

# Environmental Assessment Methods in Abu Dhabi

Huda Al Salmi, Hisham Al Kadi, and Simone Leao

**Abstract**—Abu Dhabi is one of the fastest developed cities in the region. On top of all the current and future environmental challenges, Abu Dhabi aims to be among the top governments in the world in sustainable development. Abu Dhabi plans to create an attractive, livable and sustainable managed urban environment in which all necessary services and infrastructure are provided in a sustainable and timely manner. Abu Dhabi is engaged in a difficult challenge to develop credible environmental indicators that would assess the ambitious environmental targets. The aim of those indicators is to provide reliable guidance to decision makers and the public concerning key factors that determine the state of urban environment and identify major areas for policy intervention. In order to ensure sustainable development in UAE in general, and of Abu Dhabi City in particular, relevant and contextual environmental indicators need to be carefully considered. These indicators provide a gauge at a national government scale of how close countries are to establish environmental policy goals. The environment indicators assist city decision-making in such areas as identification of significant environmental aspects and observation of environmental performance trends. Those can help to find ways of reducing environmental pollution and in improving eco-efficiency.

This paper outlines recent strategies implemented in Abu Dhabi that aims to improve the sustainable performance of the city's built environment. The paper explores the variety of current and possible indicators at different levels and their roles in the development of the city.

**Keywords**—Abu Dhabi, Sustainable Development, Indicators, Assessment Methods.

## I. INTRODUCTION

**S**USTAINABLE development (SD) has been promoted as the solution for the environmental, social and economic crises. In 1987, the World Commission on Environment and Development's (WCED), also known as the Brundtland Commission, released the Our Common Future Report which included what is now one of the most well-known definitions for sustainability development "the need of the present without compromising the ability of future generations to meet their own need" [35]. Based on WCED report, UN called for "Earth summit" Conference in Rio de Janeiro in 1992 to motivate countries to develop and assess the sustainability by construction sustainability indicators according to their local concerns, Agenda 21 which is the main achievement of the

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Rio conferee, stated in Chapter 40.4 that "Indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems" [36]. Since the Rio Conference, several initiatives have been launched to define and create the sustainable development indicators (SDI) [19]. There has been a strong need, among all who address the issues of sustainability, to provide indicators that can measure and monitor sustainable development [5], [15]. The United Nation Commission on Sustainability Development UNCSD published the first set of sustainability indicators in 1996 [41]. According to Singh the indicators are implemented because of its capacity to summarize the huge complexity of our dynamic environment to a suitable amount of meaningful information. Sustainability indicators can play a key role in helping decision-makers to ensure the sustained success of their cities [30].

There are several methodologies for assessing environmental impacts; these include Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment (BREEAM), sustainable building Tool (SBTool), Cost benefit analysis (CBA), Environmental impact analysis (EIA), Ecological footprint and Environmental sustainability index (ESI)[40]. Some of the assessment methods aimed at the ensuring of the buildings sustainability and the performance of their components. On the other hand, a range of environmental assessment systems has also emerged to take into account neighborhood, community and regional concerns. Assessment tools not only differ in target group, they also vary in their focus on environmental issues, and in the basic choice of indicator types [14]. The list below are the levels at which the criteria and premises of urban sustainability can be applied [16]: Buildings, Groups of buildings, City blocks, Neighborhoods, Networks of neighborhoods, Downtowns, Sections of cities, Cities, Regions and Countries.

## II. ENVIRONMENTAL ASSESSMENT METHODS

Reaching a sustainability lifestyle today is of high importance for the life of future generation. Government of Abu Dhabi has endorsed sustainability as the cornerstone of its short and long term policy Agenda. Abu Dhabi government is engaging in building up a list of environmental indicators and the development of information systems to capture assessment of environment issues at a local level. Environment indicators

assist city decision-making in areas such as identification of significant environmental aspects and observation of environmental performance trends. These indicators can help to find ways of reducing environmental pollution and in improving eco-efficiency. This paper outlines recent strategies implemented in Abu Dhabi that aim the sustainable performance of the city. The paper studies the most important indicators at a building, neighborhood and regional level as an essential part of the development of cities.

Several environmental assessment methods for buildings are applied in the United Arab Emirates (UAE), including: Leadership in Energy & Environmental Design (LEED), British Research Establishment Environmental Assessment Method (BREEAM), Estidama, United Nation Environmental Program (UNEP) and World Wildlife Federation (WWF) One Plant Future. Table I is a summary of the main environmental assessment methods used in UAE; taking into account building, district and global levels.

