

# Carbon and Energy Use Reporting for Buildings in Putrajaya: Implementation Status and Drive Factors

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This study is aimed at investigate to what extent does the carbon (CO<sub>2</sub>) and energy use reporting being incorporated in the existing reporting practices by facility managers for government office buildings in Putrajaya. The findings indicate that CO<sub>2</sub> and energy use reporting activity are affirmed and current level of engagement in this reporting practice appears to be high. The reporting status has showed no significant association with their company size. The leading drive factors which influence this reporting status are the regulatory compliance and relationship building with stakeholders. Presently, main reporting obligation for energy use is through contract document whereas measuring and reporting of CO<sub>2</sub> are upon stakeholders' request. This study provides overview on current status of CO<sub>2</sub> and energy use reporting for government office buildings that is expected to give positive impact on future mandatory reporting programme and to demonstrate as a new policy instrument for building sector CO<sub>2</sub> mitigation in Putrajaya.

## 1. Introduction

Putrajaya is the Federal Government Administrative Centre of Malaysia, a city that has been determined by the federal government to be developed as one of the pioneer green cities in the nation and focusing on reducing carbon (CO<sub>2</sub>) emissions in the city. A specific policy to reduce the carbon footprint has been incorporated into the city's statutory development plan - Putrajaya Structure Plan 2025 and supported with an citywide energy use related CO<sub>2</sub> reduction target of 60 % by 2025 (Perbadanan Putrajaya, 2012). Three main CO<sub>2</sub> emitting sectors have been identified namely building, land transportation and solid waste sector. The highest emissions reduction was anticipated from building sector due to its emissions coverage estimated by 2025 will be 55 % (2,304 ktCO<sub>2</sub>) of total citywide emissions. The citywide GHG inventory for 2014 estimated that existing building stocks had produced 67 % (1,038 ktCO<sub>2</sub>) of the emissions in the city (Perbadanan Putrajaya, 2015). Buildings are long lived urban component and its potential service life span can lasted estimated for hundreds of years with proper and regularly maintenance (Konig et al., 2010). Yet, its CO<sub>2</sub> emissions are occurring throughout the whole life cycle and highest emissions during the use phase when energy is consumed for building operations (UNEP, 2009). Hence, a mechanism for emissions performance monitoring and engaging building stakeholders' involvement in CO<sub>2</sub> reduction is necessary to be implemented. Building's emissions and energy use reporting is one of the mechanisms which widely practiced by cities in developed nations. Reporting system may allow government to collect data and gain insight of bottom-up emissions reduction possibilities as a crucial first step in GHG management process particularly in improving energy efficiency (Ayalon et al., 2014). The implementation cost is relatively lower as compared to other energy efficiency policy options and any necessary mandatory requirement for reporting can be passed at state or local level (Hsu, 2013). Presently, existing floor areas coverage for government office buildings (33.6 %) are much higher than commercial buildings (8.8 %) (Perbadanan Putrajaya, 2015). Hence, government lead by example is considered desirable and cost-efficient to demonstrate new practices in emissions mitigation for building sector in Putrajaya. The main objective of this study is to investigate the carbon and energy use reporting status by facility managers for government office buildings. We also examine the drive factors and barriers influencing their participation in this reporting practice. This study intends to fill the gap in existing literature of CO<sub>2</sub> and energy use reporting at facility (building) level which is still minimal research. The research findings demonstrate the current state of stakeholder's

engagement and driver factors which can be a guide to formulate policy for building sector's CO<sub>2</sub> emissions mitigation at city level.

## 2. Literature Reviews

### 2.1 Overview of Carbon and Energy Use Reporting

Many governments at different levels have started to introduce mandatory or voluntary reporting for carbon and/or energy use information (KPMG, 2010). This reporting practice can be applied at company or facility (building, outdoor application) level and it is normally required to support government actions for GHG mitigation. Prior studies related to CO<sub>2</sub> and/or energy use reporting for buildings were found in megacities such as Tokyo in Japan (Nishida and Hua, 2011), New York, Seattle, San Francisco in United States (Hsu, 2014) and Hong Kong (Lai, 2014). In practice, reporting programme for buildings may require both CO<sub>2</sub> emissions and energy use data or only focusing on energy consumption data. Energy use is considered an easy to obtain data for most of the building stakeholders and usually does not require further calculation as compared to reporting of CO<sub>2</sub> emissions.

