Master Thesis in Built Environment (15 credits)
Implementing Sustainable Construction Practices in Dubai – a policy instrument assessment

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Implementing Sustainable Construction Practices in Dubai – a policy instrument assessment

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SUMMARY

Recognized as one of the main obstacles to sustainable development, climate change is caused and accelerated by the greenhouse gas (GHG) emissions generated from all energy end-user sectors. The building sector alone consumes around 40% of all produced energy worldwide. Reducing this sector’s energy consumption has therefore come into focus as one of the key issues to address in order to meet the climate change challenge.

Implementing sustainable construction practices, such as LEED, can significantly reduce the building’s energy and water consumption. Prescribing these practices may however encounter several barriers that can produce other than intended results. Since the beginning of 2008 Dubai mandates a LEED certification for the better part of all new constructions developed within the emirate, nevertheless the success of this regulation is debatable.

This thesis identifies the barriers the introduction of the sustainable construction practices in Dubai faced and analyses the reasons why the regulatory and voluntary policy instruments were not effective in dealing with these barriers.

Understanding these barriers as well as the merits and weaknesses of the policy instruments will help future attempts to introduce sustainable construction practices.

To put the research into context a literature review of relevant printed and internet sources has been performed. In order to further understand the barriers the construction market in Dubai faced, qualitative observational research methods have been used. In addition the input of different key stakeholders with unique knowledge of the construction market was deemed to be necessary. Finally, for purposes of verification, the research relied on quantitative methods using different databases that provide detailed information about construction projects in the United Arab Emirates.

The thesis concludes that several barriers, such as a) financial, b) market related, c) behavioral and organizational, d) political and structural, d) technical and e) information barriers hindered the introduction of sustainable construction practices in Dubai.

Furthermore the introduced policy mechanisms were not effective in providing clarity on the scope of the policies and environmental goals, failed to provide financial incentives to investors or developers and considered only weak enforcement mechanisms.

As a final outcome the thesis presents a number of suggestions that should increase the number of LEED certified projects. These suggestions include changes in the current regulations, the introduction of new policy mechanism such as a building code and major changes to the energy policy such as the correction of the utility prices and the liberalization of the energy market.

Key Words: Dubai, LEED, sustainable construction practices, Dubai World, policy instruments, barriers, Green Dubai resolution
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1. INTRODUCTION

1.1 Background

Climate change, which is recognized as one of the main barriers to sustainable development (Wilkinson, Reed, 2007) is caused and accelerated by the greenhouse gas (GHG) emissions generated from all energy end-user sectors. Among transportation, industry, agriculture, energy and waste management, the building sector alone consumes around 40% of all produced energy (The World Business Council for Sustainable Development, 2008). Energy use in buildings has therefore come into focus as one of the key issues to address in order to meet the climate change challenge (Koeppel, Uerge-Vorsatz, 2007).

The World Business Council for Sustainable Development (2008) estimated that commercially available technologies can significantly reduce the building’s energy consumption, countering commonly heard arguments maintaining that it is too difficult or too expensive to increase energy efficiency in buildings (Mandyck, 2011).

Green construction has therefore become a flagship of sustainable development in this century (Ali, Nsairat, 2009). Generally, green buildings are deemed to be more energy efficient, consume less water, more durable and non-toxic, with high-quality spaces and high-recycled content materials than conventional ones. This reduces operating costs, increases occupants productivity, enhances building and organizational marketability and provides a positive impact on public health and the environment helping to create a sustainable community (Ali, Nsairat, 2009).

Tools to develop green buildings, commonly known as “sustainable construction practices” are based on a holistic approach that minimizes the negative impact of building on the environment and occupants balancing long-term economic, environmental and social health (Hikmat, Nsairat, 2009) with a special focus on energy usage, as one of the most important resources used in buildings over their lifetime (Thormark, 2001).

Since 2008 the government of Dubai mandates the use of internationally accepted environmentally friendly construction guidelines for all new construction projects (Green Dubai Resolution published on Arabian Business Newspaper, 01. November, 2007) a decision that in practice translated into a mandatory LEED\(^1\) certification for most new developments (Roderick, McEwan, Wheatley, Alonso, undated).

Nevertheless as explained later prescribing a sustainable construction practices can encounter several barriers. According to the MEED construction database, which registers those projects with an individual value of at least US 50 million, 310 projects were completed in Dubai since the announcement of the “Green Dubai” resolution. The

\(^1\) Leadership in Energy and Environmental Design (LEED): is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies that will minimize its negative environmental impact.
US Green Building Council has however awarded only 27 LEED certification\textsuperscript{2} (USGBC, 2011) in the same period of time.

Although it is well understood that building markets are not able to adopt sustainable design standards without the support of government policies (Koeppel, Uerge-Vorsatz, 2007), this thesis will show that it becomes necessary to understand which barriers these markets face in order to develop appropriate regulatory and voluntary instruments.

The literature review reveals that while many authors highlight benefits of sustainable construction practices (Ball, 2002; D’Antonio, 2007; Ali, Nsarait, 2009), others address the barriers implementing these practices present (Lee, Yik, 2004; Matar, Georgy, Ibrahim, 2008; Osaily, 2010).

The significant role policy instruments play in achieving sustainable construction has been partially addressed by those papers reviewing how effective policy mechanism have been in improving energy efficiency in the building sector (D’Antonio, 2007; Koeppel, Uerge-Vorsatz, 2007).

Other authors such as Salama and Hana (2010) and Samari and Qudah (2007) identify some the challenges of implementing sustainable construction in the UAE. It seems, however that no attempts have been made in trying to understand how effective the policy instruments implemented in Dubai have been in addressing these challenges and subsequently transforming the construction market. This thesis attempts to provide further clarity on the matter.

Understanding these barriers as well as the merits and weaknesses of the policy instruments will help policy makers define the set of relevant instruments needed to effectively introduce sustainable design requirements in the construction market.

\textbf{1.2 Disposition}

Following this section, which provided an overview of the background, motivation and the issues that are dealt within the thesis, is the presentation of the questions this research aims to answer.

The subsequent “Methods” chapter describes the scientific methods and approaches used in order to provide scientific value to the analysis, conclusions and suggestions. This section is followed by a comprehensive theory chapter, which offers essential information in different areas that are related to this research.

The main results of this work are presented in the “Analysis” chapter, which is followed by the discussion and conclusions that summarizes the results and research questions. In

\textsuperscript{2} Certified project: A project is considered certified after an independent third party verification of the projects design and construction information has determined that the project fulfills the requirements of the LEED rating system. The certification can be achieved in 4 levels: certified, silver, gold and platinum.
the final chapter of this thesis a number of suggestions that could be address in future researches are outlined.

1.3 Aim and Research Questions

In order to understand why the “Green Dubai” Resolution has produced but moderate results, this paper reviews the barriers the construction market in Dubai faced while the policy mechanisms were introduced and how effective these tools have been in dealing with these barriers.

This paper aims to answer the following questions:

- Which barriers were faced by the construction market in Dubai in complying with the mandatory sustainable construction practices?
- How have these barriers contributed to the low number of LEED certified projects in Dubai?
- Which changes to the currently used instruments would increase the number of LEED certified projects in the emirate of Dubai?

