32/Scentre-Group-2018-Sustainability-Report\\_V2.pdf?ext=.pdf](https://www.scentre.com.au/getmedia/e29122fe-784f-42f4-88cc-d3657f5f8a32/Scentre-Group-2018-Sustainability-Report_V2.pdf?ext=.pdf); Stockland Property portfolio, [https://www.stockland.com.au/~/\\_media/corporate/pdf/investor-centre/property-portfolio/stockland-property-portfolio-1h19.xls.ashx](https://www.stockland.com.au/~/_media/corporate/pdf/investor-centre/property-portfolio/stockland-property-portfolio-1h19.xls.ashx).

### *Energy use and energy costs*

Shopping centre energy is similar to office and can be broken into ‘base building’ and ‘tenant’. Base building covers energy use such as lighting in common areas, car parks, heating and cooling, elevators and escalators. Tenant energy use covers lighting and equipment within the tenanted area. Major tenants may also provide their own heating and cooling, rather than using services provided by the shopping centre.

The lease arrangements for shopping centres, similar to offices, can be gross lease or net lease. Larger tenants more typically pay a gross rent and the energy costs of the building are the responsibility of the building owner. Smaller tenants typically pay a net rent and then pay outgoings, of which energy costs are one component.

Utilities costs (of which energy is a part) of a shopping centre is estimated by IBISworld at 2.5 per cent of the shopping centres costs (not including the tenants costs).<sup>42</sup> Using data on energy intensity from NABERS energy ratings, the share for energy is smaller. For example, a typical shopping centre uses 300-400 MJ of energy per m<sup>2</sup> of GLAR. At a cost of 5-10 cents per MJ, this equates to \$1.5-\$4 per square metre. In comparison, property portfolio income per square metre for a business such as Scentre is ~\$600 per square metre.<sup>43</sup> Sales of goods per square metre for some retail space can be above \$10 000.<sup>44</sup>

### *Current disclosure of energy performance by shopping centres*

Shopping centres undertake a range of existing disclosures of energy performance, both mandatory and voluntary.

<sup>42</sup> Kelly, A. (2016), IBISWorld Industry Report OD5255, Shopping Centre Operators in Australia.

<sup>43</sup> CIE calculations based on Scentre Annual Report 2018.

<sup>44</sup> Scentre Annual Report 2018, p. 6.



Shopping centre owners have legislative requirements to provide tenants with estimates of outgoings, which includes energy costs.<sup>45</sup> For example, in NSW, the *Retail Lease Act 1994* specifies that an outgoing statement should include the following information on electricity costs and gas costs (Schedule 2, Part 5, clause 14.11), as well as other outgoing such as waste management, air conditioning maintenance, administration and security.

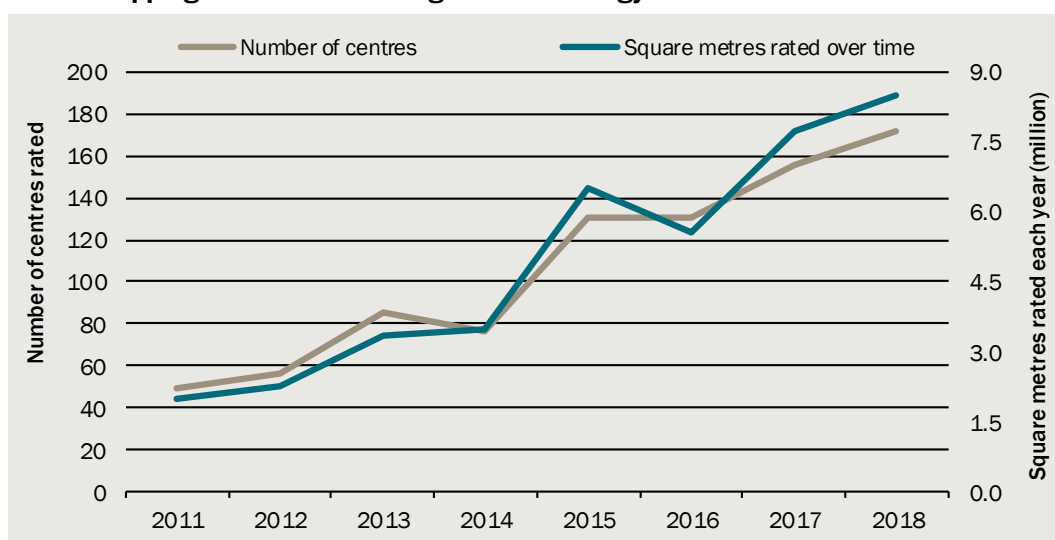
Shopping centres also often disclose their environmental performance, in public sustainability reports.

- Metrics presented include GHG emissions and GHG emissions per square metre of GLAR, as well as energy intensity (MJ or MWH per GLAR)
- Where companies use NABERS or other tools such as GreenStar, these ratings are often (but not always) reported in sustainability reports
- Sustainability reports either present data in aggregate for the retail portfolio, or at an individual asset level (i.e. for each shopping centre).

Disclosure of energy performance also includes a large number of shopping centres that use NABERS energy ratings. In 2018, over 7.5 million square metres was rated using the NABERS energy tool covering 172 centres (chart 7.2). In total, more than 230 centres have been rated at some time. NABERS estimates that 46 per cent of the shopping centres over 15 000 m<sup>2</sup> are rated.<sup>46</sup>

The penetration of NABERS energy ratings into shopping centres on a voluntary basis indicates that many shopping centres find that it provides them with useful information to either improve or promote their energy performance.

## 7.2 Shopping centres rated using NABERS energy



<sup>45</sup> *Retail Shop Leases Act 1994* (Queensland); *Retail Leases Act 1994* (NSW) ; *Leases (Commercial and Retail) Act 2001* (Australian Capital Territory); *Retail Leases Act 2003* (Victoria); *Fair Trading (Code of Practice for Retail Tenancies) Regulations 1998* (Tasmania); *Retail and Commercial Leases Act 1995* (South Australia); *Commercial Tenancy (Retail Shops) Agreements Act 1985* (Western Australia) ; and *Business Tenancies (Fair Dealings) Act* (Northern Territory).

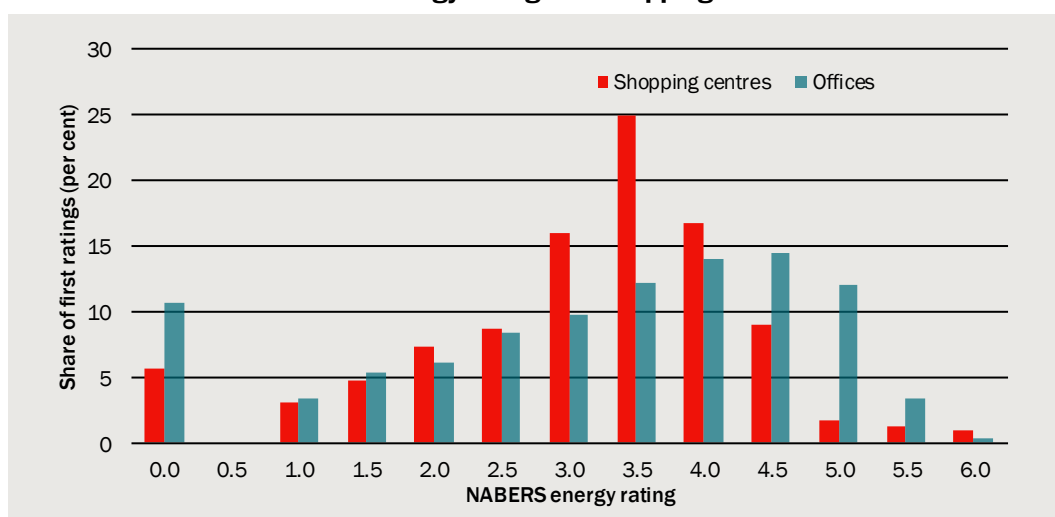
<sup>46</sup> NABERS 2018, Annual Report 2017/18, p. 12.

Note: Square metres rated is gross lettable area retail (GLAR).  
Data source: NABERS; CIE analysis.

### *Energy performance of shopping centres that use NABERS energy ratings*

The majority of shopping centres entering NABERS have ratings of 3-4 stars (chart 7.3). The distribution is also more concentrated in the middle than for offices, with a smaller share of shopping centres with very low levels of energy efficiency and very high levels of energy efficiency, relative to offices. Note that this presents the distribution based on the first rating for each shopping centre following the change in the NABERS energy tool in 2013, and the first rating for offices following mandatory disclosure. Some shopping centres and offices were engaged in NABERS energy prior to this.

### **7.3 Distribution of NABERS energy ratings for shopping centres**

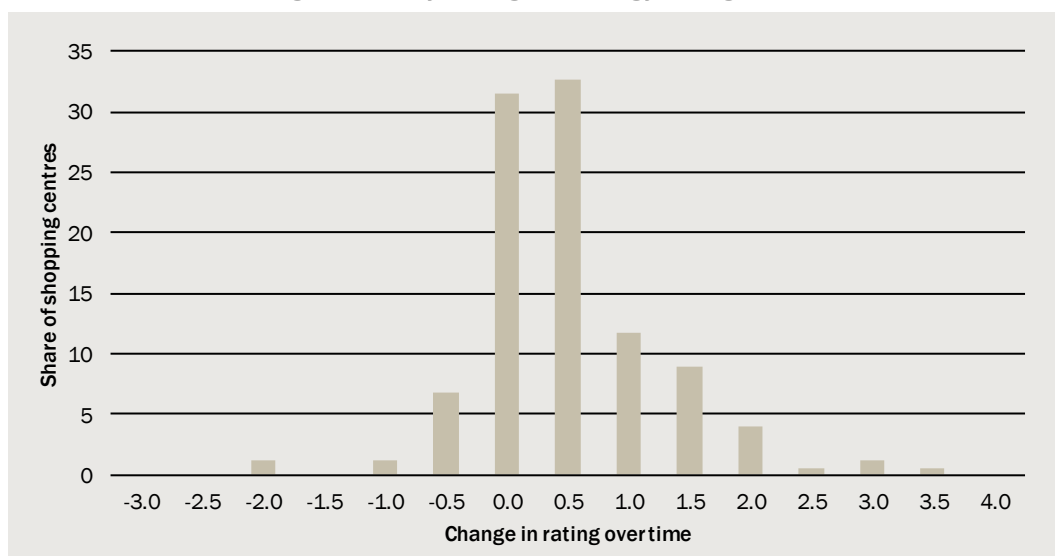


Data source: CIE analysis of NABERS energy ratings from 2013 onwards.

The shopping centres that have used NABERS energy and have rated multiple times have improved their energy efficiency over time. We have tracked performance of each individual shopping centre, to get as close to a like-for-like comparison, as possible. Note that there are still changes arising from shopping centre redevelopment, as shopping centres are not static buildings like offices tend to be, but often add space as demand grows.

On an individual shopping centre basis, most shopping centres that have been rated multiple times have either stayed at the same energy rating or have improved by 0.5 stars (chart 7.4). Almost 30 per cent have increased their NABERS energy rating by 1 star or more.

## 7.4 Share of shopping centres by change in energy rating

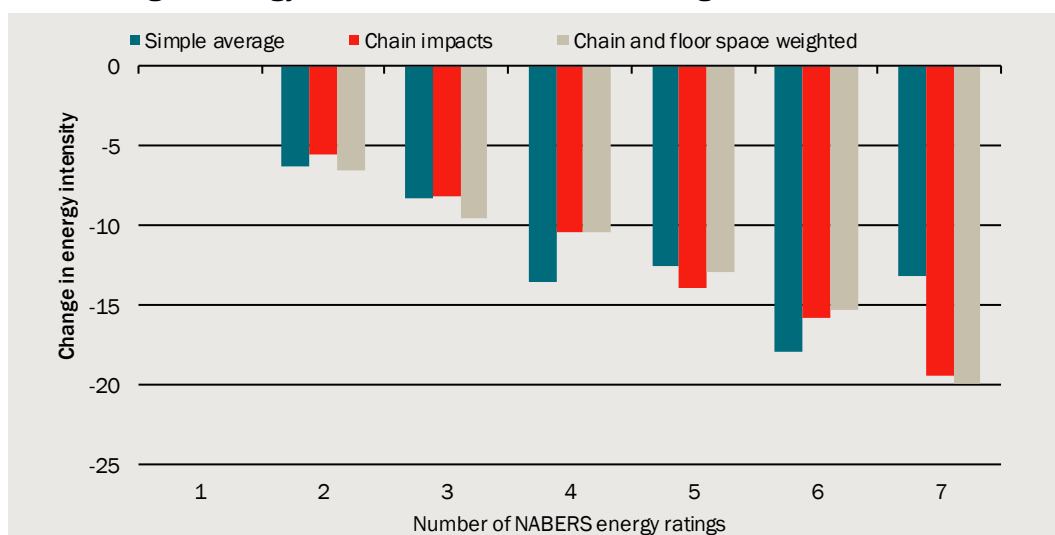


Note: This excludes ratings under the previous NABERS tool (pre 2012). The energy rating is without greenpower.

Data source: NABERS; CIE analysis.

In terms of translating these changes into reductions in energy, we have used an approach to measure the change in energy use for centres after 1 rating, two ratings etc. This avoids issues with looking at average ratings over time, which are impacted by changes in the composition of the buildings that are rated. A shopping centre that has undertaken 7 NABERS ratings, which is the maximum in the sample, has achieved a reduction in energy use of ~20 per cent.

## 7.5 Change in energy use for different number of ratings



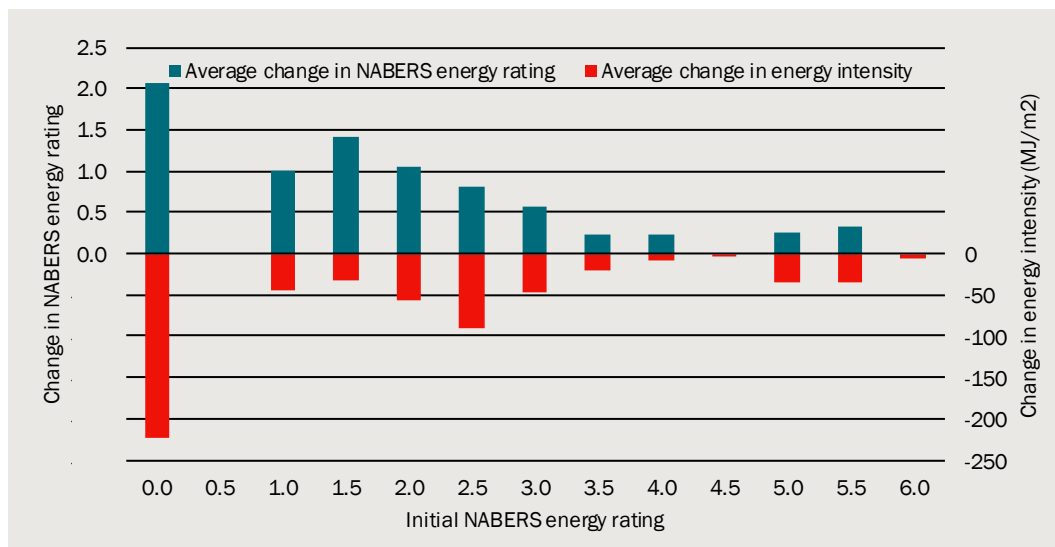
Data source: The CIE, based on NABERS shopping centre data.

Similar to offices, the shopping centres that had the lowest initial ratings have had the largest changes in ratings and largest reductions in their energy use (chart 7.2). The pattern is most distinctive for shopping centres with a zero star initial rating, and less strong than offices across higher ratings. For the shopping centres that had a zero initial

star rating, some changes appear to be changes in what energy was captured in the NABERS energy rating, rather than real improvements in energy performance.

Note that on a percentage basis, the largest impacts have been achieved by shopping centres that started with a 5.5 star rating — they have reduced their energy use by 45 per cent on average.

## 7.6 Change in NABERS energy rating and energy intensity by starting rating



Note: This only compares shopping centres that have been rated multiple times.

Data source: The CIE based on NABERS dataset.

## Evidence of market and behavioural failures

### Bounded rationality of shopping centre owners and operators

Within shopping centres, there is little evidence of behavioural issues that lead to poor energy decisions, such as salience and bounded rationality.

- Shopping centres tend to be larger professionally managed buildings that understand the cost trade-offs for different decisions impacting on energy use. Many shopping centres voluntarily use NABERS to assist in these decisions and to communicate their performance, while other shopping centres use other information.
- Consultations with shopping centre owners that do not use NABERS indicated that they understood their energy use relative to others and they measured their energy performance. One shopping centre owner indicated that they had tracked their reduction in energy use over time and this was similar to what they could see from NABERS rated shopping centres.

We have sought to more systematically examine the performance of shopping centres that have rated using NABERS energy and shopping centres that have not used NABERS energy ratings. In chart 7.7 we show energy intensity trends for different

shopping centre companies, against shopping centres that were in the NABERS in 2013. We start each company at 100 for the first year for which we have data.

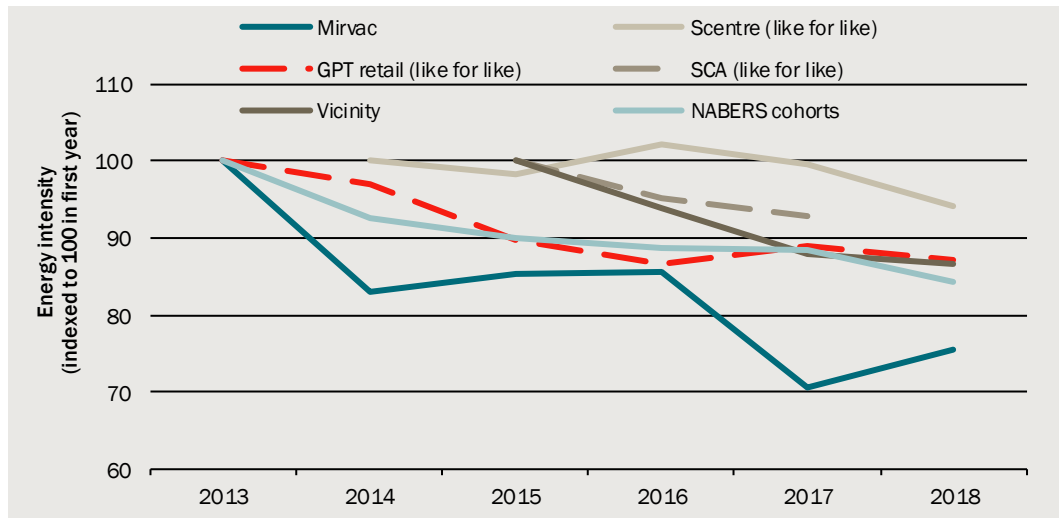
- Shopping centres that have used NABERS have improved their energy intensity substantially, by about 15 per cent from 2013 to 2018, which is a **3.3 per cent annual reduction**.
- The companies for which we have data, which comprise various users of NABERS energy ratings, have also all improved their energy performance
  - Scentre, which is focused on large shopping centres, has reduced its energy per square metre by 1.5 per cent per year. All of its shopping centres have been rated using NABERS energy at some time, although they are not consistently rated and Scentre does not report NABERS energy ratings in its sustainability reporting any more
  - Mirvac has reduced its energy per square metre by 5.5 per cent per year, the most of any company.<sup>47</sup> Mirvac does not use NABERS energy ratings
  - Vicinity, which has a portfolio comprising mostly of smaller and medium-sized shopping centres, as well as the high-profile Chadstone Shopping Centre and Emporium Melbourne. It has reduced its energy per square metre by 4.3 per cent per year. It rates all its shopping centres using GreenStar and rates most shopping centres that are able to be rated with NABERS using NABERS. For 2017 and 2018 we have data on each shopping centre. Comparing on a like-for-like basis, the energy use per square metre of floor space for those rated with NABERS energy fell by 3.6 per cent in one year, compared to a 3.3 per cent fall for those not rated with NABERS energy
  - GPT retail, which uses NABERS energy ratings for all its retail assets, reduced its energy use by 2.7 per cent per year on a like-for-like basis
  - Shopping Centres Australasia (SCA), which concentrates on smaller shopping centres that have not until recently been able to be rated with NABERS energy, has reduced its energy use by 3.7 per cent per year on a like-for-like basis

The companies reporting sustainability data are likely to be more focused on energy performance than some others. However, these companies do not all use NABERS energy and would be required to if mandated. The evidence of historical changes in energy intensity is not sufficient to conclude that there is an impact from adopting NABERS energy ratings.

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<sup>47</sup> Note that Mirvac reports contain different estimates for the 2013 starting point. We use the reductions as stated by Mirvac in its sustainability reporting.

## 7.7 Energy intensity changes for companies using and not using NABERS energy

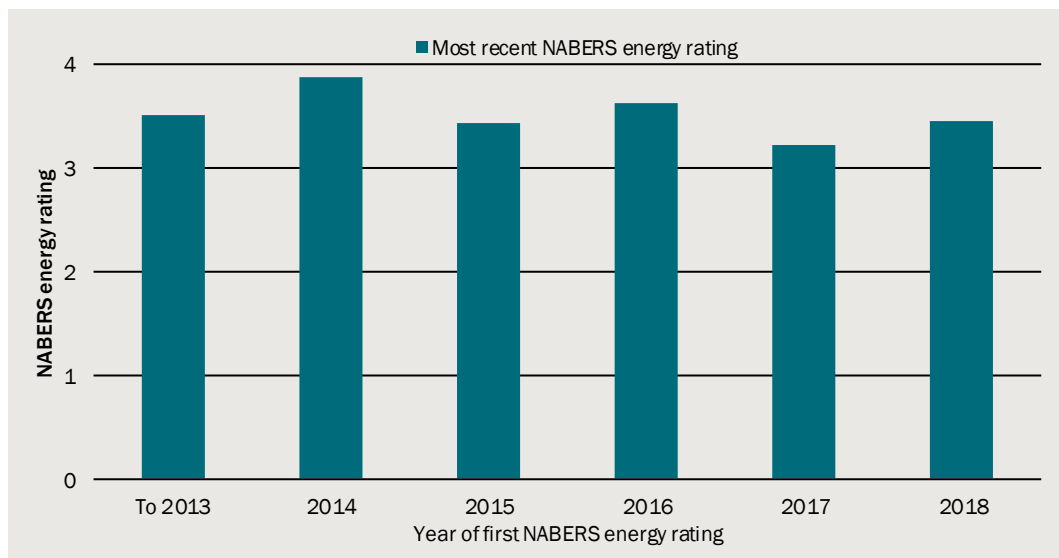


Note: To make comparisons as like for like as possible, where we have data for individual shopping centres, we have removed centres whose GLAR has changed by more than 5 per cent.

Data source: Sustainability reports and data packs for each company.

We can also look at the most recent NABERS energy rating to observe how new or newer entrants to NABERS perform relative to those shopping centres that have already been using NABERS. If NABERS was making a substantial difference to shopping centre energy performance, then the newer entrants would have poorer ratings than those already using NABERS to improve their energy performance. The average of the most recent ratings for shopping centres that started using NABERS energy ratings at different time periods is shown in chart 7.8. There is not a clear pattern of higher ratings for shopping centres that have been part of NABERS for longer. Hence this does not support a conclusion that shopping centres using NABERS have improved their performance while others have not.

## 7.8 Most recent rating achieved for each shopping centre that has been rated



Note: NABERS without greenpower.

Data source: NABERS; CIE analysis.

Consultations have suggested that bounded rationality issues may be more likely for smaller shopping centre owners or operators than those that we have obtained data for.

- The data does not support that owners of *small shopping centres* will be impacted particularly by a NABERS energy rating, as Vicinity and SCA both have a large number of smaller centres that are improving their energy performance.
- We cannot evaluate whether *small owners* of shopping centres — i.e. companies that may own only one or two smaller shopping centres — would be impacted. However, given the highly capital intensive nature of shopping centres and reports noted above on ownership and operator concentration, any such centres would be a fairly small share of the market.

### ***Unmet demand for energy efficiency information from tenants***

There is also no evidence that tenants are seeking comparative energy efficiency information, but cannot obtain this.

- We have received submissions from the two major groups representing retail tenants, the National Retailers Association and the Australian Retailers Association. Both submissions noted that tenants main requirement is for information on costs, including costs of energy that they pay in their outgoings. Their views are that existing disclosure requirements from state governments require comparable information on costs, including energy costs, to be disclosed to tenants. Disclosure of energy efficiency information would therefore be less useful to tenants than existing disclosure arrangements that are focused on cost.
- We have been provided with evidence from the Shopping Centre Council of Australia that compares NABERS energy ratings and costs for tenants. This does not show conclusive evidence that a higher NABERS energy rating will mean a lower cost for tenants. There are many reasons for this, including climate zones, contracts for energy and other factors NABERS accounts for in its benchmarking.
  - This is not surprising, as NABERS has intentionally been designed to measure the performance of a particular building. As such it seeks to use factors that could influence cost, but would provide a misleading view as to how well a building performs relative to how well it could perform.
  - Stakeholders have indicated widespread acceptance of the view that energy efficiency and cost are different, and one is not a good indicator of the other.
- Other parties not actually in the shopping centre industry have suggested that energy efficiency is the information that retail tenants require. However, given the views of the tenant associations, we place no weight on these views.

Based on these consultations, we consider that there is not sufficient demand from tenants to support making disclosure of relative energy efficiency mandatory, given that there are existing disclosure arrangements better suited to tenants requirements.

### ***Corporate social responsibility***

Corporate social responsibility is of relevance for shopping centre owners/investors, and some tenants, although only one of many things of relevance to investors. Many shopping centre owners present sustainability reports, often with substantial detail (regardless of whether they use NABERS energy ratings or not).

The ability to translate corporate social responsibility outcomes into higher market demand is less clear in shopping centres than in offices:

- the main focus of tenants is the location — it will generally be difficult for a tenant to consider multiple shopping centres in a similar location, unlike for offices where there will be multiple office options in a similar location. Tenants have not indicated a desire for any additional disclosure to what they currently obtain
- customers are also unlikely to be heavily influenced by energy efficiency performance in choosing which shopping centre to shop at. This differs to offices where there is both government and corporate demand for higher rated buildings.

For shopping centres, we cannot see that CSR demand that would drive better outcomes is buildings were required to provide mandatory disclosure of energy efficiency. For example, in offices, government requirements for higher star rated buildings has been important in driving change in the sector. The same driver is not present for shopping centres.

### ***Other market failures***

There is a split incentive issue where outgoings are paid by tenants, while energy efficiency improvements are paid for by the owner. Within the contract period, the financial incentive for shopping centres to improve energy efficiency is muted by having to pass savings on to tenants for part of the tenant base. The increasing focus on solar PV from shopping centre owners is interesting, because it does not suffer from this incentive issue. Note that mandatory disclosure of energy performance does not address a split incentive problem directly, and tenants already have information on energy costs, as discussed below.

As an indicator for a tenant of energy cost, the NABERS energy rating is less useful than direct information provided on estimated outgoings, which includes energy cost.

### ***Would mandatory disclosure drive behavioural change?***

Mandatory disclosure would generally only be effective if it overcomes a market or behavioural failure. Our draft view is that NABERS energy ratings continue to be promoted as a voluntary tool for shopping centres. If there are specific concerns about bounded rationality of smaller shopping centre owners, then these owners could be targeted through programs for energy audits and NABERS ratings, building on NABERS recent expansion of the tool into smaller shopping centres.

Our reasons for this view are that:



- there is no behavioural failure that mandatory disclosure of energy performance would solve for shopping centre owners or operators
- mandatory disclosure of energy performance would not provide information to tenants that is more useful than the information they currently obtain on energy costs from shopping centre owners
- there is not sufficient influence that energy performance information could have in influencing tenant or customer decisions to make this information important to the shopping centre market.

We cannot rule out that mandatory disclosure may act as a shame factor for some shopping centre owners, thereby driving some change.