III. ENVIRONMENTAL ASSESSMENT METHODS AT THE BUILDING LEVEL

A. Emirates LEED

The Emirates Green Building Council (EGBC) launched in October 2007 the first building rating system for the UAE. Leadership in Energy and Environmental Design (LEED) rating is a voluntary standard for assessing building performance and meeting sustainability goals [42]. It is based on industry standards developed by the United States Green Building Council and emphasizes state of the art strategies for sustainable site development, water saving, energy efficiency, materials selection and indoor environmental quality [3].

TABLE I  
ASSESSMENT METHODS USED IN UAE IN DIFFERENT LEVELS

Assessment Level	Assessment Method
Building level	Emirates LEED
	Gulf BREEAM
	Estidama,
City Level	Ecological foot print
	Estidama
Global/Regional Level	United Nations Development Program (UNEP)
	World Wildlife Fund (WWF) One Plant Future

LEED is a building rating system established to measure the performance of a building against pre-established parameters, and third party verification [14]. LEED assesses buildings against the following main criteria: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality [11].

The LEED system used in UAE is based on the original rating system, with modifications made to account for the local environmental conditions. The major modification to the US LEED is increasing the total scoring points from 69 to 72 as a result of adding more weight on water conservation because of its scarcity in this region [42]. A building cannot receive accreditation without a 20% reduction of potable water used in buildings, no matter how many points are achieved in other categories [15]. This measure makes the Emirates LEED more applicable to use in the emirates region. Sharma argued

that "LEED rating system is completely out-of-place for desert ecology. If you consider carefully points like Site Selection (flood plains and wetlands), Bicycle storage and changing rooms, Storm water Design, Certified wood and Maximizing of day light and views then they all fall flat on this yardstick" [29]. LEED was developed for the USA contexts and some of the points mentioned above might be seen as out of place for UAE environment. LEED can be however flexible, is internationally recognized and can be adapted and applied to UAE environment.

B. Gulf BREEAM

Building Research Establishment (BRE) has formally launched BREEAM in the Gulf on October 2008 [31], which is specifically modified for the Gulf Area. The rating system takes into account water conservation and energy issues in its new form [39]. BRE worked with Atkins and Carillion consultants to adapt its BREEAM guidelines so that they relate to the Middle Eastern climate [31]. BREEAM Gulf has been developed in collaboration with a variety of large organizations based in Qatar, Abu Dhabi and Dubai [11].

BREEAM helps in setting the standards in best practice sustainable building design and construction in order to enhance the building's environmental performance; Fig. 1 is summary of BREEAM process. BREEAM Gulf Scheme assesses the sustainability of a building in the following areas [11]: Management, Health and Wellbeing, Energy, Transport, Water, Land Use and Ecology, Materials, Waste, and Pollution. These areas' credits are assessed to evaluate the performance of the development. The overall score is then translated into a 1-5 rating, with the highest level of environmental performance rating as 5 stars [11].

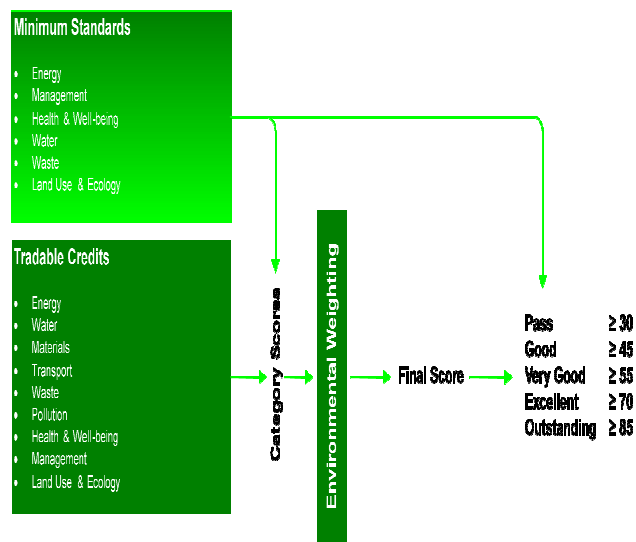


Fig. 1 General BREEAM process

The aim of the scheme is to bring together all the most commonly used building types in the area into one easy to use, accessible BREEAM Scheme which developers and assessors can use to evaluate, improve and demonstrate the

environmental credentials of their building [6]. The scheme has been developed using the same categories from the UK BREEAM Schemes and provides an independent means of assessing key environmental impacts associated with construction in the Gulf region [6]. For example, water usage in the UAE is a main environmental concern; therefore, water comprises 30% of the environmental weighting in UAE BREEAM, while it is 6 % in the BREEAM UK [15]. Unlike BREEAM in the UK, Gulf BREEAM can be used to assess mixed-use buildings such as retail, residential, commercial etc. That suitably reflects the general practice of mixed use buildings in the Gulf area [11].

