

# How effective is mandatory building energy disclosure program in Australia?

S Kim<sup>1</sup> and B T H Lim<sup>1</sup>

<sup>1</sup> Faculty of Built Environment, UNSW Sydney, High Street, Kensington, NSW, 2052, Australia

E-mail: su.kim@unsw.edu.au

**Abstract.** Mandatory green building regulations are often considered as the most effective tool to promote better energy efficiency and environmental protection. Nevertheless, its effectiveness compared to the voluntary counterpart has not been fully explored yet. In addressing this gap, this study aims to examine the environmental performance of green building stocks affected by the Australian mandatory building energy disclosure program. To this, this study analysed energy savings and carbon reduction efficiencies using the normalisation approach. The result shows that mandatory energy disclosure program did contribute to the reduction in energy usage and carbon emissions from the affected building stocks. More specifically, affected green building stocks showed a good efficiency especially in carbon reductions. The research results inform policymakers the possible improvement required for the mandatory disclosure program to increase the effectiveness towards dealing with the contemporary environmental issues aroused from the building sector, especially in energy savings perspective.

## 1. Introduction

Reduction in electricity consumption and thus carbon emission is an important task for the building sector - particularly with the sector being seen as one of the key contributors to global greenhouse gas emission [1–3]. As such, it is no surprising that the Australian government have made considerable effort to reducing its impacts for better sustainability through implementing mandatory and voluntary green building regulations. In fact, a recent survey [4] revealed that regulation is one of the top three triggers for Australians to choose energy efficient and environmentally friendly “green buildings” over its non-green counterpart.

From the government perspective, various regulations, especially mandatory programs, policies and codes could be used as the most powerful tool to promote specific activities through imposing disciplinary actions for non-compliance [5, 6]. More importantly, these mandates could contribute to the sustainable development of the building sector, for example, by pushing the property market to supply more efficiency green buildings for reduced electricity consumption and carbon emissions [7]. Nevertheless, little empirical work has been done to examine the effectiveness of mandatory regulations over voluntary regulations, especially in the Australian context.

## 2. Research aim and methodology

The aim of this paper is to examine the effectiveness of the mandatory building sustainability regulation over the voluntary counterpart in its environmental performance (i.e. energy savings, carbon reductions). Under this aim, specific objectives are to; (1) compare and contrast environmental performance of green



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

building stocks affected by two different types of regulations, and (2) analyse efficiencies in their environmental performance by incremental of sustainability rating level. In this study, the commercial office sector was selected considering that this sector comprises a large number of green buildings compared to residential and non-core sectors (e.g. healthcare) [7, 8]. Furthermore, Commercial Building Disclosure program, with the use of the National Australian Built Environment Rating System (NABERS), was selected as a mean of mandatory regulation as it is the most comprehensive mandate that covering most of the commercial office building stocks in the Australian property market. As for the voluntary adoption, it refers to commercial office buildings certified with Green Star system. For both adoptions, office building stocks with 4 Stars or above were considered as “green building” as they represent above the average performance in its sustainability standard [7]. For a fair comparison between mandatory and voluntary adoptions using the two-different building sustainability assessment schemes, a normalisation approach was adopted wherever necessary, based on the equations 1 and 2 below;

$$\text{Normalised Value for Change } (\Delta) \text{ in Energy Savings } (\%) = \frac{(E_l - E_h)}{E_l} \times 100\% \quad (1)$$

$$\text{Normalised Value for Change } (\Delta) \text{ in CO}_2 \text{ Reduction } (\%) = \frac{(\text{CO}_{2l} - \text{CO}_{2h})}{\text{CO}_{2l}} \times 100\% \quad (2)$$

where,

$E_l$ : Energy usage of lower rating

$E_h$ : Energy usage of higher rating

$\text{CO}_{2l}$ : Carbon dioxide emissions of lower rating

$\text{CO}_{2h}$ : Carbon dioxide emissions of higher rating

### 3. Effectiveness of the Australian mandatory regulation

#### 3.1. Australian mandatory building sustainability regulations

In many countries, building sustainability regulations were often imposed in conjunction with building sustainability certification schemes (e.g. LEED, BREEAM, Green Mark), with or without public disclosure [9–11]. Whilst it may be hard to say which approach is more effective [12], several studies [10, 13, 14] claimed that the mandatory disclosure programs could be the most cost-effective strategies to promote sustainable development of the building sector through information sharing. This is because mandatory disclosure of building energy efficiency and environmental performances could play a vital role not only as an obligation but also as a trigger for property investors to develop and invest in more sustainable buildings. Moreover, it allows tenants to have more choices between green and not-so-green alternative by looking at their environmental performance. In fact, when considering green buildings are relatively expensive than its non-green counterpart in spite of its benefits [15], mandatory disclosure programs could help the property market to quickly catch up with the mature green building markets [7].