### *Views of stakeholders*

A large number of consultations with groups not directly related to shopping centres (although with commercial building policy experience) have supported mandatory disclosure of energy performance for shopping centres. The reasons stated for this include:

- the retail sector is one of the largest users of energy — this is true for the retail sector as a whole, which includes tenant use and many retail activities not within shopping centres. A mandatory scheme for energy disclosure would apply to 6PJ/ year, of which slightly more than half is already rating under NABERS energy. This compares to 11PJ for the office buildings. Applying a mandatory disclosure scheme to an addition ~3PJ per year would be a substantial expansion, but not equivalent to capturing all retail energy
- shopping centres already have a high voluntary uptake rate, so it would be relatively easy to move to a mandatory disclosure scheme — a high voluntary uptake is not a basis for making the use of NABERS energy mandatory. The behaviour of those not using the NABERS energy tool, such as whether they are using other tools or analysis to understand and improve their energy use, is critical. Diversity of options for building owners to evaluate their performance should be encouraged
- shopping centres that use NABERS energy ratings have reduced their energy use — this is true. It is also true that those not using NABERS energy ratings have also reduced their energy use
- tenants are not getting information on the energy performance of the buildings that they lease — tenant groups have not supported that they desire additional information
- the skill set from the commercial building sector can be easily transferred to shopping centres — this is true and will happen as shopping centres consider their energy efficiency using NABERS energy ratings or their own methods.

### *Costs and benefits of mandatory disclosure for shopping centres*

To provide illustrative costs and benefits from expanding the CBD Program to shopping centres, we have developed a reference scheme. This scheme involves:

- mandatory NABERS energy ratings for all shopping centres above 15 000 m<sup>2</sup> on an annual basis — whether the trigger is sale or lease or periodic, we expect that shopping centres would rate annually given the large number of leases
- disclosure of ratings in any new lease documents or in sale documents, as well as on the NABERS website
- disclosure of ratings at each entrance of a shopping centre through an A4 certificate
- disclosure of ratings in advertisements for retail leases or sale of retail space, regardless of the size of the space being leased.

There are some costs that we have not quantified, such as the legal costs of changing lease documentation, checking compliance for new leases and advertising requirements.

The compliance costs of NABERS energy for shopping centres would amount to ~\$2.4 million per year, or \$17 million in present value terms over 10 years. This is a minimum estimate, as it does not account for the full range of compliance costs as discussed above.

## 7.9 Compliance costs of a mandatory rating scheme

	Shopping centres already using NABERS energy	Shopping centres not previously using NABERS energy	Total
	\$/centre per year	\$/centre per year	\$/centre per year
No. of centres	172	255	427
Cost of obtaining ratings (\$/year)	0	6 335	3 783
Cost of including in leases (\$/year)	Not known	Not known	Not known
Cost of including in advertising (\$/year)	Not known	Not known	Not known
Cost of disclosing at entrances (\$/year)	~0	~0	~0
Cost of own time managing disclosure requirements (\$/year)	~0	3 168	1 892
Total cost (\$/year)	0	9 503	5 675
Total cost across all centres (\$m/year)	0	66 742	39 857
Total cost across all centres (\$m present value over 10 years)	0.0	2.4	2.4
Total compliance cost across all centres (\$m present value over 10 years)	0.0	17.0	17.0

Source: The CIE.

We do not expect mandatory disclosure to have an impact on the energy performance of shopping centres. However, we have tested what level of energy saving would be required for shopping centres to outweigh the costs.

- We find that an energy savings of about 3-5 per cent for those not currently engaged in obtaining NABERS energy ratings would be required to justify a mandatory scheme. This is estimated by quantifying:
  - the value of energy savings, which comprises private values that are part of the price of energy and GHG emissions reductions
  - costs of upgrades. The estimate for the cost of upgrades is based on shopping centres having fewer opportunities for high pay-off activities as compared to offices, so the costs would equate to 75 per cent of the private benefits
  - compliance costs to government, which are assumed to be at the same cost per participant as offices.

These estimates are presented in table 7.10. Note that these have not been developed in the same level of detail as for offices, given our discussion around the rationale for a mandatory disclosure scheme for shopping centres. In particular, the cost of energy efficiency upgrades has not been considered in as much detail and compliance costs for disclosure, as opposed to obtaining a NABERS energy rating have not been estimated.

### 7.10 Costs and benefits of mandatory disclosure for shopping centres

	Reduction in energy use of 3 per cent	Reduction in energy use of 5 per cent
	\$m, pv	\$m, pv
<b>Private benefits/costs</b>		
Energy savings	17.9	29.9
Upgrade costs	-13.4	-22.4
Compliance costs	-17.0	-17.0
Net private benefits/costs	-12.5	-9.6
<b>Other benefits/costs</b>		
GHG emissions	7.9	13.1
Government costs	-0.7	-0.7
<b>Total net benefit/cost</b>	<b>-5.4</b>	<b>2.9</b>

Note: Based on a 10 year period and 7 per cent discount rate. This assumes the energy saving occurs over the entire period.

Source: The CIE.

### *Feedback on our draft recommendations*

We are seeking feedback on all our draft recommendations. For shopping centres, key feedback that could assist with developing our final recommendations could include:

- submissions from businesses or people who think they would use information from mandatory disclosure of energy efficiency performance of shopping centres to change their behaviour. This could include shopping centre owners or operators, tenants or customers
- any evidence of different energy performance over time for shopping centres that have adopted NABERS voluntarily versus those that have not.

## 8 *Hotels (accommodation)*

### *Key findings and draft recommendations*

Hotel (accommodation) energy performance data is less widely available than for other sectors. While many hotels have adopted sustainability tools, to communicate their sustainability actions to customers, these do not often provide energy efficiency information on an individual hotel or even aggregate company basis. Uptake of NABERS energy in hotels has been very low and falling — it appears that hotels adopted NABERS energy ratings because of an expectation that this would become mandatory, but have not found enough value from the tool to continue rating in the absence of mandatory disclosure. There is also a widespread view that NABERS energy does not provide a good benchmark for hotels from the industry. Note that the number of official NABERS energy ratings for hotels understates the use of NABERS energy, with a reasonable number of indicative NABERS energy ratings undertaken as part of energy benchmarking, which are not provided to NABERS or disclosed.

The evidence that is available for hotels indicates that they are generally improving their energy performance. This evidence base includes hotels rated using NABERS energy and public reporting by hotels in relation to sustainability. However, the sample sizes for this are small and may not represent what is happening to hotels in general. Consultations with hotel engineers, including members of the Australian Institute of Hotel Engineers, suggests that they do face pressure to reduce energy and to reduce energy costs, such as through targeted reductions year-on-year.

Evidence from energy efficiency advisers, which is based on similar or larger samples to the data available, indicates that hotels are less advanced in considering how to reduce their energy use than other commercial building sectors. The focus on energy is increasing as energy prices increase. Energy costs are already a substantial component of hotel revenue,<sup>48</sup> with IBISWorld estimating utility costs, of which energy (electricity and gas) will be the major component, are 6.3 per cent of revenue. Based on NABERS energy data on electricity and gas use, we estimate that the approximate cost of energy per room for a zero star NABERS energy rated hotel is \$6000, compared to a 3 star energy rated hotel of less than \$2000.<sup>49</sup>

Our draft findings for hotels are that:

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<sup>48</sup> Where revenue includes all costs (such as rent, purchases and wages), as well as profit and depreciation.

<sup>49</sup> This uses a weighted average price across Australian states and territories for 2018 of 9.79 cents per kwh of electricity and 2.34 cents per MJ for gas.

- NABERS energy does not currently have sufficient support from the industry to be mandated now and should be revised. Industry has indicated a willingness to provide data for this to occur
- There is no other energy efficiency tool that could be disclosed instead of NABERS energy
  - there are multiple tools used by hotels. Using a single tool consistently provides a better basis for comparison, and hence we do not support a disclosure requirement that allowed for multiple possible tools
  - NABERS energy is not the most widely used tool. However, a non-government tool could not be mandated without considerable regulation of prices and requirements
  - this leaves NABERS energy as the only possible tool
- A mandatory disclosure program for hotels would drive energy efficiency improvements mainly because it would be used in procurement by government and larger corporates
  - the government and larger corporate market would be sufficiently important that hotels would invest in energy efficiency upgrades
- Hotels consider government mandates for staying only at higher NABERS energy rated hotels to be a risk, in that they will be required to invest in expensive upgrades to improve their energy performance
  - this will vary considerably across hotels, with hotel consultations indicating particular risk for older hotels to be able to achieve cost effective energy efficiency improvements
  - current payback periods indicated by hotel groups for energy efficiency upgrades are low (4-5 years), which suggests that many hotels will find energy efficiency upgrades that can pay for themselves over a 10 year period
- Mandatory disclosure of energy performance for hotels would have a net benefit of \$26 million. However, this particularly reflects benefits from reduced GHG emissions. Hotels achieve only a small return themselves through lower energy bills, which just offsets the compliance costs of a mandatory disclosure scheme and costs of energy efficiency upgrades.

Our recommendation is that hotels should move to a mandatory disclosure of energy efficiency, subject to the steps below being satisfactorily accomplished.

- The NABERS energy tool for hotels should be revised. This should involve industry representation (as is standard NABERS practice) and would be expected to take around one year. This should be followed by NABERS engagement with the hotel industry to build trust in the outcomes of the tool
  - NABERS could also consider whether it could use a different system than stars for hotels given confusion with accommodation star ratings, such as Gold, Silver, Bronze
- Following this, a period of two years should be allowed for undisclosed ratings to be done by hotels prior to mandatory disclosure being put in place

- Hotel ratings should apply firstly to hotels with more than 100 rooms. This would cover approximately 600 hotels with 86 000 rooms. Subject to the review below, this could then be reduced to 50 room hotels.
  - this does not apply to motels and resorts, which are not rated by NABERS. It is not clear if the ABS defined 'Private hotels' would be covered – this is hotels without a public bar. Our expectation is that these are not appropriately benchmarked in NABERS as they were not part of the sample for initial benchmarking
  - the expansion would cover ~6PJ of energy, which is about half of the energy covered by the existing CBD Program
- Hotel ratings should be required every two years. Disclosure should be in the hotel foyer and on the website
- The Australian Government should consider funding support for obtaining the first NABERS energy ratings. The costs of obtaining the first rating would amount to ~\$4 million
- Four years after mandatory disclosure is put in place, its impact on hotel energy efficiency should be reviewed.

There are two areas where we do not currently have confirmed views.

- 8 We have considered whether hotels should be able to use greenpower to improve their rating, if they cannot find cost effective energy efficiency improvements. This could reduce the cost to hotels and the risks to older hotels. We so not have a confirmed view on this and seek stakeholder views on whether the focus should be on with greenpower measures, as would align to customer demand for a smaller environmental footprint of hotels, or without greenpower measures, which is consistent with the existing CBD Program.
- 9 There is the potential to allow for a reduced frequency of rating for buildings with high performance. For these buildings, energy gains are smaller from mandatory disclosure. One option would be for hotels achieving a rating higher than 4 stars only having to rate every three years, for example.

## **Market overview**

The accommodation sector in Australia consists of resorts, hotels, serviced apartments, motels as well as through the share economy such as through Airbnb. There are over 280 000 accommodation rooms in Australia across hotels, motels and serviced accommodation with 10 or more rooms (table 8.1).<sup>50</sup> This is provided across more than 4 445 establishments.<sup>51</sup>

<sup>50</sup> Australian Trade and Investment Commission (website), *Hotel Industry Trends*, available at: <http://www.tourisminvestment.com.au/en/research-insights/hotel-performance.html>, accessed 5 August 2019.

<sup>51</sup> ABS (2016), *Tourist Accommodation, Australia 2015-16*, Cat. 8635.0, Data Cube: Tourist Accommodation – Australia; accessed 31 July 2019. At the time of access, this was the most up to date data available.

## 8.1 Hotels, motels and serviced apartments, room count, by accommodation class

	1 and 2 stars	3 stars	4 stars	5 stars	Total	Total
	>=15 rooms	>=15 rooms	>=15 rooms	>=15 rooms	>=15 rooms	>=10 rooms
2012-13	-	-	-	-	-	262 347
2013-14	11 728	82 305	110 664	24 949	229 646	264 012
2014-15	12 317	85 748	122 844	27 664	248 573	267 606
2015-16	12 240	85 429	123 898	27 564	249 131	271 313
2016-17	-	-	-	-	-	275 700
2017-18	-	-	-	-	-	281 789

Note: The most recent reported figures from the ABS are reported in June 2016. For hotels with 10 or more rooms, this is reported by Tourism Australia and Austrade Partnership.

Source: ABS (2016), *Tourist Accommodation, Australia 2015-16*, Cat. 8635.0, Data Cube: Tourist Accommodation – Australia; accessed 31 July 2019; Australian Trade and Investment Commission (website), *Hotel Industry Trends*, available at: <http://www.tourisminvestment.com.au/en/research-insights/hotel-performance.html>, accessed 5 August 2019.

The majority of rooms are provided by hotels, although motels, private hotels and guest houses account for the greatest volume of establishments. There is no industry data on the number of establishments by rooms therefore, only indicative figures (of the number of rooms per establishment) can be provided.

## 8.2 Distribution of rooms by establishment

	Establishments >=15 rooms	No. rooms	Average rooms per establishment
Hotels and Resorts	967	98 315	102
Motels, private hotels and guest houses	2 404	85 636	36
Serviced apartments	1 074	65 180	61
<b>Total</b>	<b>4 445</b>	<b>249 131</b>	<b>198</b>

Source: ABS (2016), *Tourist Accommodation, Australia 2015-16*, Cat. 8635.0, Data Cube: Tourist Accommodation – Australia; accessed 31 July 2019

Note that NABERS energy applies, on our understanding, only to hotels. It does not apply to resorts, motels, serviced apartments, private hotels and guest houses.

A NABERS rating is an environmental benchmark comparison between similar hotels. NABERS Energy and Water for hotels can rate standard, all suite, boutique, conference, gaming/casino, ski and spa hotels from budget through to luxury.

While it may be possible to use the NABERS hotels tool for other hotel types such as resorts, pubs, motels, backpackers (dormitory style rooms) or hotels where more than 50% of rooms are serviced apartments, the resultant rating may not adequately describe the performance of these hotels.<sup>52</sup>

Hotels are predominantly owned by private companies. Hotel owners may choose to operate the hotel themselves, let out a management contract (typically 3-5 year term), or lease the hotel to a hotel operator (typically 10-15 year lease term). Sale turnover of hotels

<sup>52</sup> NABERS 2015, *NABERS energy and water for hotels: rules for collecting and using data*, Version 3.2, August.



is very low at around 1 per cent.<sup>53</sup> Superannuation funds, fund managers and property trusts, especially from overseas, have increasingly purchased hotels and resorts over the past five years.<sup>54</sup>

The industry is relatively competitive (in terms of operators and owners). Some of the major operators in Australia are:

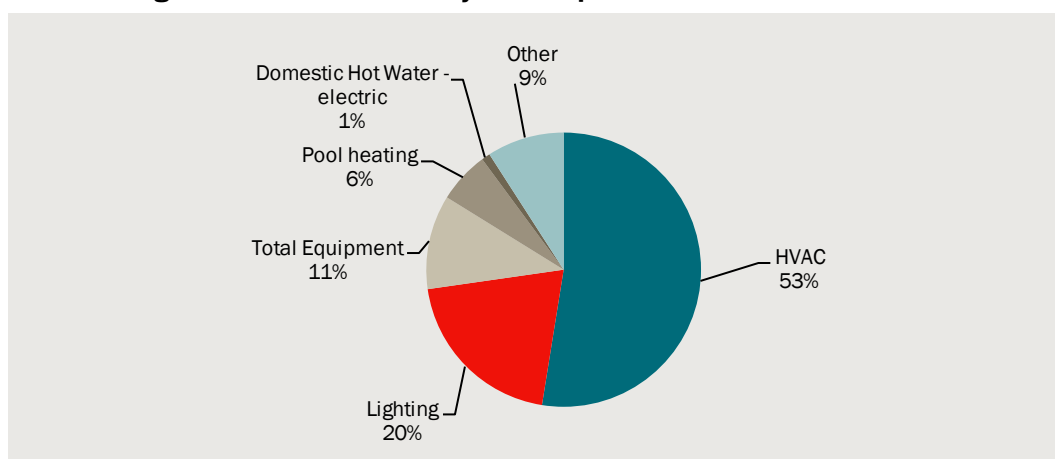
- Mantra Group Limited
- IHG Hotel Management (Australia) Pty Limited
- Marriott International Inc. (including brands Ritz-Carlton, Renaissance, JW Marriott, Westin and Sheraton)
- Event Hospitality & Entertainment Limited
- Accor (including brands Novotel, Sofitel, ibis and Pullman)
- Hilton International Australia Pty Limited (including brands Hilton and DoubleTree)

IBISWorld notes that the level of concentration of the industry is low (there are no real dominate players in the industry).

### *Drivers of energy use in hotels*

The main sources for energy in hotels are electricity and natural gas. The greatest requirement for energy comes from heating, ventilation and cooling (HVAC), and space heating (charts 8.3 and 8.4). Utility costs account for 6.3 per cent of industry revenue for hotels and resorts, which is considerably higher than the average utilities costs of all other sectors (2016-17) of 2.7 per cent.<sup>55</sup>

### **8.3 Average allocation of electricity consumption in hotels**



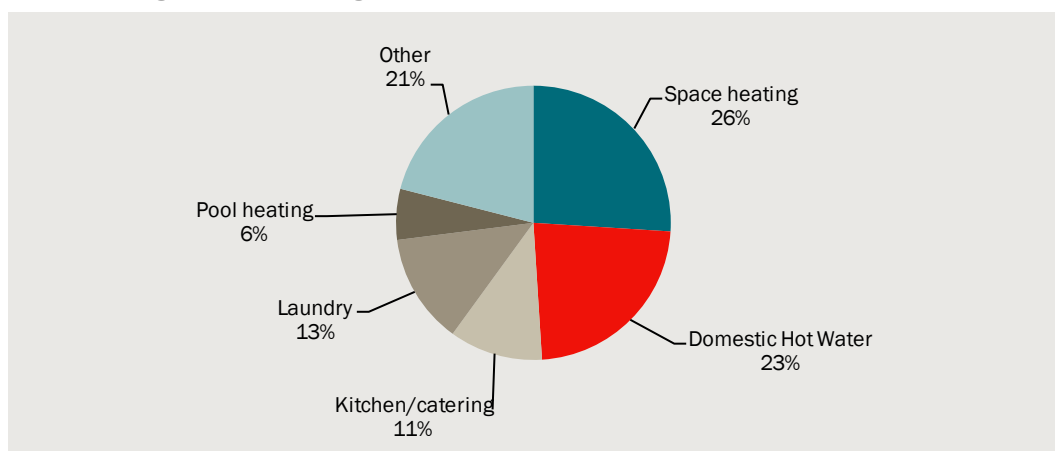
Data source: Pitt & Sherry, cited in COAG National Strategy on Energy Efficiency (2012), *Baseline Energy Consumption and Greenhouse Gas Emissions In Commercial Buildings in Australia*, p 57.

<sup>53</sup> Energy Action, EnergyConsult (2018), *CBD Expansion: Feasibility Study*, Prepared for Department of the Environment and Energy, p 2.

<sup>54</sup> Cloutman, N. (2017), IBIS World Industry Report, *Hotels and Resorts in Australia*, H4401, p 25.

<sup>55</sup> Cloutman, N. (2017), IBIS World Industry Report, *Hotels and Resorts in Australia*, H4401, p 19.

## 8.4 Average allocation of gas consumption in hotels



Data source: Pitt & Sherry, cited in COAG National Strategy on Energy Efficiency (2012), *Baseline Energy Consumption and Greenhouse Gas Emissions In Commercial Buildings in Australia*, p 57.

Using NABERS energy data on electricity and gas use, we have constructed approximate costs of energy per room. A zero NABERS energy star rated hotel would have a cost of over \$6000 per room, compared to less than \$2000 for a 3 star NABERS energy rated hotel (table 8.5).

## 8.5 Cost of energy for hotels

NABERS energy rating	Energy cost per room
	\$/room
0.0	6 293
0.5	5 125
1.0	4 174
1.5	3 399
2.0	2 768
2.5	2 254
3.0	1 836
3.5	1 495
4.0	1 217
4.5	991
5.0	807

Source: The CIE, based on NABERS energy dataset for hotels and electricity and gas prices.

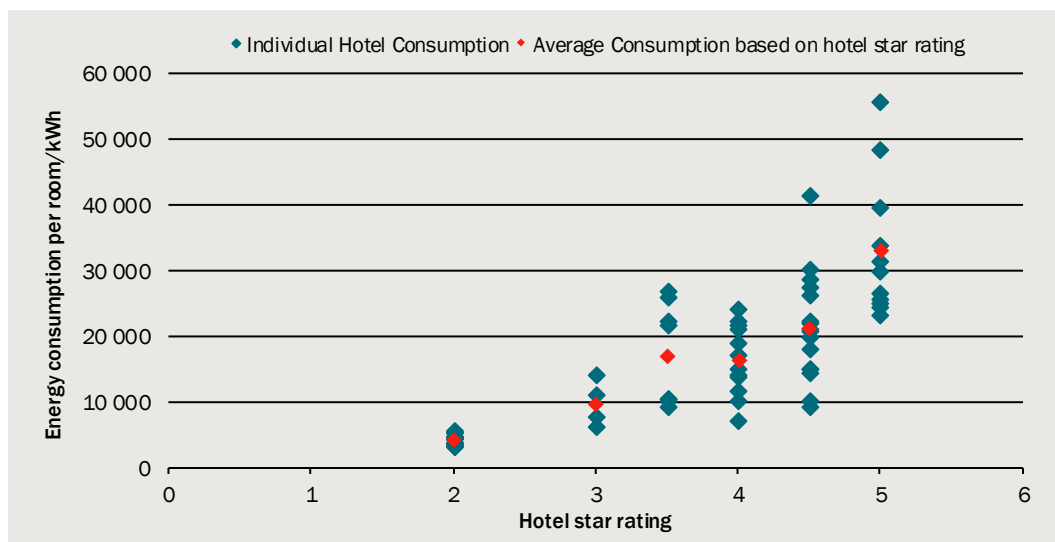
## *Energy use in hotels*

Whilst there is not an industry wide database on hotel energy use, a baseline dataset was collected in 2007 to inform NABERS implementation. From this, we can make a number of observations (n=71):

- Hotels with higher accommodation star ratings are typically associated with higher energy consumption per room

- For 4.5 accommodation star and 5.0 accommodation star hotels, there is a large variation between the lowest and highest energy consumption per room

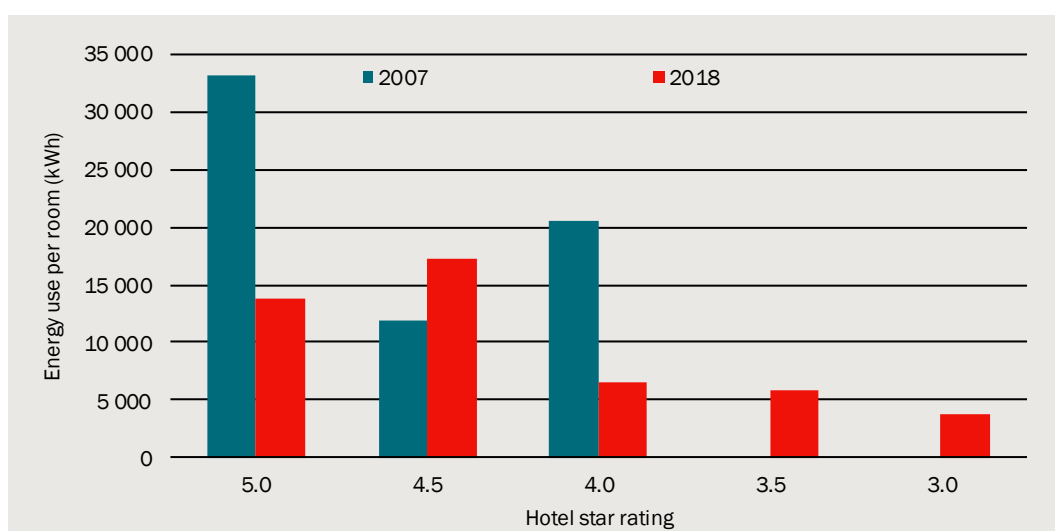
## 8.6 Energy consumption per room based on hotel star rating, 2007



Data source: NABERS 2007 dataset.

We have also obtained data on energy use from the City of Sydney, which covers an anonymised set of hotels in the City of Sydney Council. Using this, energy consumption by room id declining relative to the 2007 dataset (chart 8.7). Given that this data relates to Sydney CBD only, it is unknown if this trend is consistent across Australia. Also note that we cannot match exact hotels using these datasets.

## 8.7 Comparison of energy consumption per room (kWh) of Sydney CBD hotels in 2007 and 2018



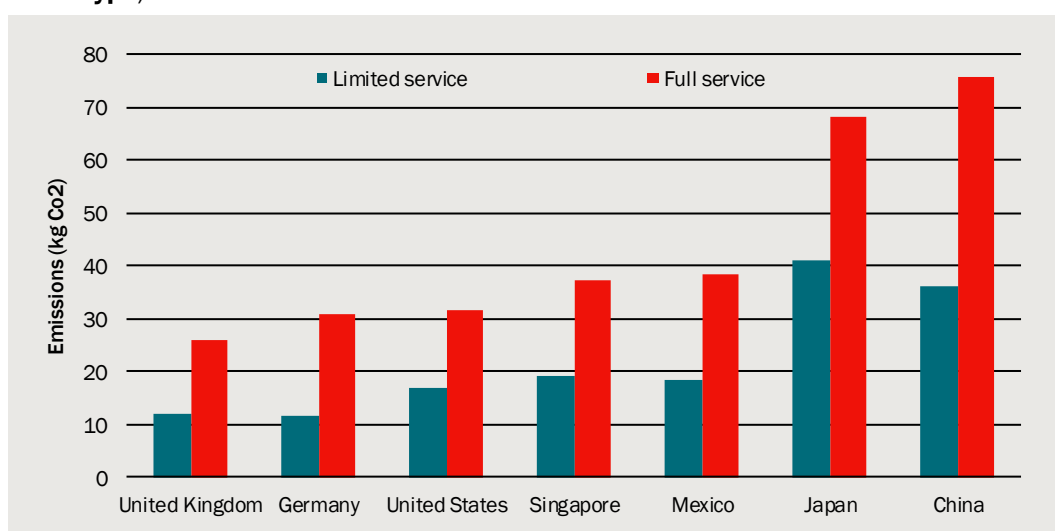
Note: The sample size of hotels in 2007 is 11 and in 2018, is 28 (including 24 hotels with a hotel star rating of 4.0 or higher). There was no data available in the NABERS dataset in 2007 for hotels in Sydney CBD with a 3 or a 3.5 star rating to compare to 2018.

Source: NABERS baseline dataset (2007), DEE dataset (2018) (not publicly available).

### *CO2 emissions per occupied room*

The link between energy and CO2 emission per room depends on the efficiency of the energy source, the efficiency devices, as well as the level of service provided by the hotel (e.g. a heated swimming pool from gas versus no pool at all). Full-service hotels (i.e. those with the highest levels of services) in Germany and the United States have similar levels of emissions per occupied room, while the United Kingdom is the most efficient. In terms of limited-service hotels, Germany and the United Kingdom are the most efficient. Chart 8.8 provides an indication of how energy translates to global emissions, per occupied room, across the globe.

#### **8.8 Median kilograms Co2 emissions per occupied room, by location and service type, 2016**



Data source: Cornell Hotel Sustainability Benchmark index cited in Urban Land Institute (2019), *Sustainability in Hotels*, p 9.

### *The effectiveness of ratings tools to reduce energy consumption*

There are many globally recognised ratings systems to measure the sustainability of a hotel. Ratings can be based on construction and design as well as performance, or may focus on just one of these variables. This regulatory approach is one method to reduce emissions with some hotels announcing that they have received a rating under a particular system.