BREEAM has a two-stage certification system, which includes a design stage and a post-construction stage [6]. The BREEAM Gulf assessment evaluates the performance of a whole building, taking into account its different uses, which suitably reflects the common practice of mixed use buildings in the region. This is different than the UK BREEAM, which looks at buildings separately [11]. To achieve BREEAM rating there are mandatory minimum credits that have to be completed. The Table II is a summary of maximum and mandatory credit in each category in Gulf BREEAM.

TABLE II  
GULF BREEAM MANDATORY CREDIT

Credit NO.	Credit Categories	Max Credits	Mandatory Credits
Man 1	Commissioning	2	1
Man 4	Building User Guide	1	1
Hea 12	Microbial Contamination	15	1
Ene 1	Reduction of CO <sub>2</sub> Emissions	1	1
Ene 2	Sub Metering of Substantial Energy Uses	3	1
Ene 5	Renewable & Low Emission Energy	2	1
Tra 5	Travel plan	1	1
Wat 1	Water Consumption	1	1
Wat 6	Irrigation Systems	1	1
Le 6	Long term impact on biodiversity	1	1
Pol 9	Refrigerant ODP	1	1

### C. Estidama

Estidama was formally launched on 15th November 2010, after two years of work [28]. The Pearls Rating System (PRS), which is a part of Estidama, a brand new system for new projects in the United Arab Emirates. The program has been initiated by a group of governments and private agencies in Abu Dhabi Emirate including Urban Planning Council (UPC), Environmental Agency (EAD), Abu Dhabi Municipality (ADM), Masdar City, Al Dar and Sorouh, to align the leadership's vision in transforming Abu Dhabi to a sustainable Arab Capital. It also helped in implementing the Plan 2030 overarching principles and its recommendations for the Abu Dhabi City future urban development [1].

The development of Estidama was the result of growing concerns about environment issues in the building industry and management, in topics such as sustainability, building performance, environmental impact, and energy consumption. Estidama, which means "sustainability" in Arabic, aims to create guidelines and regulations to ensure sustainable design,

operating and maintenance of all types of buildings and communities within the Emirates. The Pearls system is unique in that it clearly considers the increasing impacts that the carbon footprint and life cycle of counterparts on the development of national owned projects, while also founding strong partnerships [12]. Its aim is to create more sustainable communities, cities and global enterprises and to balance the four pillars of sustainability: the environmental, economic, cultural and social [28]. Estidama supports sustainable living and resources by working closely with communities, organizations, businesses and policy-makers to further encourage responsible decision making that moves Abu Dhabi and the region towards global sustainability leadership [37]. It is the first program of this kind that is tailored to the Middle East region [28].

There are difficulties in finding local data to benchmark performance and improvements against. The clear lack of reliable and sufficiently detailed database for benchmarking in the local context as against international contexts can present some challenges [17]. This is an aspect which will need to be addressed in the approach to implementing Estidama Program and its indicators. However, applying Estidama may preserve and enrich UAE's physical environmental and cultural identity [38].

The Pearl Rating System comprises the following three levels: Pearl Community Rating System, Pearl Building Rating System and Pearl Vila Rating System, each level has different criteria and different individual rating systems [22]. To achieve a higher Pearl rating (2-5 Pearls), all the mandatory credit requirements must be met along with a minimum number of credit points as shown in Table III, to achieve a 1 Pearl rating, all the mandatory credit requirements must be met [12].

TABLE III  
PEARL RATING SYSTEM CREDIT REQUIREMENTS IN EACH LEVEL

Rating level	Community Minimum	Building Minimum	Vila Minimum
1pearl	All mandatory credits	All mandatory credits	All mandatory credits
2pearl	All mandatory credits + 55 credit points	All mandatory credits + 60 credit points	All mandatory credits + 30 credit points
3pearl	All mandatory credits + 75 credit points	All mandatory credits + 85 credit points	All mandatory credits + 44 credit points
4pearl	All mandatory credits + 100 credit points	All mandatory credits + 115 credit points	All mandatory credits + 57 credit points
5pearl	All mandatory credits + 120 credit points	All mandatory credits + 140 credit points	All mandatory credits + 70 credit points

The PRS has seven categories that are fundamental to sustainable development, the credits for each category in different rating levels (Community, Building and Vila), including mandatory and optional credits [12], the three stages of certification: Design rating, Construction rating and Operational rating shows in Fig. 2, The Design Rating rewards measures accepted during the design development of the project that meet the intent and requirements of each credit

[12], it used to confirm that the proposed project design is consistent with the goals of Estidama.