1.4 Delimitations

While a large number of sustainable design tools have been developed around the world (appendix A), this paper will focus on the Leadership in Energy and Environmental Design (LEED) rating system as, for reasons explained later, it is deemed to be the predominant tool used within Dubai’s construction market.
2 METHODS

2.1 Literature review

Several printed sources have been used to understand the barriers to sustainable construction practices face; it is however necessary to highlight that one particular source by Koeppel and Ürge-Vorsatz has been consulted to clarify the weaknesses and merits of existing policy instruments.

In 2007 Sonja Koeppel and Diana Ürge-Vorsatz published the “Assessment of policy instruments for reducing greenhouse gas emissions from buildings”. This report provides an assessment and comparison of some of the most important policy instruments for achieving energy efficiency improvements and GHG emission reductions in buildings.

While the report focused its assessment on the cost effectiveness of instruments used to reduce greenhouse emissions it provides detailed information about the weaknesses and merits of several policy mechanisms.

It is also necessary to bear in mind that the intention of providing information about different policy mechanisms is to give the reader a better understanding about the possible amendments that could be made to the current legal framework in Dubai.

In addition, different sources, such as the internet portal of several commercial and governmental entities in Dubai have been reviewed to understand the existing legal framework regulating the construction market in the emirate.

2.2 Interviews

In order to understand the challenges faced in Dubai during the implementation of the policy instruments, information and experiences were collected from different key stakeholders with unique knowledge of the local construction market.

The interviews were performed as non-structured interviews with a predominance of open-ended questions. The goal of such interviews, identified from here on as “personal communication”, has been to identify and evaluate how the requirements of the “Green Dubai” resolution impacted the stakeholders’ organization and relationship to their markets.

The research targeted responders that represent all stakeholders in Dubai’s construction market, including suppliers, architects, consultants, property developers and government officials. Nevertheless, as no feedback from government official was obtained and in order to minimize the risk of a one-sided view, only the inputs related to issues within the responders own organizational boundaries have been considered.
The use of these personal communications is proposed here as a valuable component of an evidentiary strategy that encompasses, but is not limited to, more familiar quantitative techniques.

2.3 Field observations

Additionally, qualitative observational research methods have been used to further understand the barriers the construction market in Dubai faced. It is important to explain that the observed sample is limited to a reduced number of construction project the author of this paper has been directly involved in. As such these observations should not be generalized and require to be challenged when additional information is available.

2.4 Quantitative research

For the purpose of verification, the research relies on quantitative methods. The two main sources of data utilized are the US Green Building Councils database (www.usgbc.com), which, among others, registers all LEED projects developed in Dubai and the MEED construction database (www.meedprojects.com), which provides detailed information about construction projects in the United Arab Emirates.
3 LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED)

Developed by the US Green Building Council (Wheeler, Beatley, 2009) the Leadership in Energy and Environmental Design (LEED) is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO₂ emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts (USGBC, 2011).

With over 35,000 projects registered at the US Green Building Council, LEED has become one of the most successful sustainable design tools around the world to design green buildings and while it remains a voluntary certification in most parts, some government agencies have prescribed LEED as a mandatory tool for public or private developments (Maguina, 2010).

LEED’s success can be attributed to several factors: it is easy to understand; it gives credits for a wide range of sustainable features; it defines a clear baseline to be used as reference with clearly established rules for success; and it provides a recognizable metric for making market comparisons (Bennett, A.K, Brown, M, Carlisle, N, Glickman, J, Foster, M & Sandler, K, 2004).

Although it is a flexible and widely accepted program, some voices have stated that LEED’s egalitarian scoring structure does not make it the best tool to support policy objectives, as it allows developers to achieve a certification by including a number green features, which not necessarily support the policy objectives; questioning the general perception of the system’s environmental benefit (Bennett, A.K, Brown, M, Carlisle, N, Glickman, J, Foster, M & Sandler, K, 2004).

Other authors argue that energy savings produced by LEED are significant. A study that analyzed the energy savings of 117 LEED NC V2.2 certified buildings (Maguina, 2010) shows that compared to ASHRAE 90.1-2004 standards the LEED program produces average energy savings of 22.88%.

4 BARRIERS TO IMPLEMENT SUSTAINABLE CONSTRUCTION PRACTICES

While not exclusive to LEED certifications, many studies discuss the barriers the promoting of sustainable construction meets (Lee, Yik, 2004; Matar, Georgy, Ibrahim, 2008; Osaily, 2010), which illustrates the need for policy measures or helps to understand why policy tools are not as successful as expected. It’s important to understand that in most cases markets will face a combination of these barriers, which are closely linked to one another.
The next section reviews the following barriers:

1. Financial barriers
   a. First Cost / green premium
   b. Hidden costs / soft benefits
2. Market related barriers
   a. No benefit from investments
3. Behavioral and organizational barriers
   a. Lack of trust in new technology
   b. Lack of time to adapt to new requirements
4. Political and structural barriers
   a. Corruption
   b. Lack of enforcement
5. Technical barriers
   a. Lack of well defined sustainable construction practices
6. Information barriers
   a. Lack of qualified personnel

### 4.1 Financial barriers

One of the most important barriers to achieve sustainable design is the financial one. Commonly known as “green premium” purchasing more efficient equipment usually involves higher first cost which many consumers can not afford or are not interested to bear (Landman, 1999).

It is well understood that the different stakeholders pursue different interests. While a building owner may wish his building to perform well from a financial point-of-view, the occupants may be more concerned about indoor air quality, comfort, health and safety issues (Ding, 2007).

This challenge is especially evident in developing countries because energy efficient technologies have to be imported increasing the overall project cost beyond to what the market is able to absorb (Koeppel, Uerge-Vorsatz, 2007). In addition, in an effort to improve the inhabitant’s access to energy, governments tend to provide energy subsidizes (Koeppel, Uerge-Vorsatz, 2007).

The combination of these two factors imply that sustainable construction practices provide a long recovery of investment periods, making such projects unprofitable or uninteresting (Du Plessis, 2002).

### 4.2 Hidden costs and soft benefits

In addition to the higher initial costs, there are potential costs not captured directly in financial flows, such as the risks associated with the replacement of technology, the need
for specialized services or even the lack of locally available spare parts associated to the new technologies (Koeppel, Uerge-Vorsatz, 2007).

On the other hand investors are not able to capitalize many of the soft benefits of sustainable design, such as air pollution reduction and its subsequent effect on human health (Koeppel, Uerge-Vorsatz, 2007). These benefits are therefore often neglected.

### 4.3 Market failures

Often developers or building owners have no interests in reducing their projects energy consumption, as the operating costs will be beared by the end-users. This challenge prevents investors of benefiting from the energy savings (Carbon Trust, 2005) and constitutes a major barrier in promoting sustainable construction investments.

### 4.4 Behavioral and organizational barriers

Uncertainty or different priorities impact the decisions and actions of organizations and human actors which often hinder the development or introduction of new technologies and practices (Bossel, 2000). In some cases low-quality versions of the efficient products are the first movers into the market generating disappointment and mistrust in the technology (Koeppel, Uerge-Vorsatz, 2007).

### 4.5 Technical barriers

Pearce and Vanegas (2002) identified the lack of well defined sustainable construction practices as one of the contributing factors that hinders the capacity of different industry stakeholders to collaborate towards a common goal.

Although a large number of sustainable construction guidelines and systems have been developed (appendix A), they not only have their own set of assumptions and limitations (Scheuer, Keoleian, 2002), but in addition there is little agreement on how these shall be included in the construction process (Cole, 2000).