Many larger hotel brands have established targets within their sustainability reports to reduce their energy consumption and/or set emission reduction targets. It appears that hotels do not just rely on regulatory controls to take this action and that it is an internal business decision.

In terms of the ratings systems, for customers going to the hotel's website, it is generally clear that they have a rating, although information is not always readily available on what the rating means. Although, for customer bookings made through third party websites, environmental or sustainability ratings are generally not displayed, meaning that consumer decisions are made without consideration to these rating systems.

There are hundreds of ratings systems globally. This section focuses on some key systems, including some systems currently used in Australia.

### *Eco Certified Tourism*

Ecotourism Australia (EA) is a not for profit organisation focused on inspiring environmentally sustainable and culturally responsible tourism. Certification is for tours, accommodation and attractions. The program offers three levels of certification:<sup>56</sup>

- Nature Tourism - Tourism in natural areas that leaves minimal impact on the environment.
- Ecotourism - tourism in a natural area that focuses on optimal resources use, leaves minimal impact on the environment and offers interesting ways to learn about the environment with operators that use resources wisely, contribute to conserving the environment and help local communities.
- Advanced Ecotourism - Australia's leading and most innovative ecotourism products that operate with minimal impact on the environment and provide opportunities to learn about the environment with operators who are committed to achieving best practice, using resources wisely, contributing to conserving the environment and helping local communities.

There are 125 accommodation locations in Australia with some level of certification under this program.<sup>57</sup>

They also offer Climate Action Certification where many initiatives offered under this program provide cost savings to the business through efficiency gains.<sup>58</sup>

### *Green Star*

Green Star was launched in 2003 by the Green Building Council of Australia. A Green Star Certification is based on sustainable design and construction, as well as performance across a range of categories such as transport, land use, water, energy and materials. The rating system has been used for office space, shopping centres, universities, apartment blocks and, more recently, hotels. The rating system is from zero to six stars, but buildings need to qualify for at least four stars before they are eligible for the

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<sup>56</sup> Ecotourism (website), *Certification Programs*, available at: <https://www.ecotourism.org.au/our-certification-programs/>, accessed 5 August 2019.

<sup>57</sup> Ecotourism (website), available at: <https://www.ecotourism.org.au/eco-experiences/green-travel-guide/?sStates=NSW-VIC-QLD-TAS-SA-WA-NT-ACT&sCertificationDetailPages=&sExperienceTypes=15&sSearchKey=#mapContents>, accessed 5 August 2019.

<sup>58</sup> Ecotourism (website), *Climate Action Certification*, available at: <https://www.ecotourism.org.au/our-certification-programs/eco-certification-3/>, accessed 5 August 2019.

certification.<sup>59</sup> Each building is given a scorecard based on their performance. Buildings incorporate information gathered under NABERS as part of their scorecard.

A review<sup>60</sup> of Green Star after 10 years of operation found, on average (i.e., across all building types):

- Green Star certified buildings produce 62% fewer greenhouse gas emissions than average Australian buildings.
- Green Star certified buildings produce 45% fewer greenhouse gas emissions than if they had been built to meet minimum industry requirements.
- Green Star certified buildings use 66% less electricity than average Australian buildings.
- Green Star certified buildings use 50% less electricity than if they had been built to meet minimum industry requirements.

### ***Earth Check***

EarthCheck is a global environmental certification and scientific benchmarking program for the travel and tourism sectors. EarthCheck's scientific systems were developed by the Cooperative Research Centre for Sustainable Tourism in Australia over a 10 year period. EarthCheck Certified is built on the Agenda 21 principles for Sustainable Development endorsed by 182 Heads of State at the United Nations Rio De Janeiro Earth Summit in 1992.<sup>61</sup>

The ratings system for EarthCheck Certification are:<sup>62</sup>

- Bronze - Benchmarked not certified
- Silver – Certified
- Gold - Five to nine years of continuous certification
- Platinum - More than 10 years of continuous certification

EarthCheck is a performance-based scheme. The process begins with benchmarking a company's business sustainability performance quantitatively against a sector baseline to highlight areas for improvement.

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<sup>59</sup> The Green List (website), *A cheat sheet to green ratings tools*, available at: <https://thegreenlist.com.au/listing/a-cheat-sheet-to-green-rating-tools/>, accessed 2 August 2019.

<sup>60</sup> Green Building Council of Australia (2013), *The Value of Green Star - A decade of environmental benefits*, available at: [https://www.gbca.org.au/uploads/194/34754/The\\_Value\\_of\\_Green\\_Star\\_A\\_Decade\\_of\\_Environmental\\_Benefits.pdf](https://www.gbca.org.au/uploads/194/34754/The_Value_of_Green_Star_A_Decade_of_Environmental_Benefits.pdf), p 3.

<sup>61</sup> EarthCheck (website), *EarthCheck Certified*, available at: <https://earthcheck.org/products-services/certification/benchmarking-and-certification/>, accessed 2 August 2019.

<sup>62</sup> International Tourism Partnership (2016), *Know How Guide: Sustainable Hotel Certification Schemes*, available at: <http://www.greenhotelier.org/wp-content/uploads/2016/09/Know-How-Guide-to-sustainable-hotel-certifications1.pdf>.

Certification is given to a company that demonstrates 100% compliance with the EarthCheck Company Standard which has been verified by third party auditors.<sup>63</sup> The EarthCheck Company Standard addresses the Sustainable Development Goals (SDGs)<sup>64</sup> with qualitative criteria and also assesses the quantitative progress towards achieving the SDGs with its benchmarking indicators (which speak directly to the certified standard's criteria).

The certification process involves assessing applicants across a range of key performance areas (KPAs) related to environment and sustainable practices such as greenhouse gases; energy efficiency, conservation and management; management of freshwater resources; and air quality protection. The company must retain data on these KPAs.

Hotels develop or demonstrate the existence of a sustainability approach that address the KPAs based on the risk assessment of their setting – location, local impacts and size.<sup>65</sup>

### ***NABERS energy***

The NABERS hotel energy tool applies to accommodation hotels. NABERS compares like with like in recognition that there are fundamental differences between hotels (star rating, number of guest rooms, onsite laundry services, size of heating pools and function rooms). The average number of guest rooms for hotels that have been rated is 265, with the minimum being 10 rooms and the maximum 630 rooms.

Following the release of the NABERS Hotel Energy tool, there was initially reasonable uptake with the number of current ratings reaching 32 a couple of years after it was released (chart 8.9). However, the number of ratings subsequently declined, with only 3 current ratings as at June 2018 (all in NSW).<sup>66</sup>

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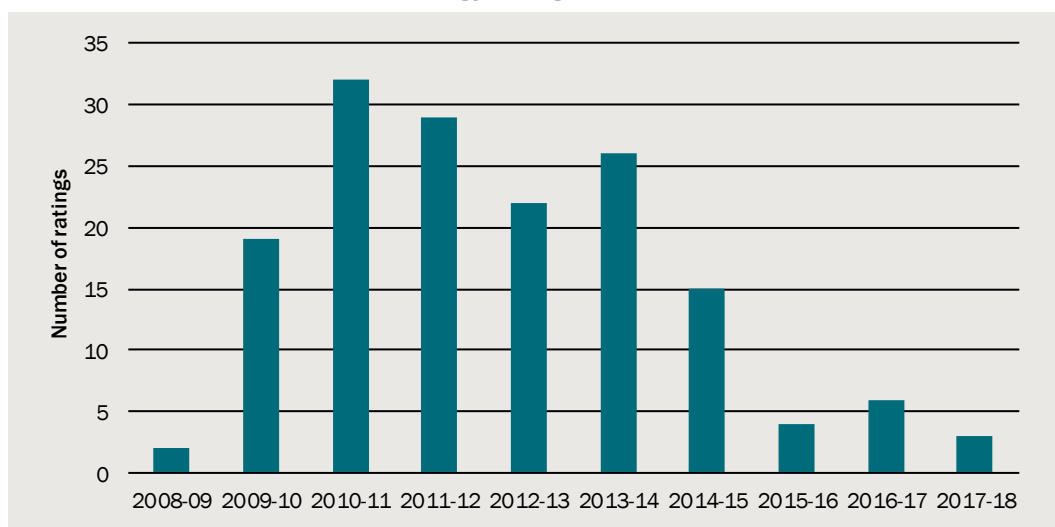
<sup>63</sup> EarthCheck (2018), *Company Standard*, version 4.0, May 2018, available at: [https://earthcheck.org/media/49073/final-master-earthcheck-company-standard\\_version-4\\_may18.pdf](https://earthcheck.org/media/49073/final-master-earthcheck-company-standard_version-4_may18.pdf).

<sup>64</sup> The SDGs for Energy include: 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services; 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix; 7.3 By 2030, double the global rate of improvement in energy efficiency; 7.A By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology; 7.B By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support. See UN website at: <https://www.un.org/sustainabledevelopment/energy/>

<sup>65</sup> International Tourism Partnership (2016), *Know How Guide: Sustainable Hotel Certification Schemes*, available at: <http://www.greenhotelier.org/wp-content/uploads/2016/09/Know-How-Guide-to-sustainable-hotel-certifications1.pdf>.

<sup>66</sup> NABERS (2018), *Nabers Annual Report 2017-18*, version 1, available at: <https://nabers.info/annual-report/2017-2018/hotel%e2%80%93energy.html>.

## 8.9 Number of NABERS Hotel Energy ratings over time



Data source: NABERS Annual Report.

### *Green Key*

Green Key is a worldwide ecolabel certification for businesses in the tourism sector. There are currently over 3000 awarded sites (hotels, hostels, small accommodation, restaurants, conference centres, attractions and campsites) across 57 countries that have achieved Green Key Certification.

The aims of Green Key are to:<sup>67</sup>

- Increase the use of environmentally friendly and sustainable methods of operation and technology in the establishments and thereby reduce the overall use of resources.
- Raise awareness and create behavioural changes in guests, staff and suppliers of individual tourism establishments.
- Increase the use of environmentally friendly and sustainable methods and raise awareness to create behavioural changes in the hospitality and tourism industry overall.

Some examples of conditions for hotels include:<sup>68</sup>

- Measuring energy consumption and calculating the annual carbon footprint
- Informing guests of the environmental information including the reduction in environmental footprint through energy and water savings.
- Having at least 75 per cent of light bulbs at the location, energy efficient
- Newly purchased mini-bars must not have an energy consumption of more than 1 kWh/day.

<sup>67</sup> Green Key (website), *Raising awareness and creating global changes*, available at: <https://www.greenkey.global/our-programme>, accessed 2 August 2019.

<sup>68</sup> Green Key (website), *Hotels and Hostels*, [criteria and explanatory notes], available at: <https://www.greenkey.global/criteria>.



## *Green Globe*

Green Globe provides certification for the sustainable operations and management of travel and tourism companies and their related supplier businesses. Green Globe also maintains a global network of independent auditors who provide third party inspection and validation.<sup>69</sup> There are members of the Green Globe initiative in over 90 countries worldwide.

Green Globe has a range of fundamental achievements related to environmental sustainability, diversity and inclusiveness of their workforce, compliance with the law, and human rights. Their environmental sustainability achievements include:<sup>70</sup>

- Members commit to managing and operating their business and organizations to the highest level of sustainability.
- Members are committed to benchmarking and managing the use of energy and water with the aim of reducing the use of these resources as well as promoting reuse and recycling of materials.
- Fundamental achievements are managed through a sustainability plan targeting over 300 activities that are carried out at all levels of the company.
- The Green Globe International Standard for Sustainable Tourism has been developed over two decades in collaboration with the travel and tourism industry, communities in tourism destinations and other stakeholders.

The International Standards contain over 330 compliance indicators and certification is only awarded to members with a compliance rating of at least 51 per cent. The Standard is the combination of various other sustainable tourism standards:<sup>71</sup>

- Global Sustainable Tourism Criteria
- Global Partnership for Sustainable Tourism Criteria (STC Partnership)
- Baseline Criteria of the Sustainable Tourism Certification Network of the Americas
- Agenda 21 and principles for Sustainable Development endorsed by 182 Governments at the United Nations Rio de Janeiro Earth Summit in 1992
- ISO 9001 / 14001 / 19011 (International Standard Organisation).

There are currently no Australian hotels participating in this program.

<sup>69</sup> Green Globe (website), *About Green Globe*, available at: <https://greenglobe.com/about/>, accessed 2 August 2019

<sup>70</sup> Green Globe (website), *About Green Globe*, available at: <https://greenglobe.com/about/>, accessed 2 August 2019

<sup>71</sup> Green Globe (website), *Green Globe's International Standard for Sustainable Tourism*, V1.7, available at: <https://shapingsustainablemarkets.iied.org/green-globe%E2%80%99s-international-standard-sustainable-tourism-v17>, accessed 5 August 2019.

### *Stocktake of hotels registered under the various certification systems*

An overall stocktake of use in Australia is shown in table 8.10. Few energy rating tools have widespread take-up. Ecotourism has the largest take-up, but is much broader than just covering energy disclosure.

#### **8.10 Different energy rating tools for hotels**

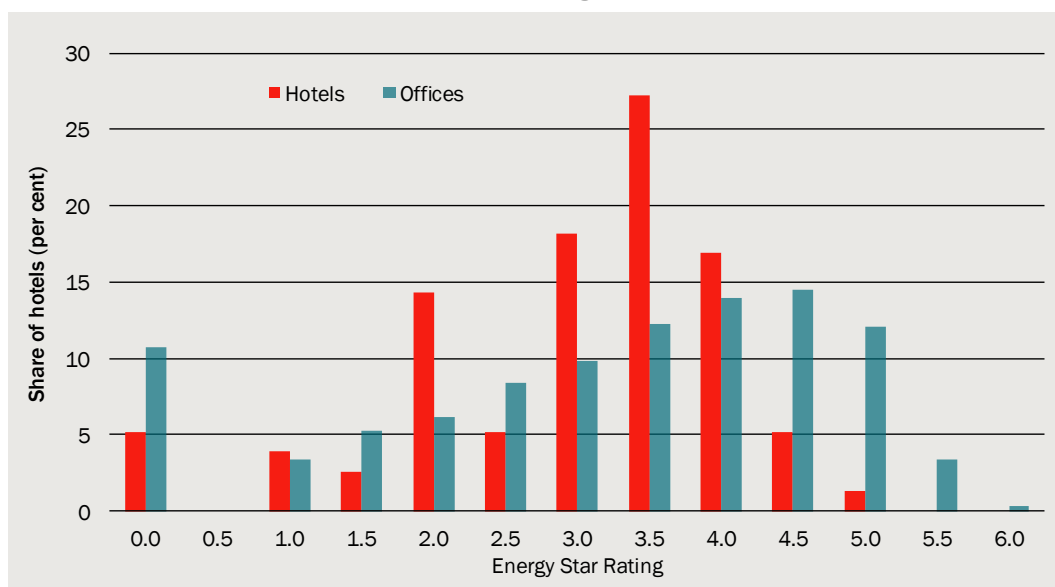
Rating tool	Hotels that use in Australia
NABERS energy	<b>Three hotels</b> certified in Australia
EarthCheck	<p>There <b>10- hotels</b> certified with EarthCheck in Australia including: Alto Hotel on Bourke, Melbourne, Certified Gold; Amora Hotel Riverwalk Melbourne, Benchmarked Bronze; Emporium Hotel, Brisbane, Certified Silver; Radisson Blu Plaza Hotel Sydney, Certified Silver; Radisson on Flagstaff Gardens, Certified Silver; The Langham, Sydney, Certified Silver; Emirates One &amp; Only, Wolgan Valley, Benchmarked Bronze; RACV Noosa Resort, Certified Silver; Tangalooma Island Resort, Moreton Island, Certified Silver; The Langham, Melbourne, Certified Silver;</p> <p>Other examples of the effects of EarthCheck include:</p> <ul style="list-style-type: none"> <li>■ Initiatives at individual locations: Thredbo where the resorts electricity supply is derived from natural resources</li> <li>■ Initiatives at the local council area: More than 30 local and international businesses from the accommodation and entertainment sectors, EarthCheck and the City of Sydney Council have signed up to the City's Sustainability Destination Partnership. Some hotels that have agreed to be part of the program include: The Langham, Holiday Inn, Hilton Hyatt Regency, and the Amora Hotel as well as the Schwartz Family Company.</li> </ul>
Green Globe	Nil
Ecotourism	<b>125 hotels</b>
Green Star	<b>Four hotels (2 certified, 2 registered):</b> Abode Woden Hotel (certified); ICC Hotel Sydney (certified); Chadstone Hotel, Melbourne (registered); The Star – Ritz Carlton Hotel Sydney (registered)
Green Key	Nil

Source: NABERS (2018) *Nabers Annual Report 2017-18*, version 1, available at: <https://www.gbca.org.au/project-directory.asp> ; EarthCheck (website), available at: <https://earthcheck.org/about/search-members/>, accessed 2 August 2019; EarthCheck (websites), available at: [https://earthcheck.org/media/49073/final-master-earthcheck-company-standard\\_version-4\\_may18.pdf](https://earthcheck.org/media/49073/final-master-earthcheck-company-standard_version-4_may18.pdf); <https://earthcheck.org/news/2019/july/thredbo-an-earthcheck-sustainable-destination-powered-by-renewable-energy/>; <https://earthcheck.org/news/2018/june/making-green-venues-a-tourism-drawcard/>; accessed 5 August 2019.

### *Energy performance of hotels*

With the introduction of the NABERS rating for hotels in 2007, 50 per cent of hotels registered with a NABERS rating of three stars or less (chart 8.11).

### 8.11 Distribution of hotels with NABERS rating



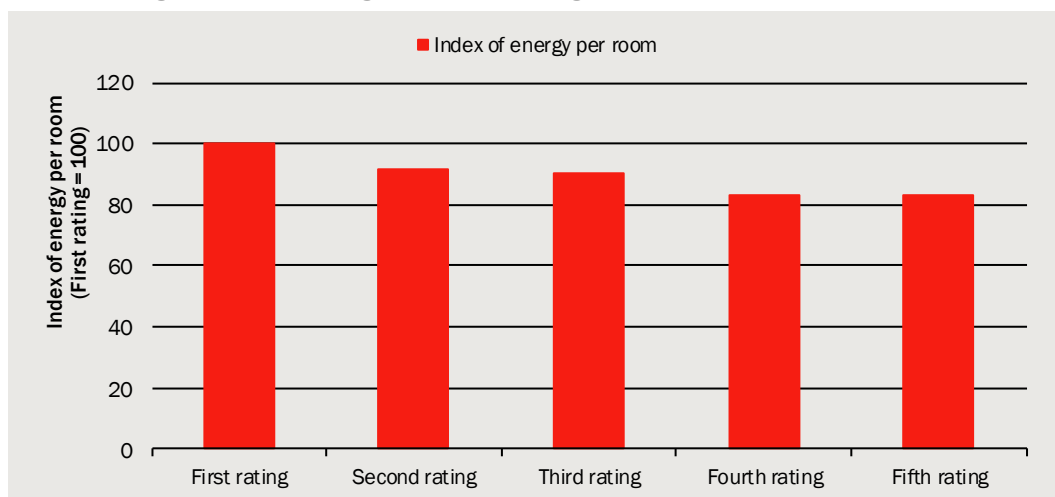
Note: The year of 'first ratings' vary for each hotel.

Data source: NABERS dataset.

The average energy intensity for hotels rated multiple times has improved. A hotel that has rated 4-5 times has reduced its energy per room by ~20 per cent (chart 8.12).

However, participation also falls over time, with the number of hotels that acquire additional ratings after the first falling, and very few hotels having rated 4-5 times.

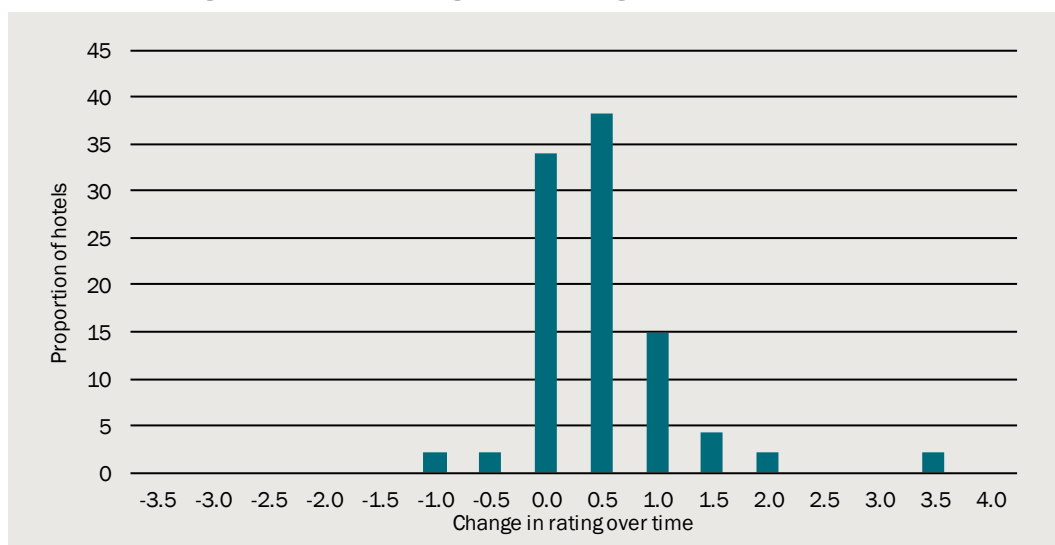
### 8.12 Average NABERS rating with more ratings



Data source: The CIE, CBD dataset

Around 35 per cent of hotels rated multiple times had no change in rating, while those that improved mainly saw increases in their rating by 0.5 stars (chart 8.13). Some hotels achieved larger changes in performance.

### 8.13 Comparing first NABERS rating to last rating



Data source: The CIE, CBD dataset

### *Case studies of hotels reducing energy*

Many of the larger hotel chains have independently implemented sustainability initiatives that reduce energy consumption per room. This section provides a number of case studies.

#### *Accor in Australia*

Accor is Australia's largest hotel group accounting for approximately 7.3 per cent of the market.<sup>72</sup> Accor sets annual reduction targets for each hotel in Australia for water and energy. Hotel performance is monitored using the web based Gaia platform, which tracks a range of the hotel's metrics including: energy and water consumption; hotel characteristics (for example, number of rooms and facilities); and activity (such as occupancy rates).<sup>73</sup> This analytics assists hotels track their progress.

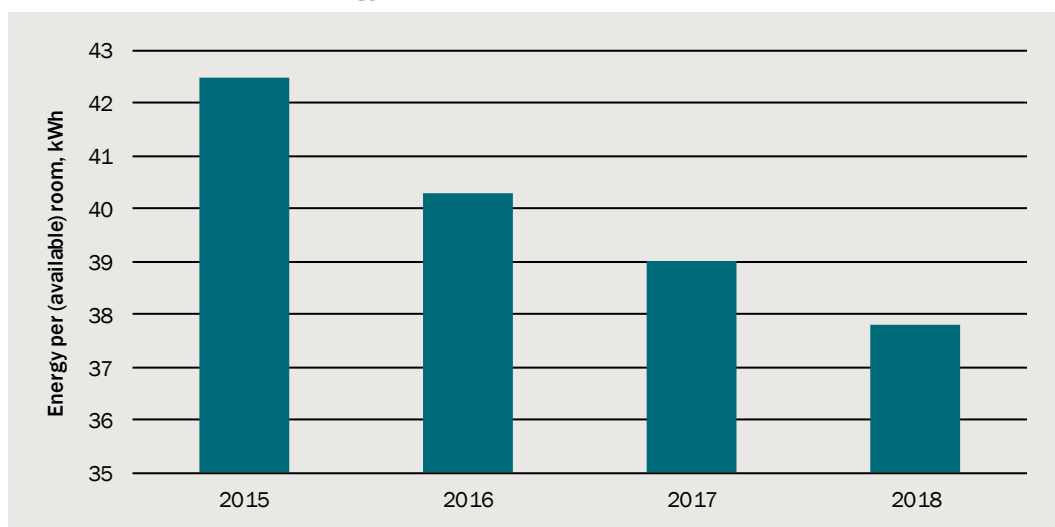
A number of hotels have implemented solar photovoltaic systems such as the Novotel Barossa Valley Resort and Sydney Olympic Park (125 kW and 75 KW, respectively).

Notably, energy per available room has reduced 11 per cent between 2016 and 2018 (Chart 8.14).

<sup>72</sup> Cloutman, N. (2017), IBIS World Industry Report, *Hotels and Resorts in Australia*, H4401, p 23.

<sup>73</sup> Accor (2018), *Corporate Responsibility Report – Australia 2018*, available at: <https://images.jobsataccor.com.au/wp-content/uploads/AccorHotels-Corporate-Responsibility-Report-2018.pdf>, p 39.

### 8.14 Accor Australia's energy per room has continued to decline



Note: Data from 2015 includes 122 owned, leased and managed hotels, and for 2016-2018, is for 116 hotels.

Data source: Accor (2018), *Corporate Responsibility Report – Australia 2018*, available at: <https://images.jobsataccor.com.au/wp-content/uploads/AccorHotels-Corporate-Responsibility-Report-2018.pdf>, p 39; Accor (2016), *2016 Corporate Responsibility Report*, available at: <https://images.jobsataccor.com.au/wp-content/uploads/accorhotels-australia-corporate-responsibility-report-2016-lr.pdf>, p 68.

### Langham Hotels

The Langham brand has 21 properties worldwide. Due to energy efficiency projects, energy intensity (as measured by MJ per guest night) declined 2 per cent in 2017 from the 2016 result. Furthermore, in 2017, carbon equivalent emissions associated with energy used decreased by 4% compared with the previous reporting year.<sup>74</sup>

### 8.15 Comparing energy and carbon intensity, Langham Hotels, 2013-2017

		2013	2014	2015	2016	2017
Energy intensity	MJ per guest night	221.5	194	207.18	201.63	195.55
Carbon intensity	Kg per guest night	29.75	27.57	29.61	28.36	26.62

Source: Langham Hospitality Group (2017), *Sustainability Report*, available at: <http://www.langhamhospitalitygroup.com/cdn-600efdb1/globalassets/lhg/about-us/corporate-social-responsibility/lhg-csr-report-2017-en1.pdf>, pp 13-14.

### Hilton Hotels

Hilton Hotels set an ambitious target to reduce direct and indirect carbon intensity by 61 per cent by 2030 (using 2008 emissions as the baseline). Since 2008, they have achieved a reduction of 34 per cent by doing the following:<sup>75</sup>

<sup>74</sup> Langham Hospitality Group (2017), *Sustainability Report*, available at: <http://www.langhamhospitalitygroup.com/cdn-600efdb1/globalassets/lhg/about-us/corporate-social-responsibility/lhg-csr-report-2017-en1.pdf>, pp 13-14.

<sup>75</sup> Hilton (website), *Energy & Carbon*, available at: <https://cr.hilton.com/environment/#energy>; accessed 5 August 2019.

- Setting science-based carbon reduction target that align with the Paris Climate Agreement
- Use of alternate energy sources (such as the photovoltaic solar array currently being installed at the Grand Wailea – A Waldorf Astoria Resort)
- Hilton's LightStay initiative – a platform that has enabled the company to track environmental, operational and social impacts and reduce energy use by 14.5 per cent, carbon output by 20.9 per cent, waste output by 27.6 per cent and water use by 14.1 per cent in six years.<sup>76</sup>

### ***Marriott International***

Marriott International has set out to achieve a minimum of 30 per cent renewable electricity use as well as committing to review opportunities to set science based targets. In 2017, several properties installed new, on-site solar photovoltaic systems which are expected to contribute nearly 2000 metric tons in avoided emissions.<sup>77</sup> Furthermore, a number of programs were executed globally:<sup>78</sup>

- Selection of projects that focus on energy efficiency such as lighting upgrades, installation of variable frequency drive pumps, fans and air handling units, and chiller upgrades
- Third party studies of complex facilities to identify the efficiency opportunities including those related to heating, ventilation and air conditioning, chiller and boiler systems
- Building automation systems such as smart, integrated occupancy thermostat systems that interlock with entry doors and the property management systems to deliver agile temperature setback efficiency.

