

Bond University
Research Repository



The path towards greening the Malaysian construction industry

Mohamad Bohari, Asmah Alia; Skitmore, Martin; Xia, Bo; Teo, Melissa; Zhang, Xiaoling; Adham, Khairul Naim

Published in:
Renewable and Sustainable Energy Reviews

DOI:
[10.1016/j.rser.2015.07.148](https://doi.org/10.1016/j.rser.2015.07.148)

Licence:
CC BY-NC-ND

[Link to output in Bond University research repository.](#)

Recommended citation(APA):

Mohamad Bohari, A. A., Skitmore, M., Xia, B., Teo, M., Zhang, X., & Adham, K. N. (2015). The path towards greening the Malaysian construction industry. *Renewable and Sustainable Energy Reviews*, 52, 1742-1748. <https://doi.org/10.1016/j.rser.2015.07.148>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

For more information, or if you believe that this document breaches copyright, please contact the Bond University research repository coordinator.

The path towards greening the Malaysian construction industry

Asmah Alia Mohamad Bohari^{a, b*}, Martin Skitmore^a, Bo Xia^a, Melissa Teo^a, Xiaoling Zhang^c,
Khairul Naim Adham^d

^a *School of Civil Engineering and Built Environment, Queensland University of Technology, Brisbane, Australia*

^b *Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA Sarawak, Kota Samarahan, Sarawak, Malaysia*

^c *Department of Public Policy, City University of Hong Kong, Kowloon, Hong Kong*

^d *SCP Malaysia, Economic Planning Unit, Environment and Natural Resources Economic Section, Prime Minister Department, Putrajaya, Malaysia*

Abstract

Construction industry contributes significantly to environmental degradation, and governments in many countries which are endeavouring to address the situation. Malaysia is no exception. This paper examines the path towards green construction project delivery in Malaysia, focusing on current green policies and initiatives by governments. The historical waves in Malaysian approaches to tackling environmental issues are described, starting from the early 20th century, through the 1990s to the present, and the influence of these approaches on construction practices is analysed. Based on the findings of policy review, essential green construction practices aimed at mitigating the adverse effects of construction activities on the environment in Malaysia were identified. This paper paves the way for future studies in construction and sustainability in Malaysia, especially for the Southeast Asian region where sustainability practices are urgently needed.

Keywords: Malaysia; construction industry; environmental protection; policy; green practices.

* Corresponding author. Tel.: +6082678200
E-mail addresses: alyiaboh@gmail.com; asmahalia@sarawak.uitm.edu.my

1. Introduction

Development of the built environment is predicted to destroy natural habitats and wildlife on over 70% of the earth's surface by 2032, and developing countries account for 23% of global construction activities [1,2]. Studies on a global scale indicate that such expansion increases the urbanisation of human kind and involves rapid development and large consumption of resources. In Malaysia, the population increased to 28.3 million in 2010 from 23.3 million in 2000 [3], creating more demand for building and infrastructure development. Malaysia has been driven towards industrialisation since the 1980s [4] and is expected to become a high-income developed nation by 2020. In responding to the world agenda for sustainable development, Malaysia's development needs to be on a green path [5, 6]. Its construction industry thus faces a challenging shift to a greener mode of operation involving low carbon growth, energy conservation and the use of green technology.

The term "green" is associated with different concepts such as "energy-efficient" and "sustainable" which share the aim of creating environmentally-friendly products and services [8, 9]. It is widely acknowledged that the terms "green" and "sustainability" are vague, uncertain and interpreted differently by different people and organisations [7]. This paper agrees that it is important to establish the terms to be used based on the specific context and situation in order to avoid confusion. Therefore, the term "green" in the context of this paper refers to the recognition, integration and implementation of environment practices, initiatives or systems as highlighted in the *Our Common Future, Report of the World Commission on Environment and Development* (the Brundtland Report) [10].

Although the issue of environment protection was introduced in Malaysia in the 1960s, it is only recently that the green concept has become the centre of attention among construction stakeholders in Malaysia. The aim of this paper is to review the government policies and initiatives that support Malaysia's sustainability goals and to discuss their influence on the directions and practices in the construction industry. This paper provides insights into current policies and initiatives and thus opens the door for future studies, especially in the Southeast Asian region.

2. Waves of environmental protection approaches in Malaysia

Malaysia's historical approaches to environmental issues can be divided into three waves (Fig. 1). The first wave (1900–1980s) was the result of a commitment to protect nature and control pollution levels at the first United Nations Conference on the Human Environment in 1973 (the Stockholm Conference) [11]. Around the same time, the modern environmental movement was initiated in response to the 1974 oil crisis and concerns over pollution [12]. At this stage, the environment and development were treated separately and pulled in different directions. In Malaysia, the construction industry was left with a conflict of priorities, namely, to meet the demand for development and to minimise the impact on the environment. This conflict had slowed the progress towards green development.—In Malaysia, the Local Agenda 21 provides external driven factors for environmental reform. Agenda 21, a voluntarily implemented action plan of the United Nations, represented a significant agreement to make environmental development a global commitment [13]. Other relevant instruments include Malaysia's Environment Quality Act 1974 which aims to control pollution levels. The environmental impact assessment (EIA) process was also introduced as a proactive tool in the project planning and approval process to monitor environmental impacts and as a means of mitigation [14].