The lack of a mature and well developed framework that regulates the application of sustainable practices in the construction market constitutes therefore one of the main barriers to transform this market (Pearce, Vanegas, 2002).

### 4.6 Political and structural barriers

Inadequate enforcement structures and institutions, including the lack of qualified personnel, corruption or limited capacity to enforce the regulations are among the most frequent political and structural barriers (Deringer, 2004). These barriers typically derive from an overall lack of government interest.
4.7 Information barriers

Finally, the lack of training and education in sustainable design (Du Plessis, 2002) in addition to a general lack of information about the possibilities, techniques and potentials of sustainable design solutions (Evander, 2004) is another barrier sustainable construction faces.

Identifying and addressing these barriers becomes instrumental when developing and implementing adequate policy instruments.

The next section of this paper reviews some key differences, merits and weaknesses of the regulatory and voluntary instruments for promoting green construction.

It is important to note that while not all the reviewed policy instruments specifically address sustainable construction practices, they are presented here as a mechanism that can contribute to a market and behavior transformation, providing either additional benefits or creating awareness.

5 POLICY INSTRUMENTS TO PROMOTE SUSTAINABLE CONSTRUCTION PRACTICES

This section presents a number of policy instruments implemented in several countries to improve the energy efficiency in buildings. Although most of these have not been considered in Dubai, they provide a wider range of options to amend Dubai’s current legal framework.

In a report prepared by the Central European University (Koeppel, Uerge-Vorsatz, 2007), the policy instruments for reducing greenhouse gas emissions from buildings are divided into four categories:

- **Regulatory- normative instruments** imply a prescriptive regulation end-users are obliged to follow. Within this category this paper will review the Building Codes.

- **Economic/ market-based** instruments are usually based on market mechanisms and contain elements of voluntary action or participation. Although this category includes several instruments, this paper will review the Energy performance contracting mechanism.

- **Fiscal instruments and incentives** usually correct energy prices either by a tax aimed at reducing energy consumption or by financial support that addresses first-cost related barriers. These instruments include Energy or carbon taxes and Tax exemptions.
5.1 Regulatory-normative instruments

5.1.1 Building codes

Building codes are one of the most frequently used instruments to improve energy efficiency in buildings (Birner and Martinot, 2002) as they define the performance requirements for entire buildings or individual building systems such as heating, ventilation or air conditioning.

Although building codes have proven to be the most efficient instrument to address energy efficiency in certain contexts, their effectiveness varies from country to country (Koeppel, Uerge-Vorsatz, 2007).

While Hui (2002) argues that the main barriers this instrument has faced in China is the lack of well trained building officials and inspectors, Deringer (2004) attributes its ineffectiveness to a lack of capacity to enforce the code, lack of knowledge and corruption.

5.2 Economic and market-based instruments

Economic instruments for energy efficiency improvements are based on market mechanisms and usually contain elements of voluntary action or participation, which are often initiated or promoted by regulatory incentives. They are therefore not real policy instruments, but rather vehicles or agents for implementing and financing energy efficiency projects (Koeppel, Uerge-Vorsatz, 2007). For reasons explained later it’s important to review one particular tool, the Energy performance contracting.

5.2.1 Energy performance contracting/ ESCO support

Energy performance contracting is a mechanism thru which a contractor, typically identified as Energy Service Company (ESCO), guarantees certain energy savings for a location over a specified period of time by implementing energy efficiency improvements at its own cost. The instrument assumes that the contractor will recover his investment from the estimated energy cost reductions achieved through these improvements.

Koeppel and Uerge-Vorsatz (2007) argue that the key factors that drive the success of the Energy performance contracting are the fact that no public spending or market interventions are needed. In addition a mature financial sector willing to lend for energy efficiency projects, unsubsidized energy prices and supportive legal, financial and business environments are required.

Furthermore, Polo and Scarpa (2003) concluded that the activity of ESCOs increases in countries where the energy market has been liberalized, which triggers the competition among utility companies and provides a wider range of energy rates.
5.3 Fiscal instruments and incentives

Fiscal instruments and incentives can be defined as policy tools which influence energy prices either by imposing a tax aimed at reducing energy consumption or by financial support if first-cost related barriers are addressed (Koeppel, Uerge-Vorsatz, 2007).

5.3.1 Energy or carbon taxes

Taxes are increasingly implemented, either as CO₂-tax or as energy tax. Taxes have a number of advantages: they can reinforce the impact of other instruments such as standards and subsidies, or make energy efficiency investments more profitable.

Koeppel & Uerge-Vorsatz (2007) point out that energy or carbon taxes, in contrast to regulatory instruments, directly affect the whole building lifecycle, i.e. construction, operation, renovation, demolition as well as the performance of in-building energy systems.

Although environmental taxes are increasingly used in developed countries due to their assumed economic efficiency, these instruments are less frequently found in developing countries where energy prices are subsidized rather than taxed (Koeppel, Uerge-Vorsatz, 2007).

5.3.2 Tax exemptions and reductions

If properly structured, tax exemptions and tax reductions can stimulate the introduction of energy efficiency technologies and the development of energy efficient buildings (Koeppel, UERGE-VORSATZ, 2007). While these exemptions need to be flexible concerning who receives the credit, free-riders are considered the major barrier to the effectiveness of this mechanism (Koeppel, Uerge-Vorsatz, 2007).
6 DUBAI - PRESENTATION OF THE STUDY OBJECT

The next section briefly describes Dubai’s urban development and provides the background under which the “Dubai Green” resolution has been enacted highlighting the role the state controlled commercial entities play in the implementation and enforcement of regulatory aspects.

6.1 Urban development of Dubai

Dubai is one of the seven emirates of the United Arab Emirates\(^7\) (UAE). It is located south of the Persian Gulf on the Arabian Peninsula and has the largest population with the second largest land territory by area of all the emirates, after Abu Dabi\(^8\).

Since the beginning of the 20\(^{th}\) century Dubai has experienced a remarkable economic and urban development. Dumper and Stanley (2007) argue that where the transition from preindustrial to postindustrial status occurred over a period of two centuries in major western cities, Dubai experienced this transformation in only fifty years.

The origins of modern Dubai are rooted in the tribal culture of the region. In 1833, 800 members of the Bani Yas\(^9\) tribe moved away from Abu Dhabi and founded Dubai (Pacione, 2005).

By 1902 the importance of Dubai as a commercial hub was reinforced after the Persian government imposed high customs duties on merchants operating from their ports. As a consequence a large part of the Indian trade including merchants, craftsmen and their families moved to the more liberal economic climate of Dubai (Pacione, 2005).

Until 1955, in a period characterized by economic constrains, Dubai experienced a slow urban expansion. The population of 10,000 inhabitants was concentrated in three residential quarters of Deira covering 3.2 km\(^2\) urban areas (Dumper, Stanley, 2007).

Dubai saw the development of its first master plan between 1956 and 1970, which was a period of compact growth in line with the emirates pre oil resources. Prepared by the British architect John Harris, the master plan called for provision of a road system, zoning of the town into areas for different land uses, and creation of a new town centre.

This period also saw the construction of the first house using concrete blocks in 1956 (Pacione, 2005) and the definition of land ownership under the arab-islamic traditions in

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\(^7\) *United Arab Emirates (UAE)*: is a federation of seven states situated in the southeast of the Arabian Peninsula in Southwest Asia on the Persian Gulf, bordering Oman and Saudi Arabia. The seven states, termed emirates, are Abu Dhabi, Ajman, Dubai, Fujairah, Ras al-Khaimah, Sharjah, and Umm Al-Quwait.

