Emirates Green Building Council

Technical Workshops

2015 Briefs

Emirates Green Building Council (EmiratesGBC) Technical Workshops are intended to gather EmiratesGBC members and partners on a monthly basis to discuss specific topics that are relevant and beneficial to the green building industry.

As a knowledge-sharing platform, the workshops allow EmiratesGBC members to highlight challenges and solutions in their specific areas of work, and to exchange with professionals from other companies, sectors, and areas of the green building industry. They also support the EmiratesGBC objectives to be an active and pro-active knowledge center to its members.

EmiratesGBC
مجلس الامارات للابنية الخضراء
Emirates Green Building Council

The Emirates Green Building Council was formed in 2006 with the goal of advancing green building principles for protecting environment and ensuring sustainability in the United Arab Emirates.

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EmiratesGBC Technical Workshop #2015-1

Energy Saving with Lighting Technology

January 27, 2015

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Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: Energy Efficiency, LED Lighting, Lumen Efficiency

Introduction

Energy efficiency retrofit projects can reduce a building's energy consumption levels and save large amounts of money. Using of efficient lighting technologies can significantly facilitate the process. There are several parameters that can leverage the energy saving potential of a building retrofit project through cost effective selection of available lighting technology. In addition, proper lighting can affect the performance, visual comfort and well-being of building users.

In January 2015, the EmiratesGBC monthly Technical Workshop discussed the role of lighting in energy efficiency retrofit projects; the lighting tools and strategies in a retrofit project; how the energy efficiency industry keeps itself up to date with the latest lighting technologies and the qualitative and quantitative parameters of energy efficient lighting technologies.

Background

Key Drivers of Energy Efficiency

1) **Climate Change** – The increased generation of CO2 emissions, either through industrial and/or human-activity emissions, or through the elimination of carbon sequestration methods (deforestation), has been accounted for the rise in the earth temperature. The elevation of CO2 levels is now scientifically linked with climate change because the gas remains trapped in the Earth's atmosphere causing global warming. The need of energy efficient production is also linked

with the high levels of CO2 gas emissions as electricity production largely entails the burning of fossil fuel and the subsequent emissions of CO2. In Asia, nearly 0.65 kg of CO2 is emitted for every kWh produced. This has led to a drive to improve the energy efficiency in urban developments throughout the world.

2) **Rising energy prices** – Energy efficiency is also in part promoted by an increase in tariff rates both for the production and usage of electricity. Due to increased demand, electricity rates have risen steadily. In the UAE, in 1984, electricity was charged at 7.5 fils per kWh. In 2014, that rate shot up to 33 fils per kWh. In the GCC countries electricity is highly subsidized and this means increased cost to the utility and the federal authorities. In 2011, Abu Dhabi contributed 84% to the cost of electricity for its citizens, and 53% for its expatriate populations.

3) **Lack of energy** – Economies of scale are influencing supply of efficiently produced energy. Inefficiently produced energy is unsustainable and as a result is becoming scarcer as technology is shifting to more efficient methods

Energy Impact of Lighting

According to the International Energy Agency, lighting consumes 19% of all electricity in the world. In the Middle East, the percentage is 22%. This is largely influenced by the type of lighting technology used. Incandescent and halogen lamps which are the most inefficient lamps in the market comprise 25% and 16% of the total number of lamps used in the market. Both incandescent and Halogen lamps convert about 5% of energy consumed into light, and the remaining 95% is converted into heat. Fluorescent lighting (TL) uses approximately 36% of the share.

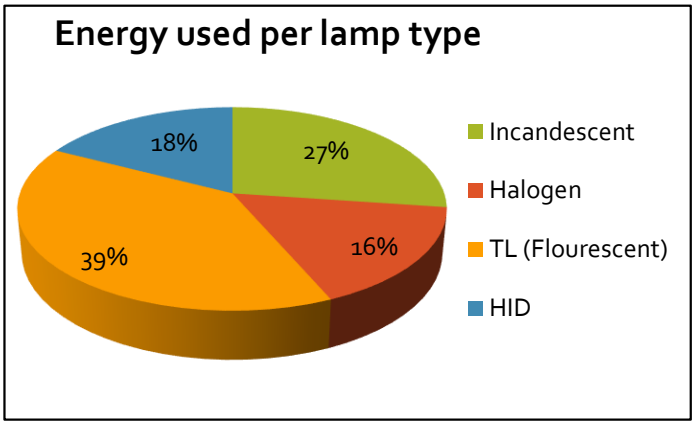


Figure 1: Energy used per lamp type in the Middle East.