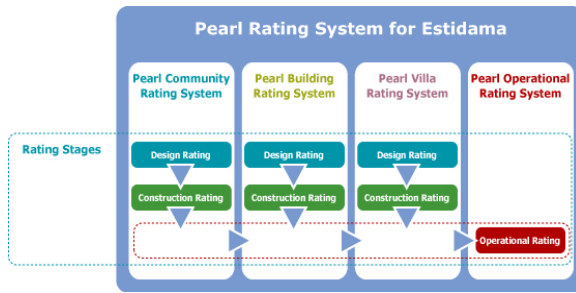


Fig. 2 PRS Stages

Following construction completion, a Pearls Construction Rating is provided. The Construction Rating ensures that the commitments made for the Design Rating have been achieved [12]. At the final stage, the operational rating measures the built-in features and operational performance of an existing building [12]. This stage of certification has not been applied yet [19].

To support guidelines and to record the scores given to a building against each criterion, a spreadsheet tool has been developed. This spreadsheet allows the assessor to apply a score to the building design, providing the design team with an indication as to how the building design is performing against the green building assessment criteria. It provides a summary of the total score and a graphical representation of which categories of the building design has performed well [38].

In Abu Dhabi, one of the most important environmental initiatives is Estidama. Estidama, which includes green building features and a rating system for new constructions building and community, will reduce energy consumption of buildings and minimise their environmental impact. However, Estidama is only applied to new constructions and not to existing buildings. There are 2500-2700 high rise buildings in Abu Dhabi Island alone. Electricity consumption per household in Abu Dhabi is 10 times the World Average while water consumption rate per capita is 2.5 times the world average[2]. Existing buildings also can be upgraded to significantly reduce their energy and water consumption, improve their indoor air quality and increase overall operation efficiencies.

There are one more concerns of Estidama. After six month of applying pearl rating system in Abu Dhabi, Urban Planning Council (UPC) suspended the PRS for residential, buildings and villa as a result of difficulties in applying this system. The municipalities' engineers, consultants and the building owners couldn't understand how to apply the systems in new projects. Since May 2011, all new applications submitted to the municipalities for new, 1 Pearl villa or building had to meet the only three revised Temporary Program Requirements listed below (UPC, 2011):

- Minimum Interior Water Use Reduction (Only specifications for fittings, fixtures, and regulators are required)

- Minimum Energy Performance (Wall and Roof insulation)
- Hazardous Materials Elimination: (not using Asbestos Containing Materials (ACMs) and Chromate Copper Arsenate (CCA) - treated timber).

Launching PRS without a well-articulated implementation plan led to fail in achieving its objectives. In order to reverse this situation, the UPC must prepare strong campaign aimed at municipality's employee, Consultant, Contractors and Public. This campaign must include different level of training courses, determining the true costs and benefits of green buildings and who would get these benefits. It is also important to gradually apply PRS. The Abu Dhabi Municipality struggled to process new building permits in the Abu Dhabi municipality in the three month of starting Estidama program. The accumulated applications reached 860 pending transaction. Only 50 applications received preliminary approvals. Many consultants find it difficult as they are not familiar with Green Building Rating Systems.

#### D. Estidamavs. LEED & BREEAM

Estidama Pearl Rating system is based on both BREEM and LEED [38]. PRS has been developed to support the sustainable buildings in Abu Dhabi's desert hot weather. The Pearls Rating system (PRS) is a government initiative developed by the Abu Dhabi government. The formulation of the Estidama in line with the 2030 Master plan highlights Abu Dhabi strategic objective of making the city a sustainable place to live for its next generations and for people and investors who flock to this Emirate from all over the world [12]. LEED, on the other hand, was developed by The United States Green Building Council (USGBC); a non-profit organization dedicated to sustainable building design and construction [13]. The British Research Establishment (BRE) was a former UK government establishment before becoming a private organization, funded by the building industry; BRE founded and operates BREEAM [7]. LEED and BREEAM are mainly the two representatives of sustainable building rating systems around the world.