\(^8\) *Abu Dhabi*: is the capital and the second largest city in the United Arab Emirates.

\(^9\) *Bani Yas*: is a tribe in the United Arab Emirates that had a coalition with many other tribes in the region. The tribal coalition which consists of tribes from Dubai to Khawr al Udayd southeast of Qatar, was called the Bani Yas Coalition. The tribe was led by their rulers the Al Nahyan and their headquarters were in Al Dhafra and Abu Dhabi. The ruling family of the United Arab Emirates and Abu Dhabi, Al Nahyan, which is a branch of Al Falahi, descend from this tribe, as well as the emirs of Dubai, Al Maktoum, which is a branch of Al Falasi.

Maguina, Marco

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1960, which established that any plot of land that had been occupied by a homestead for a
lengthy period belongs to the inhabitant, the remaining land fell under the disposal of the
ruler (Dumper, Stanley, 2007).

In 1971, as a result of the availability of oil and gas resources a new and more ambitious
master plan was conceived by John Harris (Pacione, 2005). The plan made provision for
ring roads around the city as well as the development of several infrastructure projects
including the Shindagha Tunnel beneath the creek to connect Bur Dubai and Deira, and
construction of the Al Maktoum and Al Garhoud bridges linking city districts on both
sides of the creek.

This period also saw the planning of Port Rashid and a large residential area extending
towards Jebel Ali, now named Jumeirah (Pacione, 2005). Known as the New Dubai, the
corridor along the Sheikh Zayed Road emerged as the new commercial and financial
center of the city.

Between 1980 to 2002 the city experienced a period of rapid urban expansion, in terms of
both the scale and diversity of development projects and physical spread of the city
(Pacione, 2005).

From 2002 until 2009, following a decree that allowed foreigners to buy and own
freehold property in selected areas of the city; Dubai experienced an unparallel
construction boom.

During this period the city-state experienced the world highest annual population and net
immigration growth (CIA fact book, 2010), and its urban area was projected to grow
from 605 km$^2$ in 2004 (Pacione, 2005) to 1106 km$^2$ in 2015 (Fazal, 2008). As seen on as
seen on appendix C, during the same period energy and water demand in Dubai increased
by 113% and 75% respectively.

Since 2009 Dubai has experience a period of urban development stagnation. While the
construction boom was driven mostly by institutional investors, confronted with the
consequences of the global financial crisis the city saw the cancellation of over US$ 347
billion worth in construction projects (MEED projects, 2010).

Revenues from oil and natural gas allowed the government of Dubai to diversify from a
trade-based, oil-reliant economy to one that is service and tourism-oriented (DeNicola,
2005). Subsequently the government, represented almost exclusively by Sheikh
Mohammed bin Rashid Al Maktoum as the Ruler of Dubai, holds interests in a large
variety of commercial entities (Appendix G).

Furthermore, as described in appendix H, in some cases, these commercial entities
function as governmental agencies in charge of regulatory aspects, licensing and fulfilling
compliance functions.
6.2 Policy instruments to promote sustainable construction

On October 24th, 2007 Dubai’s leader, His Highness Sheikh Mohammed Bin Rashid Al Maktoum, issued a resolution that mandated all new commercial and residential building projects to comply with internationally recognized sustainable construction practices in order to turn Dubai into “Green Dubai” (Arabian Business Newspaper, 01. November, 2007).

The decree, while laying strong emphasis on the need for sustainability, did not say how Dubai entities were to respond. It was left to the individual companies to take the sustainability initiative further.

While some companies, such as Dubai Holding decided to mandate a LEED certification for selected projects (Appendix D), others, such as Union Properties or Thani Investments have not announced which standards their projects will follow.

Dubai World\textsuperscript{10}, the government owned investment company that controls the largest parts of Dubai (Appendix D) and on which lands the better part of new projects are developed, mandated a USGBC LEED certification for all buildings build on its land.

In order to customize the LEED rating system to local needs EHS\textsuperscript{12} (also see appendix H), Dubai World’s verifying body, modified LEED requiring all new constructions to achieve a minimum of 32 LEED credits and a minimum gold certification for all waterfront properties (EHS, 2008).

Despite of this, secondary developers\textsuperscript{13} experienced a number of difficulties in complying with the Green Building Regulation, these included a lack of well defined goals, a tiered approached, financial barriers, an inapplicability of the mandatory LEED credits, inadequate enforcement and a lack of resources as seen in the next section of this paper.

\textsuperscript{10} Dubai World: is a government investment company that manages and supervises a portfolio of businesses and projects for the Dubai Government across a wide range of strategic industry segments and projects that make Dubai a leading hub for commerce and trading.

\textsuperscript{12} Environment, Health and Safety (EHS) is the regulatory arm of Trakhees-Ports, Customs &Free Zone Corporation (PCFC). EHS controls, regulates and enforces rules and regulations related to all aspects of Environment, Health, Safety, Sustainability, Green Construction and Fire Protection.

\textsuperscript{13} Secondary Developer: acquire plots of land from the master developers in order to develop a single or a group of buildings. Secondary developers are usually privately owned, with the exception of the case when the master developer decided to perform this role. By January 2009 there were over 450 companies registered as developers in the UAE.
7 ANALYSIS

In order to better understand the strengths and weaknesses of the “Green Dubai” resolution it becomes necessary to review the barriers developers and professionals faced in understanding and applying its requirements.

7.1 Policy aim

Stated as “transform Dubai into Green Dubai” (Arabian Business Newspaper, 01. November, 2007), the aim of the “Green Dubai” degree provides little information regarding its specific goals such as energy savings, material selection or standards to be followed.

As seen on the citation below the subsequent regulations, developed by Dubai World failed to provide clarity regarding specific environmental targets as well. Dubai World limited the aim of their regulations to mandate a LEED certification.

Aim of the Green Building Regulations No. GB-001, 2008:

"Given the fact that the requirements of Dubai and the Middle East Region are unique, the Objective of these Regulations, is to ensure that developers in Dubai World incorporate minimum critical sustainable development requirements (especially in terms of efficient energy and water/waste water management) rather than focus on lesser (cosmetic) aspects of Green Building Certification, which may also be part of the International Green Building Certification Process. These minimum requirements (as need to be certified by in dependent accredited “Certifying Agencies”) have been drawn from the existing (International) LEED (V 2.2) parameters to outline an obligatory requirement from EHS. This Regulation takes into account existing Good Development practices by Dubai World Developers and existing Regulations. This Regulation does not limit any developer from achieving higher /more stringent requirements (e.g. Silver, Gold or Platinum LEED Certification) and such higher initiatives are welcomed and encouraged, but without compromising on the critical/ mandatory EHS requirements."

7.2 Policy scope

Although the scope of the “Green Dubai” degree covered all private and public institution in practice, standards vary wildly across Dubai. As described above, build on any land controlled by Dubai World, developers had to achieve a LEED certification.

However little information was provided for those projects developed outside Dubai World’s control (Appendix D). While, for instance, Dubai Holding pursues a LEED certification in some cases, no information has been provided about the standards projects
within the other areas, such as those under the jurisdiction of Dubai Municipality, have to follow.