### **8.16 Reductions in energy and carbon intensity at Marriott International**

	2016	2017	Difference
			Per cent
<b>Energy Intensity (kWh per m<sup>2</sup> of air-conditioned space)</b>			
Americas	351.9	347.7	<b>-1.2</b>
Asia Pacific	408.8	389.2	<b>-4.8</b>

<sup>76</sup> Hilton (website), *Hilton Wins Product of the Year from Environmental Leader for Corporate Responsibility Measurement Platform 'LightStay'*, 23 June 2016, available at: <https://newsroom.hilton.com/corporate/news/hilton-wins-product-of-the-year-from-environmental-leader-for-corporate-responsibility-measurement-platform-lightstay>, accessed 6 August 2019.

<sup>77</sup> Marriott International (2018), *2018 Serve 360 Report Sustainability and Social Impact at Marriott International*, available at: [http://serve360.marriott.com/wp-content/uploads/2018/10/2018\\_Serve\\_360\\_Report.pdf](http://serve360.marriott.com/wp-content/uploads/2018/10/2018_Serve_360_Report.pdf), p 29.

<sup>78</sup> Marriott International (2018), *2018 Serve 360 Report Sustainability and Social Impact at Marriott International*, available at: [http://serve360.marriott.com/wp-content/uploads/2018/10/2018\\_Serve\\_360\\_Report.pdf](http://serve360.marriott.com/wp-content/uploads/2018/10/2018_Serve_360_Report.pdf), p 29.

	2016	2017	Difference
			Per cent
Europe	428.3	394.8	<b>-7.8</b>
Middle East and Africa	437.1	347.0	<b>-20.6</b>
<b>Carbon intensity (kg per m<sup>2</sup>)</b>			
Americas	101.9	100.7	<b>-1.1</b>
Asia Pacific	181.9	166.2	<b>-8.6</b>
Europe	120.3	98.5	<b>-18.1</b>
Middle East and Africa	218.6	147.0	<b>-32.8</b>

Source: Marriott International (2018), *2018 Serve 360 Report Sustainability and Social Impact at Marriott International*, available at: [http://serve360.marriott.com/wp-content/uploads/2018/10/2018\\_Serve\\_360\\_Report.pdf](http://serve360.marriott.com/wp-content/uploads/2018/10/2018_Serve_360_Report.pdf), p 30.

### *Other initiatives*

As an alternative to mandated information disclosure, there are a number of initiatives established by policy makers/industry bodies or interest groups that also drive change.

**The Better Building Challenge**, driven by the US Department of Energy aims to make commercial, public, industrial and residential building 20 per cent more energy efficient over the next decade.<sup>79</sup> This is done through four key strategies - market leadership (demonstrating what's possible, and setting goals), providing better information, workforce development and innovation and emerging technologies. The initiative is built on voluntary partnerships with the private and public sector rather than regulation. A number of hotels (including the Las Vegas Sands; Loews Hotels & Co; MGM Resorts International and Hilton) have had energy savings as a result of this Challenge.<sup>80</sup>

**Energy Star certification** for products and buildings is a US Government backed symbol for energy efficiency that allows customers and businesses to make informed decisions. Hotels require a score of at least 75 (out of 100) to achieve an energy star certification, where energy scores are provided to each building based on a number of variables including rooms, workers, refrigeration, weather etc.<sup>81</sup>

**Science based targets initiative** is a collaboration between the CDP<sup>82</sup>, the United Nations Global Compact, World Resources Institute, and the World Wide Fund for

<sup>79</sup> US Department of Energy (website), available at: <https://betterbuildingssolutioncenter.energy.gov/about-better-buildings-initiative>, accessed 7 August 2019.

<sup>80</sup> US Department of Energy (2019), *Working Toward a More Innovative, Affordable, and Energy Efficient Future, Progress Report 2019*, available at: [https://betterbuildingssolutioncenter.energy.gov/sites/default/files/program/DOE\\_BBI\\_2019\\_Progress\\_Report.pdf](https://betterbuildingssolutioncenter.energy.gov/sites/default/files/program/DOE_BBI_2019_Progress_Report.pdf), p 25.

<sup>81</sup> Energy Star (website), available at: <https://www.energystar.gov/about>, accessed 7 August 2019.

<sup>82</sup> The CDP was formerly known as the Carbon Disclosure Project. The CDP currently runs the global disclosure system that enables companies, cities, states and regions to measure and

Nature and one of the We Mean Business Coalition commitments. The initiative demonstrates the broader benefits to industry about setting science based targets, defines and promotes best practice and offers resources, workshops and guidance to reduce barriers to adopting and independently assesses and approves companies' targets.<sup>83</sup>

## *Evidence of market and behavioural failures*

### *Bounded rationality of hotel operators*

There is mixed evidence of behavioural failures in energy efficiency of hotels, and this evidence is largely anecdotal.

- Consultations with technical advisers have suggested that the energy performance of a hotel is not something that is given substantial focus by hotel managers/owners.
  - consultations indicated that hotel management arrangements are often based on a share of revenue, which leads to a stronger focus on revenue/marketing rather than cost reduction
- Consultations with hotel engineers, individually and as a group arranged through the Australian Institute of Hotel Engineers (AIHE), indicated that they face targets to reduce energy use and energy cost
  - some hotel engineers knew how their hotels compared to others, and some focused on trends in their own hotel or hotels over time
- Evidence from hotel advisers indicated that, unlike in other sectors, new hotels were often not better in their energy efficiency than existing hotels
- The facilities management aspects of hotels are substantially less professional than those of offices, and are not improving over time. Energy advisers consider that the management of assets and systems is poor, particularly the HVAC and electrical systems. It was suggested that there has been a significant skills deterioration within the sector in regards to technical management over the last 20 years
  - this may partly reflect efficiencies from aggregating functions for multiple hotels.

Based on this, hotels are likely to be driven to better manage their energy use if this was measured and made prominent.

### *Demand from customers*

Given the competition in the hotel industry, including the presence of Airbnb, hotels are increasingly looking for ways to increase their brand and appeal to customers. If being 'green' or 'sustainable' were key drivers for consumer decision making, this would be a powerful influence on a hotel owner or operator's willingness to implement change.

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manage their environmental impacts. For further information, see their website:  
<https://www.cdp.net/en>.

<sup>83</sup> Science Based Targets (website), *About the Science Based Targets Initiative*, available at: <https://sciencebasedtargets.org/about-the-science-based-targets-initiative/>, accessed 7 August 2019.



According to PWC's *What's Driving Customer Loyalty for Today's Hotel Brands* survey, sustainability is not a key attribute that customers are looking for in a hotel. Rather, these are:<sup>84</sup>

- Room Quality
- Accessibility (convenience, ease of finding and number of locations)
- Promotions (rates, upgrades, points for loyalty programs, free nights) and
- Service.

However, there is some growing evidence (globally) that sustainability is starting to become more important to guests:

- A recent survey of 72 000 Hilton Hotel customers (globally), found that 33 per cent of respondents prefer hotels with environmental and social programs. For guests aged less than 25, this increases to 55 per cent.<sup>85</sup>
- Booking.com's 2017 Sustainable Travel Report found that 65 per cent of global travellers expressed an intention to stay in an 'eco-friendly' or 'green accommodation' at least once compared to 34 per cent who stayed in one or more last year. Furthermore, 68 per cent confirm that they are more likely to consider choosing an accommodation knowing that it was eco-friendly.<sup>86</sup>
- Accor, through the research arm of Planet 21, found that sustainability initiatives deliver positive paybacks by reducing costs (energy, waste) and increasing revenues (enhanced reputation and guest satisfaction).<sup>87</sup> Furthermore, (Accor's) trends show that business to business clients increasingly consider environmental performance an important driver. This was demonstrated in changing attitudes between their 2012 survey and another survey conducted in December 2014-January 2015. The 2012 survey found that approximately 50 per cent of respondents rated their level of concern for Environmental Performance (reduction of energy consumption, water consumption, water pollution, waste quality, etc.) as very important or important, which increased to 58 per cent in the most recent survey.<sup>88</sup>

There is some evidence the "green" hotels are becoming a selling point for some hotels, with a number of venues across Australia identifying with the term 'ecotourism'. There does not, however, appear to be any evidence of customers choosing to go elsewhere

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<sup>84</sup> PWC, *What's driving customer loyalty for today's hotel brands*, available at: <https://www.pwc.com/id/en/publications/assets/ticpublications/cis-hotel-loyalty.pdf>, pp 7-8.

<sup>85</sup> Urban Land Institute (2019), *Sustainability in Hotels*, p 6.

<sup>86</sup> Booking.com (2017), *2017 Sustainable Travel Report*, available at: <https://news.booking.com/bookingcoms-2017-sustainable-travel-report/>, accessed 7 August 2019.

<sup>87</sup> Planet 21 Research, Accenture strategy, Accor (2015), *AccorHotels: sustainability initiatives contribute to guest satisfaction and business performance*, available at: <https://group.accor.com/en/commitment/sharing-our-knowledge/csr-and-performance>, page 19.

<sup>88</sup> Planet 21 Research, Accor (2015), *What are the links between business and CSR performance for AccorHotels's strategic and key B2B accounts*, available at: <https://group.accor.com/en/commitment/sharing-our-knowledge/csr-and-performance>, p 10.

because the hotel that they are looking at does not have identify with any environmental standards. Evidence in the Australian market of how consumer demand is influenced by a hotel's sustainability practices is somewhat limited, and most literature relates to tourism blogs and press releases that promote their sustainability improvements. Regardless, understanding how consumers feel about environmental sustainability, and the impact that these feelings have on their choices is an area that could be further explored. As consumer behaviour evolves in this area, hotels and other commercial organisations will need to respond.

There is also expected to be demand for government and corporates for energy efficient hotels, similar to offices. In consultations several large corporates noted that they were trying to choose hotels based on sustainability but could not do so easily because of inconsistent metrics. They indicated that they would preference hotels with higher NABERS energy ratings if this was possible. Some government stakeholders have also indicated an interest in preferencing hotels with higher NABERS energy ratings, but an inability to do this at the moment.

### *Would mandatory disclosure drive behavioural change?*

Mandatory disclosure of energy performance is expected to drive behavioural change in hotels for two reasons:

- 10 There would be sufficient interest from customers through corporate and government procurement that hotels would feel compelled to increase their energy performance if there was a mandatory disclosure scheme in place
- 11 There is some evidence that hotels are less advanced in considering energy use than other sectors, and comparative performance information would identify gaps in performance for some hotels. However, hard evidence for or against this is difficult to obtain.

In our view, the first of these is the most critical for a mandatory disclosure scheme to improve energy efficiency. The extent to which hotels are less advanced in considering energy, the higher the private benefits available to hotels will be — otherwise there may be a net cost imposed on hotels from having to obtain energy ratings.

### *Options for mandatory disclosure*

#### *Disclosure tools*

As set out above, there are many different energy and sustainability tools available in the hotel industry.

It would not be desirable to mandate the use of a tool where the prices are determined by private companies, a non-Australian government and are not regulated. This essentially means that mandatory disclosure could only be used for a government tool (NABERS) or could cover multiple tools.

- Covering multiple tools that allow for disclosure of energy performance has the advantage of encouraging competition.
- However, with multiple tools consumers would not be able to compare across hotels. This would be a very significant reduction in benefit of a mandatory disclosure scheme.

Furthermore, other tools tend not to restrict themselves to energy disclosure, but cover a broader set of environmental indicators. This would then be pushing outside of the scope of our review, which is focused on energy disclosure.

We also consider NABERS to be preferable to checklist type measures because it is focused on actual recorded energy use.

For these reasons, the only option that can reasonably be considered for mandatory disclosure is using a NABERS energy rating.

Currently, there is little industry support for NABERS energy, and a view that it does not provide good benchmarks that account for factors outside of a hotel's control. These may be misperceptions or real issues. In either case there is a need to re-look at the benchmarking tool. The current tool could not be mandated without substantial engagement with industry.

## *Costs and benefits of mandatory disclosure*

### *Reference scheme*

To examine the costs and benefits of mandatory disclosure of energy performance for hotels we have designed a reference scheme and evaluated the costs and benefits of this scheme. The reference scheme involves:

- a mandatory disclosure scheme focused on NABERS energy
- this would begin ramping up in 2021 to be fully taken up and disclosed by 2023
- disclosure would involve disclosure in a hotel foyer and on a hotel website
- disclosure would apply to hotels with more than 100 rooms. Hotels would be defined as per ABS definition, as Establishments with 100 or more rooms which operate a public bar and which provide accommodation on a room/unit/apartment/suite basis. This would not cover pubs, motels, guest houses, private hotels or resorts. Advice would be required as to how to define a resort versus a hotel
- a NABERS energy rating would be required every two years.

This scheme would cover approximately 640 hotels and 86 000 rooms.

### *Costs benefit analysis results*

The results of the cost benefit analysis are shown in table 8.17.

- We estimate an overall net benefit of \$26 million, which covers a period of 20 years from today.

- There is a small private net benefit of \$6.2 million. This reflects the avoided electricity and gas savings being larger than the compliance and upgrade costs.
  - we have compared the private payback periods from the analysis to those suggested in consultations. For a 3 star NABERS energy rated hotel, the payback period is ~4 years now for actions and gradually increases to 6 years as less costly actions are undertaken first. This is similar to the payback hurdle rates suggested in industry consultations
  - we also expect that some hotels will face much higher paybacks than others, based on consultations.
- There are GHG emissions reduction benefits of \$21 million in present value terms.

### 8.17 Cost benefit analysis results for hotels

Australia	
\$ million, present value	
<b>Private benefits/costs</b>	
Electricity savings	25.1
Gas savings	11.5
Upgrade costs	- 16.1
Compliance costs	- 14.2
<b>Net private benefits/costs</b>	<b>6.3</b>
<b>Other benefits/costs</b>	
GHG emissions	20.6
Government costs	- 0.5
<b>Total net benefit/cost</b>	<b>26.4</b>

Note: Using a 7 per cent discount rate.

Source: The CIE.

The cost benefit analysis results are built up in a similar way as for offices. Key inputs and assumptions are:

- the number of hotels and hotel rooms covered by the scheme — this is based on ABS data for hotels and resorts. We have then used NABERS 2007 sample data to apportion this to different size thresholds. This may well overstate the share of hotels that have higher number of rooms. It also overstates the number of buildings impacted, as resorts cannot be rated using the NABERS energy tool
- the current energy intensity of hotels with different NABERS energy ratings. This is based off data provided by NABERS
- the impact of the scheme on hotel energy efficiency. This is assumed to be half that attributed to the CBD Program for offices. The driver of this is that consultations indicated hotels would have to respond to achieve higher energy efficiency performance to address the risk that this would be required by government and corporate clients. However, the share of the market for hotels for these customers is substantially smaller than for offices.

- the net benefit is \$67 million if a similar impact is achieved as has been achieved by offices
- the cost of upgrades — this is based off costs per MJ avoided for offices, for different starting levels of performance. The costs get higher as hotels become more efficient over time
- the initial performance of hotels — we have assumed that the full set of hotels would have a similar performance to those hotels already rated. If hotels have a higher performance, then the costs of additional upgrades are larger and the impacts of mandatory disclosure are smaller, and vice versa
- energy prices and the avoided GHG costs are consistent with assumptions made for offices
- costs for obtaining a NABERS energy rating are based on the survey of assessors. We have allowed for internal hotel costs of 50 per cent of assessor's costs, which is higher than for offices. This reflects consultations indicating a higher level of difficulty for initial hotel ratings in particular.

Particular details of our estimates that we would appreciate industry feedback on are set out below.

### *Costs of improving energy efficiency*

The costs that we have estimated for energy efficiency improvements and that form part of the cost benefit analysis are set out in table 8.18. The costs are higher for higher rated hotels, as they have already adopted the easier and less costly improvements. Costs get higher as each hotel improves its performance over time.

#### **8.18 Costs of improving energy efficiency for hotels**

NABERS energy rating	One-off cost of energy efficiency improvements
	\$/MJ
0.0	0.05
0.5	0.06
1.0	0.06
1.5	0.07
2.0	0.07
2.5	0.08
3.0	0.09
3.5	0.11
4.0	0.13
4.5	0.15
5.0	0.19
5.5	0.26
6.0	0.40

Source: The CIE.

### *Impact of mandatory disclosure on energy performance*

The estimated impacts of mandatory disclosure on hotel performance are set out in table 8.19, for different initial energy performance levels. For example, a hotel with a 2 star NABERS energy rating would have an average starting energy use of 107 015 MJ/room per year and an energy cost of \$2768 per room per year. This will differ depending on factors such as climate and energy contracts. The cost benefit analysis is based on achieving a reduction of 2587 MJ/room after 3 ratings and twice this after five ratings.

#### **8.19 Impacts of mandatory disclosure for hotels**

	Current		Savings after 3 ratings		Savings after 5 ratings	
	MJ/room	\$/room	MJ/room	\$/room	MJ/room	\$/room
0.0	243 305	6 293	-5 882	- 152	-11 763	- 304
0.5	198 141	5 125	-4 790	- 124	-9 580	- 248
1.0	161 361	4 174	-3 901	- 101	-7 802	- 202
1.5	131 408	3 399	-3 177	- 82	-6 353	- 164
2.0	107 015	2 768	-2 587	- 67	-5 174	- 134
2.5	87 150	2 254	-2 107	- 54	-4 214	- 109
3.0	70 973	1 836	-1 716	- 44	-3 431	- 89
3.5	57 798	1 495	-1 397	- 36	-2 794	- 72
4.0	47 069	1 217	-1 138	- 29	-2 276	- 59
4.5	38 332	991	- 927	- 24	-1 853	- 48
5.0	31 217	807	- 755	- 20	-1 509	- 39
5.5	25 422	658	- 615	- 16	-1 229	- 32
6.0	20 703	535	- 500	- 13	-1 001	- 26

Source: The CIE.

### *Views of stakeholders*

Stakeholders consulted during the review have provided the following views.

- Tourism Accommodation Australia does not support mandatory disclosure of NABERS energy ratings for hotels. TAA argues that:
  - there is inadequate data to support that an expansion of the CBD Program to hotels
  - hotels are already achieving energy efficiency improvements without the need for the program
  - a mandatory scheme applied to hotels would further distort the accommodation playing field, with some accommodation providers required to be part of the scheme and others not required to
  - the NABERS energy benchmarking tool for hotels would need to be improved, with input from the accommodation sector

- if expansion proceeds, the CBD Program must include other internationally recognised certifications (e.g. Green-Key, EarthCheck)
- the star ratings system of NABERS is potentially confusing for customers as opposed to star rating for service standard
- Hotel groups consulted with individually presented a range of views, with a common theme that:
  - a mandatory disclosure program focused on NABERS would lead them to invest in improving energy efficiency. In some cases this would require high cost upgrades, particularly for older buildings
  - NABERS energy is not currently providing a trusted benchmark for the hotel industry, either because of perceptions about what it does or actual real issues
  - there is a need to do something to focus the hotel industry on improving its energy efficiency performance, but an expansion of the CBD Program was not clearly the solution.
- Advisers to the hotel industry suggested:
  - NABERS energy as a benchmark needs to be revised, as there are some issues with the benchmarks that it generates for hotels
  - hotels are starting to focus on energy efficiency but a lot more could be done, and hotels lagged other commercial building sectors considerable.

We have sought to take these views on board in our recommendations set out at the start of this chapter. We welcome further feedback from the industry.

## *Feedback*

We are seeking feedback on all our recommendations in our draft report. There is substantial uncertainty about the extent to which a mandatory disclosure program will improve energy efficiency of hotels and the costs of improving energy efficiency. We would particularly like feedback on:

- the types of accommodation establishments that are captured under the Program. The current recommendation is limited to the coverage of the NABERS energy rating tool. Potentially, this could be extended to serviced apartments and motels. The legislation would also need a clearer definition of an accommodation hotel than provided by the NABERS energy tool to enable businesses to understand whether they are or are not covered
- whether a scheme should allow for a higher rating if renewable energy is purchased by the hotel
- the costs and level of impact we have assumed to achieve a sustained reduction in energy use for hotels
- interest in participation in updating of energy efficiency benchmarks for hotels
- any further data on hotels relevant for the coverage of the scheme, and impacts of the scheme proposed
- views on the proposed transition path for hotels.



## 9 *Data centres*

### *Key findings and draft recommendations*

- **There is currently insufficient evidence to support the expansion of the CBD Program to cover data centres.**
- Data centres are harder to define than other types of commercial buildings and the market is constantly evolving.
- For colocation data centres, the available (albeit limited) evidence suggests that mandatory disclosure is unlikely to drive significant improvements in energy efficiency for existing data centres.
  - Energy is a much more significant proportion of costs than for other commercial buildings and colocation data centres must closely manage energy costs to compete effectively in the market. As such, there is much less likely to be poorly performing colocation data centres (the benefits of mandatory disclosure for office buildings has been driven to a significant extent by large improvements in buildings that were performing poorly when they entered the NABERS system).
  - There is little evidence of a systematic improvement in energy performance over time among the small number of data centres that voluntarily rate.
  - There are significant barriers to improving the energy efficiency of existing data centres through end of life replacement of cooling systems.
- Less is known about the performance of private data centres. Some stakeholders suggested that many of these data centres perform poorly (particularly government-owned data centres).

Given that various governments own and operate a significant number of data centres and the energy efficiency of these data centres is reportedly poor, governments could choose to obtain NABERS ratings and report the rating in their annual report, without the need for regulatory change.

- We recommend that the Commonwealth and state governments commit to obtaining NABERS ratings for the data centres they own. This process should be used to gather information on:
  - the practical challenges associated with rating existing data centres
  - identifying whether the process of obtaining a NABERS rating identifies any cost-effective options for improving the energy efficiency of existing data centres
  - the cost of improving the energy efficiency of existing data centres.
- Based on these findings, the government could re-consider expanding mandatory disclosure requirements to data centres.



## *Market overview*

Data centres house information technology (IT) equipment, as well as protecting it against disruption and ensuring it can operate reliably and securely. Data centres are large users of energy and are a growing sector.

### *Market structure*

There are broadly two types of data centres:

- **Co-location data centres** — these are data centres that lease space for IT equipment to clients, where the client generally installs its own IT equipment.
- **Private data centres** — rather than subcontracting to a colocation data centre, many larger organisations own and operate their own data centres. That said, one stakeholder noted that some private data centres can be capable of delivering cloud services to thousands of customers under a Service Agreement.

### *Colocation data centres*

Colocation data centres operate at both the wholesale and retail level.

- Wholesale colocation data centres lease out larger spaces generally have long leases (10-15 years).<sup>89</sup>
- Retail data centres generally lease smaller spaces (sometimes at the rack level) and have shorter lease terms (typically around 3 years).

The arrangements for energy costs can vary.

- Similar to office buildings, the energy consumption of the IT equipment is generally metered separately, with the client billed directly.
- The arrangements for infrastructure energy costs (including cooling etc.) can vary depending on the lease or Master Service Agreement. Infrastructure energy costs may be:
  - passed onto tenants as a separate charge
  - included in the lease rate (i.e. a gross lease).

### *Private data centres*

Data centres that are owned and operated by the same company are referred to as private data centres. Note that this includes data centres owned and operated by various government agencies. Private data centres could be data rooms within another building (such as an office building); or a dedicated building.

As they are embedded in large organisations and not necessarily disclosed publicly, there is little information available on private data centres, including the number, size and location of private data centres or their energy performance.

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<sup>89</sup> Energy Action, CBD Expansion: Feasibility Study: Shopping Centres, Data Centres and Hotels, 20 June 2018, p.

## *Trends*

Data centres have been a fast-growing sector. Stakeholders have reported a trend towards moving data centres from within the buildings that they service to specific-purpose buildings (such as colocation data centres). Separately metering data centres within office buildings (to exclude them from the base building rating) has been one strategy used to improve the base building rating.

More recently, there has been a growing trend back towards small and mini decentralised data centres located closer to the customer and the data centre user. A survey of data centre professionals estimated that these ‘Edge’ data centres would grow by 226 per cent by 2025.

## *Voluntary uptake of NABERS*

There are various NABERS tools for data centres.

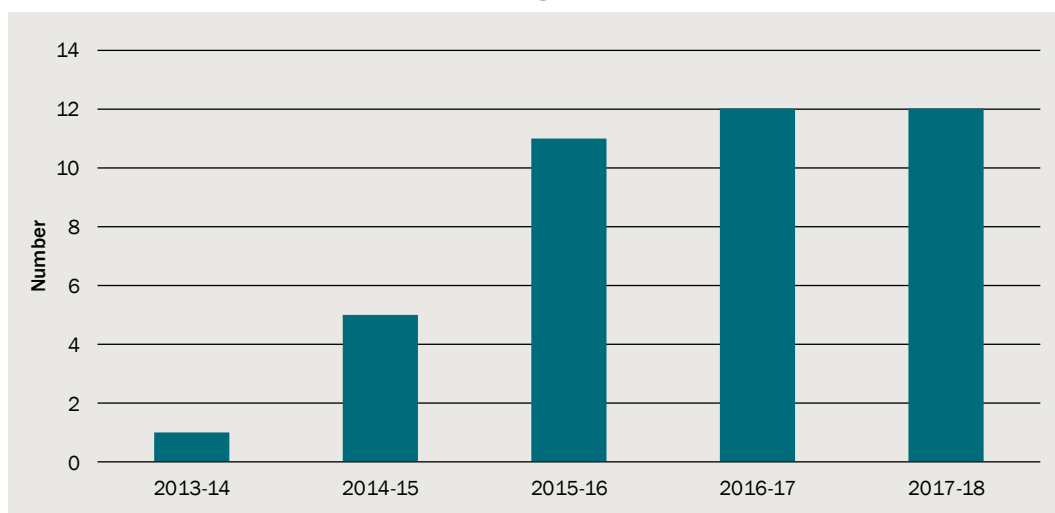
- NABERS Energy for data centres (Infrastructure) — this rating is suitable for colocation data centres and measures a facility’s efficiency in supply the infrastructure services to the IT equipment housed in the data centre (i.e. the energy consumption that the data centre owner/manager has control over). This measure is analogous to the base building rating for office buildings.
- NABERS Energy for data centres (IT Equipment) — this rating is for organisations that house their own IT equipment in the data centre (i.e. the clients of colocation data centres). It is analogous to the office tenancy rating.
- NABERS Energy for data centres (Whole facility) — this rating covers both the IT equipment and the infrastructure. It is therefore suitable for private data centres where the owner both manages and occupies their data centres. It can also be used where internal metering arrangements do not permit a separate IT Equipment or Infrastructure rating. This tool is analogous to the office whole building rating.<sup>90</sup>

Although relatively new, the voluntary uptake of the NABERS data centre tools has been modest. There have been 47 ratings in total across 18 separate data centres, with all but four of these ratings covering the infrastructure only (implying a colocation data centre). As at 30 June 2018, there were 12 current ratings (chart 9.1).

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<sup>90</sup> NABERS website, <https://www.nabers.gov.au/ratings/spaces-we-rate/data-centres>, accessed 9 May 2019.

### 9.1 Number of NABERS data centre ratings over time



Data source: NABERS Annual Report.

### *Other reporting requirements*

As large energy users, some data centre owners are covered by reporting requirements under the National Greenhouse and Energy Reporting Scheme (NGERS). The facility and corporate group thresholds for these reporting requirements are shown in table 9.2.