One of the most progressive aspects of Estidama is that it is being incorporated in the master plan of Abu Dhabi, as mandatory for all new construction and is integrated in the permitting process [37]. Abu Dhabi Executive Council mandated that all new communities, buildings and villas must achieve the minimum credit requirement of a 1 Pearl rating while government funded buildings, schools and mosques are required to achieve a minimum 2 Pearl rating [28]. Pearls rating system which is a part of Estidama includes requirements similar to LEED's and BREEAM's Mandatory Credits, which do not award points but are mandatory for certification.

Pearls, LEED and BREEAM have many similarities. The three rating systems recognized "label" for certification and point-based systems, all of them has main sections that divide into sub sections with different credits have qualified weights depend on its relevance. For example water and energy conservation are giving more weight within the current

UAE context. As previously mentioned, Estidama is the first program of its kind that is totally tailored to the Gulf region. Although Pearl Rating system is based on BREEM and LEED, Pearl consists of a number of criteria which have been design specifically for this area. Fig. 3 displays the main categories and its weights in PRS, LEED and BREEM.

Despite that the three rating (PRS, LEED and BREEM) methodologies have a lot of similar requirements; the three rating methodologies are applied through different approaches, making each of them more readily functional for particular situations. These include: Phase of development to be certified, Feasibility of meeting assessment requirements and Potential for contracting necessary expertise [26].

The Pearls Rating System is its integration into the Abu Dhabi development codes. Unlike the LEED and BREEM systems, which isolated in the rating system, the planning and building codes for the city of Abu Dhabi are currently being redrafted to integrate Estidama's goals and Pearls requirements into them [38]. Abu Dhabi municipality is working with UPC to develop a compulsory building code that will include a number of sustainable criteria.

PRS like LEED follows the American ASHRAE standards that are capable of performing both load and dynamic simulations (ASHRAE Standard 90.1-2007). In BREEM, there are two classes of approved software for energy performance assessment (Simplified Building Energy Model (SBEM) engine and Dynamic Simulation Modelling (DSM)) [27].

LEED and BREEM have both two assessment phases, one at the design phase and another more follows the completion of construction. LEED requires Design Phase and Construction Phase documentation and reviews, delaying the accomplishment of any LEED certification until completion of construction and making the timeline for certification substantially longer [26]. On the other hand, Elgendy argued that LEED is more common to state the intention and leave it up to designers' discretion. This meant that the LEED calculations methods and documentation became more rigorous, and consequently LEED requires more work to prove accreditation [10]. This has led to the perception that LEED projects need to provide more extensive documentation than BREEM. PRS have three assessment phases, Design, construction and operational. The operational phase is unique to the PRS. The operational phase checks the performance of the building to be sure that it completes sustain abilities goals.

BREEM & LEED were developed for the different environment from UAE while Estidama tailored for UAE environment. While LEED and BREEM have processes and methodologies that are easy to follow, Estidama needs time and a lot of training of all stockholders involved to achieve its goals.

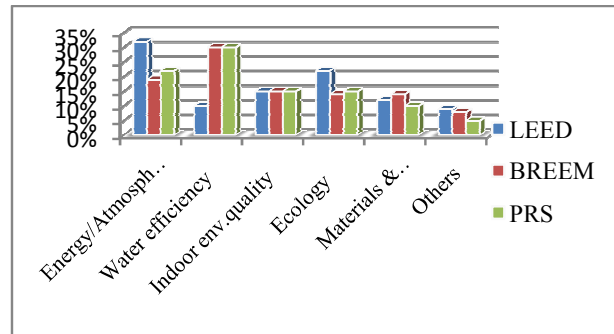


Fig. 3 Weight of different criteria of assessment methods in UAE

#### IV. ENVIRONMENTAL ASSESSMENT METHODS AT THE CITY LEVEL

##### A. Environment Agency (EAD) Indicators

The Environment Agency – Abu Dhabi (EAD) is a governmental agency that was established in 1996 [8]. EAD committed to protecting and managing biodiversity, providing a clean environment and promoting Sustainable Development in the Emirate of Abu Dhabi [8].

In 2005, the Environment Agency – Abu Dhabi (EAD) was nominated as the United Arab Emirates Designated National Authority (DNA) for the Clean Development Mechanism (CDM) [18]. The CDM part of the Kyoto which supports business industry to reduce their greenhouse gas by offering them a tradable Certified Emission Reduction (CER) or 'carbon credit' against every ton of carbon dioxide equivalent reduced [33].