In addition the initial mechanism implemented by Dubai World (Green Building Regulations, Regulations Nr. GB-001 first edition of January 2008 and second edition of March 2009) only differentiates between inland and waterfront developments, mandating 32 credits for the former and a LEED gold certification for the later one. There was however no differentiation according to the type of property being developed. This generated that both, a light construction warehouse as well as a 5-star hotel had to comply with similar the LEED requirements.

In October 2010 Dubai World amended the Green Building Regulation setting different requirements for commercial, residential and industrial properties in addition of defining a minimum building area projects need to exceed in order to fall into the scope of the regulation.

7.3 Financial barriers

Salama and Hana (2010) identified that the large majority of construction executives in Dubai believe that green buildings costs more to construct and that their benefits are in fact hard to quantify; a perception that poses an important obstacle to the acceptance of the new policy. A number of financial barriers did in fact influence the effectiveness of the policy mechanism.

On one hand the added cost for sustainable design, known as “green premium” was considerable. While most US based studies have identified that the green premium for LEED projects varies between 0 - 8.5% (D’Antonio, 2007), the added cost is considerable higher in Dubai. The United Technical Services – Carrier headquarter project for instance experienced an overall construction cost increase of 30%, (field observation) mainly due to the lack of locally available equipment and regional materials as well as the use of highly specialized services. Although this increase might be considered as uncommonly high, all projects within Dubai World were affected by the green premium (Gonzalo Seminario, personal communication).

Another factor increasing the cost was the use of LEED consultants. Developers were required to use consultants that had been previously approved by Dubai World and their fees would increase the overall construction cost by an average of 1.52% (appendix E).

7.4 Market related barriers

To understand how this challenge affected Dubai it becomes necessary to understand how the construction market evolved within the last years. Following the opening of the property market to foreign investors in 2002, property prices experienced a double-digit growth each year until 2009 (The Times online, 2008).
The construction boom was largely fuelled by institutional investors, who had no intention of ever living in the buildings, but quickly selling them instead (The Times, 2008); a practice known as property flipping. This created an environment where energy efficiency was not demanded, as most investors would not benefit from reducing the building’s operating costs.

During the same period, drawn by its free market and booming economy the city experienced the world highest annual population and net immigration growth (CIA fact book, 2010). This meant that that building owners had no difficulties in finding tenants or buyers for their commercial or residential properties, regardless of the construction practices they followed.

7.5 Behavioral and organizational barriers

Many stakeholders did not trust new energy efficient technologies (Salama, Hana, 2010) because of lack of knowledge or negative experience with these. As a consequence and in the absence of a proven track record building or system designers hesitated to specify new technologies due to the risk these might not perform as expected and the contractual liability they may face in such an event (field observation), which hindered the overall ability to achieve a LEED certification.

On the other hand, suppliers could not react to new requirements as fast as the market required it. The Green Dubai resolution was announced in October 2007 and came into effect two months later, in January 2008. Although the resolution and subsequent regulations called for the use of more energy efficient technologies, it did not provide companies enough time to understand the requirements, yet alone to develop or put new products in the market.

As a reference, the typical time to develop a new Air Conditioning unit varies between 3 to 5 years (Daniel Williams, personal communication). The process includes program pre-planning, concept development, engineering development, testing/qualification and product launch.

7.6 Political and structural barriers

As seen on appendix B, which graphically describes the procedure to obtain the construction permit from Dubai World (EHS-GBP-05) during the initial phase of the regulation developers were only required to show that their projects were certifiable on paper (LEED feasibility report) in order to obtain the construction permit.

Until December 2009 the established process did not consider any provisions to ensure that the projects would actually certify. After December 2009, provisions for commercial projects intended as office facilities without any physical storage/operational activity or shops were included (appendix B). While these provisions require the award of the certification as a precondition of obtaining the Operation Fitness Certificate (OFC) no requirements have been considered for other type of projects (EHS-IOP-01, 2009).
7.7 Technical barriers

One of the main barriers the market transformation in Dubai faces is the lack of a local building code (Austrade, 2010). In the absence of a formal building code, the applied standards across the UAE and Dubai varied wildly. Authorities and master developers accepted and tolerated designs based on American, European, mainly British and Australian standards (Austrade, 2010) and their usage depended in turn on the designer’s schooling or background (field observation).

In addition, as seen on the table below, despite of Dubai World’s attempt to mandate those credits that would reduce emissions, conserve resources and enhance energy security, in some cases these credit were inapplicable and in others they mandated the use of services or materials not available in the UAE at the time.

7.7.1 Inapplicable LEED credits

| Credit: Sustainable Sites – Credit 1: Site Selection |
| Requirement: Do not develop buildings, hard cape, roads or parking areas on previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries which support or could support fish, recreation or industrial use, consistent with the terminology of the Clean Water Act. |
| Barrier: Not possible to comply with on waterfront properties which are required to achieve a LEED Gold certification. |

| Credit: Energy & Atmosphere – Prerequisite 1 & Credit 3: Fundamental & Enhanced Commissioning of the Building Energy Systems |
| Requirement: Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities. |
| Barrier: Being building commissioning a highly specialized activity, it was not until October 2008, 10 months after the regulation came in effect, that the first Commissioning Authority (CxA) was available on the Dubai market (Appendix F). |

| Credit: Energy & Atmosphere – Credit 2: On-Site Renewable Energy |
| Requirement: Use on-site renewable energy systems to offset building energy cost. |
| Barrier: While developers assessed the use of non-polluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies, they were not able to take advantage of net metering with the local utility company as local regulations forbid the connection to the energy grid (DEWA, 2011), increasing the overall project cost due to the need of off-grid renewable systems and dual electrical network within the buildings. |

| Credit: Material & Resources – Credit 4.1: Recycled Content: 10% |
| Requirement: Use materials with recycled content such that the sum of post-consumer |
recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.

**Barrier:** The compliance of this credit requires manufacturers and suppliers to issue products bill of material certifications, although experience shows that most suppliers were not ready or willing to share this information (field observation). An additional barrier arose from the fact that the great majority of construction materials was sourced from countries unfamiliar with the LEED program and did not understand its spirit and requirements (field observation).

**Credit:** Innovation & Design – Credits 2: LEED AP

**Requirement:** At least one principal participant of the project team shall be a LEED AP.

**Barrier:** While Dubai World mandates the use of approved LEED consultants in order to obtain the construction permit (EHS-GBP-006: Client Procedure for Green Building Submissions during “EHS-NOC” Building, 2011), as explained later the number of available LEED consultants increased slowly generating project hold ups.

### 7.8 Information barriers

Salama and Hana (2010) found that the lack of awareness of the benefits emerging from sustainable construction was the most significant challenge to promote “green construction” within the UAE.

When announced the new construction requirements caused a great deal of activity and concern in the building design and construction sectors in Dubai and throughout the UAE as there was little or no sustainable design awareness in the market (Michael Sahm, personal communication).

Although most large developers were able to add some in-house LEED capabilities, they still had to rely on external consultants appointed by Dubai World (Gonzalo Seminario, personal communication) to obtain the construction permit (EHS-GBP-006: Client Procedure for Green Building Submissions during “EHS-NOC” Building, 2011).

Furthermore, as seen on appendix G, the approval process for additional LEED consulting (LEED AP) companies as well as Commissioning Authority (CxA) is slow.

While only 12 LEED AP were approved within the first year of the regulation, it was not until October 2008, 10 months after the regulation came in effect, and that the first Commissioning Authority (CxA) was available on the Dubai market (Dubai World, EHS).