The second (1990s–2005) and the third wave (2006 onward) of approaches to environmental protection in Malaysia are characterised by a focus on sustainability. The concepts of sustainability and balanced development were first coined in the Brundtland Report which highlighted the need for sustainable development [10, 15]. The idea is for economic growth to continue but with a minimal impact on the environment. According to [16], the two factors that induced Malaysia to embrace sustainable development in the 1990s were diplomacy and external pressure from the international community over the problem of deforestation. Reported by FAO (2010) [17], the total annual deforestation in Malaysia between the years 1990-2000 and 2000 - 2005 increased to 77%. However, between the later part of second wave (2000-2005) and starting of third wave (2005-2010) there is an indication of slight improvement where deforestation decreased to 37%.

The third wave is particularly concerned with the attainment of long-term benefits through green investment. Since the launch of the National Green Technology Policy (NGTP) in 2009, the green technology agenda in Malaysia has been headed by the Ministry of Energy, Green Technology and Water (MEGTW) [18]. This focuses on low carbon growth, conservation of energy, technology localisation, heading towards sustainable development, conserving the environment and enhancing public education and awareness of green technology. In 2009, the Green Technology Financing Scheme was launched to support the diffusion of green technology and green development [19], and the formulation of policy became geared towards promoting the green concept in the Malaysian construction industry.

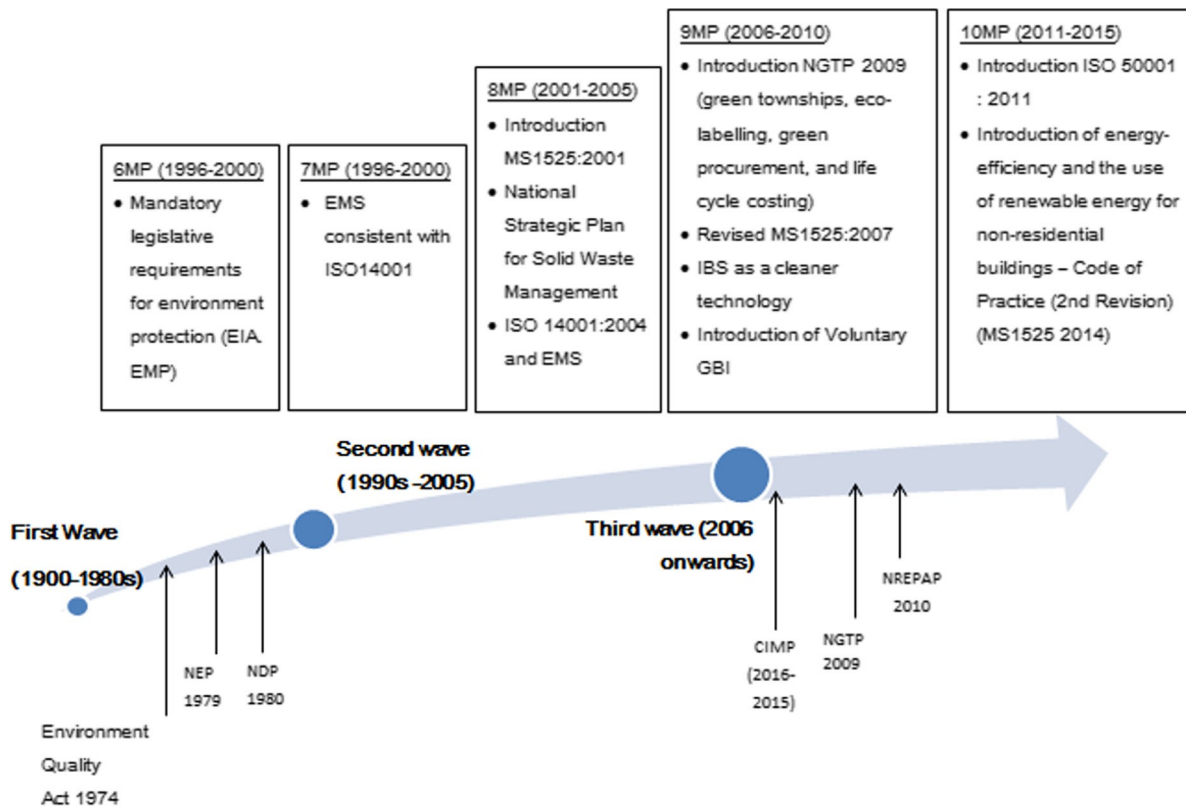


Fig.1: Policies and key practices related to environmental concerns in Malaysia. Authors' compilation from [5], [6], [11], [16], [18], [33], [33], [45]

3. The construction industry in the Malaysian economy and environment

The construction industry is an important economic sector in every country, providing physical facilities and infrastructure. In addition, construction has a strong indirect influence on other industries [20] through the pattern of demand and supply. Construction projects demand materials or products from other industries, such as the manufacturing industry, in order to produce buildings and infrastructure that are, in turn, beneficial for those industries. This supply and demand pattern has significantly contributed to economic growth [21,22]. Construction is the largest industrial sector in Europe and the US, representing 10–11% and 13% of GDP, respectively [23].