### 2.2 Roles and Contributions

Most of the researches recognised that reporting as an important and necessary part of the overall emissions management process. The first step in this emissions management cycle is to understand where emissions are from, by measuring the emissions and supports by the theory of 'what gets measured, gets managed' (DEFRA, 2010). Proponents of transparent disclosures argued that when information is made available action is possible (Andrew and Cortese, 2011). Reporting can also be considered as a proxy for government to identify whether building stakeholders have taken initial steps in the wider emissions management cycle by understanding their building emissions. Through publicly sharing the information can reflect the organisation's commitment in climate change mitigation (Halkos and Skouloudis, 2015). One assumption can be made was information may empower policy makers to demand certain performance and accountability from large emitters. Such information based approach to regulation has offered an alternative to the traditional regulation-enforcement based environmental policies (Brown et al., 2008). Government and building stakeholders are able to track the progress of their emissions reduction measures undertaken by consistently measure and reporting. Besides, consumption based quantified information (numbers) such as energy use and CO<sub>2</sub> footprint provide guidance in the decision making process (Chakraborty and Roy, 2012). In addition, Nishida et al. (2016) has pointed out the gap between design and real performance have been recognised due to the factors such as building user awareness, operation/maintenance, difference of designed and actual performance of equipment. Hence, regulating the design specification alone might not be able to guarantee of the desire emissions reduction when buildings in operation. An enabling tool for embedding and sustain the organisational strategies to CO<sub>2</sub> management is necessary. Reporting can be a 'driver' to generate pressure for organisational further action and keeping CO<sub>2</sub> reduction on the agenda (Ennis et al., 2012).

### 2.3 Drive Factors for Carbon and Energy Use Reporting

The implementation of reporting activity is usually depending on a number of factors to support the actions, often a single drive factor will act as tipping point.

**Regulatory compliance:** power of regulation is effective to exert pressure and creating great force for reporting obligation. The United Kingdom Financial Times Stock Exchange companies admitted on their website that importance of present and future regulations as a key driver to incorporate carbon management in their corporate strategies (Okereke, 2007). Future expected regulations are also an important factor to encourage voluntary CO<sub>2</sub> reporting from stakeholders and treated as first-mover advantages for early preparation (Kauffmann et al., 2012). Apart from the government laws and regulations, initial engagement in reporting practices could be driven by other regulations such as contracted requirement (IEMA, 2010).

**Energy cost savings:** energy related expenditure is part of the recurrent annual spending for companies. Companies will be induced to undertake emissions reduction practices when they realise the relationship between reducing CO<sub>2</sub> emissions and energy cost savings. Raising energy costs are driving companies to reduce their energy use and improve energy efficiency, thereby also to reduce GHG emissions (OECD, 2010). Organisation's attitudes on environmental issues not necessarily drive their behavioural change if benefits are not justified (Wong and Zapantis, 2013).

**Leadership:** success implementation of a new policy or programme often associates with a careful design plan and the introduction phase of the programme, strong leadership is essential for this phase (Nishida and Hua, 2011). From the perspective of policy implementer such as local government, a decisive leader in executing the new policy programme and handling negotiation process with stakeholders is essential driver in engaging stakeholders' continuous commitment. On the other hand, leadership is important within the reporting entity

organisation when making decision to undertake emissions reporting activities. A key individual of organisation such as chief executive director or managing director who is responsible for promoting and championing the reporting activities have been identified as internal drivers (Farneti and Guthrie, 2009).

Reputation building: reporting CO<sub>2</sub> emissions performance externally could increase the transparency on how the firm's response and concern in the issue of climate change. Transparency has been recognised by majority of the companies in United States and European as the main factor to influence their corporate reputation compared to other factors such as quality of product or services, financial return, trust and leadership (McCarty et al., 2011). Reporting provides an opportunity to improve 'green' reputation by showcasing best practices in CO<sub>2</sub> reduction and comparison against peer's performance. Subsequently, this 'green' reputation brings secondary benefits to company competitiveness such as to attract skilled employees (Pellegrini-Masini and Leishman, 2011) and gain more business opportunity from clients who are environmentally sensitive.

Relationship building with stakeholder: maintaining good perception from stakeholders particularly those knowledgeable and highly concern in climate-change development such as law makers, environmentalists, customers and public will help to strengthen relationship and benefits for their business activities as well. The number based information would help in strengthening relationship with the shareholders in the event that the latter may want to invest only in environmentally and socially responsible companies (Chakraborty and Roy, 2012). In the event which stakeholder demand in the environmental accountability is weak the reporting will most likely to be overlooked and disregarded (Halkos and Skouloudis, 2015).

Environmental awareness: this factor involves the ethical consideration on the desire to do the right thing and concern of the environmental impact from business activities or building operations. The internal values of self-consciousness have existed. Scholtens and Kleinsmann (2011) revealed that the British logistic subcontractors appeared to realise and have internalized that their business operations will impact the well-being of future generations. Environmental awareness is a very strong incentive for them to adopt CO<sub>2</sub> reduction practices. Other than the costs and benefits consideration, managers' environmental values and attitudes are important factor to drive their voluntary actions for environmental protection (Nakamura et al., 2001).