Fluorescent Lamps and High Intensity Discharge lamps (HID), may use less energy comparatively but their short lifetimes, mercury content, and incompatibility with modern digital systems reduces their feasibility in energy efficient lighting applications.

Energy Saving Opportunities

In the Middle East, the opportunities to save energy have grown tremendously in the past decade. This is largely due to the increasing age of buildings in urban cities, and the outfitting of older and less efficient lighting technology. Hence, the current changeover rate to new lighting technologies

is picking up rapidly. Today, building owners can realize savings of up to 40% by simply upgrading their exiting lighting system.

Strategies for Energy Efficiency

The following strategies are essentially solutions to create energy efficiency which also factor in education and awareness of efficient lighting technology:

Legislative Strategy

The phasing out of incandescent light bulbs has become a nationwide movement; receiving federal backing from several countries. As of January 1st, 2015, the UAE has mandated the market phase-out of incandescent light bulbs. This will significantly impact the retrofit market and the new construction industry. Other lighting strategies that pave the way for a more energy efficient world include:

Lighting Norms

The latest norms are calling for appropriate and uniform lighting on a task area and the surrounding area (whenever known) as compared to old standards that considered the entire floor area as a work surface. Several countries currently use these lighting norms to improve their interior spaces such as offices, classrooms, art rooms, stairs, entrances, and laboratories.

Direct glare specifications have also been standardized by the Unified Glare Rating (UGR) which, in addition to the reflected glare, would ensure optimum comfort of users. Light color rendering (see Qualitative Lighting section below) is also critical and its proper application has also been standardized for different applications such as shops, museums, schools, hospitals, and sport arenas.

Labelling

A new Labeling policy was adopted indicating the energy saving category of each light source. This was meant to influence consumers' preference for products on the basis of their contribution in saving electricity consumption.

Value Chain Strategy

Determining the Total Cost of Ownership (TCO) is an important strategy as it dispels a common misconception among consumers regarding the ROI on lighting technology. Understanding TCO allows the consumer to see the bigger picture and this strategy is an effective way to create awareness among end users as it differentiates between the initial cost of lighting products and their running cost. The running cost is the most significant cost throughout the life cycle of the

lighting product, yet it is often ignored as all attention is paid to the initial purchase price. The TCO's concept is critical for the proper selection of lighting systems. It requires, however, an adequate education of all parties involved in the decision making process such as end users and consultants.

As a general rule, light systems with the lowest initial price have the highest 'full life' costs of ownership. The following graphic simplifies TOC:

Total Cost of Ownership*

Initial Purchase Costs	+	Energy Cost & Maintenance/replacement cost	=	**Total Cost of Ownership**

* Removal and recycling costs add more variables which are not covered in the running cost example.

Table 1: Total Cost of Ownership

For more information, see Cost Aspects of Lighting (below).

Solution Creation Strategy

In the lighting world, the best solution towards improvement in energy efficiency is innovation. Innovative Technologies such as LED (Light Emitting Diode) and digital lighting control system can be effectively applied in indoor and outdoor installations to ensure maximum flexibility and energy saving without impairing comfort and flexibility.

Qualitative Aspects of Lighting

To ensure optimum visual performance, comfort, and wellbeing of people, the qualitative aspects of a light cannot be ignored. These characteristics interact closely with human biology and can influence moods and create the required ambience.:

Color

To characterize the color of light we associate it with its color temperature which is expressed in

Kelvin (K). This temperature affects the appearance of light.

Bluish light is associated with cool daylight and yellowish light to warm white.