Described as an “upper-middle-income economy”, Malaysia is on track to achieve a high-income economy status by 2020 [24,25]. This significant growth has created a great demand for physical developments to provide infrastructure for social and business purposes such as education, housing, retail and manufacturing. This has made Malaysia, according to the Australian Business Council for Sustainable Energy 2007, one of the fastest emergent construction industries in the world [26]. The Malaysian economy is expected to rise by 4.4% per annum primarily from construction-related activities and the Malaysian construction sector is projected to contribute 2.9% to GDP by 2015, with a 3.7% annual growth from 2011 to 2015 (Fig. 2). The government’s Tenth Malaysian Plan (10MP) includes a RM230 billion development fund and RM20 billion facilitation fund, of which 60% (RM138 billion) will be spent on physical building development that will be undertaken directly by the construction sector [25]. This indicates that there will be a great deal of construction activity in future to meet the demand for economic growth as planned [6].

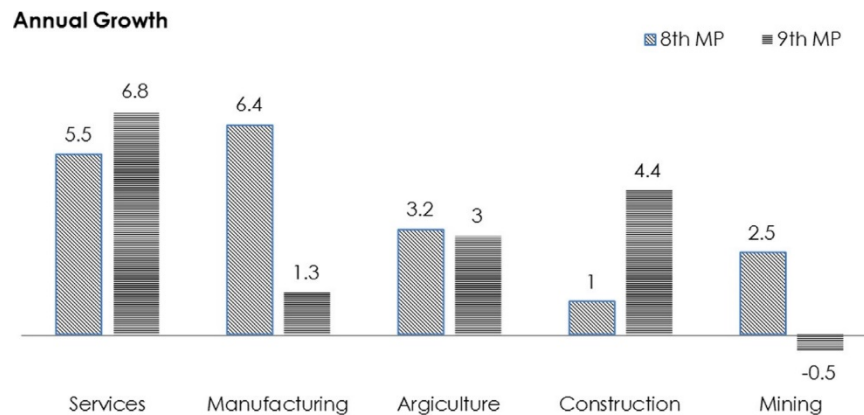


Fig. 2: Sector performance under the Eighth and Ninth Malaysian Plans. Adapted from [6].

This expansion pattern is associated with the world's environmental degradation problem. As a developing country, Malaysia is also suffering from deforestation with major causes attributed to large-scale land development including construction activities. Built environment contribute significantly to global environmental problems throughout the construction phases [26]. Continuing to deliver construction projects in the current way will create more pressure on the environmental situation in Malaysia. The identified environmental problems include inefficient waste management [27,28], indoor and outdoor environmental pollution [29,30,31,32], inefficient energy usage [33,34] and depletion of natural resources [5, 35]. Pitt et al. (2009) [36] found that the built environment in the UK was responsible for 50 percent of the country's total energy consumption. In the US, building development accounted for 39 percent of the total energy usage in 2005 [37]. In Malaysia, the building sector consumed nearly 8,000 GWh of energy in 2008 [38]. The construction industry also accounts for one-third of global CO₂ emissions due to non-renewable energy usage [29]. According to Kameyama and Sari [39], Asia's projected carbon emission contribution will significantly increase the world's total CO₂ emission.

Green construction seeks to counter these influences. Agenda 21 (Chapter 7) aims to promote sustainable construction activities [40]. Green construction is an approach taken by the building industry to achieve sustainable development [41] and aims to reduce the overall impact on the natural environment by reducing greenhouse emissions, lowering the levels of pollutants, conserving resources through reuse and renewal strategies and reducing waste throughout all the stages of building construction. Similarly, according to Kibert [42], a green building "as the end product must be able to reduce the overall impact on the natural environment by reducing greenhouse emissions, conserving resources through reuse and renewal strategies and reducing waste".

4. Greening Malaysian construction projects- policy and practice review

Kibert [43] suggests that the construction industry must shift to a greener approach in order to address the problem of environmental degradation. Such a shift requires the support of the various

stakeholders of construction projects and guidance from higher-level management [44]. Many studies in the literature suggest that governments, using the top-down approach, should send a signal to the whole industry to adopt green practices by formulating standards, policies and guidelines and creating a platform to disseminate information and building skills [38].