The shortage of approved LEED AP and Commissioning Authorities had a significant impact in the acceptance of the regulation as it generated a hold-up in the project development. According to a personal communication from Dillip Rahulan, Chairman...
and CEO of the Middle East Center for Sustainable Development, the first EHS approved LEED consultant, the MECSD experienced a project addition rate of approximately 60 – 70 projects per month and had a backlog of 245 projects as of April 2008.
8 DISCUSSION

The intention of the “Green Dubai” resolution was to transform the construction market and that the subsequent regulations prescribed a LEED certification for all new projects.

The analysis seems to suggest that the implemented instruments failed to be effective in recognizing and dealing with the barriers this transformation would generate. It did not provide clarity on the scope of the policies and environmental goals. Furthermore no financial incentives to investors or developers were considered and the implemented enforcement mechanisms were weak.

While I would have expected that the better part of all projects completed since the enactment of the resolution had achieve a certification by now, it is possible that a number of factors influenced the analysis and conclusions of this thesis.

First, it is feasible that the low number of LEED certified projects was partially triggered by the slowdown the construction market in Dubai experienced since 2009.

Second, as described in the methods section, given the fact that this thesis does not include any assessments or input from government officials its analysis and conclusions could be considered one-sided.

It is therefore possible that government agencies view the achieved results as a highly positive development. For once a number of studies related to construction market transformation highlight that the process demands a considerable amount of time (Nadel, Thorne, Sachs, Prindle, Elliott, 2003; Blumstein, Goldstone, Lutzenhiser, 2000) confirming that no dramatic changes should be expected in just a few years.

In addition, the resolution has been effective in changing some of the dynamics within Dubai’s construction market.

Initially developers had little or no understanding of the requirements or certification process (Michael Sahm, personal communication), the new requirements however produced an unprecedented interest in sustainable construction practices. The number of professionals obtaining the LEED AP\textsuperscript{14} professional accreditation in Dubai increased from 1 in 2007 to 810 in 2011 (USGBC, 2011).

Despite of these evident weaknesses, this thesis demonstrate that any attempt to transform construction markets will face a number of barriers, which have to be identified and understood in order to develop appropriate regulatory or voluntary instruments.

These results gain significance as a number of Middle Eastern governments are in the

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\textsuperscript{14} LEED Accredited Professional (LEED AP) is a credential granted to a person that has demonstrated in depth knowledge about the LEED rating system. In order to gain this credential the person needs to successfully pass the LEED professional exam administered by the Green Building Certification Institute (GBCI).

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process of implementing sustainable construction regulations.

In 2010 for instance, the government of Abu Dhabi launched the Pearl Rating System, part of the Estidama\textsuperscript{15} program (Poston, Emmanuel, Thomson, 2010), a customized green building rating system which sets sustainable construction practices for all projects developed within the emirate.

The Kingdom of Saudi Arabia announced in 2009 its intention to mandate the LEED standards in the development of their six Economic Cities projects (The State of Queensland, 2009).

Qatar is following Dubai example in “going green”. While Mega projects like the Energy City Qatar are already making plans to obtain the LEED Certification from the US Green Building Council by 2012, the government is working on developing the Qatari Green Building Construction code (The State of Queensland, 2009).

\textsuperscript{15} Estidama is a building design methodology for constructing and operating buildings and communities more sustainably. The program is a key aspect of the "Plan Abu Dhabi 2030" drive to build the city of Abu Dhabi according to innovative green standards. "Estidama" is the Arabic word for sustainability. The program is not itself a green building rating system like LEED or BREEAM, but rather a collection of ideals that are imposed in an elective building code type of format.
9 CONCLUSIONS

The main barriers Dubai’s construction market faced while complying with the mandatory sustainable construction practices included the following:

First, little information was provided regarding the goals the implemented instrument intended to achieve allowing a broad range of interpretations.

Second, no clarity was provided on the scope of the policy. While in theory all new developments were required to follow international recognized green construction practices, only Dubai World developed specific regulations to be followed. No information about which standards were to follow outside Dubai World was provided.

Third, the increased cost for sustainable construction implied very long payback periods for these investments, making such projects unattractive. This was especially evident during the time when the regulation did not provide a tiered approach (January 2008 to October 2010). It remains to be seen which results the amended regulation will produce.

Fourth, given the fact that the “Green Dubai” resolution came into effect two months after being announced construction market stakeholders had little time to understand and adapt to the new requirements.

Fifth, no enforcement mechanisms were considered for the first two years. The only real barrier developers had to overcome in order to obtain the construction permit from Dubai World was to demonstrate that their projects were “certifiable on paper”. Today, the enforcement remains weak, as only a mechanism for some projects has been included.

Sixth, the lack of a local building code generated confusion for the better part of the designer community. There was little agreement on how the requirements of “imported” construction practices shall be included in the established construction process. While authorities and master developers tolerated designs based on several international building codes, designers were unfamiliar with the requirements, assumptions, limitations and simulation tools the USGBC mandates. In addition efforts to customize the system were ineffective as a number of requirements remained inapplicable.

Seventh, a generic lack of awareness about the possibilities, techniques and potentials of sustainable design solutions generated that designers hesitated specifying new technologies or construction processes.

These barriers produced a significantly impact on the compliance of the Green Building Regulation. In addition one of the key factors that contributed to the low number of LEED certified projects is related to Dubai’s construction market business model.
The increased construction costs in combination to a severe shortage of experience staff and the absence of strong enforcement mechanism created an environment where sustainable construction was low on the list of investor’s priorities.

In addition, given the demanding market pace investors were unable to identify any benefit they could capitalized from.

The following changes to the current instruments could increase the number of LEED certified projects in Dubai:

First, it seems evident that government agencies would do well in using established institutions, such as the Emirates Green Building Council, to develop a participatory process that would give all stakeholders the opportunity to discuss, understand and prepare to face future requirements. Furthermore this forum could become instrumental in developing new regulations that could enable pursuing a LEED certification in all areas of the emirate, as oppose to only those controlled by Dubai World.

Second, Dubai World should consider gradually easing the regulations that require the use of a small number of selected LEED AP to develop projects. This would not only reduce the project cost but also eliminate any hold ups by allowing a larger number of currently available LEED AP to work on project design.

Third, I believe that the current enforcement mechanism needs to be improved. It seems that in an environment where construction projects switch ownership several times prior being completed, a mechanism that requires the LEED certification to be awarded for the property end-users to receive an operations permit will not force initial investors or designer teams to pursue the certification. Furthermore, given the nature of the LEED certification process, there is little that property end-users can do to fulfill any missing requirement ones the building is completed.

A mature and well developed framework that defines the responsibilities of the application of sustainable practices in the construction market is therefore needed. One instrument that authorities could evaluate is an “award guarantee”; a mechanism that mandates initial investors or developers to deposit a significant amount in an escrow account that they could withdraw once the LEED certification has been awarded.

Fourth, it seems equally important to develop a Building Code, which should serve as the framework that regulates the application of sustainable practices in the construction market. Although it is known that Dubai Municipality has been working on developing a Building Code (Khaleej Times, 2010), authorities should consider establishing a Federal Building Code valid for all emirates, rather than only Dubai.
10 SUGGESTIONS TO FUTURE RESEARCH

Additional mechanisms that could increase the number of LEED certified projects by either increasing the sustainability awareness among the investor’s community or creating an environment where energy efficiency is high on the priority list could be considered in future research.