Hitherto, the Australian government has imposed several regulations, including the building energy disclosure program, for mandatory adoption of green buildings. As of 2017, these mandatory regulations include, but not limited to, (1) Energy Efficiency in Government Operations (EEGO), (2) National Green Leasing Policy (NGLP) and (3) Commercial Building Disclosure (CBD) Program (Table 1).

EEGO was established in 2006 by the Australian Department of Environment and Water Resources as an updated version of the old policy “Measures for Improving Energy Efficiency in Commonwealth Operations (1997)” [16]. As its name represents, it gives a special attention to the improvement of building energy efficiency for affected government occupied buildings. The policy requires both government agencies and building owners to commit the use of Green Lease Schedule (GLS) [17] which sets minimum ongoing operational building energy efficiency of NABERS 4.5 Stars [18, 19].

**Table 1.** Description of Australian mandatory building sustainability regulations for office sector.

	<b>EEGO</b>	<b>NGLP</b>	<b>CBD</b>
<b>Effective from</b>	2006	2010	2010
<b>Major approach</b>	Setting up minimum requirements	Setting up minimum requirements	Public disclosure
<b>Major scope</b>	Government operations (incl. substantially budget funded agencies)	Government operations, Private sector operations	(Mainly) Private sector operations
<b>Related program/policy</b>	Green Lease Schedule (GLS)	Green Lease Schedule (GLS)	Building Energy Efficiency Certificate (BEEC)
<b>Requirements &amp; goals</b>	Inclusion of GLS in new buildings, or new lease over 2 years, or major refurbishment over 2,000sqm where government is the tenant  Achievement of 4.5 Stars or above in NABERS	Inclusion of GLS in new lease or lease renewal of offices over 2,000sqm with the lease term over 2 years, and where government is the tenant  Achievement of 4.5 Stars or above in NABERS	Acquisition and disclosure of BEEC containing NABERS ratings for sales or lease of offices over 2,000sqm (1,000sqm from June 2016)

Similar to EEGO, NGLP's primary concern is to enhance the building energy efficiency. The practical significance of the NGLP is two-fold; (1) the policy is the first nationally consistent approach across the federal, state and territory governments in its implications [20], and (2) the policy covers not only the government operations but also the non-government operations [18]. NGLP aims at accelerating private sector to uptake the GLS to ensure landlords and tenants to use office building in a sustainable manner [19, 20].

Whilst the first two policies use minimum standards (e.g. achievement of NABERS 4.5 Stars) as a regulatory compliance, CBD program rather acts as a mandate for public disclosure of building energy efficiency. Similar to the US and UK [13, 14], the program requires public disclosure of building energy efficiency using a certificate called Building Energy Efficiency Certificate (BEEC). BEEC contains information on the building energy efficiency using NABERS rating level as well as other building information such as lighting efficiency, building size and name of the building owner. The program is currently applicable for office buildings over 1,000 square meters or more for sale or lease [21] regardless whether they are government operations or not. To this extent, the CBD program could be regarded as the most comprehensive mandatory regulation covering offices from small to large size as well as both government and non-government operations.

### 3.2. Effect of mandatory disclosure program in energy consumption & carbon emission

Table 2 presents the annual environmental performances of green building stocks affected by the mandatory disclose program (NABERS) and green building stocks that are adopted purely voluntarily (Green Star). The result shows that, in general, NABERS certified office buildings generated relatively more carbon dioxide and consumed more energy than their Green Star counterpart. The gap between these two is more apparent for "just above the average" green buildings as 4 Stars rated NABERS certified buildings consumed twice more energy and produced almost 40% more carbon than 4 Stars rated Green Star certified buildings. Interestingly, a similar trend was noted with the 5 Stars rated buildings although the gap between these two groups of building stocks becomes narrower. Conceptually, higher rated green buildings are supposed to be more energy efficient. However, it found that NABERS 5.5 Stars buildings consumed more energy than 5 and 4.5 Stars rated buildings. This phenomenon is further reinforced by the Kruskal-Wallis test result that there are no statistical significant differences between the NABERS rating level and energy consumption ( $p=0.833$ ), and their carbon emission level ( $p=0.940$ ) of those building samples. However, when considering this research focuses

on green buildings located at central business districts, the level of energy consumption and carbon emissions might be affected by characteristics of green buildings attached to specific location.