EAD works to reduce the energy and water use, the waste produce and overall carbon footprint in UAE. EAD are currently developing their "Environment Vision 2030" for Abu Dhabi. "ENV2030" is intended to provide a comprehensive environmental roadmap and agenda that will drive many agencies' strategic planning in the Emirate [17]. AD Environment 2030 project mission as defined by the EAD project initiation team: "to integrate a variety of different perspectives to shape a comprehensive view of the role played by the environment in the sustainable development in Abu Dhabi." [17].

EDA is working in building up a list of environmental indicators at a local level, According to Dr. Jaber, there are needs to select criteria, strategies and measurable indicators in order to anchoring formulation, controlling implementation and evaluating results of city policies in sustainable basis, AD environmental 2030 vision include environmental indicators for emirate of Abu Dhabi [17]. EAD assessed each system component in terms of key attributes used in benchmark environmental frameworks.

EAD selected indicators for each attribute to reflect best practices, data availability and the unique challenges facing Abu Dhabi. The indicator set consists of 37 metrics, divided into six key themes: Air & Climate Change, Water, Marine, Energy, Biodiversity and Waste. The 37 selected indicators represent physical quantities that can be measured and monitored [17].

### B. Masdar City

Although the UAE has no consistent policy framework for sustainable technologies and renewable energies, it has planned economic development programmers dedicated to establishing new economic sectors focused on alternative energy and sustainable technologies [24].

UAE has one of the counties' highest energy consumption. The energy consumption in 2006 per capita reached 11.04 tones oil equivalents (toe/capita) [8], while the world and OECD averages were 1.80 and 4.70toe/capita, respectively [8]. Despite this Abu Dhabi emirate moves to use renewable energy, through construction of low energy and free carbon emission built environment. There are some remarkable projects going on in the UAE such as Masdar city.

Abu Dhabi government owned Mubadala Development Company announced the creation of the Masdar Initiative in 2006, a major program for the development and commercialization of renewable and sustainable energy technologies [21], the objective of the Masdar city is to be home to a population of 90,000 made up of 40,000 residents and 50,000 daily commuters [25]. Masdar city is a strategic initiative with four key objectives [20]:

- 1) Contribute to the economic diversification of Abu Dhabi.
- 2) Maintain, and later expand, Abu Dhabi's position in evolving global energy markets.
- 3) Position Abu Dhabi as a developer of technology, rather than an importer.
- 4) Make an important input towards sustainable human being development.

As the idea is not new; Masdar City approximately 6km<sup>2</sup> is planned to be a carbon-neutral, zero-waste city with the aim of being one of the world's most sustainable urban development powered by renewable energy [21]. Masdar City is still in the early construction phases and will complete between the year 2016 and 2020 [23]. It will be home to the International Renewable Energy Agency's (IRENA) headquarters after the organization chose Abu Dhabi as its host country in June 2009 [9].

Masdar will combine the complete set of renewable energy for sustainable city; it will use an array of sustainable technologies to reduce the city's ecological footprint. These technologies include: Wind, Photovoltaic, Concentrated Solar Thermal, Geothermal, Hydrogen, Waste-to-Energy and Personal Rapid Transit [32]. Masdar works with the private sectors to enhance the position of the Abu Dhabi as a supplier of energy to the world. The initial collaborative private companies' partners working towards these outcomes with Abu Dhabi include BP, Shell, Occidental Petroleum, TOTAL Exploration and Production, GE, JODCO, MITSUI, Mitsubishi, and Rolls Royce [1]. As with most dynamic technology clusters, the city has a top-notch research university that is a source for innovation, technologies, R&D and highly skilled graduates [21].

According to Stilwell, Masdar will be the world's most sustainable city, but it will be surrounded by some of the world's most unsustainable developments, Masdar City Located near excessive projects ranging from indoor ski

slopes, artificial islands, and luxurious hotels are built with money from oil and gas production [32].

## V. ENVIRONMENTAL ASSESSMENT METHODS AT THE REGIONAL LEVEL

### A. UNDP Emirates

The United Nations Development Program has been working in the UAE since 1977 [8]. The UNDP has a local office in Abu Dhabi and has striven to develop a good working relationship with the government of the UAE; it has been working closely with national counterparts on the development of nationally owned projects, while also founding strong partnerships. The UAE Office is also responsible for UNDP's operations in Qatar and Oman [34]. The country program is fully funded by the UAE Government, which gives the UAE its status as a Net Contributing Country (NCC) [34]. The program is intended to develop local capabilities and it combines a large group of partners, The UAE government in corporation with UNDP UAE prepared the Second UAE MDG report which was launched in 2007, The report highlights UAE's overall progress on the economic and social fronts in the past two decades and concludes that is on target to achieve the Millennium Development Goals in 2015 [34]. However, it also indicates the Fields that needs national coordinated effort to a chive Millennium Development Goals and objectives within the planed time.