### 9.2 NGERS reporting thresholds

Thresholds	
Facility threshold	<ul style="list-style-type: none"> <li>25 kt or more of greenhouse gases (CO<sub>2</sub>-e) (scope 1 and scope 2 emissions)</li> <li>production of 100 TJ or more of energy, or</li> <li>consumption of 100 TJ or more of energy.</li> </ul>
Corporate group thresholds	<ul style="list-style-type: none"> <li>50 kt or more of greenhouse gases (CO<sub>2</sub>-e) (scope 1 and scope 2 emissions)</li> <li>production of 200 TJ or more of energy, or</li> <li>consumption of 200 TJ or more of energy.</li> </ul>

Source: Clean Energy Regulator website, <http://www.cleanenergyregulator.gov.au/NGER/Reporting-cycle/Assess-your-obligations/Reporting-thresholds>, accessed 9 August 2019.

### *Options for mandatory disclosure*

Some design considerations for a mandatory disclosure regime for data centres are outlined below.

### *Information disclosed*

In practice the relevant NABERS rating is the only feasible option for mandatory disclosure.

- Power usage effectiveness (PUE) is a measure of the efficiency of the infrastructure (this is particularly relevant to colocation data centre, but there is currently no standard way of measuring PUE and it is therefore open to gaming. A key advantage of the NABERS ratings is the rigorous quality assurance processes (such as assessor accreditation); NABERS ratings appear to be trusted and respected across the industry.
- As with other industries, an adjusted measure is the best indicator of how efficiently the data centre is being managed and is likely to most closely align with the market/behavioural failure being addressed (see below).

Stakeholders generally agreed that the NABERS Energy for data centres (Infrastructure) tool is the most relevant. Stakeholders variously noted that the other tools are:

- difficult to use; and
- unlikely to drive improved energy performance (most businesses choose their IT Equipment to meet their functional needs, rather than energy efficiency).

### *Defining a data centre*

In general, data centres are harder to define than other types of commercial buildings. At its broadest, the term 'data centre' could cover a range of facilities, including: computer rooms within office buildings (or other commercial buildings); separate buildings that house IT equipment and a range of other arrangements.

Given the large variation in the size of data centres (ranging from a small room within another building up to a designated building), setting an appropriate minimum threshold is likely to be important; the cost of obtaining a NABERS rating for very small data centres is likely to outweigh any potential energy savings.

The threshold could be set in terms of either:

- energy consumption
- storage capacity, or
- processing capacity.

Some proposed standards for defining the size and density of data centres prepared by the Strategic Directions Group Pty Ltd in collaboration with the AFCOM Data Center Institute are outlined in table 9.3 and table 9.4.

### **9.3 Data centre size**

Size metric	Rack yield	Compute space (m <sup>2</sup> )
Mega	>=9001	>=22 501
Massive	3001 – 9000	7501 – 22 500
Large	801 – 3000	2001 – 7500

Size metric	Rack yield	Compute space (m <sup>2</sup> )
Medium	201 – 800	501 – 2000
Small	11 – 200	26 – 500
Mini	1 – 10	1 – 25

Source: Strategic Directions, Data Centre Standards, Data Centre Size and Density, White Paper, Prepared by the Strategic Directions Group, 1 October 2014.

#### 9.4 Data centre density

Density metric	Per rack (Kw)	Compute space (Kw)
Extreme	>= 16	>= 16
High	9 – 15	9 – 15
Medium	5 – 8	5 – 8
Low	0 – 4	0 – 4

Source: Strategic Directions, Data Centre Standards, Data Centre Size and Density, White Paper, Prepared by the Strategic Directions Group, 1 October 2014.

The NABERS Energy for data centres rating is suitable for data centres with energy consumption greater than:<sup>91</sup>

- 10 000 kWh for a 40 day period for IT Equipment ratings;
- 87 600 kWh for 1 year or with IT equipment greater than 10 kW for Infrastructure ratings;
- 175 000 kWh for 1 year or with IT equipment greater than 10 kW for Whole Facility ratings.

Whilst data centres with lower consumption can be rated, NABERS does not guarantee accuracy. As NABERS cannot guarantee accuracy, mandatory disclosure for smaller data centres would be inappropriate.

One stakeholder suggested starting with a relatively high threshold that captures only the very large data centres. This could then be reduced if mandatory disclosure is effective at driving improved energy efficiency in those data centres covered by the mandatory disclosure requirements.

However, focusing only on large data centres exclude ‘Edge’ data centres, which are expected to be an increasing share of the market. Furthermore, larger data centre owners may already have reporting obligations under NGERs (albeit, not necessarily at the facility level).

#### *Trigger*

A sale or lease trigger is unlikely to be appropriate for data centres. The sale or lease trigger would not capture private data centres (unless sold).

<sup>91</sup> NABERS, NABERS Energy for data centres, Rules for collecting and using data, July 2014, p. 10.

The main barriers that mandatory disclosure would overcome are behavioural failures, rather than an information asymmetry or split incentives. As such, a periodic trigger would be more appropriate.

### *Disclosure arrangements*

Even with a periodic trigger, similar sale and lease disclosure requirements that currently apply for office buildings could be applied to colocation data centres.

In relation to private data centres, the NABERS rating would largely be providing a 'nudge' for owners to improve performance (i.e. addressing behavioural failures). As such, there is no obvious need for that information to be disclosed. That said, some stakeholders argue that disclosure has been important in driving behavioural change in the office market, due in part to the 'embarrassment factor' associated with disclosing a low rating.

In the case of private data centres, disclosing the NABERS rating in the foyer of the data centre is unlikely to provide any additional motivation to improve performance as data centres would be less frequently visited than office buildings. The main option for disclosure is therefore on company websites and/or annual reports (where relevant).

### *Other issues*

As little information is available on private data centres, enforcement is likely to be a key challenge. That said, some stakeholders suggested that the owners of larger private data centres are generally larger publicly-listed companies and may therefore choose to comply, even if an effective enforcement mechanism is in place.

## *Evidence of market and behavioural failures*

### *Colocation data centres*

As colocation data centre industry involves leasing, there is potential for information asymmetries to arise. That said, industry stakeholders had mixed views on the transparency around energy costs. To the extent that the transparency around energy costs is a problem, this may be best dealt with through explicit transparency requirements, rather than through mandatory NABERS ratings.

Given the length of some leases (particularly in the wholesale market), split incentives can arise in relation to colocation data centres; some industry stakeholders provided anecdotal evidence of owners of colocation data centres being reluctant to invest in improving the energy efficiency of the heating and cooling infrastructure because the tenant would ultimately receive the benefits. However, split incentives that arise due to the structure of the lease would not necessarily be addressed through mandatory disclosure.

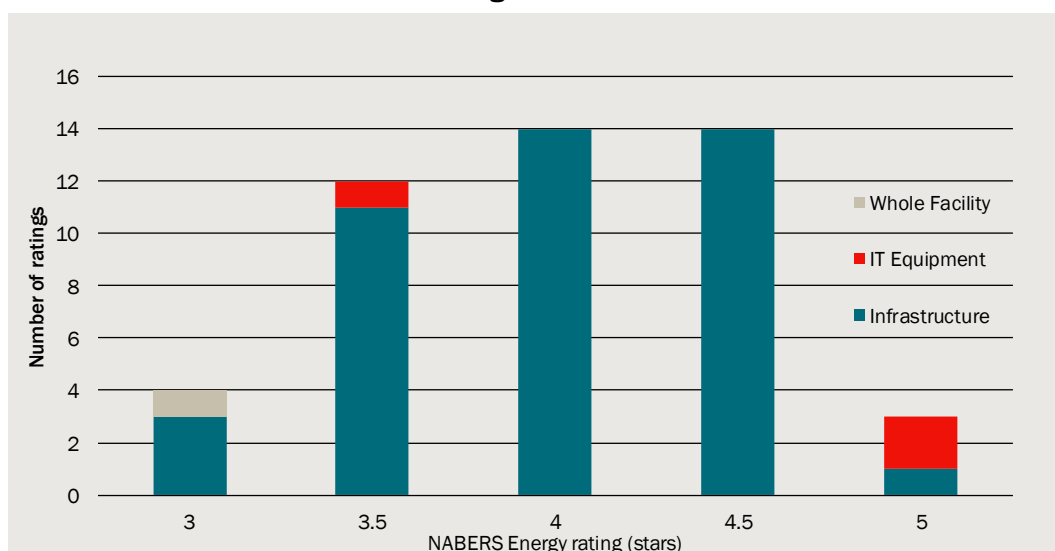
Some industry stakeholders also argued that behavioural failures are less likely in colocation data centres because energy is a much higher proportion of total costs (i.e. there is no insalience problem).

- As the industry is highly competitive, energy costs must be managed to compete effectively.
- Metrics such as power usage effectiveness (PUE) are already monitored closely.

This implies that colocation data centres are operated closer to maximum efficiency given the design of the building.

The objective evidence gathered tended to support this view. The NABERS Infrastructure star ratings that have been completed are generally in a relatively narrow range. All of the ratings to date have been in the 3 to 5 star range (2 out of the 3 ratings of 5 stars were IT Equipment ratings), with most in a relatively narrow range between 3.5 and 4.5 stars (chart 9.5).

### 9.5 Distribution of NABERS star ratings



Data source: NABERS database.

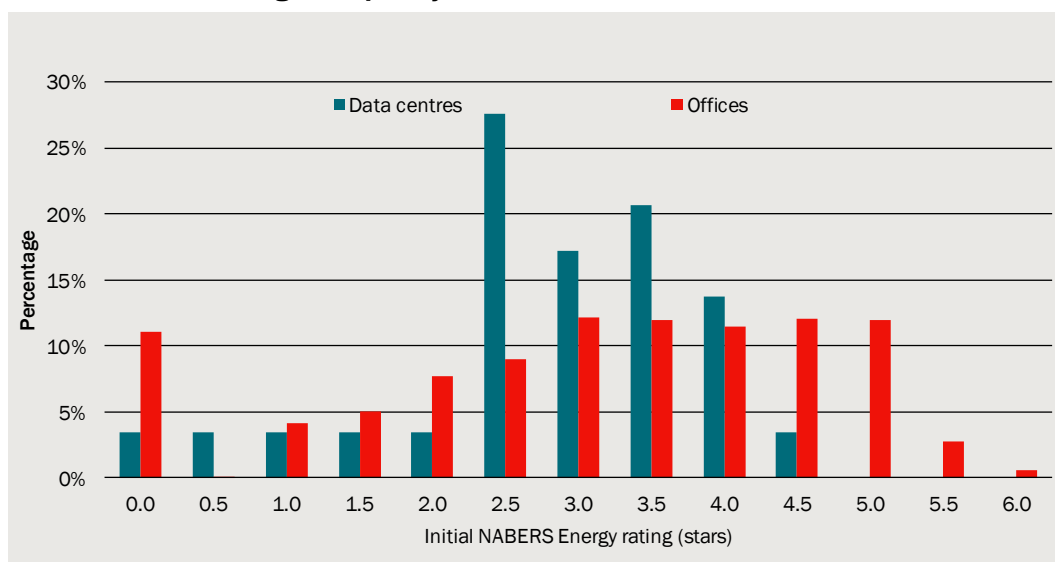
That said, it may be that the data centres that are currently rating voluntarily (and disclosing the rating) perform better than average, as there is little incentive for those that perform worse than average to disclose the rating by formally lodging it with NABERS.

- The average across the sample of voluntary ratings (using the NABERS data centres infrastructure tool) is around 4 stars.
- This is higher than the average of the initial sample of data centres that were used to develop the NABERS tool (the star rating bands are set such that the average is 2.75 (the midpoint of the 2.5 to 3 star band)).

Chart 9.6 compares the distributions of the initial sample of data centres used to develop the NABERS tool (29 data centres) with the first rating of all office buildings that have had a NABERS rating.

- Most data centres are close to the average (2.5 to 4 stars), with relatively few in the ‘tails’ of the distribution (i.e. 4.5 stars and above or 2 stars and below).
- By contrast, the initial rating of office buildings were much more dispersed.

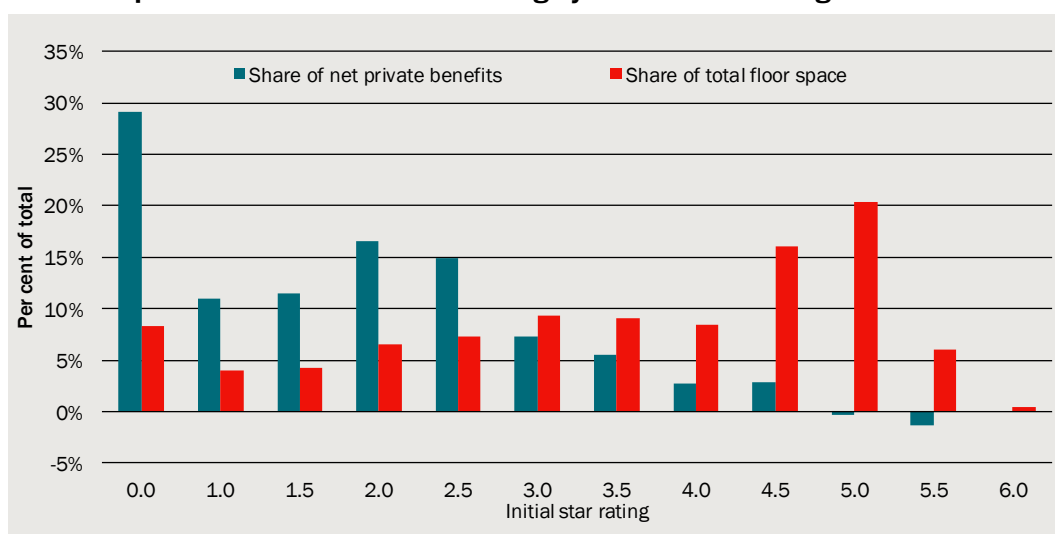
## 9.6 Initial star rating – frequency distribution



Data source: CIE based on NABERS data.

This suggests there is generally less scope for short-term improvements through low-cost operational changes (i.e. low hanging fruit). These types of changes have been a key driver of the improvements that have been achieved in the office market. In particular, we estimate that for the office market more than two-thirds of the net private benefits (excluding compliance costs) were achieved by buildings with a first NABERS rating of 2 stars or less, even though these buildings made up only 30 per cent of total floor space (chart 9.7).

## 9.7 Net private benefits for office building by first NABERS rating



Data source: CIE estimates.



### *Market and behavioural failures relating to private data centres*

That said, some industry stakeholders argued that mandatory disclosure could encourage owners/managers to make more energy efficient decisions in the longer-term, through end-of-life equipment replacements. Some assessors provided anecdotal evidence of 'like-for-like' replacements, rather than more energy efficient options that would have a very short payback period. However, other stakeholders argued that there are often valid reasons why energy efficiency opportunities are not implemented (see below).

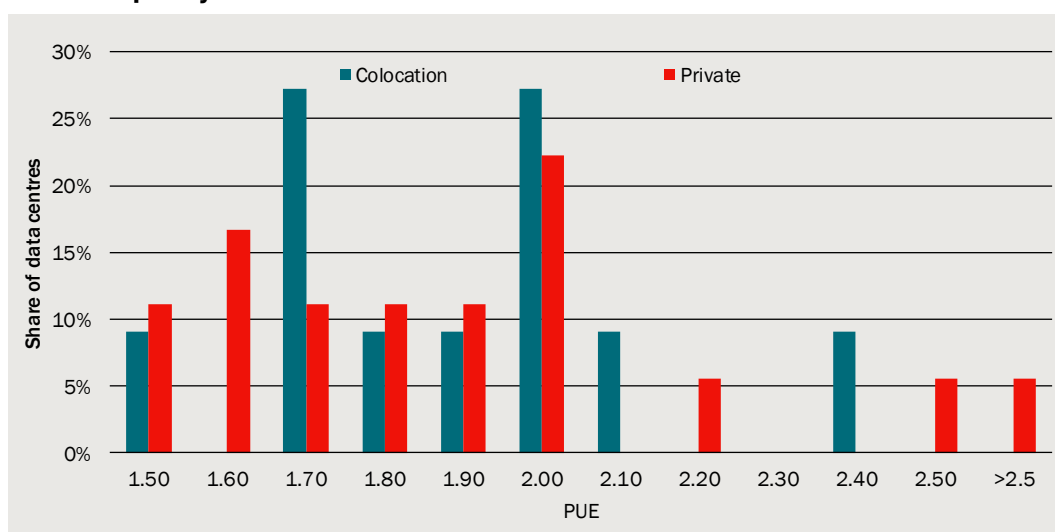
Several stakeholders argued that although there are no information asymmetries or split incentives (i.e. they are owner-operated), behavioural failures are likely to be more prevalent in private data centres.

- Although data centres are energy intensive, the energy used by a private data centres is likely to be a small share of overall business costs for large organisations. This can potentially lead to the insalience problem.
- As private data centres are generally embedded in large organisations, they are not subject to the same competitive pressures as colocation data centres that must keep energy costs low to compete effectively in the market.

This view is supported by anecdotal evidence from assessors who have encountered some very inefficient private data centres (including data centres owned by government agencies).

On the other hand, based on the sample of data centres gathered to develop the NABERS tool, there does not appear to be a systematic difference between the performance of private and colocation data centres. This sample included: 11 colocation data centres; and 18 private data centres. The average PUE across the two samples was about the same (see chart 9.8).

### **9.8 Frequency distribution of PUE**



Data source: NABERS.

### *Would mandatory disclosure drive behavioural change?*

There is little evidence to suggest that mandatory disclosure would drive energy efficiency improvements in data centres.

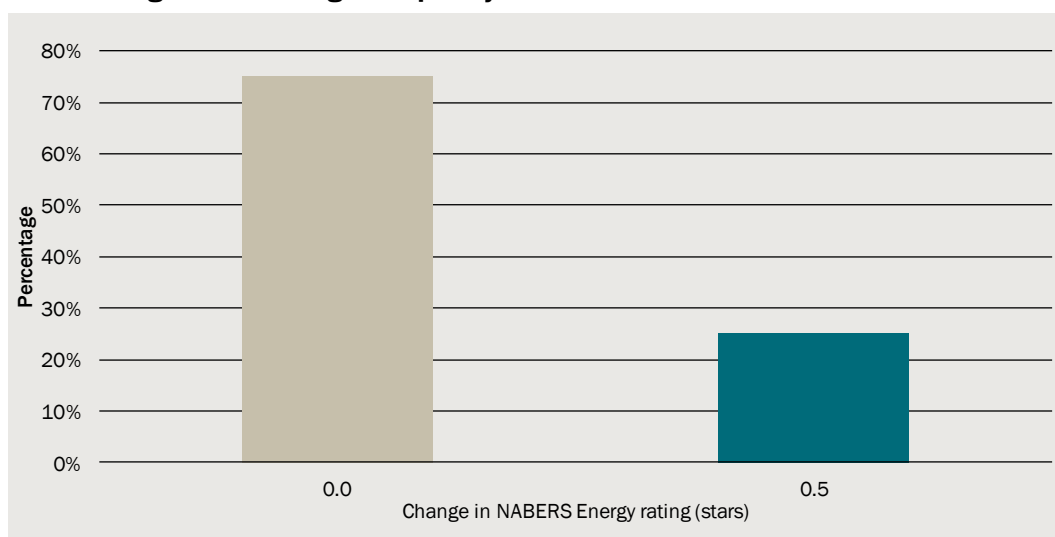
#### *Limited appetite for rated data centres*

The low uptake of voluntary NABERS ratings suggest a limited appetite for rated data centres. In general, it would be reasonable to expect that were there demand from data centre clients for NABERS-rated data centres, the market would respond with greater uptake of the voluntary NABERS tool and improving ratings over time.

#### *Evidence from voluntary NABERS ratings*

There is little evidence of a systematic improvement in performance over time for those data centres with multiple NABERS ratings. In total, there are 12 data centres with multiple ratings (ranging from 2 up to 5 ratings). Comparing the first and last rating, there was no change in the star rating for 9 of these data centres, with the remaining 3 improving by half a star (chart 9.9).

#### **9.9 Change in star rating – frequency distribution**



Data source: CIE based on NABERS data.

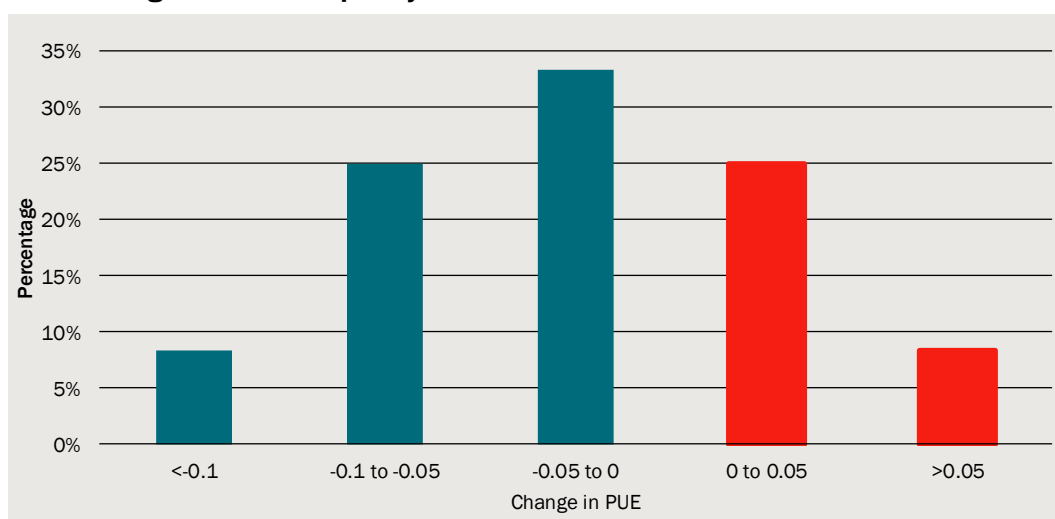
This tends to support the view of most stakeholders that most colocation data centres are operating close to maximum efficiency given the design of the building and the technology in place (see below). As noted above, this suggests there may be limited opportunities for low-cost operational changes that have been a significant driver of the net benefits achieved in the office sector.

Power usage effectiveness (PUE) is an industry measure of the efficiency of a data centre's infrastructure. It is the ratio of total facility energy consumption to the energy consumption of the IT equipment (implying a PUE of 1 if the data centre uses no energy on infrastructure). The NABERS data centre infrastructure rating is largely based on

PUE (with some adjustments). The average change in PUE between the first and last rating was -0.02 (i.e. a small improvement in performance).

- 8 data centres reduced PUE (i.e. improved performance), with the largest reduction - 0.11 (chart 9.10).
- For the remaining 4 data centres with multiple ratings, PUE increased between the first and last rating.

### 9.10 Change in PUE – frequency distribution



Data source: CIE based on NABERS data.

### *Barriers to improving the energy efficiency of existing data centres*

Many stakeholders agreed that there is limited scope for to improve the energy efficiency of existing data centres. A key industry stakeholder outlined a range of barriers that may prevent any significant improvement in the energy efficiency of existing data centres. In particular, the cost structure of data centres (including both privately owned and colocation facilities) are significantly different to most other commercial buildings. The following ‘rule of thumb’ was provided to explain the difference in cost structure.

- In a typical commercial building, around 80 per cent of the cost relates to the land and building, and 20 per cent relates to infrastructure (power, cooling, security, etc).
- By contrast, in a typical data centre, around 80 per cent of the cost relates to infrastructure (power, cooling, security, etc) and 20 per cent relates to land and building.

The difference in cost structure of data centres means that there are a range of valid reasons for ‘like for like’ replacement of infrastructure, even when more energy efficient alternatives are available (i.e. the failure to replace infrastructure at end of life with the most energy efficient alternative is not necessarily a ‘behavioural failure’).

- A data centre’s infrastructure is built around aligned subsystems that were originally selected to meet operational, spatial, interoperability, fire risk management, high availability and maintainability objectives. In many cases, more efficient cooling systems cannot simply be retrofitted into existing buildings. For example, moving to a

free-air cooling system might require substantial building works, electrical system redesign, control systems redesign and update. The total cost of upgrading to a more efficient cooling system may therefore be significantly higher than it appears.

- As data centres are central to supporting their clients core business operations, service availability is critical. For example, banks (to support ATM and POS services), hospital and police and emergency services require their systems to be available all of the time. Service availability therefore takes precedent over energy efficiency for many data centre clients. Any risk of reducing the availability or performance of the data centre through a change in core systems (power or cooling infrastructure) to improve efficiency is unlikely to be palatable to either the data centre owner or the tenants/customers. Anecdotal evidence was provided of both government and business customers of colocation facilities refusing to have redundant systems closed down or placed into 'standby' mode in order for the facility to become more efficient (i.e. customers were not willing to accept the trade-off between lower operational availability/uptime of systems supporting their core business services for improved energy efficiency). That said, there may be options to work around these risks (such as using Variable Air Valves to provide redundancy for HVAC to racks), but willingness to consider change may require greater liaison between policy makers and data centre operators to identify and address any information gaps.

These barriers to improving energy efficiency in existing data centres suggest that mandatory disclosure is likely to have a limited impact on energy performance.

### *Stakeholder views*

There have been mixed views among stakeholders on the expansion of the CBD Program to data centres.

- A number of stakeholders supported expanding mandatory disclosure requirements to data centres based on:
  - general support for the principle of mandatory disclosure
  - the observation that mandatory disclosure for office buildings has helped to drive behavioural change in the office market.
- Some industry stakeholders also supported expanding mandatory disclosure to data centres (although this support largely came from data centre owners that already rated).
- Other industry stakeholders did not support mandatory disclosure on the basis that mandatory disclosure is unlikely to drive significant behavioural change and mandatory disclosure requirements would be an unnecessary impost on data centres.

### *Information on costs and benefits*

In general, there is insufficient information available to complete a rigorous CBA of options to expand mandatory disclosure requirements to data centres under the CBD Program.

We estimate the cost of obtaining a NABERS Data Centre (Infrastructure) rating would be around \$6600 per rating (table 9.11). This estimate is based on the following information.

- Only 3 respondents to our survey of assessors indicated they had completed a NABERS Data Centre (Infrastructure) rating (no respondents indicated they had completed an IT Equipment or Whole Facility rating). The average cost across these respondents was around \$4500.
- NABERS fees are as set out on their website.<sup>92</sup>
- We previously estimated internal costs of arranging a NABERS rating for office buildings at around \$1000. We assume a similar cost would apply to data centres.

### 9.11 Cost of a NABERS rating for data centres

	Estimated cost
	\$
Consulting fees	4 504
NABERS fees	1 108
Internal administration costs	1 000
<b>Total</b>	<b>6 612</b>

Source: CIE survey of assessors, NABERS website, <https://www.nabers.gov.au/pricing>, accessed 9 August 2019.

The cost of changing the metering arrangements to allow a NABERS rating could be significant. Some stakeholders reported these costs could be as high as \$50 000 for some facilities.

On the other hand, there is little reliable evidence on:

- the number of private data centres or their energy consumption
- the extent to which mandatory disclosure could drive improved performance (there have been insufficient voluntary ratings to assess the impact that the use of NABERS tools has on energy performance)
- the cost of improving the energy efficiency of data centres (although anecdotal evidence suggests this is likely to be significantly higher than office buildings)
- the average cost of changing metering arrangements to facilitate a NABERS rating.

### *Feedback on our draft recommendations*

For data centres, feedback that would assist with developing our final recommendations includes:

- any information on the number of private data centres (and the size)
- feedback for data centre owners and clients on how NABERS ratings would be used
- any information on the cost of obtaining the first NABERS ratings (including the cost of any necessary metering changes)
- any information on the costs and benefits of energy efficiency upgrades for data centres.

<sup>92</sup> NABERS website, <https://www.nabers.gov.au/pricing>, accessed 9 August 2019.