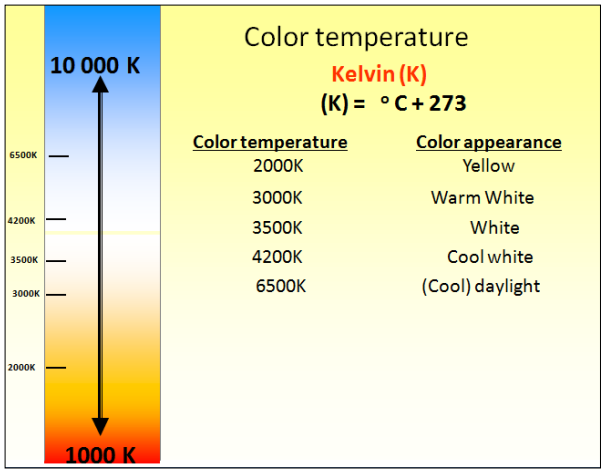


Figure 2: Image showing color temperature.

Biological Effects – Like natural lighting, electric lighting can also stimulate alertness and sleepiness by affecting the production of cortisol and melatonin hormones in our body. Indoor lighting with higher K level can induce alertness and is more suited for office and work settings. Lighting with lower K levels is more suitable for the residential and hospitality sector, as people perceive light which prompts them to relax.

Color rendering is the ability of a light to reproduce true colors of objects. This criterion is expressed as Ra where $0 \leq Ra \leq 100$. $Ra > 80$ is the recommended color rendering in all working environments where visual tasks need to be perceived.

Figure 3: Example of color rendering by artificial light and how it is perceived by the human eye at different R_a values

Quantitative Aspects of Lighting

Lighting Level and Uniformity

The amount of light available on working surface (lighting level) and its distribution (uniformity) defines the extent a visual task can be performed with accuracy and speed. The quantitative aspect studies:

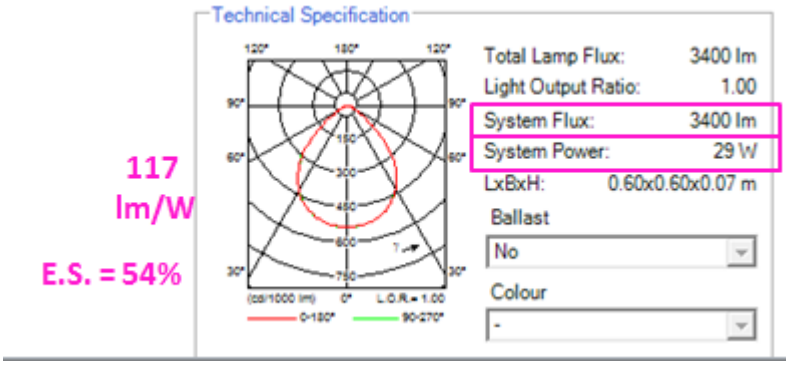
1) The amount of light which falls on a surface from all directions per unit of surface. This is called illuminance and expressed in Lux.

2) Amount of light emitted by light sources per second. This is called luminous flux and expressed in Lumen.
3) Amount of light which leaves the luminaire compared to the total amount of light emitted by the lamps that are housed inside the luminaire. This is called luminaire's efficiency and is expressed in %.
4) The light emitted by the luminaire, compared to the energy consumed by this luminaire. This is called system efficacy and is expressed in Lm/W.
5) The lifetime of the lamps.
6) The way the light is distributed by the luminaire.
7) Glare characteristics.

For a lighting retrofit project, a lighting engineer would take into account the above aspects when quantifying initial investment values, energy consumption, as well as maintenance.

Cost Aspects of Lighting

The most common thinking stipulated that T5 lamps are highly efficient light sources with an efficacy of 96lm/W when the lamp burns bare. But when this lamp is housed inside the luminaire the efficacy of the system falls to 56 lw/W. To achieve the same lighting level, we can use an LED luminaire consuming 29W with an efficacy of 117lm/w, resulting in energy saving up to 54%.



Light-Emitting Diode (LED) Lamps

LED lighting technology delivers exceptional TCO. It has the longest technical lifetime in the market today and because its internal components use a microchip, it is well suited for integration into modern buildings which use an automation/management system. Similarly, LED has a clear future with wireless technology as it can be easily integrated to optimize facility use. LED

technology is clearly achieving market dominance with an expected market share of 75% by 2020.