In Malaysia, the green approach focuses on low carbon growth, energy conservation and the use of green technology. This includes the construction industry. The Malaysian five-year Development Plan, the NGTP, the National Energy Policy (NEP) and the National Policy on Climate Change (NPCC) play a significant role in guiding the construction industry towards the sustainability agenda. The NPCC drives every industry, including construction, to make a substantial contribution to tackling climate change issues. The NEP was launched to ensure the adequacy of energy supply, efficient utilisation of energy and minimisation of the environmental burden. In achieving these objectives, subsequent energy policies, such as the National Depletion Policy (NDP) and the Four-Fuel Diversification Policy (4FDP) were formulated in 1980 and 1981 respectively [29]. In recognising the importance of sustainable energy, Malaysia has made efforts to intensify the development of renewable energy and encourage energy efficiency. The potential of renewable energy and initiatives to encourage its use were initiated through the Five-Fuel Diversification Policy (5FDP) under the Eight Malaysian Plan in 2001. The inclusion of energy efficiency in that plan marked an important step in energy conservation.

The National Renewable Energy Policy and Action Plan (NREPAP) was launched in 2010 to enhance the utilisation of indigenous renewable energy resources to contribute towards national electricity supply security and sustainable socioeconomic development [18]. The NREPAP suggests the use of building-integrated renewable energy as a requirement in upgrading federal government buildings and the provision of special rewards to commercial and agriculture building owners that integrate renewable energy technologies (such as PV in building claddings) into their new or refurbished buildings. Energy efficiency is implemented through demand side management and enforcement of the Energy Efficiency Regulations, which include amendments to the Building By-Laws.

The Malaysian Government’s commitment to environmental protection has also been expressed in its five-year development plans (see Table 1). Malaysia aims to move towards a low-carbon or green economy and ultimately achieve sustainable development [45]. Since the Sixth Malaysian Plan (6MP), the Government has highlighted the efficient management of the environment. The introduction of the National Green Technology Policy under the 9MP shows a greater focus on environmental problems. The most recent plan, the 10MP, reflects the Government’s commitment to sustainably managing the environment in order to reduce the emission of greenhouse gases and conserve existing resources [46].

Table 1: Malaysian Development Plans – Environmental goals and impacts on the construction industry. Adapt from [5], [6], [14], [24], [29], [32], [34], [37], [44], [45], [46].

Plan	Environmental goals	Impacts on the construction industry
Sixth (6MP; 1991-1995)	Efficient management of the environment to ensure a balanced development	<ul style="list-style-type: none"> • Mandatory legislative requirements for environment protection
Seventh (7MP; 1996-2000)	Integration of environmental considerations in the economic planning process for economic growth and environmental conservation	<ul style="list-style-type: none"> • Mandatory legislative requirements for environmental protection • Introduction of environmental management systems (EMS) consistent with International Organisation for Standardisation (ISO) 14001 certification
Eighth (8MP; 2001-2005)	Achieving sustainable growth by promoting cleaner technologies and overall environmental management practices	<ul style="list-style-type: none"> • Introduction of the low-carbon building initiatives Malaysian Standard (MS1525:2001) • Formulation of the National Strategic Plan for Solid Waste Management • Introduction of ISO 14001:2004 and Environmental Management Systems
Ninth (9MP; 2006-2010)	Greater focus on pollution prevention and increasing environmental protection efforts with the establishment of key agencies and policy	<ul style="list-style-type: none"> • Formulation of NGTP (2009) (green technology financing scheme, green townships, eco-labelling, green procurement, and life cycle costing) • Revision of Uniform Building By-Laws to incorporate MS1525:2007 and ISO

Tenth (10MP; 2011-2015)	Massive transformation aimed at turning Malaysia into a high-income and sustainable developed nation	<ul style="list-style-type: none"> • Introduction of IBS as a cleaner technology • Introduction of voluntary rating tools (e.g. Green Building Index) • Economic Transformation Programme (ETP) • Introduction of the Energy Management System (ISO 50001:2011) • Establishment of a framework for the design process of energy saving single family residential/small commercial buildings • Introduction of energy-efficiency and the use of renewable energy for non-residential buildings – Code of Practice (2nd Revision) (MS1525 2014)
-------------------------------	---	--

With a specific focus on the construction industry, the Malaysian Construction Industry Master Plan (CIMP) is a ten-year plan (2006–2015) that charts several well-thought-out plans for the future direction towards sustainability in the construction industry. The CIMP has become a blueprint document for the Malaysian construction industry and focuses on creating demand to improve performance in areas such as environmental sustainability [47]. The CIMP addresses the issues of sustainability by emphasising environment practices and aiming “to foster quality and an environmental-friendly culture” [45].

The policies and guidelines will help to drives the industry at the macro level. It is, however, important to interpret the policy based on the needs of specific projects in order to ensure successful implementation [48]. For example, the need to reduce energy use is outlined in the NEP and NGTP. For the construction industry, the Uniform Building By-Laws Code of Practice (MS1525:2014) (2nd revision) was introduced to ensure compliance with the requirements for energy efficiency in buildings as early as the planning stage.