### 3. Research Methodology

This study identifies facility manager (FM) who is responsible for the operation and maintenance of existing government office buildings as the key preparer for building performance report. Public Works Department (JKR) is one of the key responsible agencies managing government buildings in Putrajaya including appointment of FM for building operations and maintenances (DPM, 2003). The exception of this responsibility can be given for government office buildings which occupying by single ministry/department (non-shared office). A list of 27 FMs has been obtained from JKR Putrajaya except two non-shared government office buildings. Contacts were made with officers from the two buildings to obtain the list of their FMs. As a result, the total number of FM identified was 29, this is considered small number therefore no sampling is required. To investigate the reporting status and drive factors for reporting, face to face interviews were carried out with a questionnaire consisted of close-ended and open-ended questions. The drive factors summarised from the literature are (1) regulatory compliance, (2) energy cost saving, (3) leadership, (4) reputation building, (5) relationship building with stakeholder and (6) environmental awareness. Respondents were requested to rank the drive factors in sequence from rank 1 to rank 6. Rank 1 as the most influential drive factor whereas 6 as the least influential drive factor. Mean value is used to determine the rank and based on the above rules, the lower the mean value for a drive factor represented the higher of its rank. The data collected were analysed using frequency analysis and Pearson chi square test of independence to analyse the association between reporting status and company size. Company size is measured by number of employees. The significance level in this test is set at 0.05 to determine whether to accept the null hypothesis ( $H_0$  = reporting status and company size are independent) or alternative hypothesis ( $H_1$  = reporting status and company size are not independent). To interpret the test result, p value is compared to the significance level (0.05). Null hypothesis will be accepted if p value is greater than 0.05, otherwise accept alternative hypothesis. In the case of small data set and expected frequencies are less than 5, the assumption necessary for asymptotic p value method may be violated. Therefore, a more accurate exact p value results should be obtained.

### 4. Findings and Analysis

#### 4.1 Carbon and Energy Use Reporting Status

Overall results showed that there is a high level of CO<sub>2</sub> and energy use reporting among facility managers for government office buildings in Putrajaya. A high percentage of 93.0 % of respondents have reported for CO<sub>2</sub> and/or energy use, whereas only 7.0 % of respondents indicated that they have not yet engage in any of the reporting activity (Table 1). It can be noticed that reporting for energy use information was slightly higher than

reporting for CO<sub>2</sub> emissions. A small percentage of 11.1 % FM only report for energy use without further calculates the energy use related CO<sub>2</sub> emissions. Based on this status, the future implementation of mandatory reporting for government office buildings seem promising.

Pearson chi square test of independence has been conducted to explore the relationship between reporting status and company size. Table 2 indicates that 7 cells have expected frequencies less than 5. Hence, test result are obtained from exact p value (p value= 0.371>0.05). With this result, null hypothesis is accepted and concludes that there is no statistical significant association between reporting status and company size. This might reflects that the existing reporting obligation could be easy to comply, does not require higher human and financial resources from large company to enable this reporting status.

*Table 1: Different Reporting Status among Facility Managers*

Reporting	No. of FM	Percentage (%)
CO <sub>2</sub> & Energy Use	24	83.0
Energy Use only	3	10.0
Not Reporting	2	7.0
Total	29	100.0

*Table 2: Chi Square Test (Reporting Status and Company Size)*

	Value	df	Asymp. Sig.(2-sided)	Exact Sig. (2-sided)
Pearson Chi Square	4,112 <sup>a</sup>	4	.391	.371

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .21

#### 4.2 Drive Factors for Reporting

To examine the drive factors influencing their participation in reporting, the FMs ranked each of the six drive factors (Table 3). It is clearly evidenced that regulatory compliance and relationship building with stakeholders have been indicated as utmost leading drive factors for initial engagement. Other drive factors such as energy cost savings and leadership are expected to contribute in sustaining the existing reporting practices. Environmental awareness and reputation building are the least influential factors. This finding suggests that, level of environmental consciousness among FMs is low to act as tipping point for voluntary engagement in reporting activity. The FMs may not aware of the secondary benefits of 'green' reputation may increase company competitiveness.