European definition of LED systems' lifetime

Lifetime is expressed by LxBy which is the length of time after which y% of a population of operating LED based luminaries of the same type fail to provide at least x% of the initial luminous flux. In Europe the standards for:

- Outdoor lighting: L10B10
- Indoor Luminaire: L90B50, L80B50, L70B50

American Definition of LED systems' lifetime is expressed as Lx where x% is the length of time an LED luminaire delivers a minimum acceptable level of light in a given application. For general lighting applications the minimum standard is L70.

For cost purposes, to convert conventional lighting to LED, specify lumen per watts. LED is still a developing technology and hence specifications change with time. Hence, it is often more cost-effective to determine target savings and then choose lighting specifications based on the current technology available.

Discussion Points

How important is lighting in energy efficiency projects?

With reported savings of up to 57% in actual retrofit projects due to renovated lighting technology, participants discussed how ESCO projects typically devalue lighting and the efficiency that comes with using the right lamps. This is usually because of cost estimations which run higher after assessments are conducted. For instance, the replacement of an entire fixture can increase overall cost in addition to the purchase of energy efficient lighting.

On the other hand, there are clear advantages of using lighting technology but it typically conflicts with the way construction is done in the Middle East. On the one hand there is an ESCO payback guarantee and on the other hand, during the design phase of the project, an MEP contractor will value engineer a project to an extent where the end product is not what the client was really asking for.

What strategies and tools are used when approaching lighting and energy efficiency projects?

Knowing how to use the right technology can solve several problems which prevent the integration of lighting technology into retrofit projects. For instance, LED spot lights that are replacing low voltage halogen lamps are typically rejected because they are not compatible with existing low voltage transformers that are initially conceived to switch ON a minimum load of 20W. Standard LED spots would flicker or simply fail to start. Those functioning, apparently well, might be equipped with a resistor that increases the system load to 20W. The solution to this problem lies in the use of LED lamps equipped with an intelligent driver that generates a virtual 20W load in the starting phase. Once the lamps start, the virtual load is removed forcing the transformer to supply the right power to the lamp.

Issue of Guarantee – there is no real tangible guarantee with lighting technology. As per standards of LED, the lifetime of an LED is the number of burning hours after which 50% of the lamps will have their lumen decrease by 30%. Guarantees for LED are tricky and hence are looked as a function of average burning hour in relation to the average number of lamps.

Conclusion

Lighting quality supersedes quantity, and in addition to innovation, building owners and consultants need to gain awareness and be educated about the different ways efficient lighting technology can be utilized for optimum TCO. The real cost of a lamp, such as an LED, determines the overall effectiveness of an energy efficient solution, and that needs to be learned as it is often overlooked for retrofit projects, to the detriment of building owners. Finally, the color rendering and placement, the quantitative aspects of light can significantly impact building occupant's moods and creativity and cannot be ignored.

References | Recommendations for Further Reading

- International Energy Agency (IEA), Organisation for Economic Co-operation and Development (OECD), Light's Labour's Lost: Policies for Energy-efficient Lighting, 2006.
- Municipality of Abu Dhabi City, The Abu Dhabi Sustainable Lighting Strategy, Presentation made during the World Future Energy Summit, 16 January 2013.

EmiratesGBC Technical Workshop #2015-2:

Green facility management for villas and residences

February 10, 2015

Facilitators:
Asoka Dissanayake, Emaar Community Management LLC
Marie-Helene Westholm-Knebel, EmiratesGBC
Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: Facility Management, Accommodation, Green Community

Introduction

Facility Management (FM) organizations in the UAE have been acknowledged as critical stakeholders that can help in achieving sustainable operations of constructed green buildings, especially in the context of high-rises and commercial facilities. The need to "green" individual villas and residences, also called "horizontal communities", is however growing in the region. This growth raises various difficulties in terms of identifying the priority areas, accepting the financial burdens and educating the market. Many financial opportunities can arise while the "green potential" (i.e. energy savings, awareness, sustainable landscaping...) is tremendous but still not exploited to its highest level.

In February 2015, the EmiratesGBC monthly Technical Workshop addressed the challenges, benefits and solutions of implementing a proactive collaboration amongst all stakeholders involved in the construction and in the FM world.