A recent analysis released by Frost & Sullivan (2011), indicates that due to growing concerns over increased energy demand at the cost of depleting oil reserves the performance contracting market in Dubai could grow significantly over the next five years.

The government of Dubai would therefore be called to create an attractive atmosphere that would allow Energy Service Companies to invest in energy saving measurements.

Such atmosphere would not only require political stability and a mature financial sector, partially available in Dubai at the moment, but also unsubsidized energy prices in addition to liberalizing the government controlled energy market.

I would argue that correcting the energy price alone, either by reducing subsidizes or introducing an energy tax, would not be feasible.

Given the dramatic increase energy and water demand experienced at hand of the urban development (appendix C) it seems evident that the Government of Dubai intents to improve access to energy for inhabitants rather than to improve energy efficiency.

Furthermore given the fact that the market is driven by institutional investors implementing an energy tax for commercial properties alone would not increase the number of LEED certified projects.

The liberalization of the energy market in addition to correcting the energy prices might however produce the desired results. New players in the energy generation market might not only improve the access to energy, but also foment the power generation diversification. Allowing the introduction of new generation technologies such as solar, wind or geothermal energy would not only reduce the Emirate’s dependence on gas consumption for its electricity generation, but also reduce the generation of Greenhouse Gas emissions, responsible for global climate change.

It becomes therefore necessary to understand which immediate benefits, future opportunities and threats such actions would generate.
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- Seminario, Gonzalo, former LEED Manager Nakheel, current Sustainability Manager AECOM for Masdar City. Email Communication 16th March 2011.
- Williams, Daniel, Global Director Strategic Product Development, Carrier Corporation. Email Communication 23rd January 2011.
Appendix A: Sustainable design rating systems

This appendix lists some of the sustainable design rating systems developed world wide.

<table>
<thead>
<tr>
<th>Country</th>
<th>Rating System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>SI-5281</td>
</tr>
<tr>
<td>Italy</td>
<td>Protocollo Itaca</td>
</tr>
<tr>
<td>Mexico</td>
<td>LEED Mexico</td>
</tr>
<tr>
<td>Netherlands</td>
<td>BREEAM Netherlands</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Green Star NZ</td>
</tr>
<tr>
<td>Portugal</td>
<td>Lider A</td>
</tr>
<tr>
<td>Singapore</td>
<td>Green Mark and Construction Quality Assessment System (CONQUAS â)</td>
</tr>
<tr>
<td>South Africa</td>
<td>Green Star SA</td>
</tr>
<tr>
<td>Spain</td>
<td>VERDE</td>
</tr>
<tr>
<td>United States</td>
<td>LEED</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>BREEAM</td>
</tr>
<tr>
<td>Abu Dhabi</td>
<td>Pearl System</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>HKBEAM</td>
</tr>
<tr>
<td>India</td>
<td>GRIHA / LEED India</td>
</tr>
<tr>
<td>South Korea</td>
<td>Greening Building System</td>
</tr>
<tr>
<td>Australia</td>
<td>Nabers / Green Star</td>
</tr>
<tr>
<td>Brazil</td>
<td>AQUA / LEED Brazil</td>
</tr>
<tr>
<td>Canada</td>
<td>LEED Canada / Green Globes</td>
</tr>
<tr>
<td>China</td>
<td>GB Evaluation standard for green building</td>
</tr>
<tr>
<td>Finland</td>
<td>PromisE</td>
</tr>
<tr>
<td>France</td>
<td>HQE</td>
</tr>
<tr>
<td>Germany</td>
<td>DGNB</td>
</tr>
</tbody>
</table>

Appendix B: EHS LEED NC v2.2 Facilitation Process

The chart below shows the process agreed between EHS and the approved LEED consultants. It describes the necessary steps developers and consultants need to undertake in order for EHS to grant the Building Permit and subsequent Operation Fitness Certificate.

Source: Middle East Center for Sustainable Development’s LEED Technical Manual

The charts below show the energy and water consumption in Dubai between 2002 and 2009.

While the first chart shows the electricity installed capacity (MW) versus the emirates peak demand year over year the second draft represents Dubai’s water generation capacity versus the peak demand. These charts reflect that major infrastructure investments were necessary in order to quote with the rising demand.

Source of data: Dubai Electricity and Water Authority (DEWA)

Source of data: Dubai Electricity and Water Authority (DEWA)
As of April 2011 the MEED construction project database registers 894 active construction projects in Dubai. Most of these projects are considered either “Sub-Megaprojects” or “Standalone projects” as they are being developed within an area controlled by a government-owned commercial entity.

Although the “Green Dubai” resolution applied to all new developments with the emirate only the larger state controlled developers such as Dubai World and Dubai Holding have committed to LEED, it remains however unclear which standard other developments follow.

The list below shows some of the mayor developments within Dubai.

<table>
<thead>
<tr>
<th>ID</th>
<th>Project</th>
<th>Developer</th>
<th>Follows LEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Palm Jumeirah</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Palm Jebel Ali</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Palm Deira</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>The World</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Waterfront</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>Jumeirah Islands</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>Jumeirah Village</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Jumeirah Park</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Jumeirah Heights</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>Ibn Battuta Mall</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>No.</th>
<th>Project Name</th>
<th>Developer</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Discovery Gardens</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>12</td>
<td>International City</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>The Gardens</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>Al Furjan</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
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<td>15</td>
<td>Dragon Mart</td>
<td>Nakheel</td>
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</tr>
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<td>16</td>
<td>Mina Rashid</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>17</td>
<td>The Universe</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>18</td>
<td>Jebel Ali Free Zone Extension</td>
<td>JAFZA</td>
<td>Yes</td>
</tr>
<tr>
<td>19</td>
<td>Dubai Techno Park</td>
<td>JAFZA</td>
<td>Yes</td>
</tr>
<tr>
<td>20</td>
<td>Al Maktoum Int. Airport</td>
<td>Dubai Holding</td>
<td>Expected</td>
</tr>
<tr>
<td>21</td>
<td>Dubailand</td>
<td>Dubai Holding</td>
<td>Expected</td>
</tr>
<tr>
<td>22</td>
<td>Dubai Sports City</td>
<td>Dubai Holding</td>
<td>No</td>
</tr>
<tr>
<td>23</td>
<td>Dubai Golf City</td>
<td>Thani Investments</td>
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<tr>
<td>24</td>
<td>Dubai Motor City</td>
<td>Union Properties</td>
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<tr>
<td>25</td>
<td>Dubai Lifestyle City</td>
<td>Dubai Holding</td>
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<tr>
<td>26</td>
<td>City of Arabia</td>
<td>Dubai Holding</td>
<td>Yes</td>
</tr>
<tr>
<td>27</td>
<td>Dubai Outlet City</td>
<td>Dubai Holding</td>
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</tr>
<tr>
<td>28</td>
<td>Business Bay</td>
<td>Union Properties</td>
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<tr>
<td>29</td>
<td>Dubai Marina</td>
<td>Emaar</td>
<td>Partially</td>
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<td>30</td>
<td>Jumeirah Lake Towers</td>
<td>Nakheel</td>
<td>Yes</td>
</tr>
<tr>
<td>31</td>
<td>Dubai Festival City</td>
<td>Al Futtaim Group</td>
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</tr>
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<td>32</td>
<td>Dubai Promenade</td>
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<td>33</td>
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<td>Dubai Holding</td>
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<tr>
<td>34</td>
<td>Tecom</td>
<td>Dubai Holding</td>
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</tr>
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</table>

Source: Nakheel and MEED
Appendix E: Approved LEED consultant’s fees.