Some of these practices are already established in other countries, but implementation may vary significantly between countries and specific case studies are required to enhance the understanding of implementation. Roy and Koehn [49] argue that previous research outcomes in developed countries may not be applicable for developing countries due to the different nature of construction in these types of economies. Based on a review on the current policies in Malaysia,

this paper has identified a number of potential green practices that can mitigate the adverse effects of construction in Malaysia as follows:

Table 2 Summary of potential green practices

Green Practices	Description and Potential Impacts
ISO 14001:2004 and Environmental Management Systems (EMS)	This instrument was mentioned in the 7MP is used as part of the environmental management within construction projects or companies, and also provides a signal to stakeholders that the firm has improved environmental performance [49,50,51]. It has been recognised globally and plays an active role in ensuring green practices throughout the development process [52].
Uniform Building Laws (UBBL) Code of Practice (MS1525:2001)	The UBBL Code of Practice was introduced under the 8MP to provide basic guidelines on green design for non-residential buildings with the aim of highlighting the concepts of energy efficiency and low-carbon construction. It necessitates every project to comply with its requirements in order to obtain building plan approval by the authority. Under the NGTP, the existing UBBL was revised to seek a more sustainable living environment with the use of green technologies in buildings. In the current 10MP, the UBBL Code of Practice (MS1525:2014) (2nd revision) introduced the requirements of energy efficiency and the use of renewable energy for non-residential buildings.
Waste management	Waste management is one of the priorities that have been highlighted in order to achieve environmentally-friendly development. The National Strategic Plan for Solid Waste Management was launched since the 8MP and urged every organisation to practice sustainable waste management. The

Malaysian construction sector reported a 5% productivity growth in 2013 [53] supporting the prediction that the rate of construction waste generation will continue to increase. Practices such as the recycling of materials (e.g. formwork for concrete works, environmentally-friendly packaging and efficient waste management on site) should be underlined as mandatory requirements in project implementation.

Green labelling

Green labelling helps the stakeholders to identify green products and assists in formulating green specifications for a project, as highlighted under the NGTP. Through the Standards and Industrial Research Institute of Malaysia (SIRIM), the Malaysian Government is also developing eco-labelling for local products which will be internationally recognised in support of green procurement [32]. To support greater participation of the industry in the production of green products and services, green labelling should be mandatory in establishing green criteria (e.g. selection of construction materials).

Green technology

Under the NGTP, the Industrialised Building System (IBS) was introduced as a green technology that helps to improve the current environmental problems in the construction industry (e.g., through increased site cleanliness). The IBS Roadmap 2011–2015 focuses on encouraging the involvement of the private sector in adopting IBS in construction [54]. According to Oostra and Claeson-Jonsson [55, 56], the IBS has been successfully implemented in many parts of the world including Japan, the UK, Sweden and the Netherlands.

Voluntary rating tools

As suggested by Lehtiranta et al. [57], the focus on the green

concept is not only relevant in the construction stage but is continuous throughout the entire process. It has to be initiated as early as the strategic planning stage and continue to the project implementation stage. The Green Building Index (GBI) is similar to established assessment and rating tools around the world such as BREEAM, BEPAC, LEED and HK-BEAM. The GBI was developed specifically for the Malaysian tropical climate, with consideration of its environmental and developmental context, as well as its cultural and social needs [32]. It is a voluntary rating system for environmental assessment that is used to assess the environmental design and performance of Malaysian buildings [37].

Green procurement

Green procurement initiatives commenced under NGTP (2009) through the *MyHIJAU* program. Greening the procurement process means to recognise, integrate and implement environmentally-friendly practices throughout all the processes. For construction, green procurement has been recognised as a vital tool to manage environmental issues. Practising green procurement means that organisations should commit to minimising the environmental consequences of construction activities. It underlines the practice of acquiring a selection of products and services that minimise environmental impact and also requires the assessment of the products at all the various life cycle stages. This green practice also extends to the impact on social performance in terms of creating awareness and promoting green efforts. In Malaysia, the mechanism is to be developed under MEGTW and the Ministry of Finance. The Government Green Procurement (GPP) Short-Term Action Plan [6] paves the

way towards Malaysia's long-term GGP strategy. The National Sustainable Consumption and Production (SCP) Policy framework will be in the form of a SCP Blueprint and input to the 11MP (2016–2020).

5. Discussion

The early environmental waves in Malaysia had limited impact due to challenges such as the lack of awareness and expertise, as well as insufficient knowledge. Lack of guidelines, misconceptions over green or sustainability concepts and high costs were other factors that slowed green progress in the construction industry. Since the green industry is very new, efforts to promote green adoption are still needed. The Malaysian Government, through top-down approaches including the launch of various policies and initiatives, aims to guide the industry into becoming more sustainable in delivering its projects. An understanding of how development and the environment are interconnected as a single issue has emerged, as underlined in the Brundtland Report. The Government is paving the way to green investment by introducing new schemes and amendments to current policies. More rigorous effort is being made during the third wave of environmental approaches in Malaysia to push the construction industry forward. The policies and initiatives are set and monitored by a range of different government agencies [44].