**Table 2.** Environmental performances of CBD located NABERS and green star certified office buildings.

NABERS				Green Star <sup>a</sup>			
Rating	Energy consumption (kWh/m <sup>2</sup> )	Carbon emission (kgCO <sub>2</sub> -e/m <sup>2</sup> )	Size m <sup>2</sup> (NLA)	Rating	Energy consumption (kWh/m <sup>2</sup> )	Carbon emission (kgCO <sub>2</sub> /m <sup>2</sup> )	Size m <sup>2</sup> (NLA)
5.5	113	53	273,493	6	24	44	26,500
5	93	65	1,667,938	5	49	58	16,900
4.5	106	79	1,885,856	4	64	73	11,200
4	128	101	1,503,775				

<sup>a</sup> Due to unavailability of raw data, values were extracted from a publication from Green Building Council of Australia [22].

Then, the normalisation process was undertaken using the equation 1 and 2, mentioned above, for a fairer comparison for green buildings certified with mandatory and voluntary adoptions. Table 3 presents the result of the normalisation process showing the level of increase in ratings in NABERS and Green Star in relation to the energy savings and reduced carbon emissions. The result shows that 1 Star increment, i.e. from 4 Stars to 5 Stars in mandatorily NABERS, resulted in 27.3% of the reduction in energy consumption. However, there was no significant difference between the upgrade from 4.5 Stars to 5.5 Stars. Moreover, it is found that 0.5 Star increase from 5 Stars to 5.5 Stars, could even result in an increase in energy consumption of 21.5%. This finding contradicts to that of the Green Star system, whereby a similar 1 Star increment – especially from 5 Stars to 6 Stars – would bring about a significant energy savings up to 51.0%. It is notable that even a bigger energy usage reduction was highlighted when obtaining 6 Stars instead of 4 Stars in Green Star as they could save up to 62.5% of the energy compared to the 4 Stars rated buildings.

Meanwhile, Table 3 shows more consistent results for carbon emissions reduction. There was a correlation between the increment of a star rating and carbon reduction level. For instance, 0.5 Star increment in NABERS certified green buildings could result in a reduction of carbon emissions up to 21.8%. Additional reductions up to 47.5% could be achieved when there was a further increase in rating levels. This clearly reflects that putting some extra efforts to achieve the more than average green buildings could contribute to reduce carbon emissions. This is consistent for the voluntarily adopted Green Star certified green buildings albeit with fewer degrees. Overall, it seems that mandatory adoption of green buildings showed relatively better efficiency in dealing with the carbon emission issue although voluntarily adopted green buildings were not far behind.

**Table 3.** Results of normalisation.

NABERS			Green Star		
Rating increase	ΔEnergy savings (%)	ΔCarbon reduction (%)	Rating increase	ΔEnergy savings (%)	ΔCarbon reduction (%)
1.5 (4→5.5)	11.7	47.5	2 (4→6)	62.5	39.7
1 (4→5)	27.3	35.6	1 (4→5)	23.4	20.5
1 (4.5→5.5)	-0.07	32.9	1 (5→6)	51.0	24.1
0.5 (4→4.5)	17.2	21.8			
0.5 (4.5→5)	12.3	17.7			
0.5 (5→5.5)	-21.5	18.5			

#### 4. Conclusions

This research aimed to examine the environmental performance of green building stocks affected by the Australian mandatory building energy disclosure program. Our results indicate that the mandatory building energy efficiency program could help mitigating the contemporary environmental issues in the building sector. More precisely, this study points to the ‘need for regulations’ for better efficiency for both energy and carbon reduction targets. At a first glance, mandatorily adopted NABERS certified green buildings that showed higher level of electricity consumption and carbon emissions. However, when we looked at their performance more carefully using the normalisation approach, it seems that it is the mandatorily adopted green building stocks showed better efficiency in carbon reductions. At the same time, it seems that in general, higher ratings led to less energy consumption and carbon emission level for both mandatorily and voluntarily adopted building stocks. This reflects that better efficiency could be achieved when an overall increase in building sustainability level could be achieved. Thus, regulations for encouraging putting some extra effort to achieve the “more than the average” level of green buildings could be highly recommended to further increase the effectiveness of the currently imposed regulations.

However, we do acknowledge that there are some limitations in this research. For example, whilst at least three mandates are currently implemented by the Australian government, we only had to consider the energy disclosure program in our analysis. Moreover, the result of our analysis might be influenced by the unique characteristics of NABERS and Green Star. Further investigation is highly suggested with a careful consideration of possible influence of these limitations as well as different aspects of environmental performance of affected green & non-green buildings other than energy and carbon emission levels. This would allow us to fully examine the effectiveness of the currently implemented regulations and possibly lead to the development of further strategies for better sustainability level of the Australian building sector.