*Table 3: Drive Factors for Reporting*

Rank	Drive factor	Count of FM by Rank						Total Value	Mean
		1	2	3	4	5	6		
1	Regulatory compliance	13	3	3	6	4	0	72	2.48
2	Relationship building with stakeholder	6	10	6	1	2	4	82	2.83
3	Energy cost saving	2	5	8	6	5	3	103	3.55
4	Leadership	5	3	4	4	10	3	107	3.69
5	Environmental awareness	2	5	3	6	4	9	119	4.10
6	Reputation building	1	3	5	6	4	10	126	4.34
	Total	29	29	29	29	29	29		

Total value: sum by multiply the count of FM in each rank for respective drive factor. Mean: total value/29.

For a better understanding of the drive factors influence, all FM have been classified into two groups. Group A: FM reporting CO<sub>2</sub> and energy use (n=24); Group B: FM reporting energy use only / not reporting (n=5). Two aspects were further investigated, the current reporting obligations and reasons (barriers) inhibit their participation. For the first aspect, responses from Group A FM revealed that contract document appears to be their main reporting obligation for energy use information whereas, reporting of CO<sub>2</sub> emissions is upon the request from key stakeholders (client/building user), using a specific online system or other printed materials. The findings above reflect that in the absence of a specific legislation for mandatory reporting in Putrajaya, the contract document has played a vital role in creating reporting obligation. On the other hand, demand of CO<sub>2</sub> performance information from stakeholders (client/building user) with environmental consciousness has exerted reporting pressure to FMs due to their desire to maintain good relationship with these key stakeholders. 17 % of the FM stated that adoption of environmental management policies by their companies required the monitoring and reporting of environmental performance data. This is including ISO14001, Health, Safety and

Environment (HSE) policy and carbon neutral policy in business operations. Apart from the above, maintaining their certified green building status and local government's low carbon vision have been recognized as other obligations for reporting.

The second aspect, Group B FM were asked to give the reasons inhibit their engagement in CO<sub>2</sub> and energy use reporting (Figure 2). No stakeholder request (client/building user) for information (80 %) has been identified as the main reason, followed by not in the contract scope (60 %), no regulations (60 %), lack of knowledge for reporting (40 %) and lack of awareness (20 %). It is noticeable that eliminating these barriers will also result to the creation of drive factors as some of the reasons provided were in line with their previous responses in Table 3. Though stakeholder request for information and contract document can be used as an alternative to legislation for reporting, the consistency could be difficult to maintain in the long run. A standardization of FM's contract scopes and demand of building performance data among building users are necessary to overcome this issue. Besides, the knowledge barrier and awareness level should be given attention by policy makers in order to increase the reporting rate.

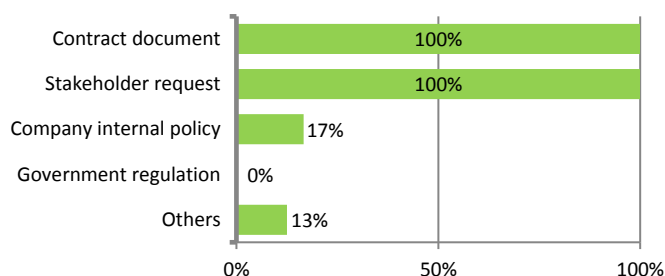


Figure 1: Share of Facility Managers by Reporting Obligation

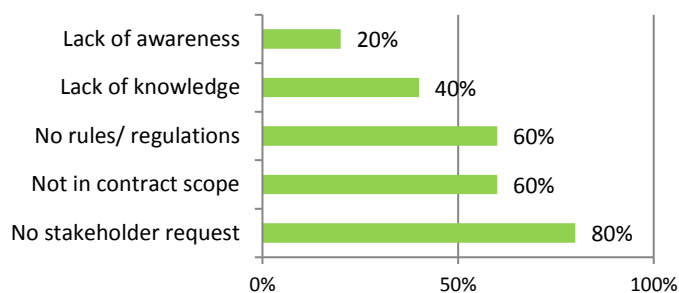


Figure 2: Share of Facility Managers by Barriers

## 5. Conclusions

This study is aimed at investigate to what extent does the CO<sub>2</sub> and energy use reporting being incorporated in the existing reporting practices for government office buildings in Putrajaya. The findings conclude that carbon and/or energy use reporting activity by facility managers who managing the government office buildings in Putrajaya is affirmed with more than 90 % engage in the reporting activity. This high level of reporting status is expected to give positive impact on future mandatory reporting and to demonstrate as new instrument for building sector CO<sub>2</sub> mitigation in Putrajaya. Regulatory compliance and relationship building with stakeholder have been identified as the leading drive factors for facility managers' initial engagement in reporting activities. There is a need for local government to establish a uniform and consistent reporting obligation for reporting CO<sub>2</sub> and energy use information. A human network through task force setting between local government and key building stakeholders (building managers/end users) is as vital as technology solutions in achieving emissions reduction.

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