However, to ensure effectiveness, the government needs to encourage participation from the industry. Moving towards a green industry requires support from the stakeholders and should involve the various types and levels of stakeholders throughout the construction process. Changing old routines and mind-sets is a challenge in greening construction practices. One way to obtain support from stakeholders is through legislative pressure. Voluntary involvement or self-regulation helps to strengthen the effort and performance; however, in Malaysia, participation is still very low [58]. It is widely understood that there is no standard solution in addressing environmental issues. The environmental strategies and approaches should be based on local culture and needs. Malaysia is expected to be a role model in the global energy market in future,

especially in the context of developing countries. The obvious challenge is to bridge the policy towards successful implementation. An effective framework that guides the relevant stakeholders could potentially drive the industry towards sustainability.

6. Conclusions

Construction industry has been associated with environment degradation and deforestation in Malaysia and beyond. This paper identifies various green policies that have been formulated and introduced by the Malaysian Government. In addition, this paper collates the information on green practices that can help the stakeholders at project level to produce green construction and mitigate the adverse effects of construction on the environment such as the introduction of ISO/EMS, Uniform Building By-Laws on environmental preservation, green technology, green procurement, green labelling, green building rating tools and waste management. These practices however must be translated based on the needs of construction industry specifically for successful implementation. This paper highlighted that there is the needs to develop some framework and guideline that will guide the construction stakeholders to produce environmentally friendly construction development.

The vision of a green future is bright in Malaysia, but still relies on all the parties involved cooperating and collaborating to make the plan a success. The signs are that this is likely to increase in the coming years as the urgency of the situation, and the pressing need for action, are increasingly realised. Further, comprehensive policies and training should be able to nurture self-awareness in protecting the environment and need to be considered urgently in order to improve current support and implementation in the Malaysian construction industry.

Acknowledgement

The authors wish to acknowledge the support of the Ministry of Education, Malaysia.

References

- [1] Green24 Website. Environmental impacts of building materials: Facts and figures. Building and design, <http://www.green24.com/building/envimpbuildmats.php> [Accessed July 06, 2014].
- [2] United Nations Environment Programme (UNEP). Sustainable building and construction: facts and figures. UNEP Industry and Environment 2003; 5–8, <http://www.uneptie.org/media/review/vol26no2-3/005-098.pdf> [Accessed 6 July 2014].
- [3] Population and Housing Census of Malaysia Website. Population distribution and basic demographic characteristics 2010: 1–133), http://www.statistics.gov.my/mycensus2010/images/stories/files/Taburan_Penduduk_dan_Ciri-ciri_Asas_Demografi.pdf [Accessed 5 July 2014].
- [4] Mustafa Kamal E, Haron SH, MdUlang N, Bahanrum, F. The critical review on the Malaysian construction industry. *Journal of Economics and Sustainable Development* 2012; 3(13): 81–87, <http://iiste.org/Journals/index.php/JEDS/article/viewFile/3492/3517> [Accessed 12 April 2014].
- [5] Adham KN, Siwar C. (2012). Empirical investigation of government green procurement (GGP) practices in Malaysia. *OIDA International Journal of Sustainable Development* 2012; 04: 04.
- [6] Economic Planning Unit Malaysia. Tenth Malaysia Plan 2011-2015 Report 2010, http://www.pmo.gov.my/dokumenattached/RMK/RMK10_Eds.pdf [Accessed 5 March 2014].
- [7] Fischer EA. Green procurement: overview and issues for congress. Congressional Research Service (CRS) Report for Congress April 2010.
- [8] Suliman LKM, Omran A. Sustainable development and construction industry in Malaysia. *Manager Journal: University of Bucharest, Faculty of Business & Administration: (10) 2009.*

- [9] Shelbourn MA, Bouchlaghem DM, Anumba CJ, Carillo P, Khalfan MM, Glass J. Managing knowledge in the context of sustainable construction. *ITcon*, 2006;11: 57–71. Retrieved from http://www.itcon.org/data/works/att/2006_4.content.07629.pdf [Accessed 19 July 2014].
- [10] World Commission on Environment and Development (WCED). *Our Common Future*, Report of the World Commission on Environment and Development. Published as Annex to General Assembly document A/42/427, Development and International Co-operation: Environment August 2, 1987. Retrieved from <http://www.un-documents.net/wced-ocf.htm> [Accessed 4 July 2014].
- [11] Hezri AA. Sustainable Shift : Institutional challenges for the environment in Malaysia, *Akademika* 2011; 81(2): 59–69.
- [12] Williamson TJ, Radford A, Bennetts H. *Understanding sustainable architecture*. London: Taylor and Francis; 2003.
- [13] Dodds F, Schneeb K, Ullah F. Division for sustainable development sustainable development in the 21st century review of implementation of agenda 21 and the Rio principles synthesis 2012, [http://www.uncsd2012.org/content/documents/194Synthesis Agenda 21 and Rio principles.pdf](http://www.uncsd2012.org/content/documents/194Synthesis%20Agenda%2021%20and%20Rio%20principles.pdf) [Accessed 25 April 2014].
- [14] Department of Environment of Malaysia Website. Environment impact assessment (EIA) procedure and requirements in Malaysia, <http://www.doe.gov.my/eia/wp-content/uploads/2013/06/EIA-Procedure-and-Requirements-in-Malaysia.pdf> [Accessed 1 May 2014].
- [15] World Summit on Sustainable Development (WSSD). *Plan of Implementation of the World Summit on Sustainable Development Contents 2002*; Johannesburg, South Africa.
- [16] Hezri AA, Hasan MN. Towards sustainable development? The evolution of environmental policy in Malaysia. In *Natural Resources Forum* 2006 : 30(1): 37–50. Blackwell Publishing Ltd doi:10.1111/j.1477-8947.2006.00156.x