MDGs7 serve as the framework for sustainable development by setting social equity goals and targets that aim at contributing to economic development while ensuring environmental sustainability [34], under MDG 7."Integrating sustainable development principles into national policies is critical to successful implementation and promotion of environmental sustainability".

UNDP's focus in the United Arab Emirates (UAE) for the period 2008-2011 is to make a positive contribution towards the attainment of the national development objectives in the following areas:

- Gender, Social and Economic Development
- Democratic Governance
- Environment and Energy
- HIV-AIDS

### B. WWF One Plant Future

The World Wildlife Fund (WWF) promotes the concept of "One Plant Future" where societal and individual demands on our planet are balanced with those of nature and the resources available, to guarantee a sustainable and equitable future [4]. (WWF) UAE Project Office was established in February 2001 and it was the first WWF office to be set up in the Middle East [43]. Emirates Wildlife Society is a local (UAE) environmental non-governmental organization. EWS is established under the patronage of HH Sheikh Hamdan bin Zayed Al Nahyan, Ruler's Representative in the Western region and Chairman of Environment Agency - Abu Dhabi (EAD) [43]. EWS works in association with WWF. EWS-WWF has initiated and implemented several environmental

protection and education initiatives within the area.

WWF released its Living Planet Report on the Earth’s health, collaborating with the Zoological Society of London and the Global Footprint Network [44]. The ‘Living Planet Report’ (World Wildlife Federation, 2006, 2008) assigned the UAE the highest ecological footprint per person; this is mostly from carbon dioxide emissions and water withdrawal rates [44]. Without doubt, the design and operation of green buildings can help limit these figures and achieve a more environmentally sustainable.

The ‘Living Planet Report’ estimated that the UAEs ecological footprint is 9.5 global hectares per capita?, The WWF’s Living Planet Report 2008 ranked UAE as the country with the world's largest Ecological Footprint per capita in 2005, which is more than three times higher than the average humanity's Footprint. Fig. 4 summary of ecological footprint for UAE, USA and Australia extracted from living plant report 2008 and 2010.

From the figure we can note the increasing rate of ecological footprint for UAE in 2010 compare with 2008, "If everyone in the world lived like an average UAE resident, we would need four and a half planets to sustain our lifestyles. We only have one planet," Said Laila Abdullatif, sustainability coordinator of the Emirates Wildlife Society [45].

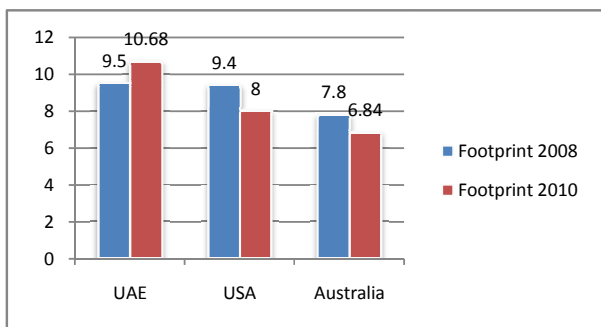


Fig. 4 Footprint for different countries 08- 10

There is still, however, a level of denial among the UAE professionals for example Dr. Jaber from Abu Dhabi Environment Agency said "Ranking UAE in the world's largest Ecological Footprint is inaccurate assess". The large ecological footprint for UAE is due to rise in the ambient air-temperature, Desalination of sea water and the massive urban development which lead to a significant increase in electricity consumption [17].

According to Emirates WWF, UAE Ecological Footprint Initiative (EFI)’s broke the UAE’s Footprint down into its contributing sectors, finding that households are the major provider, responsible for 57%, followed by the business/industry 30% and government sectors 12% as showing in Fig. 5.