Back to Basics: Concepts and Potential

What is "horizontal Facility Management"?

Small and large FM organizations and associations in the UAE have showed their commitment to be part of the country's greening process of existing buildings, while guaranteeing top-quality services to these buildings' owners and occupants. Their involvement however has mainly been related to the management of commercial and retail activities or high-rises buildings; activities

and processes dedicated to individual villas and residences remains an area of work that has not been touched a lot and where the potential for positive change is high.

Talking about “vertical” versus “horizontal” communities reflects at first the physical aspect of the premises themselves: a building can be defined as a high-rise tower that accommodates private apartments, offices, retails...which will be structured vertically. A development comprised of villas and individual residences will need on the other hand a broader and thus more horizontal surface to be launched and to operate.

The distinction between “vertical” and “horizontal” community on a more systemic and administrative approach relates also to the way the building or the development itself is managed. While “vertical” management refers to a rather top-down way of dealing with decisions and actions through standards, processes and regulations, a “horizontal” one depicts a community-based engagement where owners and occupants are involved throughout the decision process via neighbourhood consultation, feedback mechanisms...

As the concept has not been utilized much in the region, “horizontal facility management” in the UAE mainly refers to the first definition that would also integrate inputs of community engagements.

The ideal model of integrative Facility Management

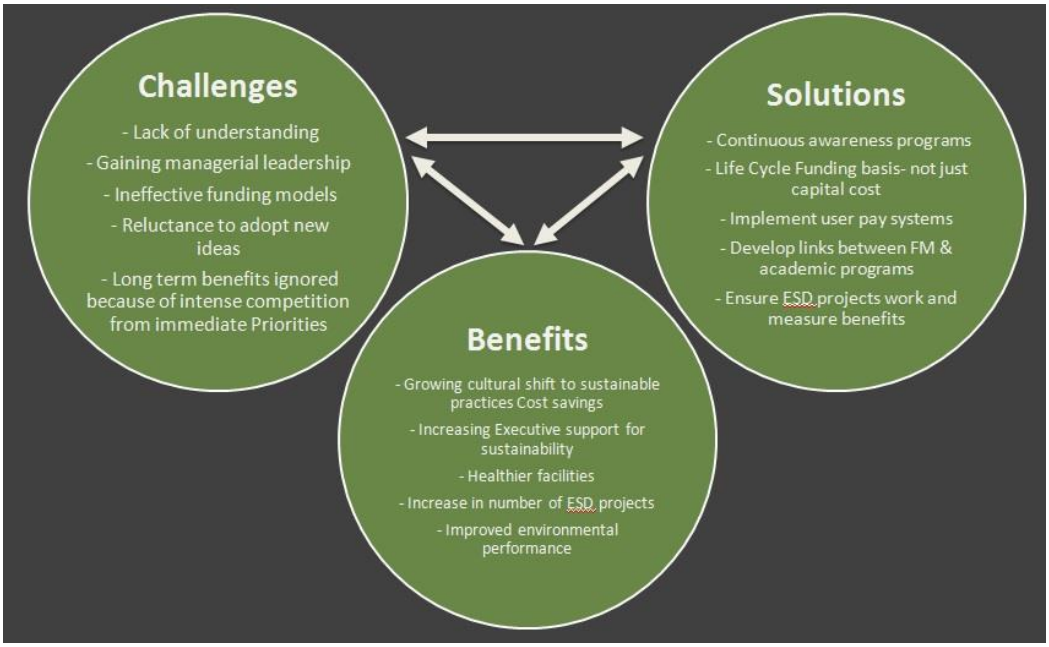
Integrative management is considered as one of the key and easiest measure to ensure the successful conduction of a project. In the field of FM however, common practice has been involving FM organizations at the building handover stage only, after the development has been completed. Expectations from the FM organization to implement corrective measures in a timely manner are then high, while an early involvement would have prevented issues to appear at first.

Facility managers indeed have the possibility to influence the sustainability outcomes and decide on a broad number of critical issues such as:

- physical planning and design;
- villas construction and maintenance;
- waste management;
- environmental management, including water, energy, HVAC...;
- landscaping and irrigation including maintenance; and
- access to community facilities, amongst others roads, street lighting, access to general services (healthcare, education, retail, public transports...)