- [17] FAO. Global Forest Resources Assessment 2010. Main Report, FAO Forestry Paper 163, FAO, Rome;2010.
- [18] Ministry of Energy, Green Technology and Water Malaysia (MEGTW). The Renewable Energy Policy and Action Plan Malaysia: 2010.
- [19] Shafie SM, Mahlia TMI, Masjuki HH, Andriyana A. Current energy usage and sustainable energy in Malaysia: a review. *Renewable and Sustainable Energy Reviews* 2011;15(9):4370-4377.
- [20] Field B, Ofori G. Construction and economic development: a case study. *Third World Planning Review* 1988;10(1): 41.
- [21] Abdullah F. Construction industry and economic development: the Malaysian scene. Malaysia :Universiti Teknologi Malaysia; 2004.
- [22] Ofori G. Greening the construction supply chain in Singapore. *European Journal of Purchasing and Supply Management* 2000; April: 195–206.
- [23] Halliday S. Sustainable construction. USA: Routledge; 2008
- [24] Shari Z. Development of a Sustainability Assessment Framework for Malaysian Office Buildings Using a Mixed-Methods Approach 2011; PhD Thesis, The University of Adelaide; Unpublished.
- [25] Abu Mansor S. The construction sector at the onset of the 10th Malaysia Plan; Keynote and opening address. In the 7th Malaysia construction sector review and outlook seminar. Kuala Lumpur; 2010, http://www.kkr.gov.my/files/PRESS_CIDB_3_Ogos_0.pdf [Accessed 23.6.2014].
- [26] Elforgani M, Rahmat I. Green Design Performance of Malaysian Building Projects- Descriptive Study. *ARNP Journal of Engineering and Applied Sciences* 2011; 6 (11): 68-78

- [27] Nagapan S, Rahman IA, Asmi A, Memon AH, Latif, I. Issues on construction waste: The need for sustainable waste management. 2012 IEEE Colloquium on Humanities, Science and Engineering (CHUSER) 2012; 325–330. doi:10.1109/CHUSER.2012.6504333
- [28] Yeheyis M, Hewage K, Alam MS, Eskicioglu C, Sadiq, R. An overview of construction and demolition waste management in Canada: a lifecycle analysis approach to sustainability. *Clean Technologies and Environmental Policy* 2012; 15(1): 81–91. doi:10.1007/s10098-012-0481-6
- [29] Ding GKC. Sustainable construction—the role of environmental assessment tools. *Journal of Environmental Management* 2008; 86(3): 451–64, doi:10.1016/j.jenvman.2006.12.025
- [30] Geng Y, Doberstein B. Greening government procurement in developing countries: building capacity in China. *Journal of Environmental Management* 2008; 88(4): 932–938, doi:10.1016/j.jenvman.2007.04.016
- [31] Matar MM, Georgy ME, Ibrahim ME. Sustainable construction management: introduction of the operational context space (OCS). *Construction Management and Economics* 2008; 26(3): 261–275. doi:10.1080/01446190701842972
- [32] Ofori G. Greening the construction supply chain in Singapore. *European Journal of Purchasing and Supply Management* 2000; April: 195–206.
- [33] Chua SC, Oh TH. Green progress and prospect in Malaysia. *Renewable and Sustainable Energy Reviews* 2011; 15(6): 2850–2861, doi: 10.1016/j.rser.2011.03.008
- [34] Hussin JM, Abdul Rahman I, Memon AH. The way forward in sustainable construction: issues and challenges. *International Journal of Advances in Applied Sciences* 2013; 2(1): 15–24. doi:10.11591/ijaas.v2i1.1321
- [35] Construction Industry Development Board. Strategic Thrust 5; 2007, Retrieved from <https://www.cidb.gov.my/cidbv4/images/pdf/st5.pdf> [Accessed 25 June 2014].