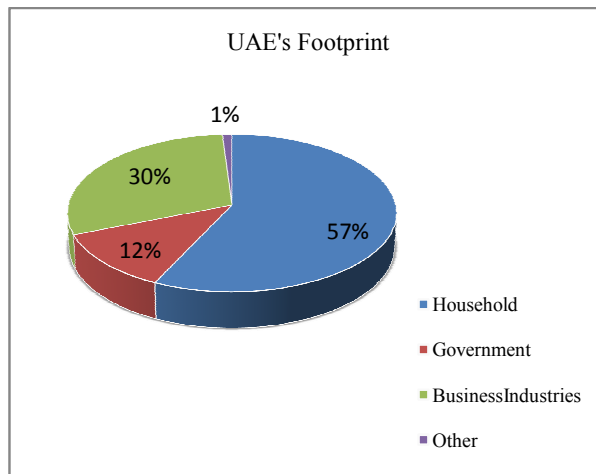


Fig. 5 UAE’s Footprint sectors

The rapid and increasing economic expenditure with huge architectural projects, population growth rates and a fairly low energy cost are increasing the UAE’s energy consumption, making it one of the highest energy consumers per capita in the world.

The EWS-WWF work to conserve the natural heritage of the UAE and to promote sustainable lifestyle, it has a valuable role to play in [43]:

- Raising awareness and advocating actions to reduce the Ecological Footprint of the UAE
- Promoting a sustainable lifestyle in the UAE
- Contribution to the shaping of a still evolving, institutional framework in the UAE, so that local, regional and global environmental issues are addressed together
- Highlight the responsibility of the UAE on the international conservation scene.

The EFI is working to enhance public awareness on the conserve our natural environment and it has developed a lot of initiatives to assist policy design to track the main source of ecological footprint. Awareness is also being raised amongst children who are taught about the need to conserve water and instilling the next generation with an environmental consciousness at a very early age.

VI. DISCUSSION

UAE emirates are embarking on understanding what sustainability means to the country future and are starting to develop the necessary framework to support commitment to embedded sustainability within the operational practices. This is just the first step in a long journey towards sustainable future. Emirate of Abu Dhabi has adopted positive approaches towards addressing environmental problems on different levels. The “Estidama” program and Masdar City may be the first step in the development of consistent environment strategy in the UAE, but the sustainability concept still needs further enhancement across the various stakeholder groups. This is so since a change towards the green culture will be necessary to reduce carbon emissions and encourage best

practices. Stakeholder cooperation coupled with government support is critical for enabling UAE to address its sustainable development.

Despite the life style, culture and behavior which are fundamental issues affecting significantly the habitual consumption of Emirati people, sound government policies can help cities to adopt better strategies to manage their energy and water resources. UAE behavior change in sustainable development policy must be based on social marketing principles. To achieve its goal, the government should rethink how to encourage personality behavior change of Emirati people.

The first action to be taken is to start a campaign, aimed at raising awareness about the carbon footprint, climate change, and how these issues can be tackled via rationing energy consumption and waste production. Environmental awareness heightening campaign must cease to be superficial, and lay greater emphasis on observation and analysis within different levels.

Applying green policy in UAE cities is a challenge and opportunity. The challenge is to see the city in a different light – no longer as somewhere we work, or had to go to, or wanted to live – but as a community we are now an ongoing part of. We have the opportunity to adopt it, own it, value it and to help make Abu Dhabi even better than it has been. We can choose to invest in our city knowing that our care will effectively save our earth to make a positive difference in the lives and future of our next generation.

## VII. CONCLUSIONS

Fast urbanization, non-planned urban growth and industrial expansion have increased pressure on the environment. UAE governments and organizations all together must exert more effort in reducing threats to the environmental, Built up areas are one of the largest consumers of energy and consequently they are the largest contributor to the increase in the atmospheric CO<sub>2</sub> and hence global warming and climate change. Usage of renewable energy is very limited in Abu Dhabi. Availability of cheap fuel in the emirate has to some extent discouraged the search of the use of renewable sources of energy. Masdar may serve as the foundation for extending the activities in the fields of making low-carbon emission buildings and using renewable resources with the objective and goal of reducing the impact of global warming, economy and above all enhancing our built environment.

The environment assessment strategy could be further developed for enhanced sustainable environment result. Sustainability indicators can play key role in helping Abu Dhabi Government to ensure the sustained success of Abu Dhabi city. The indicators measure the achievement of strategies, policies and developmental programs related to a specific urban area. They as well provide decision makers with full and comprehensive information about the existing condition. They also increase the local people understanding of the reality of comprehensive development of his their city. The indicators also represent the analytical side of the planning and because of that their credibility and stabilization

are critical when chosen as planning tools. In order to have successful indicators, they have to serve as an excellent guide in the process of change.

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