The table below presents the negotiated fees (last price) of Dubai World approved green consulting companies for a 14,876 m² commercial project with an overall value of 4,680,000 Euro. Tendered services include Preliminary energy modeling, design submittals, IAQ Plan and Construction submittals (Cx excluded). Tender process was done in August 2009.

<table>
<thead>
<tr>
<th>Company</th>
<th>Fees as % of project value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Engineering Systems</td>
<td>1.05%</td>
</tr>
<tr>
<td>Royal Haskoning</td>
<td>1.03%</td>
</tr>
<tr>
<td>Arkiplan</td>
<td>0.99%</td>
</tr>
<tr>
<td>Mario Associates</td>
<td>0.97%</td>
</tr>
<tr>
<td>Greenfield Services</td>
<td>0.97%</td>
</tr>
<tr>
<td>Scott Wilson</td>
<td>1.31%</td>
</tr>
<tr>
<td>Green Technologies</td>
<td>1.29%</td>
</tr>
<tr>
<td>MECSD</td>
<td>1.56%</td>
</tr>
<tr>
<td>EMSI</td>
<td>4.66%</td>
</tr>
<tr>
<td>Woods Bagot</td>
<td>1.18%</td>
</tr>
<tr>
<td>Whitby &amp; Bird</td>
<td>1.80%</td>
</tr>
<tr>
<td><strong>Average fee</strong></td>
<td><strong>1.52%</strong></td>
</tr>
</tbody>
</table>

Source: own
Appendix F: Timeline of enactment of green building regulations in Dubai.

This appendix shows the timeline under which the different green building regulations came into effect in Dubai.

Source data: EHS
Appendix G: Dubai World approved LEED consultants and CxA

The availability of approved LEED APs and Commissioning Authorities has remained very low since the enactment of the Green Building Regulation in January 2008.

While the number of approved LEED AP’s remains at 22, the number of CxA has not exceeded 8. Furthermore it was not until October 2008, 10 months after the regulation came in effect, that the first Commissioning Authority (CxA) was available on the Dubai market (Dubai World, EHS).

The chart below shows the number of approved LEED APs and CxA available to work on Dubai Worlds project and the timeline in which these have been approved.

Source data: EHS
Appendix H: Government owned companies in Dubai

Revenues from oil and natural gas allowed the government of Dubai to diversify from a trade-based, oil-reliant economy to one that is service and tourism-oriented. Subsequently the government, represented almost exclusively by Sheikh Mohammed bin Rashid Al Maktoum as the Ruler of Dubai, holds interests in a large variety of commercial entities.

Some of state-owned companies include:

**Airlines**
- Emirates: is the national airline of Dubai, United Arab Emirates. It is the largest airline in the Middle East, operating over 2,400 passenger flights per week, from its hub at Dubai International Airport.
- Flydubai: is a low-cost airline of the United Arab Emirates, operating out of Dubai International Airport

**Airports**
- Al Maktoum International Airport: is a major airport in Jebel Ali, Dubai, United Arab Emirates that opened on 27 June 2010. Previous working names have included "Jebel Ali International Airport," "Jebel Ali Airport City" and "Dubai World Central International Airport". It will be officially known as Al Maktoum International Airport. It has been named after the late Sheikh Maktoum bin Rashid Al Maktoum, the former ruler of Dubai.

**Media**
- Arab Media Group (AMG): is a Dubai, United Arab Emirates, based media company, part of TECOM, the technology and media holdings management arm of Dubai Holding. Founded in March 2005, AMG has a workforce of just under 300 staff across its three Dubai-based offices.
- Arabian Television Network (ATN): was a Dubai; United Arab Emirates based broadcast media company, part of Arab Media Group. Its staff and resources have been merged in to Dubai Media Incorporated.

**Oil / Gas**
- Emirates National Oil Company (ENOC): is the Dubai Government owned diversified energy group. One of its subsidiaries, ENOC Processing Company LCC (EPCL) runs the Jebel Ali refinery in Dubai. ENOC is a multi-interest oil and gas group and has operations in Dubai and Northern Emirates in UAE, although it does not have operations in Abu Dhabi, the largest of the emirates.

**Real Estate**
- Dubai Holding: is a holding company that belongs to the Government of Dubai (Sheikh Mohammed bin Rashid Al Maktoum as the Ruler of Dubai holds 99.67% of the company). It manages and controls 20 companies, which operate in real estate, hospitality, finance, healthcare, energy, research, education, entertainment, media, internet, tourism and biotechnology.
• Tatweer: is a member company and subsidiary of Dubai Holding, a Dubai-based holding company set up by the government of Dubai to manage its assets and investments. Tatweer is created to manage and develop a group of Dubai Holding's companies and projects that have interest in the healthcare, energy, tourism, entertainment and industrial sectors.

• Dubailand: is an entertainment complex under development in Dubai, United Arab Emirates, which is owned by Tatweer (which belongs to Dubai Holding). When announced in 2003 it was one of the most ambitious leisure developments ever proposed anywhere in the world, but development has been severely impacted by global recession and Dubai's financial crisis.

• Several Free Zones such as: Dubai Internet City, Dubai Knowledge Village, Dubai Lifestyle City, Dubai Media City and Dubai Studio City

Leisure
• Leisurecorp: formerly Istithmar Leisure, is a subsidiary of Dubai World, established in 2006, that invests in sports and leisure facilities, with golf being a particular focus

Diverse
• Dubai World: Established in 2006 Dubai World is an investment company that manages and supervises a portfolio of businesses and projects for the Dubai government across a wide range of industry segments and projects that promote Dubai as a hub for commerce and trading. It is the emirate's flag bearer in global investments and has a central role in the direction of Dubai's economy.

Dubai World subsidiaries include:
  o Dubai Ports World
  o Jafza
  o Nakheel
  o Dubai Drydocks
  o Maritime City
  o Dubai Multi Commodities Centre
  o Tamweel
  o Tejari
  o Limitless
  o Leisurecorp
  o Istithmar
  o Island Global Yachting
  o Inchcape Shipping Services
Appendix I: Structure of EHS

At hand of the example of EHS, this appendix shows how commercial entities, Dubai World in this case, function as government agencies in charge of regulatory aspects, licensing and fulfilling compliance functions.

**Ports, Customs & Free Zone Corporation**

In 2000 the Government of Dubai decided to create PCFC by merging 3 previously separate entities:

- Dubai Ports Authority: established in 1991 from the merger between Jebel Ali Port and free Zone and Port Rashid.
- Dubai Customs: a Government body that facilitates free trade and help secure the integrity of Dubai’s borders.
- Jebel Ali Free Zone Authority (subsidiary of Dubai World)

**Trakhees**

At the beginning of 2008 Trakhees was established by the Ports, Customs and Free Zone Corporation with the aim of integrating licensing and compliance functions as well as providing services to businesses, owners and tenants of the new Dubai World Communities.

**Environment, Health & Safety (EHS)**

Environment, Health and Safety (EHS) is the regulatory arm of Trakhees-Ports, Customs &Free Zone Corporation (PCFC). EHS controls, regulates and enforces rules and regulations related to all aspects of Environment, Health, Safety, Sustainability, Green Construction and Fire Protection. It covers all Dubai World Business Units such as Nakheel, DMCC, DMC, Limitless, DP World, JAFZA, Istithmar amongst others.