## 10 Other issues

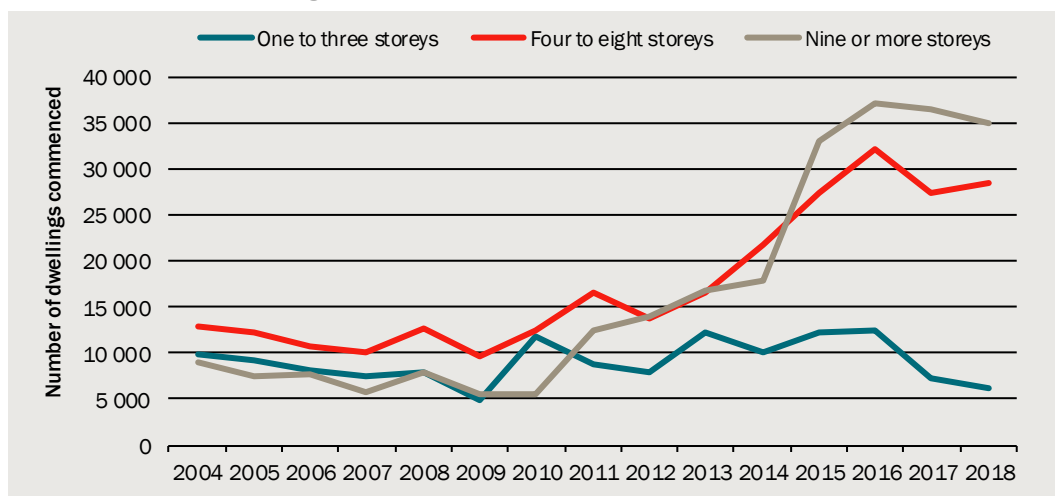
### *Sectors not reviewed in detail*

The review terms of reference focuses on commercial building disclosure, in particular, the expansion to sectors covered above. A number of stakeholders have raised apartments (the common areas only) as a possibility for mandatory disclosure. We have not looked at this in detail but make the following observations.

Apartments present an opportunity to reduce energy use and associated greenhouse gas emissions. There are 8.7 million dwellings in Australia as at 2016, of which 13.1 per cent are apartments.<sup>93</sup> These apartments are home to around 10 per cent of the population.<sup>94</sup>

The growth in the number of occupied apartments (dwellings) over the past 25 years has increased by 78 per cent<sup>95</sup> with most growth coming from higher density apartments (chart 10.1).

#### 10.1 Number of dwellings commenced, 2003-04 to 2017-18



Data source: ABS (2018), *Building Activity, Apartments by Number of Storeys*, Cat. 8752.0, Data Cube, available at: <https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8752.0Dec%202018?OpenDocument>, accessed 9 August 2019.

<sup>93</sup> ABS (2017), *Census of Population and Housing*, Cat. 2071, Table 2, available at: <https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0~2016~Main%20Features~Apartment%20Living~20>, accessed 9 August 2019.

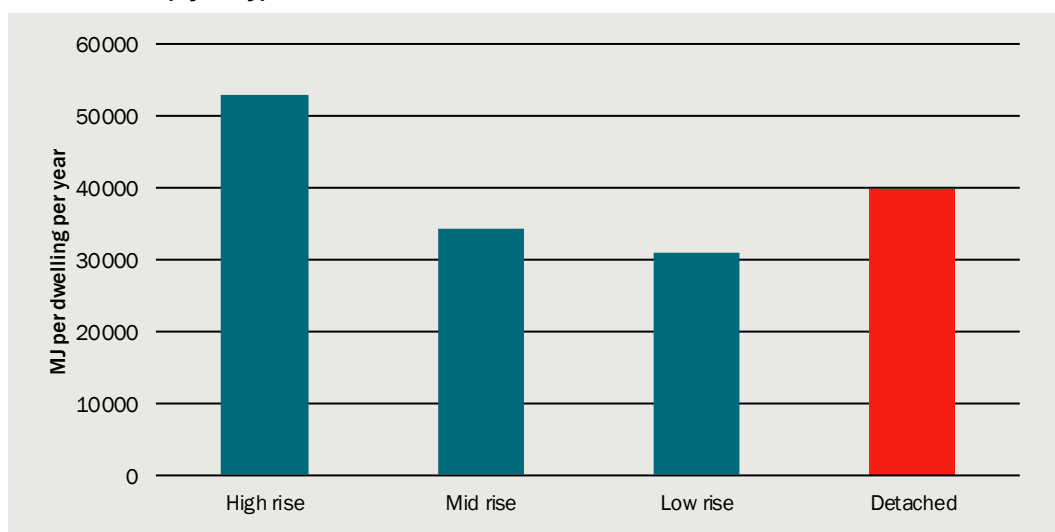
<sup>94</sup> ABS (2017), *Census Data Summary*, available at: [https://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/19DA38C6B6AF5E9FCA25814B00030D2E/\\$File/snapshot%20of%20australia,%202016%20census%20data%20summary.pdf](https://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/19DA38C6B6AF5E9FCA25814B00030D2E/$File/snapshot%20of%20australia,%202016%20census%20data%20summary.pdf), accessed 9 August 2019.

<sup>95</sup> ABS (2017), *Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016*, available at: <https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0~2016~Main%20Features~Apartment%20Living~20>, accessed 9 August 2019.

The drivers for energy use in the common areas of apartments are heating, ventilation and air conditioning, lighting and other common amenities (such as swimming pools) driving energy costs.

Energy consumption per dwelling tends to increase as the density of the dwelling increases (chart 6.2).

## 10.2 Energy consumption for apartments based on density compared to a detached house (Sydney)



Note: High rise 9 storeys and above; mid rise 4 to 8 storeys; low rise 1 to 3 storeys.

Data source: Tupper, C., Energy Australia, *Energy efficient apartment buildings*, available at: [https://www.northsydney.nsw.gov.au/files/assets/public/docs/4\\_waste\\_environment/sustainability/energy\\_efficiency\\_energyaustralia.pdf](https://www.northsydney.nsw.gov.au/files/assets/public/docs/4_waste_environment/sustainability/energy_efficiency_energyaustralia.pdf).

Only a part of the energy use of an apartment reflects common area energy use. Based on the small set of apartments that have undertaken NABERS assessments, this ranges from 1000 to 20 000 MJ per apartment per year — the apartments rated using NABERS so far are achieving high star ratings, so the higher end of the band is more likely to be average. This suggests that the level of energy use for common areas of apartments is likely to be larger than for the energy use currently covered by the CBD Program.

In terms of whether mandatory disclosure would have net benefits for apartments:

- apartments are the building type most similar to office buildings in the way that they are built and in the market structures
- apartments fit clearly into issues of both bounded rationality and demand from tenants/owners for information on performance
  - the management of apartments will often be less professional than for offices as apartments are managed by body corporates. This means that they may lack the technical training to consider how energy efficiency options may work in the building.

However, apartments cannot be regulated by the Australian Government, because they are not generally operated as companies. As is the case with commercial buildings, this is because strata titled buildings cannot be covered by the Commonwealth under the

Corporations Act. This means that it would require state government agreement to make any regulations around disclosure for apartment buildings.

Including apartments would somewhat reduce issues raised by hotels about a lack of a level playing field with other accommodation providers (e.g. Airbnb, serviced apartments).

- **State and territory government should agree to a detailed examination of mandatory disclosure of NABERS ratings for apartment buildings, including consideration of an appropriate legal framework.**

### *Cost recovery arrangements*

Under the Australian Government *Cost Recovery Guidelines*, a key early step in developing a new cost recovery mechanism is to establish the policy case for cost recovery.<sup>96</sup> There is an in-principle case to recover the cost of administering the CBD Program (including compliance and enforcement activities that form an integral part of the CBD Program's regulatory framework) through user charges.

Although recovering the costs of administering the CBD Program through user charges would be broadly consistent with the Australian Government Cost Recovery Guidelines, cost recovery would be unlikely to deliver any significant efficiency benefits.

Furthermore, (current) processing time between the accounts and the DEE CBD team around payments for assessor accreditation and exemptions indicate that the processing time may significantly slow down the time for BEECs and TLAs, which could impact adversely on time sensitive leasing and sales transactions. However, there is an equity case for cost recovery, as user charges would ensure that the costs of administering the CBD Program would be borne by those who cause the costs to be incurred (i.e. building owners and tenants).

Cost recovery can improve efficiency where it encourages the regulated community to consider the cost of operating the regulatory framework in their decisions. However, passing the costs incurred by DEE onto users is unlikely to significantly affect a decision to obtain a BEEC because it is a mandated requirement. Obtaining more BEECs than is mandated, such as by obtaining an annual BEEC even if space is not leased or sold, is possible (and occurs). Passing through costs for compliance to BEECs may somewhat reduce this. This in turn would reduce administrative costs. However, this would not be likely to reduce compliance costs, as costs will depend on checking of disclosure.

From an equity perspective, the case for cost recovery generally rests on who benefits or who causes the cost to be incurred. In relation to cost recovery for regulatory functions, this is normally interpreted as those whose activities cause the costs to be incurred (or cause the need for regulation) should bear the costs. Under this interpretation, there would be some equity benefits as the industry would bear the costs, rather than the broader community.

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<sup>96</sup> Australian Government Department of Finance, *Australian Government Cost Recovery Guidelines*, Resource Management Guide No. 304, July 2014 – Third edition, p. 1.



The above suggests there is some case for cost recovery, but there is no particularly strong gain from making users pay the costs of the scheme.

- **Recovering the costs incurred by DEE in administering CBD Program through user charges would be broadly consistent with the Australian Government Cost Recovery Guidelines, although cost recovery is unlikely to deliver significant efficiency benefits.**
- **DEE should develop a cost recovery framework that complies the Australian Government Cost Recovery Guidelines.**

## A Cost-benefit analysis by state and territory

### Net benefits to date

The cost-benefit analysis over the period from 2010-11 to 2018-19 by state and territory is shown in table A.1.

#### A.1 CBD Program to 2018-19 – cost-benefit analysis

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million
<b>CBD Program - original design</b>									
<b>Private benefits/costs</b>									
Electricity savings	27.81	31.35	19.40	11.83	3.20	- 7.31	2.85	0.61	89.74
Gas savings	15.24	8.80	11.33	2.10	1.82	6.62	2.85	0.27	49.04
Upgrade costs	- 21.93	- 19.36	- 13.33	- 6.41	- 2.42	- 0.28	- 3.82	- 0.52	- 68.07
Compliance costs - NABERS ratings	- 8.98	- 6.23	- 5.28	- 2.98	- 1.34	- 0.55	- 1.73	- 0.45	- 27.54
Compliance costs - TLAs	- 3.38	- 1.66	- 1.30	- 0.84	- 0.39	- 0.07	- 0.50	- 0.05	- 8.19
<b>Net private benefits/costs</b>	<b>8.77</b>	<b>12.91</b>	<b>10.82</b>	<b>3.69</b>	<b>0.87</b>	<b>- 1.59</b>	<b>- 0.35</b>	<b>- 0.14</b>	<b>34.98</b>
<b>Other benefits/costs</b>									
GHG emissions	18.90	24.72	11.75	5.30	1.26	0.00	2.25	0.29	64.48
Government costs	- 3.76	- 2.65	- 2.32	- 1.39	- 0.61	- 0.23	- 0.74	- 0.20	- 11.91
<b>Total net benefit/cost</b>	<b>23.92</b>	<b>34.98</b>	<b>20.25</b>	<b>7.60</b>	<b>1.52</b>	<b>- 1.83</b>	<b>1.16</b>	<b>- 0.05</b>	<b>87.54</b>
<b>CBD Program - 2017 changes</b>									
<b>Private benefits/costs</b>									
Electricity savings	0.03	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.15
Gas savings	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.06
Upgrade costs	- 0.02	- 0.02	- 0.02	- 0.02	0.00	0.00	0.00	0.00	- 0.09
Compliance costs - NABERS ratings	- 0.40	- 0.32	- 0.39	- 0.31	- 0.12	- 0.02	- 0.07	- 0.04	- 1.67
Compliance costs - TLAs	0.36	0.11	0.06	0.04	0.00	0.00	0.03	- 0.07	0.52
<b>Net private benefits/costs</b>	<b>- 0.02</b>	<b>- 0.18</b>	<b>- 0.30</b>	<b>- 0.24</b>	<b>- 0.12</b>	<b>- 0.02</b>	<b>- 0.03</b>	<b>- 0.11</b>	<b>- 1.03</b>
<b>Other benefits/costs</b>									
GHG emissions	0.02	0.03	0.02	0.02	0.00	0.00	0.00	0.00	0.10

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million
Government costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total net benefit/cost</b>	<b>0.00</b>	<b>- 0.15</b>	<b>- 0.28</b>	<b>- 0.23</b>	<b>- 0.12</b>	<b>- 0.02</b>	<b>- 0.03</b>	<b>- 0.11</b>	<b>- 0.93</b>
<b>CBD Program - total</b>									
<b>Private benefits/costs</b>									
Electricity savings	27.84	31.39	19.43	11.87	3.20	- 7.31	2.85	0.61	89.89
Gas savings	15.26	8.81	11.36	2.11	1.82	6.62	2.86	0.27	49.11
Upgrade costs	- 21.95	- 19.38	- 13.35	- 6.43	- 2.43	- 0.28	- 3.82	- 0.52	- 68.16
Compliance costs - NABERS ratings	- 9.38	- 6.54	- 5.67	- 3.30	- 1.46	- 0.57	- 1.80	- 0.49	- 29.22
Compliance costs - TLAs	- 3.01	- 1.56	- 1.25	- 0.80	- 0.38	- 0.08	- 0.47	- 0.12	- 7.67
<b>Net private benefits/costs</b>	<b>8.75</b>	<b>12.72</b>	<b>10.52</b>	<b>3.45</b>	<b>0.75</b>	<b>- 1.62</b>	<b>- 0.39</b>	<b>- 0.25</b>	<b>33.95</b>
<b>Other benefits/costs</b>									
GHG emissions	18.92	24.76	11.77	5.32	1.26	0.00	2.26	0.29	64.58
Government costs	- 3.76	- 2.65	- 2.32	- 1.39	- 0.61	- 0.23	- 0.74	- 0.20	- 11.91
<b>Total net benefit/cost</b>	<b>23.92</b>	<b>34.83</b>	<b>19.97</b>	<b>7.38</b>	<b>1.40</b>	<b>- 1.85</b>	<b>1.13</b>	<b>- 0.16</b>	<b>86.62</b>

Note: Costs and benefits are presented in present value terms over the period from where the CBD Program commenced in 2010/11 to 2018-19. As the energy efficiency upgrades made over this period will continue to deliver benefits into the future, energy saving benefits have been extended for an additional ten years.

Source: CIE estimates.

## *Business as usual to 2030*

Assuming 'business as usual' out to 2029-30, the cost-benefit analysis for the CBD Program is shown in table A.2.

### **A.2 CBD Program 'business as usual' to 2029-2030 — cost-benefit analysis**

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million
<b>CBD Program - original design</b>									
<b>Private benefits/costs</b>									
Electricity savings	57.39	72.67	38.98	24.09	6.96	- 20.03	6.48	1.30	187.85
Gas savings	32.96	20.87	23.34	4.26	3.90	19.28	6.83	0.57	112.02
Upgrade costs	- 53.07	- 53.66	- 27.32	- 13.68	- 5.55	- 0.74	- 9.26	- 1.11	- 164.39
Compliance costs - NABERS ratings	- 14.61	- 10.21	- 9.29	- 5.67	- 2.52	- 0.97	- 3.10	- 0.78	- 47.15
Compliance costs - TLAs	- 3.38	- 1.66	- 1.30	- 0.84	- 0.39	- 0.07	- 0.50	- 0.05	- 8.19

	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million	\$ million
<b>Net private benefits/costs</b>	<b>19.29</b>	<b>28.01</b>	<b>24.42</b>	<b>8.16</b>	<b>2.41</b>	<b>- 2.54</b>	<b>0.45</b>	<b>- 0.07</b>	<b>80.13</b>
Other benefits/costs									
GHG emissions	44.26	62.52	26.01	11.57	2.93	0.05	5.88	0.67	153.88
Government costs	- 6.62	- 4.67	- 4.09	- 2.46	- 1.07	- 0.41	- 1.31	- 0.35	- 20.98
<b>Total net benefit/cost</b>	<b>56.93</b>	<b>85.86</b>	<b>46.33</b>	<b>17.28</b>	<b>4.26</b>	<b>- 2.90</b>	<b>5.02</b>	<b>0.25</b>	<b>213.03</b>
<b>CBD Program - 2017 changes</b>									
Private benefits/costs									
Electricity savings	0.38	0.47	0.46	0.47	0.04	0.00	0.07	0.05	1.94
Gas savings	0.23	0.14	0.28	0.08	0.02	0.00	0.08	0.02	0.85
Upgrade costs	- 0.35	- 0.33	- 0.32	- 0.24	- 0.03	0.00	- 0.08	- 0.03	- 1.37
Compliance costs - NABERS ratings	- 0.40	- 0.32	- 0.39	- 0.31	- 0.12	- 0.02	- 0.07	- 0.04	- 1.67
Compliance costs - TLAs	1.95	0.72	0.29	0.35	0.07	- 0.01	0.20	- 0.57	2.99
<b>Net private benefits/costs</b>	<b>1.82</b>	<b>0.68</b>	<b>0.33</b>	<b>0.35</b>	<b>- 0.03</b>	<b>- 0.03</b>	<b>0.20</b>	<b>- 0.57</b>	<b>2.74</b>
Other benefits/costs									
GHG emissions	0.32	0.43	0.33	0.24	0.02	0.00	0.07	0.03	1.43
Government costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total net benefit/cost</b>	<b>2.14</b>	<b>1.10</b>	<b>0.66</b>	<b>0.58</b>	<b>- 0.01</b>	<b>- 0.03</b>	<b>0.27</b>	<b>- 0.55</b>	<b>4.17</b>
<b>CBD Program - total</b>									
Private benefits/costs									
Electricity savings	57.77	73.15	39.45	24.56	7.00	- 20.03	6.56	1.35	189.79
Gas savings	33.19	21.00	23.63	4.34	3.92	19.28	6.91	0.59	112.87
Upgrade costs	- 53.41	- 53.99	- 27.63	- 13.92	- 5.58	- 0.74	- 9.34	- 1.14	- 165.76
Compliance costs - NABERS ratings	- 15.01	- 10.53	- 9.68	- 5.98	- 2.64	- 0.99	- 3.17	- 0.82	- 48.82
Compliance costs - TLAs	- 1.43	- 0.95	- 1.02	- 0.49	- 0.31	- 0.09	- 0.31	- 0.62	- 5.20
<b>Net private benefits/costs</b>	<b>21.11</b>	<b>28.69</b>	<b>24.75</b>	<b>8.51</b>	<b>2.38</b>	<b>- 2.57</b>	<b>0.65</b>	<b>- 0.64</b>	<b>82.88</b>
Other benefits/costs									
GHG emissions	44.58	62.94	26.34	11.81	2.94	0.05	5.95	0.69	155.30
Government costs	- 6.62	- 4.67	- 4.09	- 2.46	- 1.07	- 0.41	- 1.31	- 0.35	- 20.98
<b>Total net benefit/cost</b>	<b>59.07</b>	<b>86.96</b>	<b>47.00</b>	<b>17.86</b>	<b>4.25</b>	<b>- 2.93</b>	<b>5.29</b>	<b>- 0.30</b>	<b>217.20</b>

Note: Costs and benefits are presented in present value terms over the period from where the CBD Program commenced in 2010/11 to 2029-30. As the energy efficiency upgrades made over this period will continue to deliver benefits into the future, energy saving benefits have been extended for an additional ten years.

Source: CIE estimates.

## *B Valuing the benefits of saving energy*

Energy saved is typically valued in terms of:

- the resource cost savings, and
- the environmental benefits.

### *Resource cost savings*

According to Lazar and Colborn (2013)<sup>97</sup>, there are two broad approaches to valuing the benefits of reduced energy consumption.

- Capacity and energy approach — under this approach, the costs of building and operating power plants are separated into capacity component (this includes the capital costs of meeting peak demand) and an energy component representing the remaining costs of power supply.
- Market pricing approach — under this approach, the energy saved through improved energy efficiency is valued based on the market price (i.e. bill savings). Lazar and Colborn (2013) argue that in many cases, the market price internalises many of the generation, transmission and distribution costs and therefore may be a more precise measure of costs (depending on what costs are internalised in the market price).

Both approaches have been used in energy efficiency studies in the Australian context.

### *The capacity and energy approach*

In a CBA of NSW Government energy efficiency schemes, Jacobs (2014) used the capacity and energy approach, with the benefits including:

- Wholesale market benefits, including:
  - electricity market benefits, such as avoided fuel costs, avoided variable operating and maintenance costs and deferred infrastructure; and
  - gas market benefits including deferred gas production and delivery infrastructure.
- Network benefits, including transmission and distribution infrastructure deferrals. These are estimated by:
  - estimating peak reduction by network service area by converting the energy savings to peak reduction using estimates of the conservation load factor (CLF);

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<sup>97</sup> Lazar, Jim and Ken Colborn 2013, *Recognizing the Full Value of Energy Efficiency (What's Under the Feel-Good Frosting of the World's Most Valuable Layer Cake of Benefits)*, September 2013, available at <http://www.raponline.org/wp-content/uploads/2016/05/rap-lazarcolburn-layercakepaper-2013-sept-9.pdf>.

- converting peak demand reductions to an estimate of network capacity deferral, by calculating the year on year incremental growth; and
- applying a distribution and transmission deferral benefit factor to the estimates of network capacity deferral.<sup>98</sup>

Similarly, a recent report by Houston-Kemp for the Department of the Environment and Energy (DEE) setting out a CBA methodology in relation to residential energy efficiency, also advocates valuing energy savings based on avoided wholesale and network-related costs, although proposes a different approach to valuing these elements. Under the approach proposed by Houston-Kemp:

- wholesale costs are valued at wholesale market prices; and
- network-related costs are valued using the long-run marginal cost (LRMC — see box B.1 for further details).<sup>99</sup>

### **B.1 Long-run marginal cost**

Marginal cost is a key concept in economic analysis. It is the additional cost of supplying an additional unit of production. Standard economic theory suggests that in a competitive market, prices reflect the marginal cost of the last unit traded.

In the context of network services, there is an important distinction between:

- short-run marginal cost (SRMC) — this is defined as the cost of an incremental change in demand holding physical capacity constant; and
- long-run marginal cost (LRMC) — this is the cost of an incremental change in demand including the cost of expanding network capacity.<sup>100</sup>

### ***The retail price approach***

On the other hand, a range of other studies have valued energy savings based on retail prices. There are broadly four components to retail electricity prices:<sup>101</sup>

- Wholesale costs — these costs are set in the wholesale market.
- Network costs (including transmission and distribution) — reflecting the natural monopoly characteristics of electricity networks, this element is regulated by the Australian Energy Regulatory (AER).

<sup>98</sup> Jacobs 2014, *NSW Energy efficiency programs: Cost-benefit analysis*, Final report to the NSW Office of Environment and Heritage, pp. 68-75.

<sup>99</sup> See Houston Kemp Economists 2017, *Residential Building Regulatory Impact Statement Methodology*, A report for the Department of the Environment and Energy, 6 April 2017, pp. 14-15.

<sup>100</sup> NERA Economic Consulting 2014, *Economic Concepts for Pricing Electricity Network Services: A Report for the Australian Energy Market Commission*, 21 July 2014, pp. 4-6.

<sup>101</sup> Australian Competition and Consumer Commission 2017, *Retail Electricity Pricing Inquiry*, Preliminary report, 22 September 2017, pp. 53-75.

- Environmental schemes — this includes costs imposed on retailers (and passed onto users) associated with schemes, such as:
  - the Renewable Energy Target;
  - State-based certificate and efficiency schemes (such as the Victorian Energy Efficiency Target, the NSW Energy Saving Scheme); and
  - solar feed-in tariffs.
- Retail costs and margins — together retail costs and margins are referred to as the gross margin. The costs incurred by retailers can sometimes be split into: costs to serve (the costs incurred to provide retail services to an existing customer, such as billing services, losses to bad debts, customer assistance and regulatory compliance costs); and the costs to acquire and retain customers (this includes marketing and advertising). Also included is a net margin for the retailers.

### *Comparing the various approaches*

An obvious difference between the two approaches is that the approach based on retail pricing includes some additional costs, including the cost of environmental schemes and retail costs and margins.

- Where there is a reduction in demand, retailers will generally incur lower costs to comply with the various environmental schemes. These costs should therefore be included.
- On the other hand, most retail costs and the net margin may not change much due to lower demand. This suggests there is a conceptual case to exclude these costs. That said, the ACCC reports that these costs made up only around 3 per cent of the retail price for commercial and industrial customers in 2015/16.<sup>102</sup> We note that the Houston-Kemp report relates to residential buildings, where retail costs and margins make up around 24 per cent of total costs.

The other significant difference relates to the treatment of avoided network costs. The approach used by Jacobs and others explicitly attempts to measure the reduction in peak loads and the extent to which this defers investment to expand capacity. However, in general, the approach to estimating the unit cost of expanding supply capacity is less robust than LRMC estimates suggested by Houston-Kemp. In particular, it appears to be based on capital expenditure related to demand growth in a single year.

As discussed above, network charges are regulated by the AER. Under the AER's pricing principles, each tariff must be based on the long run marginal cost of providing the service to which it relates to the retail customers assigned to that tariff with the method of calculating such cost and the manner in which that method is applied to be determined having regard to:

- the costs and benefits associated with calculating, implementing and applying that method as proposed;

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<sup>102</sup> *ibid*, p. 51.

- the additional costs likely to be associated with meeting demand from retail customers that are assigned to that tariff at times of greatest utilisation of the relevant part of the distribution network; and
- the location of retail customers that are assigned to that tariff and the extent to which costs vary between different locations in the distribution network.<sup>103</sup>

Consequently, retail tariffs should broadly reflect the LRMC of supply.

- If the energy saved through energy efficiency measures is skewed towards peak times (or more skewed towards peak times than average consumption) and/or buildings are not on tariffs that differentiate between peak and off-peak times, the retail price approach may understate peak-related costs.
- On the other hand, if the energy saved is skewed towards non-peak times (or more skewed toward non-peak times than average consumption), the retail price approach could potentially overstate peak-related costs.

That said, there is limited information available on peak load profiles for commercial buildings and these may vary significantly across different buildings and climate zones. The CLFs used in some CBAs may be an approximation only, so it is unclear whether the alternative approach would be an improvement.

Some studies appear to argue that the impact of energy efficiency policies on peak demand should be included in **addition** to the bill savings (based on retail prices).<sup>104</sup> However, this approach double-counts the network component of costs.

In the CBA we use the retail price approach to valuing energy savings. As this approach includes retail costs and margins that would be excluded from the capacity and energy approach, it may result in slightly higher estimates of the benefits of energy efficiency.

The Department of Environment and Energy has also commissioned Energeia to examine the impacts of reduced commercial energy use. The results of this study are set out in box B.2. This confirms that using the retail price may overstate estimated benefits relative to measuring the avoided costs for power generators, and distributors.

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<sup>103</sup> National Electricity Rules, Chapter 6: Economic Regulation of Distribution Services, p. 762.

<sup>104</sup> See for example, Isaac, T. and Pears, A. 2016, *How cautious analysis could lead to a 'do nothing' policy: A case study of the 6-star housing Regulation Impact Statement*, July 2016, pp. 13-16; and pitt&sherry 2013, *Final report: Quantitative assessment of energy savings from building energy efficiency measures*, Prepared for: Department of Climate Change and Energy Efficiency, 20 March 2013, pp. 36-41.



## B.2 Energeia study on impacts of reducing commercial energy use<sup>105</sup>

Energeia examined the cost reductions from reducing energy use for buildings. In particular, the draft National Construction Code expects to reduce residential and commercial electricity consumption by 36 TWh, in 2050, with a gradual accumulation to this level of savings. The study modelled a 16 per cent reduction in residential electricity consumption and 15 per cent reduction in commercial electricity consumption, compared to the baseline or do-nothing option.

The avoided network and generation capex costs were estimated at \$7.5 billion and \$4.1 billion, respectively.