#### References

- [1] Lean H H and Smyth R 2010 CO<sub>2</sub> emissions, electricity consumption and output in ASEAN *J. Applied Energy* **87** 1858
- [2] Saddler H 2016 *Australia's Carbon Emissions and Electricity Demand Are Growing: Here's Why* Retrieved on September 30, 2017 from <https://theconversation.com/australias-carbon-emissions-and-electricity-demand-are-growing-heres-why-57649>
- [3] A M and SB R 2015 Building Energy Consumption and Carbon dioxide Emissions *J. of Earth Science & Climatic Change* **3** 1
- [4] Dodge Data & Analytics and United Technologies 2016 *World Green Building Trends 2016: Developing Markets Accelerate Global Green Growth* SmartMarket Report (Bedford, MA: Dodge Data & Analytics) pp 1-66
- [5] Kontokosta C E 2013 Energy disclosure, market behavior, and the building data ecosystem *Ann. N.Y. Acad. Sci.* **1295** 34
- [6] Choi E 2010 Green on Buildings: The Effects of Municipal Policy on Green Building Designations in America's Central Cities *J. of Sustainable Real Estate* **2** 1
- [7] Kim S, Lim B T H and Kim J 2016 The Effect of Building Sustainability Regulation on the Green Office Building Stock in Australia *Proc. Int. Conf. on Sustainable Built Environment: Actions for the Built Environment of Post-Carbon era Complying with COP21 Sustainable Built Environment 16 Seoul (Seoul)* pp 470–473
- [8] Kim S, Kim J and Lim B T H 2015 Who Occupies the Green Building: a Case of Australia Global Collaboration for Asia's Construction Challenges *Proc. The 6th Int. Conf. on Construction Engineering and Project Management (ICCEPM 2015) (Busan)* pp 549-552
- [9] Iwano J and Mwasha A 2010 Implications of building energy standard for sustainable energy efficient design in buildings *Int. J. Energy Environ* **1** 745
- [10] Grande H C, Creyts J, Derkach A, Farese P, Nyquist S and Ostrowski K 2009 *Unlocking Energy*



- Efficiency in the U.S. Economy* McKinsey Global Energy and Materials (New York: McKinsey & Company) pp 1-14
- [11] Bulkeley H, Schroeder H, Janda K, Zhao J, Armstrong A, Chu S Y and Ghosh S 2009 *Cities and climate change: The role of institutions, governance and urban planning* (UK: Durham University & Oxford University) 1-92
  - [12] Circo C J 2007 Using Mandates and Incentives to Promote Sustainable Construction and Green Building Projects in the Private Sector: A Call for More State Land Use Policy Initiatives *Penn St. L. Rev.* **112** 731
  - [13] Hsu D 2014 How much information disclosure of building energy performance is necessary? *J. Energy Policy* **64** 263
  - [14] Roussac A C and Bright S 2012 Improving environmental performance through innovative commercial leasing *Int. J. of Law in the Built Environment* **4** 6
  - [15] Kim S, Lim B TH and Kim J 2017 Green Features, Symbolic Values and Rental Premium *Procedia Engineering (Sydney)* (Amsterdam: Elsevier) **180** 41
  - [16] Australian Greenhouse Office 2007 *Energy Efficiency in Government Operations (EEGO) Policy* (Canberra: Department of Environment and Water Resources) pp 1-29
  - [17] Department of the Environment and Energy n.d. *Energy Efficiency in Government Operations Policy* Retrieved on January 3, 2017 from <https://www.environment.gov.au/energy/internationalengagement/apecworkinggroup/energy-efficiency-government-operations-policy>
  - [18] Department of the Environment and Energy n.d. *Green Lease Schedules (GLS) for Government Buildings* Retrieved on January 3, 2017 from <https://www.environment.gov.au/energy/efficiency/non-residential-buildings/government-buildings/eego/green-lease-schedules-gov-buildings>
  - [19] Burroughs S 2011 Green Leases in Australia: An Analysis of Current Trends and Issues SB11 Helsinki World Sustainable Building Conference *SB11 Helsinki World Sustainable Building Conference (Helsinki)* pp 1-13
  - [20] APCC n.d. *National Green Leasing Policy* (Deakin. ACT: Australasian Procurement and Construction Council) pp 1-19
  - [21] Department of the Environment and Energy n.d. *What is CBD?* Retrieved on September 27, 2017 from <http://cbd.gov.au/overview-of-the-program/what-is-cbd>
  - [22] GBCA 2013 *The Value of Green Star - A Decade of Environmental Benefits* GBCA Publications (Sydney: Green Building Council Australia) pp 1-51