- [36] Pitt M, Tucker M, Riley M, Longden J. Towards sustainable construction: promotion and best practices. *Construction Innovation* 2009; 9(2): 201-224.
- [37] US EPA. Buildings and their Impact on the Environment: A Statistical Summary Revised April 22, 2009, US EPA Archive Document retrieved from <http://www.epa.gov/greenbuilding/pubs/gbstats.pdf> [Accessed July 27, 2014].
- [38] Suhaida MS, Chua, KH, Leong YP. Sustainable Development in the Building Sector: Green Building Framework in Malaysia, 15th International Conference on ISO & TQM (15-ICIT), 26-28th July 2011, Residence Hotel, Bangi.
- [39] Kameyama Y, Sari AP. Climate change in Asia. Perspectives on the Future Climate Regime; 2008.
- [40] International Council for Research and Innovation (CIB). Agenda 21 on sustainable construction. CIB Report Publication 237. Rotterdam, The Netherlands; 1999
- [41] Bourdeau L. Sustainable development and the future of construction: a comparison of visions from various countries. *Building Research and Information* 1999; 27(6), 354–366.
- [42] Kibert CJ. Sustainable Construction: Green Building Design and Delivery: Green Building Design and Delivery. John Wiley & Sons; 2012.
- [43] Kibert CJ. The next generation of sustainable construction. *Building Research & Information* 2007; 35(6), 595-601.
- [44] Eisenhardt KM, Martin JA. Dynamic capabilities: What are they? *Strategic Management Journal* 2000; Oct/Nov(10/11), 1105–1121
- [45] Adham KN, Merle K, Weihs G. Sustainable consumption and production in Malaysia. A baseline study on government policies, institution and practices. Economic Planning Unit, Prime Minister’s Department (1st Edition., pp. 1–219). Putrajaya: Percetakan Nasional Malaysia Berhad; 2013.

- [46] Kahlenborn W, Mansor N, Adham KN. Government green procurement (GGP) short-term action plan 2013-2014. Sustainable consumption and production (SCP) policy support Malaysia 2013;1–25.
- [47] Construction Industry Master Plan (CIMP) 2006–2015, Construction Industry Development Board Publication, Malaysia, Kuala Lumpur; 2007
- [48] Ugwu OO, Haupt TC. Key performance indicators and assessment methods for infrastructure sustainability—a South African construction industry perspective. *Building and Environment* 2007; 42(2), 665–680.
- [49] Roy SK, Koehn EE. Construction labor requirements in developing countries. In Proceedings of the 2006 ASEE Gulf-Southwest Annual Conference Southern University and A & M College-Baton Rouge American Society for Engineering Education 2006. Retrieved from http://aseegsw.com/past_Proceedings/83.pdf [Accessed July 06, 2014].
- [50] Bouwer M, et al. Green Public Procurement in Europe 2006, Conclusion and recommendations. Netherlands. Retrieved from <http://europa.eu.int/comm/environement/ggp> [Accessed July 20, 2014].
- [51] Qi GY, et al. Diffusion of ISO 14001 environmental management systems in China: rethinking on stakeholders' roles. *Journal of Cleaner Production* 2011; 19(11), 1250–1256.
- [52] Varnäs A., Balfors B, Faith-El C. Environmental consideration in procurement of construction contracts: current practice, problems and opportunities in green procurement in the Swedish construction industry. *Journal of Cleaner Production* 2009; 17(13), 1214–1222.
- [53] Testa F, Iraldo F, Frey M, Daddi T. What factors influence the uptake of GPP (green public procurement) practices? New evidence from an Italian survey. *Ecological Economics* 2012; 82, 88–96.
- [54] Malaysia Productivity Corporation (MPC). Productivity Performance of Construction Sector Chapter 7. Productivity Report 2013/2014; 2014. Retrieved from

<http://www.mpc.gov.my/mpc/images/file/APR%202013%202014/Chapter%207.pdf>
[Accessed May 1, 2015].

- [55] Construction Industry Development Board (CIDB). IBS Roadmap 2011-2015; 2011. Retrieved from http://www.ibscentre.com.my/ibsweb/index.php?option=com_content&view=article&id=48&Itemid=106&lang=en [Accessed June 12, 2014].
- [56] Oostra M, Claeson-Jonsson C. Best Practices: Lessons learned on building concept; open building manufacturing – Core Concept and Industrial Requirement. Finland: Manubuild Consortium and VTT Finland Publication; 2007. Retrieved from <http://www.cinark.dk/archive/media/303.pdf> [Accessed July 29, 2014].
- [57] Bohari AAM, Mahat N, Kipli K. Industrialised Building System (IBS) in Sarawak construction industry. In 2012 International Conference on Innovation Management and Technology Research IEEE; 2012.
- [58] Lehtiranta L, Hampson KD, Kenley R. Evaluation of Green Public Road Procurement in Australia: Current Practices and Gaps to Fill. In 4th CIB International Conference on Smart and Sustainable Built Environments (SASBE2012), 28-29 June 2012, Brazilian British Centre, Sao Paulo; 2012.