Note that this is small relative to what would be measured using retail prices. For example, with an average retail price of between 10 cents (large commercial) and 30 cents per kwh (residential), avoiding 36 TWh is equivalent to \$3.6 billion to \$10.8 billion in 2050 alone. The estimated bill savings occur in each year. Even with discounting and a gradual accumulation of impact, this suggests that the avoided capex costs are a small fraction of the estimates using market prices for energy.<sup>106</sup>

### *Electricity prices*

The series for commercial electricity prices were manually calculated, as no time series for the sector are currently published. To create a measure, prices were constructed by combining:

- Regulated transmission and distribution prices — the Australian Energy Regulator (AER) regulates network prices, meaning that they are publicly available. These prices were collected for all of the networks. Western Australian prices are regulated by the Economic Regulation Authority of WA (ERAWA), and these prices were collected in kind.
- Wholesale electricity prices — wholesale electricity prices are published by the Australian Energy Market Operator (AEMO), and these were collected for each state.
- Retailer margin — an assumed 15 per cent rate for retailer margin was used.

There are a range of different product offerings across the different networks. These include time of use charges, maximum demand charges as well as other pricing structures for customers of various sizes. Certain product offerings were selected to most represent that of a commercial customer. Across the networks, the products used to track network prices over time are stated in table B.3.

<sup>105</sup> Energeia 2019, *Trajectory for low energy buildings: Infrastructure and customer impacts*, prepared for Department of the Environment and Energy.

<sup>106</sup> Note that the Energeia study does not appear to measure changes to operating costs.

### B.3 Network product offerings used

Network	Product name/code
Ausgrid	LV > 750 MWh (System)
Energex	NTC8100 Demand Large
CitiPower	Large Low Voltage Demand C2DL
WesternPower	Reference tariff - RT6
Tasnetworks	Business low voltage kVA demand
SAPower	Large business annual agreed kVA demand (LV)

Source: The CIE, from AER/ERAWA network pricing submissions

In order to have a comparable measure of prices across states and over time, the different components of prices need to be combined to a single comparable measure. This particularly applies to peak, non-peak and shoulder pricing, which may be charged at different rates. Table B.4 outlines the periods over which prices vary by network, and the weights used to combine different time of use prices into a single measure.

### B.4 Timing weights by network

	NSW	VIC	QLD	WA	TAS	SA
	Ausgrid	Citipower	Energex	WesternPower	Tasnetworks	Sapower
<b>Times</b>						
Peak	Mon-Friday 2pm-8pm	Mon-Friday, 7am-11pm	Mon-Friday, 7am-9pm	Mon-Friday, 8am- 10pm	Mon-Friday, 7am-10pm	Mon - Friday, November to March, 12- 9pm
Shoulder	Mon-Friday 7am-2pm, 8pm-10pm, weekend 7am-10pm	NA	NA	NA	Weekend, 7am-10pm	NA
Off-peak	Rest	Rest	Rest	Rest	Rest	Rest
<b>Weights</b>						
Peak	18.7%	48.3%	45.4%	43.7%	46.9%	13.3%
Shoulder	34.7%	0.0%	0.0%	0.0%	22.2%	0.0%
Off-peak	46.6%	51.7%	54.6%	56.3%	30.9%	86.7%

Source: The CIE, based on information from AER price submissions

Prices can also be charged in different units, as is the case for maximum demand tariffs, which charge in dollars per kilovolt-ampere (kVA), while other tariffs may charge per kilowatt hour (kWh). Such tariffs might be specified as daily prices or monthly prices. The following factors were used to convert the different products to a dollar per kWh, using a power factor of 1.8 (table B.5):

## B.5 \$/kWh conversion actors

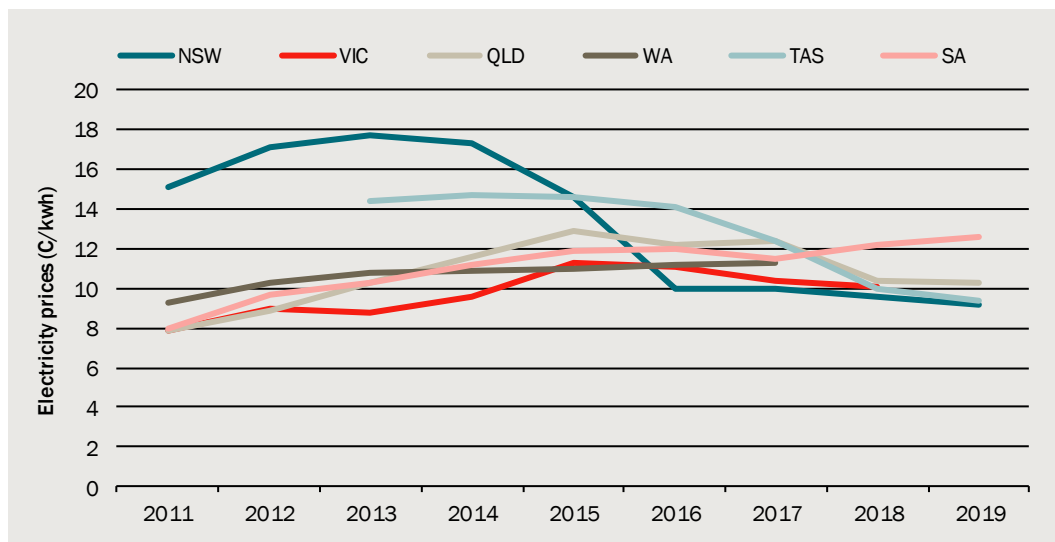
Conversion unit	Factor
kVA/year	0.000175
kVA/month	0.002096
kVA/day	0.06375
kw/month	0.002466

Source: The CIE

### Commercial electricity price series

- Using the above method, the following time series for commercial electricity prices were constructed. Prices are in 2018 dollars (using CPI) (chart B.6).
- Prices have generally increased in real terms. There have been substantial increases in wholesale prices in real terms, particularly in the last two years. However, there have been reductions in network prices over the same period, likely reflecting reductions in the weighted average cost of capital and other key regulatory parameters, as well as shifts to have less revenue collected from variable tariffs and more from fixed supply charges
- Of particular note is the strong fall in electricity prices in NSW leading up to 2016.

## B.6 Commercial electricity prices (real)

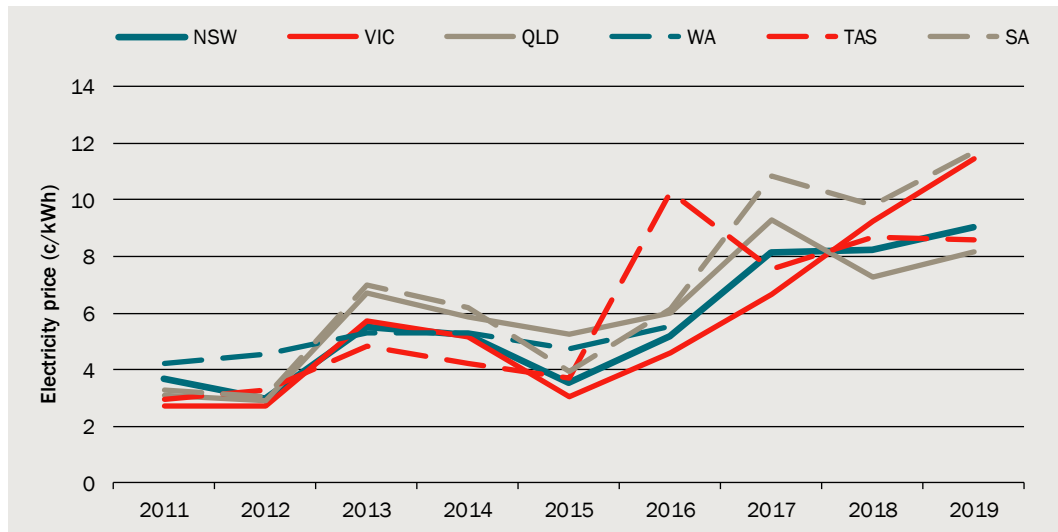


Note: Some states have incomplete data

Data source: The CIE.

Note that for reference, the nominal wholesale costs used are shown in chart B.7.

### B.7 Wholesale energy costs (nominal)



Data source: The CIE; based on AEMO data.

### Gas prices

Gas prices were sourced using Oakley Greenwood gas price trends review 2017. Commercial gas prices are not measured as part of this review, and so to compute a measure, prices were built up by re-weighting various components of household prices. Household prices were used as the basis, as commercial buildings more closely resemble households in their usage patterns, compared to other users measured in the report (such as heavy industrial users).

Prices were computed using the cost components specified in the Oakley Greenwood dataset:

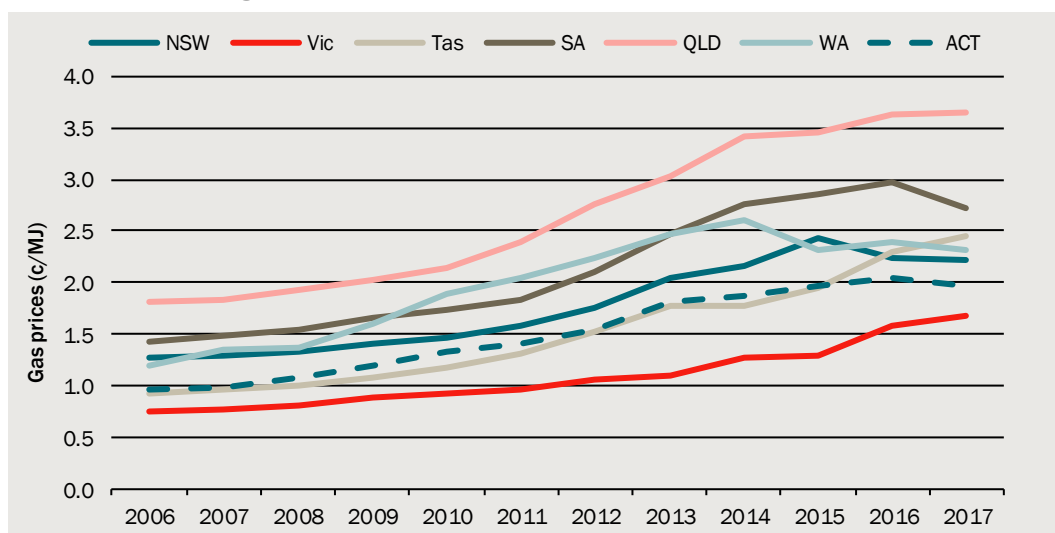
- The wholesale price for gas
- 50 per cent of transmission prices
- 50 per cent of distribution costs
- Environmental costs
- 50 per cent of the retailer component

Weights were applied to some components, based on the fact that the price per unit is lower for larger users. Commercial users would use more gas on average compared to households.

### Commercial gas prices

Using the above method, the following price series was constructed for gas (chart B.8).

## B.8 Commercial gas prices (real)



Data source: The CIE.

### *Changes over time*

For future periods, we maintain electricity and gas prices at existing levels in real terms. Most commentary, such as from the AEMC, expects that prices will moderate over the near term.<sup>107</sup> However, this is yet to be evidenced in actual outcomes.

Forecasting distribution price changes is very difficult, outside of the regulatory periods for these assets. Large changes can occur because of changes in the structure of prices. The clearest approach, and that consistent with the approach used by businesses to forecast their rates of return, is to maintain prices at existing levels.

### *Environmental benefits*

In addition to the value of the resources saved, there are also environmental benefits associated with reduced energy consumption. Here the literature tends to focus mainly on valuing greenhouse gas emissions. Other environmental benefits could include other avoided pollutants such as SO<sub>x</sub> and particulate matter.

### *Emissions intensity of energy consumption*

Greenhouse gas emissions will depend on the emissions intensity of energy consumption, which varies by energy source. As the emissions intensity of electricity varies significantly across States and Territories, it is important to take into account this variability for the purposes of the CBA.

<sup>107</sup> Australian Energy Market Commission 2018, *2018 residential electricity price trends review*, December, <https://www.aemc.gov.au/sites/default/files/2018-12/2018%20Price%20Trends%20-%20Final%20Report%20-%20CLEAN.PDF>.

The National Greenhouse Accounts Factors reports emissions factors for end users of electricity in each State and Territory (table B.9), including:

- Scope 2 emissions — these are indirect emissions from the generation of the electricity purchased and consumed; and
- Scope 3 emissions — these are indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the transmission and distribution network.

## B.9 Electricity emissions factors for end users, 2016-17

	NSW	Vic	Qld	SA	WA	Tas	ACT	NT
	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh	Kg CO <sub>2-e</sub> per Kwh
Scope 2 emissions	0.82	1.07	0.80	0.51	0.70	0.19	0.82	0.64
Scope 3 emissions	0.10	0.10	0.13	0.10	0.05	0.03	0.10	0.09
<b>Total</b>	<b>0.92</b>	<b>1.17</b>	<b>0.93</b>	<b>0.61</b>	<b>0.75</b>	<b>0.22</b>	<b>0.92</b>	<b>0.73</b>

Note: ACT and NSW are reported together.

Source: Australian Government Department of the Environment and Energy, *National Greenhouse Accounts Factors*, Australian National Greenhouse Accounts, July 2018, pp. 68-80.

For natural gas consumption, Energy Action used an emissions factor of 51.4 Kg Co2-e per GJ, which is consistent with emission factors for the consumption of natural gas reported in the National Greenhouse Accounts Factors, excluding Scope 3 emissions.<sup>108</sup> For the CBA, we add estimates of Scope 3 emissions, as reported in the National Greenhouse Accounts Factors (table B.10).<sup>109</sup>

## B.10 Natural gas emissions factors

	NSW	Vic	Qld	SA	WA	Tas	ACT	NT
	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ	Kg CO <sub>2-e</sub> per GJ
Scope 1 emissions	51.4	51.4	51.4	51.4	51.4	51.4	51.4	51.4
Scope 3 emissions <sup>a</sup>	12.8	3.9	8.7	10.4	4.0	3.9 <sup>b</sup>	12.8	4.0 <sup>c</sup>
<b>Total</b>	<b>64.2</b>	<b>55.3</b>	<b>60.1</b>	<b>61.8</b>	<b>55.4</b>	<b>55.3</b>	<b>64.2</b>	<b>55.4</b>

<sup>a</sup> Scope 3 emissions factors based on estimate for metro areas in each State. Estimates for non-metro areas vary slightly, but would not make a significant difference to the overall results. <sup>b</sup> Scope 3 emissions factors were not reported for Tasmania. Figure used based on estimate for Victoria. <sup>c</sup> Scope 3 emissions factors were not reported for the Northern Territory. Figure used based on estimate for Western Australia.

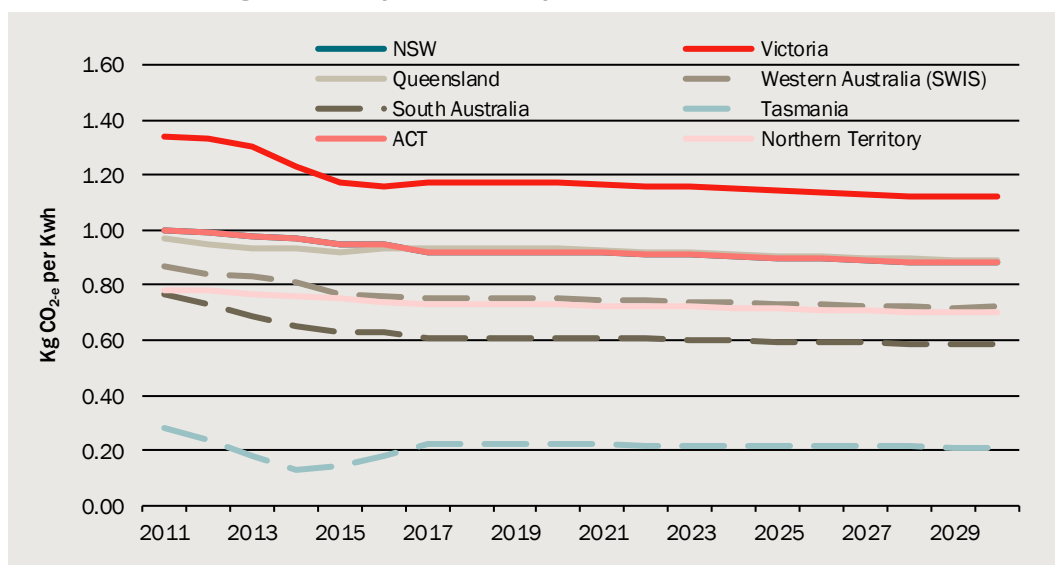
Source: Australian Government Department of the Environment and Energy, *National Greenhouse Accounts Factors*, Australian National Greenhouse Accounts, July 2018, pp. 12 and 66.

We assume that future GHG intensity in all states and territories declines in line with national estimates by the Climate Change Authority under their reference case (chart B.11).

*Accounts Factors*, Australian National Greenhouse Accounts, July 2018, p. 12.

<sup>109</sup> Australian Government Department of the Environment and Energy, *National Greenhouse Accounts Factors*, Australian National Greenhouse Accounts, July 2018, p. 66.

### B.11 Greenhouse gas intensity of electricity



Data source: Australian Government Department of the Environment and Energy, *National Greenhouse Accounts Factors*, Australian National Greenhouse Accounts, July 2018, pp. 68-80; Climate Change Authority, *Policy Options for Australia's Electricity Supply Sector: Special Review Research Report*, August 2016.

### Valuing greenhouse gas emissions

There are also various approaches in the literature to valuing these environmental benefits, including the following:

- Social cost of carbon (SCC) approach — this is a measure of the discounted value of expected future global damages from additional GHG emissions.<sup>110</sup> SCC estimates are generally based on modelling of future climate change impacts and their economic effects. Given the large uncertainties around the impacts of climate change, estimates of the SCC can vary significantly.
- Mitigation/abatement cost approach — under this approach, GHG emissions are valued using a carbon price measure, on the basis that a carbon price reflects the marginal cost of abatement. The price used to value carbon emissions could be an existing traded price, such as the EU Emissions Trading Scheme (ETS) price. Alternatively, several Australian studies value the reduction in greenhouse gas emissions using the projected carbon price from various carbon price modelling exercises (alternatively, projected future energy prices including the carbon price are used as the energy price, which also captures the value of the greenhouse gas externality).

The United States (US) Government's Interagency Working Group (IWG) on Social Cost of Greenhouse Gases revised its estimates of the social cost of carbon for Regulatory Impact Analysis in August 2016.<sup>111</sup> To generate these estimates, the IWG generated a

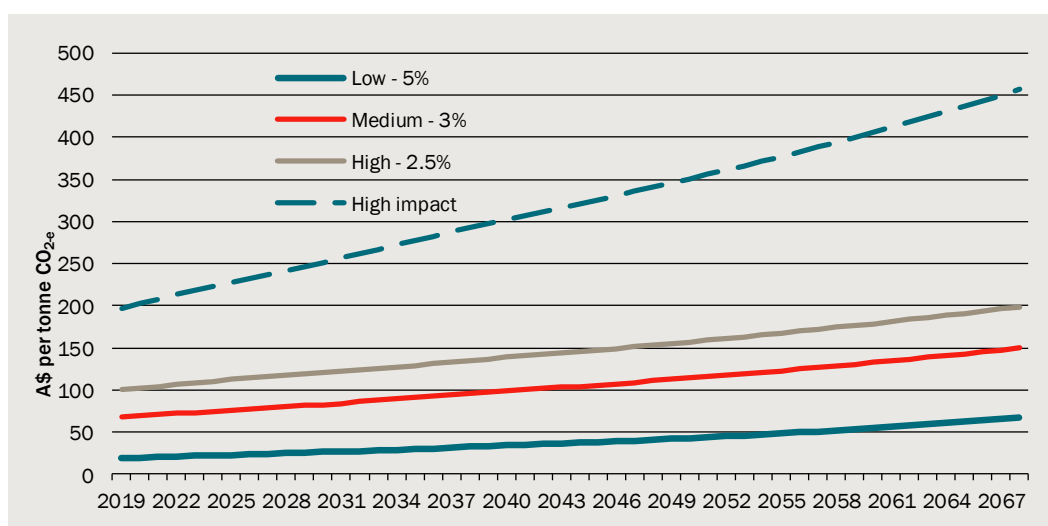
<sup>110</sup> Jotzo, F., Pezzey, J., van Dijk, J. and Mazouz, S. 2015, *Social cost of carbon for NSW policy analysis*, prepared for the NSW Department of Environment and Heritage, p. 9.

<sup>111</sup> US EPA 2017, *The Social Cost of Carbon: Estimating the Benefit of Reducing Greenhouse Gas Emissions*, [https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon\\_.html](https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html).

frequency distribution for the future costs of climate change per tonne of CO<sub>2-e</sub> based on climate modelling. Chart B.12 shows these estimates in Australian dollars:

- The low scenario, discounts the average estimate of the future costs of climate change, using a discount rate of 5 per cent.
- The medium scenario discounts the average estimate of the future costs of climate change, using a discount rate of 3 per cent.
- The high scenario discounts the average estimate of the future costs of climate change, using a discount rate of 2.5 per cent.
- The high impact scenario corresponds to the 95<sup>th</sup> percentile of the frequency distribution of the future costs of climate change, using a discount rate of 3 per cent.

### B.12 Social cost of carbon estimates



Data source: US EPA 2017, *The Social Cost of Carbon: Estimating the Benefit of Reducing Greenhouse Gas Emissions*, [https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon\\_.html](https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html).

### *Health costs of air pollution*

Air pollution can cause detrimental effects on human health and the environment. The dominant impact from air pollution is the negative effect on human health, most notably from emissions of fine particulates (PM<sub>2.5</sub>). Short and long term human exposure to air pollution can cause premature mortality, cardiovascular and respiratory disease, chronic and acute bronchitis, asthma attacks, restricted activity days, reduced lung function and reduced birth weights.

The health impacts of fine particulates (PM<sub>2.5</sub>) are of notable health concern as they can reach the air sacs deep in the lungs causing greater damage. Segments of the community that are most susceptible are infants and children, elderly people, and people with existing respiratory conditions, heart disease or diabetes.

Reducing electricity use can lead to improved air pollution outcomes for those within the region.



### *Electricity generation facilities using coal*

There are 425 facilities across Australia producing electricity using a variety of non-renewable and renewable fuel sources. This includes 19 electricity generation facilities which use either brown or black coal as the primary fuel. These 19 facilities:

- generate almost 70 per cent of the total electricity across Australia,<sup>112</sup> and
- emit over 80 per cent of PM<sub>2.5</sub> emissions (table 4.7).

#### **B.13 Production and PM<sub>2.5</sub> emissions for electricity generating facilities using coal**

Facility Name	State	Primary fuel source	Electricity Production	PM <sub>2.5</sub> emissions
			MWh	kg
Eraring Power Station	NSW	Black Coal	17 186 000	132 000
Bayswater Power Station	NSW	Black Coal	15 546 000	359 000
Liddell Power Station	NSW	Black Coal	8 519 000	218 000
Vales Point Power Station	NSW	Black Coal	8 063 000	47 000
Mt Piper Power Station	NSW	Black Coal	7 864 000	55 000
Tarong Power Stations	QLD	Black Coal	12 099 000	2 051 000
Gladstone Power Station	QLD	Black Coal	8 975 000	57 000
Stanwell Power Station	QLD	Black Coal	8 804 000	248 000
Millmerran Power Station (facility)	QLD	Black Coal	7 061 000	21 000
Callide C Power Station	QLD	Black Coal	5 840 000	290 000
Callide B Power Station	QLD	Black Coal	5 505 000	374 000
Kogan Creek Power Station	QLD	Black Coal	5 255 000	33 000
Loy Yang Power Station and Mine	VIC	Brown Coal	16 952 000	766 000
Yallourn Power Station	VIC	Brown Coal	10 239 000	755 000
Loy Yang B Power Station	VIC	Brown Coal	8 870 000	343 000
Muja Power Station	WA	Black Coal	4 400 000	241 000
Collie Power Station	WA	Black Coal	2 032 000	202 000
Bluewaters Power Station No 1&2 <sup>a</sup>	WA	Black Coal	3 342 000	25 000
<b>Australia total (all facilities generating electricity)</b>			<b>227 462 000</b>	<b>7 550 000</b>
<b>Proportion of total for Australia (per cent)</b>			<b>69</b>	<b>82</b>

<sup>a</sup> Total for the two Bluewaters Power Station facilities – number 1 and number 2.

Source: Clean Energy Regulator, 2019, Electricity sector emissions and generation data 2017-18, <http://www.cleanenergyregulator.gov.au/NGER/Pages/Published%20information/Electricity%20sector%20emissions%20and%20generation%20data/Electricity-sector-emissions-and-generation-data-2017%E2%80%9318.aspx>

Australian Department of the Environment and Energy, Latest NPI emissions for 2017-2018, <http://www.npi.gov.au/npi-data/latest-data>.

<sup>112</sup> Clean Energy Regulator, 2019, Electricity sector emissions and generation data 2017-18, <http://www.cleanenergyregulator.gov.au/NGER/Pages/Published%20information/Electricity%20sector%20emissions%20and%20generation%20data/Electricity-sector-emissions-and-generation-data-2017%E2%80%9318.aspx>.

### *Damage costs by tonne of PM<sub>2.5</sub>*

PAEHolmes undertook a study for NSW EPA in 2013 outlining a methodology for valuing the health impacts of changes in particle emissions. In the study, PAEHolmes recommended appraisal of air quality impacts from projects be based on the change in pollutant emissions. Although impacts to human health and the environment are more closely linked to changes in ambient air quality, PAEHolmes recommend an emissions-based approach for appraisal of projects due to lack of sufficient and readily available PM emission modelling information to undertake a full impact pathway process.<sup>113</sup>

PAEHolmes estimated unit damage costs by transferring existing estimates from a UK study based on transport emissions<sup>114</sup> and adjusted for population density to estimate unit damage costs weighted for population exposure for each Significant Urban Area (SUA). The local population density is a critical variable. Emission reduction in a densely populated area will have a greater relative health benefit than an equivalent reduction in a less densely populated area.

Table B.14 lists the PM<sub>2.5</sub> damage cost for the SUAs where the 20 electricity generating facilities using coal are located.<sup>115</sup> Of these SUAs, the damage cost ranges from \$15 900 per tonne in Muswellbrook to \$183 000 per tonne in Central Coast, excluding areas that are not in any significant urban area (NIASUA). The damage cost estimates account for variation in population density across areas.

#### **B.14 Damage cost estimates for PM<sub>2.5</sub> — selected significant urban area**

State	SUA name	Area	Population	Population density	Damage cost per tonne of PM <sub>2.5</sub>
		Km <sup>2</sup>	no.	no./Km <sup>2</sup>	A\$2019
NSW	Morisset - Cooranbong	341	21 775	64	21 931
NSW	Muswellbrook	262	11 791	45	15 839
NSW	Central Coast	566	304 755	538	182 760
NSW	Lithgow	120	12 251	102	35 334
QLD	Not in any significant urban area (QLD) <sup>a</sup>	1 718 546	755 687	0.4	146
QLD	Gladstone - Tannum Sands	240	41 966	175	59 702
QLD	Rockhampton	580	73 680	127	43 863
QLD	Toowoomba	498	105 984	213	73 104

<sup>113</sup> PAEHolmes, 2013, *Methodology for valuing the health impacts of changes in particle emissions - final report*. Prepared for NSW Environment Protection Authority (EPA).

<sup>114</sup> Defra, 2012, *Air Quality Damage Costs*. Published by Defra. Current damage cost values published at: <http://www.defra.gov.uk/environment/quality/air/airquality/economic/damage/>. with a guidance document on the use of the damage costs at: <http://archive.defra.gov.uk/environment/quality/air/airquality/panels/igcb/documents/damagecost-guidance.pdf>

<sup>115</sup> Electricity generation facility either located in SUA or located nearby.

State	SUA name	Area	Population	Population density	Damage cost per tonne of PM <sub>2.5</sub>
		Km <sup>2</sup>	no.	no./Km <sup>2</sup>	A\$2019
VIC	Traralgon - Morwell	235	39 706	169	57 265
WA	Not in any significant urban area (WA) <sup>a</sup>	2 520 513	30 654	0.01	4

<sup>a</sup> PAE Holmes note that the unit damage costs should not be applied to significant urban areas with less than 10 000 people.

Note: Only Significant Urban Areas relevant to this analysis have been included in this table.

Source: PAEHolmes, 2013, Methodology for valuing the health impacts of changes in particle emissions - final report. For NSW Environment Protection Authority (EPA)

The damage cost from emissions of PM<sub>2.5</sub> per GWh for each facility is shown in table B.3. These estimates assume that only the damage cost at the nearest SUA applies and does not account for dispersion of pollutants to adjacent SUAs. The damage cost per GWh varies substantially from \$0.03 per GWh to \$4220 per GWh. The variation in damage cost is due to location (i.e. density of nearby population centres) and emissions intensity (PM<sub>2.5</sub> emissions per GWh).

### B.15 Damage cost by facility

Facility Name	SUA (nearest SUA)	Emissions intensity	Damage cost	
		tPM <sub>2.5</sub> /GWh	\$/tPM <sub>2.5</sub>	\$/GWh
Eraring Power Station (NSW)	Morisset - Cooranbong	0.01	22 000	<b>168.94</b>
Bayswater Power Station (NSW)	Muswellbrook	0.02	16 000	<b>365.90</b>
Liddell Power Station (NSW)	Muswellbrook	0.03	16 000	<b>405.77</b>
Vales Point Power Station (NSW)	Central Coast	0.01	183 000	<b>1054.87</b>
Mt Piper Power Station (NSW)	Lithgow	0.01	35 000	<b>248.91</b>
Tarong Power Stations (QLD)	NIASUA (QLD)	0.17	150	<b>24.78</b>
Gladstone Power Station (QLD)	Gladstone - Tannum Sands	0.01	60 000	<b>378.72</b>
Stanwell Power Station (QLD)	Rockhampton	0.03	44 000	<b>1233.24</b>
Millmerran Power Station (facility) (QLD)	Toowoomba	0.00	73 000	<b>216.35</b>
Callide C Power Station (QLD)	NIASUA (QLD)	0.05	150	<b>7.26</b>
Callide B Power Station (QLD)	NIASUA (QLD)	0.07	150	<b>9.93</b>
Kogan Creek Power Station (QLD)	NIASUA (QLD)	0.01	150	<b>0.92</b>
Loy Yang Power Station and Mine (VIC)	Traralgon - Morwell	0.05	57 000	<b>2586.39</b>
Yallourn Power Station (VIC)	Traralgon - Morwell	0.07	57 000	<b>4221.15</b>
Loy Yang B Power Station (VIC)	Traralgon - Morwell	0.04	57 000	<b>2216.71</b>
Muja Power Station (WA)	NIASUA (WA)	0.05	4	<b>0.20</b>
Collie Power Station (WA)	NIASUA (WA)	0.10	4	<b>0.36</b>
Bluewaters Power Station No 1&2 (WA)	NIASUA (WA)	0.01	4	<b>0.03</b>

Source: CIE based on information sourced from Clean Energy Regulator, 2019, *Electricity sector emissions and generation data 2017-18*,

<http://www.cleanenergyregulator.gov.au/NGER/Pages/Published%20information/Electricity%20sector%20emissions%20and%20generation%20data/Electricity-sector-emissions-and-generation-data-2017%E2%80%9318.aspx>

Australian Department of the Environment and Energy, *Latest NPI emissions for 2017-2018*, <http://www.npi.gov.au/npi-data/latest-data>

At this stage we have not included these impacts into the cost benefit analysis, as they will be small and highly dependent on the location. To put these into perspective, a damage cost of \$1000 per GWH is equivalent to 0.1 cents per kwh. Prices for electricity are about 10 cents per kwh for large commercial customers.

## *C Statistical analysis of change in building energy use and star ratings*

### *Data used*

The data used for the analysis includes:

- the CBD dataset – this provides information on the energy use, star rating and rated area for each building over time, as well as information for each space that is part of the Tenancy Lighting Assessment
- the NABERS office dataset – this provides information on energy use, star rating and rated area for each building over time. It includes some information that is different to the CBD dataset (such as splitting out gas and electricity use, ratings with and without greenpower). It also includes NABERS energy ratings prior to the CBD Program, and for buildings where the CBD Program does not apply but that have rated voluntarily
- the CityScope commercial dataset – this includes information on building grade, age, refurbishment, site area and building area, classification (commercial, retail etc). This is merged in using address matching. Note that there are many buildings that cannot be matched between datasets, because either CityScope does not cover all commercial buildings, or addresses are different
- energy price data – this has been put together based on network prices, wholesale energy costs and a margin for electricity, and using previous studies for gas
- Government mandates – this has been put together based on reviewing the public information, and with assistance from the NABERS team.

### *Data cleaning*

The data is of high quality, particularly the CBD and NABERS datasets. The cleaning we have done is to:

- include only base building ratings
- remove ratings where the area rated is less than the maximum area rated – this removes issues associated with large changes in vacancy or where the rating is inadvertently for a part of the building, or the building has changed
- remove the top 1 per cent and bottom 1 per cent of observations based on energy per m<sup>2</sup>.

## Econometric results

Econometric results have been tested for many different models. The findings for the coefficients on number of ratings, initial star rating and number of ratings squared remain fairly similar. Results for one model for the change in star rating and one for the change in energy use per m<sup>2</sup> are shown below.

Note that there are some results that are not sensible, such as the impact of the energy price. The results we are interested in do not change whether this is included or excluded.

### C.1 Change in star rating

Variable	Coefficient	Standard error	t-value	P-value	95% CI- low	95% CI- high
	No.	No.	No.	No.	No.	No.
Change in energy price	-0.23	0.15	-1.58	0.12	-0.52	0.06
Rated prior to CBD	-0.07	0.05	-1.44	0.15	-0.16	0.02
Premium grade	0.09	0.16	0.54	0.59	-0.23	0.41
A grade	0.08	0.06	1.40	0.16	-0.03	0.19
B-D grade	-0.14	0.06	-2.43	0.02	-0.25	-0.03
<2000 m <sup>2</sup>	-1.32	0.20	-6.55	0.00	-1.72	-0.93
2000-6000 m <sup>2</sup>	-0.34	0.11	-3.11	0.00	-0.56	-0.13
6000-10,000 m <sup>2</sup>	-0.24	0.11	-2.29	0.02	-0.45	-0.03
10,000-20,000 m <sup>2</sup>	-0.12	0.10	-1.18	0.24	-0.32	0.08
20,000-40,000 m <sup>2</sup>	0.01	0.10	0.07	0.94	-0.19	0.21
>40,000 m <sup>2</sup>	0.00	(omitted)				
NSW	-0.03	0.25	-0.10	0.92	-0.52	0.46
VIC	-0.21	0.25	-0.84	0.40	-0.70	0.28
QLD	0.00	0.25	0.00	1.00	-0.49	0.49
WA	0.09	0.25	0.36	0.72	-0.40	0.58
SA	-0.10	0.26	-0.38	0.70	-0.61	0.41
TAS	-0.12	0.37	-0.34	0.73	-0.84	0.60
NT	0.00	(omitted)				
ACT	-0.01	0.25	-0.04	0.97	-0.51	0.49
Owner in GRESB	-0.06	0.05	-1.16	0.25	-0.15	0.04
Number of ratings	0.19	0.05	3.75	0.00	0.09	0.29
Number of ratings squared	-0.01	0.00	-1.70	0.09	-0.02	0.00
First rating in CBD Program	-0.41	0.02	-23.22	0.00	-0.45	-0.38
Constant	1.66	0.30	5.56	0.00	1.07	2.24

Note: There are 1050 observations and the adjusted R<sup>2</sup> is 40 per cent. Where a buildings grade is not known then it is not included in any category. The change in energy price is a percentage change based on 75 per cent electricity and 25 per cent gas.

Source: The CIE.

## C.2 Change in energy use per m<sup>2</sup>

Variable	Coefficient	Standard error	t-value	P-value	95% CI- low	95% CI- high
	MJ/m <sup>2</sup>	MJ/m <sup>2</sup>	No.	No.	MJ/m <sup>2</sup>	MJ/m <sup>2</sup>
Change in energy price	65.0	26.4	2.5	0.01	13.1	116.9
Rated prior to CBD	11.6	8.5	1.4	0.17	-5.1	28.3
Premium grade	7.2	29.1	0.3	0.81	-49.9	64.3
A grade	-8.8	10.3	-0.9	0.40	-29.1	11.5
B-D grade	20.7	10.4	2.0	0.05	0.3	41.0
<2000m <sup>2</sup>	180.2	36.3	5.0	0.00	109.0	251.4
2000-6000m <sup>2</sup>	59.9	19.8	3.0	0.00	21.1	98.7
6000-10,000m <sup>2</sup>	49.7	19.1	2.6	0.01	12.4	87.1
10,000-20,000m <sup>2</sup>	21.5	18.0	1.2	0.23	-13.8	56.8
20,000-40,000m <sup>2</sup>	4.0	18.5	0.2	0.83	-32.3	40.2
>40,000m <sup>2</sup>	0.0	(omitted)				
NSW	29.8	44.8	0.7	0.51	-58.0	117.7
VIC	39.1	45.0	0.9	0.39	-49.1	127.3
QLD	49.8	45.1	1.1	0.27	-38.8	138.4
WA	44.1	45.2	1.0	0.33	-44.7	132.9
SA	40.3	47.1	0.9	0.39	-52.2	132.7
TAS	93.7	65.9	1.4	0.16	-35.6	223.0
NT	0.0	(omitted)				
ACT	22.2	45.5	0.5	0.63	-67.2	111.6
Owner in GRESB	10.1	8.8	1.2	0.25	-7.2	27.5
Number of ratings	-23.3	9.1	-2.6	0.01	-41.2	-5.5
Number of ratings squared	0.9	0.9	1.0	0.32	-0.9	2.7
First rating in CBD Program	50.8	3.2	15.9	0.00	44.5	57.1
Constant	-256.0	53.5	-4.8	0.00	-361.0	-151.0

Note: There are 1050 observations and the adjusted R<sup>2</sup> is 26 per cent. Where a buildings grade is not known then it is not included in any category. The change in energy price is a percentage change based on 75 per cent electricity and 25 per cent gas.

Source: The CIE.

## D Buildings entering the NABERS system

### Floor space

The total floor space entering the NABERS system for the first time by state and star rating is shown in table D.1. This includes both base building and whole building ratings.

#### D.1 Floor space entering the NABERS system for the first time

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>
<b>NSW</b>									
0	174.1	71.6	29.9	27.4	32.6	0.0	5.5	17.7	0.9
1	56.1	6.6	24.0	3.2	4.2	0.0	18.0	4.5	0.0
1.5	89.7	74.8	54.6	7.3	7.0	2.3	1.9	4.3	1.6
2	130.3	62.7	16.5	6.8	0.0	6.8	19.6	5.1	12.6
2.5	155.6	77.8	98.2	45.3	12.2	7.0	3.4	4.6	1.2
3	127.9	61.7	76.5	41.8	12.2	5.0	0.0	17.2	9.6
3.5	151.4	51.5	24.9	34.9	50.1	8.4	15.9	27.2	0.0
4	128.9	55.5	41.5	73.4	37.3	8.9	8.6	31.3	23.2
4.5	65.0	49.9	122.5	229.7	76.5	21.5	40.8	42.2	43.9
5	135.8	104.2	101.5	160.7	168.8	38.8	41.2	212.9	114.7
5.5	23.9	37.6	31.3	65.3	38.2	1.9	18.6	63.4	12.4
6	4.6	0.0	11.7	0.3	2.1	3.6	13.4	0.0	2.4
<b>Total</b>	<b>1 243.3</b>	<b>653.8</b>	<b>633.3</b>	<b>696.1</b>	<b>441.1</b>	<b>104.2</b>	<b>187.0</b>	<b>430.4</b>	<b>222.5</b>
<b>Victoria</b>									
0	151.1	104.1	32.1	12.9	12.5	10.0	15.8	33.9	3.3
1	65.7	51.8	2.0	105.1	40.3	21.8	5.4	4.3	0.0
1.5	60.7	34.2	14.2	8.6	9.7	56.3	13.0	0.3	0.0
2	195.5	76.4	11.6	52.7	32.9	11.0	1.5	5.6	6.6
2.5	126.1	48.0	25.3	29.5	42.5	10.8	4.1	36.0	6.5
3	220.0	63.0	52.3	30.9	31.1	78.2	29.2	16.9	55.3
3.5	140.2	124.2	28.6	41.7	7.3	36.1	42.5	35.6	28.1
4	8.5	128.2	69.8	15.8	11.7	19.7	3.5	19.9	24.7
4.5	138.6	73.4	136.3	174.7	28.7	54.5	24.9	39.1	25.6
5	102.5	45.2	12.9	45.7	124.2	1.0	121.4	183.4	7.6
5.5	0.8	11.9	0.0	35.7	0.0	2.7	14.9	12.3	3.3
6	1.3	1.7	0.0	0.0	0.0	0.0	0.0	0.5	0.0



Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>
<b>Total</b>	<b>1 210.8</b>	<b>761.9</b>	<b>385.1</b>	<b>553.5</b>	<b>340.8</b>	<b>302.2</b>	<b>276.3</b>	<b>387.6</b>	<b>161.1</b>
<b>Queensland</b>									
0	150.5	67.2	52.4	0.0	20.4	11.1	12.1	21.9	4.2
1	43.4	10.0	21.7	5.8	3.6	4.6	4.5	2.8	9.2
1.5	24.4	25.6	9.2	5.5	9.6	0.0	9.3	0.0	0.0
2	90.2	31.7	24.0	0.0	2.7	6.8	2.9	4.1	15.4
2.5	49.8	17.4	7.3	5.8	8.8	4.1	7.5	6.3	0.0
3	54.2	48.6	4.0	15.6	3.2	0.0	15.4	4.5	14.5
3.5	69.7	30.3	23.8	17.5	15.6	4.7	1.7	37.8	11.7
4	32.4	57.7	8.7	9.9	24.8	31.3	12.6	9.5	6.6
4.5	93.4	46.4	56.9	1.6	33.7	9.2	17.5	12.4	17.6
5	139.8	86.4	99.3	50.7	126.3	23.5	41.5	102.5	32.9
5.5	9.7	60.2	30.5	68.8	34.4	22.1	24.0	78.6	2.1
6	0.0	2.4	2.2	0.0	0.0	0.0	0.0	13.6	1.0
<b>Total</b>	<b>757.7</b>	<b>484.0</b>	<b>339.9</b>	<b>181.2</b>	<b>283.2</b>	<b>117.4</b>	<b>149.2</b>	<b>293.9</b>	<b>115.2</b>
<b>WA</b>									
0	69.2	16.0	4.3	6.3	7.5	10.0	0.4	7.8	3.7
1	34.1	10.1	0.0	3.9	0.0	0.0	0.0	6.4	1.5
1.5	23.8	11.9	9.2	4.4	2.3	1.2	3.4	1.2	0.0
2	44.0	3.9	7.2	2.0	0.0	0.0	14.2	4.8	2.0
2.5	36.5	33.3	31.2	9.3	3.3	3.9	6.1	3.1	4.4
3	33.2	2.3	13.4	2.1	0.0	26.5	6.9	20.7	4.3
3.5	48.7	27.0	7.0	37.7	6.7	4.0	7.0	13.5	2.9
4	22.4	10.0	0.0	24.6	16.1	5.5	22.9	11.7	5.5
4.5	1.4	15.9	5.2	84.8	0.0	7.8	10.5	50.8	17.0
5	41.1	55.4	16.0	134.8	8.4	4.5	15.3	53.8	6.9
5.5	30.8	0.5	13.3	13.3	15.0	14.4	14.6	0.0	1.6
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>385.2</b>	<b>186.2</b>	<b>106.9</b>	<b>323.1</b>	<b>59.3</b>	<b>77.7</b>	<b>101.2</b>	<b>173.7</b>	<b>49.8</b>
<b>SA</b>									
0	0.0	3.2	7.8	0.0	1.8	6.2	0.0	0.0	1.9
1	0.0	10.9	0.0	0.0	0.0	0.0	0.0	2.3	0.0
1.5	11.2	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0
2	9.4	0.0	3.8	0.0	0.0	0.0	0.0	5.6	0.0
2.5	9.4	6.8	2.8	7.8	0.0	0.0	2.1	13.1	0.0
3	51.3	24.8	3.2	4.2	2.1	4.0	3.0	3.4	3.4
3.5	7.8	9.1	0.0	13.4	0.0	0.0	10.5	1.8	1.3
4	4.1	24.3	18.7	11.3	11.6	22.7	4.8	2.5	4.9
4.5	20.0	69.1	21.5	16.5	12.7	26.6	0.0	18.3	3.5

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>
5	1.5	17.6	28.7	34.1	0.0	37.7	1.5	3.9	4.4
5.5	0.0	0.0	0.8	0.0	0.0	0.0	0.0	1.6	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>114.7</b>	<b>165.9</b>	<b>90.8</b>	<b>87.2</b>	<b>28.2</b>	<b>97.2</b>	<b>21.9</b>	<b>52.5</b>	<b>19.4</b>
<b>Tasmania</b>									
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
2	4.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	1.6
2.5	0.0	14.4	17.6	0.0	0.0	5.1	5.4	0.0	0.0
3	0.0	5.8	0.0	7.8	0.0	0.0	4.5	3.4	0.0
3.5	4.5	7.3	6.4	0.0	0.0	0.0	0.0	5.3	1.8
4	0.5	0.5	2.8	5.8	2.5	0.0	12.9	5.8	0.0
4.5	6.9	0.0	4.9	12.3	4.2	0.8	0.7	0.0	0.0
5	5.7	3.0	0.0	4.6	0.0	4.4	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>21.8</b>	<b>35.3</b>	<b>31.6</b>	<b>30.5</b>	<b>9.8</b>	<b>10.4</b>	<b>23.5</b>	<b>17.5</b>	<b>3.4</b>
<b>ACT</b>									
0	12.2	18.9	10.6	0.0	12.7	1.9	1.7	1.0	0.0
1	10.6	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0
1.5	10.8	0.0	2.3	21.3	0.0	1.5	3.5	7.4	3.9
2	13.2	17.9	0.0	10.3	0.0	0.0	5.2	1.7	2.9
2.5	7.5	7.4	0.0	2.2	0.0	1.9	0.0	36.8	3.3
3	11.0	9.1	0.0	0.0	1.4	36.6	30.2	11.0	0.0
3.5	24.1	7.0	2.1	8.4	7.4	0.0	61.2	0.0	3.0
4	15.1	21.9	7.6	10.8	0.0	22.3	0.0	35.3	1.0
4.5	94.8	22.8	73.1	26.1	44.0	7.8	16.7	25.0	12.0
5	11.5	7.1	0.0	54.7	28.8	21.5	14.1	35.2	0.0
5.5	0.0	84.2	0.0	6.9	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>210.9</b>	<b>196.2</b>	<b>95.7</b>	<b>140.8</b>	<b>94.3</b>	<b>95.4</b>	<b>132.5</b>	<b>153.4</b>	<b>26.0</b>
<b>NT</b>									
0	4.0	0.7	0.0	0.0	0.0	0.0	0.0	2.6	0.0
1	0.0	2.1	0.0	0.0	0.0	0.0	0.0	1.7	0.0
1.5	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4.2	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0
2.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>	'000 m <sup>2</sup>
3.5	2.0	0.0	0.0	0.0	4.4	0.0	0.0	2.6	0.0
4	8.2	0.0	8.7	0.0	0.0	4.9	0.0	0.3	0.0
4.5	3.5	9.1	6.3	2.2	15.9	0.0	0.0	12.0	0.0
5	5.4	0.0	11.0	0.0	0.0	0.0	0.0	14.3	0.0
5.5	0.0	9.1	0.0	0.0	0.0	2.4	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>35.5</b>	<b>21.0</b>	<b>26.0</b>	<b>4.4</b>	<b>20.3</b>	<b>7.2</b>	<b>0.7</b>	<b>33.3</b>	<b>0.0</b>
<b>Grand total</b>	<b>3 979.9</b>	<b>2 504.2</b>	<b>1 709.4</b>	<b>2 016.8</b>	<b>1 277.0</b>	<b>811.8</b>	<b>892.3</b>	<b>1 542.3</b>	<b>597.5</b>

Note: Includes both base building and whole building ratings.

Source: NABERS database.

## Energy intensity

The average energy intensity of building's entering the NABERS system for the first time by star rating and state is shown in table D.2.

### D.2 Average base building energy intensity

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>
<b>NSW</b>									
0	1 390.7	1 861.5	3 110.7	1 467.0	921.5	0.0	914.0	1 681.7	938.0
1	871.0	771.0	784.3	1 152.0	752.0	0.0	0.0	1 055.0	0.0
1.5	801.4	716.8	812.3	843.5	622.0	712.0	684.0	663.0	0.0
2	781.3	685.1	691.0	627.0	0.0	978.0	661.3	975.0	584.0
2.5	710.9	624.0	658.5	780.4	619.0	572.5	0.0	564.5	508.0
3	597.7	569.7	594.9	708.0	549.0	0.0	0.0	572.0	542.5
3.5	513.3	543.3	477.5	551.8	497.5	529.0	459.5	540.3	0.0
4	429.4	479.0	416.0	424.8	438.0	821.0	377.0	381.4	457.0
4.5	402.0	380.5	385.7	408.3	350.3	475.7	410.1	377.7	385.0
5	300.8	321.8	313.0	411.5	313.8	291.0	281.8	334.7	351.8
5.5	274.5	409.0	200.3	265.0	241.2	0.0	307.0	199.2	260.0
6	104.0	0.0	759.0	0.0	0.0	69.5	162.0	0.0	121.0
<b>Victoria</b>									
0	1 465.0	1 394.3	1 430.3	1 679.0	1 651.0	0.0	1 537.0	1 766.5	0.0
1	1 038.1	1 126.8	0.0	1 247.0	1 102.0	647.0	0.0	609.0	0.0
1.5	864.6	916.0	1 099.0	0.0	560.0	1 035.3	977.0	0.0	0.0
2	880.1	811.9	0.0	663.0	736.3	810.0	0.0	765.0	0.0

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>
2.5	668.1	745.8	790.0	902.5	780.5	802.0	0.0	874.3	0.0
3	636.1	573.0	598.3	809.0	526.3	636.3	583.5	562.5	444.0
3.5	571.4	570.0	608.8	579.0	321.0	564.0	604.8	472.0	535.0
4	601.0	462.8	488.5	455.0	533.0	407.3	211.0	286.0	0.0
4.5	303.5	329.8	375.9	381.3	516.5	299.5	330.3	319.3	272.5
5	315.2	355.5	393.0	429.0	443.5	0.0	406.2	296.6	0.0
5.5	179.0	187.0	0.0	479.0	0.0	246.0	369.0	240.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Queensland</b>									
0	1 133.0	921.2	903.3	0.0	881.0	824.5	1 119.6	1 101.1	1 021.0
1	623.8	607.5	658.8	0.0	0.0	636.0	622.0	637.0	655.0
1.5	599.0	600.0	641.0	589.0	621.0	0.0	655.0	0.0	0.0
2	591.6	548.7	568.3	0.0	0.0	558.5	525.0	542.0	645.0
2.5	522.0	530.7	507.0	514.0	0.0	483.0	0.0	558.0	0.0
3	516.8	517.0	0.0	493.5	490.0	0.0	474.0	0.0	0.0
3.5	445.7	0.0	464.0	450.5	448.0	0.0	0.0	677.0	0.0
4	407.0	422.4	429.5	409.3	425.0	395.7	425.0	355.0	368.0
4.5	419.3	363.0	390.2	0.0	405.0	389.0	357.7	0.0	396.0
5	391.6	318.4	533.3	313.8	418.9	346.0	380.6	407.4	340.0
5.5	238.0	239.0	283.0	428.5	388.7	268.0	252.0	232.0	256.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	167.0	183.0
<b>WA</b>									
0	812.8	744.5	0.0	0.0	0.0	1 049.0	0.0	797.0	0.0
1	604.0	570.0	0.0	574.0	0.0	0.0	0.0	511.0	589.0
1.5	569.3	718.0	610.0	557.0	513.0	561.0	553.0	572.5	0.0
2	537.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.5	494.0	0.0	509.0	447.0	483.0	0.0	0.0	574.0	307.0
3	417.3	367.0	420.0	0.0	0.0	479.0	433.0	533.5	0.0
3.5	389.7	387.0	357.0	413.7	389.0	0.0	500.0	372.0	452.0
4	413.3	321.0	0.0	362.5	361.7	341.0	367.0	342.3	0.0
4.5	0.0	294.7	273.0	342.2	0.0	329.0	293.5	298.2	401.0
5	261.3	274.8	251.0	290.0	245.0	284.0	324.5	397.8	372.0
5.5	226.0	0.0	155.0	183.0	213.0	200.0	210.0	0.0	149.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>SA</b>									
0	0.0	831.0	769.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	1 154.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.5	792.0	0.0	1 059.0	0.0	0.0	0.0	0.0	0.0	0.0

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	486.0	0.0
2.5	472.0	677.0	0.0	625.0	0.0	0.0	487.0	0.0	0.0
3	578.5	535.5	398.0	446.0	475.0	417.0	0.0	393.0	0.0
3.5	515.0	407.7	0.0	602.5	0.0	0.0	375.5	0.0	0.0
4	307.0	389.8	360.0	347.5	394.0	329.0	0.0	0.0	367.0
4.5	237.0	321.0	303.0	481.7	356.5	299.5	0.0	425.0	0.0
5	211.0	294.0	252.0	196.0	0.0	235.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Tas</b>									
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	654.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.5	0.0	0.0	0.0	0.0	0.0	607.0	499.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	497.0	0.0	0.0
3.5	0.0	778.0	392.0	0.0	0.0	0.0	0.0	326.0	0.0
4	362.0	0.0	0.0	322.0	0.0	0.0	290.0	0.0	0.0
4.5	266.5	0.0	0.0	303.0	0.0	0.0	257.0	0.0	0.0
5	247.0	0.0	0.0	256.0	0.0	183.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>ACT</b>									
0	1 171.7	1 644.3	0.0	0.0	1 207.5	1 829.0	1 050.0	840.0	0.0
1	815.0	0.0	0.0	0.0	0.0	663.0	0.0	0.0	0.0
1.5	782.5	0.0	1 028.0	0.0	0.0	605.0	0.0	577.0	0.0
2	766.3	919.0	0.0	745.0	0.0	0.0	1 174.0	1 180.0	772.0
2.5	769.5	482.0	0.0	1 089.0	0.0	471.0	0.0	699.0	755.0
3	631.0	700.5	0.0	0.0	859.0	0.0	620.7	735.0	0.0
3.5	507.7	436.0	0.0	753.0	474.0	0.0	627.5	0.0	671.0
4	426.0	499.4	545.0	499.0	0.0	493.0	0.0	499.0	0.0
4.5	352.3	325.8	350.7	538.8	330.0	532.0	382.5	375.0	224.0
5	306.0	255.0	0.0	251.7	272.3	329.5	243.5	279.0	0.0
5.5	0.0	212.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>NT</b>									
0	1 123.0	1 029.0	0.0	0.0	0.0	0.0	0.0	1 352.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	784.5	0.0

Star rating	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>	MJ per m <sup>2</sup>
1.5	745.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	681.0	0.0	0.0	688.0	0.0	0.0	0.0	0.0	0.0
2.5	346.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.5	533.0	0.0	0.0	0.0	567.0	0.0	0.0	550.0	0.0
4	493.0	0.0	567.0	0.0	0.0	0.0	0.0	503.0	0.0
4.5	460.0	501.5	438.0	455.0	480.5	0.0	0.0	471.3	0.0
5	381.0	0.0	359.0	0.0	0.0	0.0	0.0	395.0	0.0
5.5	0.0	319.0	0.0	0.0	0.0	110.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: Zero energy intensity means that no buildings with the relevant star rating entered the NABERS system in that year.

Source: NABERS database.





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