Challenges, Solutions and Benefits

Involving FM organizations from the early stages, and to the level they can actually impact the decision process positively, is still a rare action, whether for vertical or horizontal projects. Obvious challenges have been encountered, while solutions have been identified and discussed, with the main purpose to have all parties involved (FM, owners, occupants, communities) benefit from these solutions:



Uniqueness of horizontal FM

A lot of characteristics, areas of decision and action, and challenges are shared between horizontal and vertical communities. One of the first challenges therefore is to determine what is unique to villas and residences in order to identify dedicated solutions and have the right stakeholders intervene in due time.

One of these unique aspects deals with landscaping and irrigation development and maintenance. In the UAE's climatic context, acting in this area is critical especially in terms of water consumption. The FM organization therefore plays a major role in the landscape design, choice of infrastructures and types of plants in order to minimize the negative impact on the local environment and thus reduce the community's ecological footprint.

The second one relates to HVAC equipment and maintenance services in the residences. This area of action is critical for all types of premises; in the context of horizontal communities however it relates even more to the villas' design itself and its building and insulation materials. The discussions highlighted that FM organizations have the duty to influence architects/designers and owners to target greener designs and invest responsibly. These expectations are even higher

from big organizations that have already demonstrated their expertise and weight on the market, as they do have the financial means and network to influence decisions, as well as a reputation to maintain.

At last FM organizations have the responsibility to maintain proper street lighting to guarantee security of the community and roads while maintaining comfort of the development's inhabitants. The opportunity of changes lays in the possibility to switch existing systems and equipment with sustainable ones (i.e. LED lightings, sensors and timers). Participants highlighted again the need for all stakeholders to be involved in the decision-making process (design, choice of equipment…) to achieve the best results.

Discussion Points: The Challenges of FM for Villas and Residences

Following the presentation on general FM considerations, the workshop's participants were invited to express their opinion regarding the specifications and future of horizontal communities and the sustainable practices they could benefit from.

Converting decisions into actions

Horizontal FM however experiences the same challenges and limitations as vertical FM in terms of identifying solutions and converting decisions into real actions.

The first point that was highlighted by the workshop's participants refers to the need to address environmental concerns and priorities (energy efficiency, water and waste management) despite the existing constraints in terms of budget, time and technical resources. Quick Returns On Investments (ROI) often remain the priority, reflecting the market's short-term way of thinking on greening developments. FM Managers often have to deal with other obligations that distract them on a daily basis from engaging in sustainable investments, reinforcing the impressions that the FM market is just not mature yet to make "green" the pillar of strategies and activities.

To tackle these unfortunately common challenges, the role of regulations and green building standards has been discussed. The regulatory "kick" (Dubai Green Building Regulations and Specifications, Estidama Pearl System, ASHRAE…) to existing and new communities' projects has positively impacted the developments (design, building materials and systems, water and waste management, energy efficiency requirements…); however, a few remaining points prevent further progress:

- **Measuring results** following the implementation of green measures is often underrated and, if available, badly communicated; this jeopardizes education and awareness, and makes benchmarking difficult;

- **Tariffs for energy and water** remain low, so there are no incentives for private users to measure and reduce their consumption. In line with this point there are no penalties
- The **lack of national and regional synergy** in terms of regulations and standards creates confusion on the market, for FM organizations as well as suppliers of sustainable materials and equipment.

FM organizations/managers therefore have a greater responsibility to tackle these issues and take the lead in greening their developments.

How should facility managers incorporate sustainability into Facility Management?

- Gain commitment from senior management
- Find a champion at senior level to support the change
- Identify risks and priorities
- Set policies, objectives and targets (long and short term) in conjunction with stakeholders
- Develop a plan to implement the process
- Allocate resources to action the plan
- Effectively communicate those details to all internal and external stakeholders

Communicating opportunities and Marketing results

At last, **data transparency and advanced public information** have been mentioned as missing items that would allow organizations and community developments to benchmark their performances. Making community consumption visible and understandable by all, including both positive and negative results, will allow:

- occupants and owners to decide whether to buy/settle down in specific communities, and thus trigger positive competition that will incites FM organizations to implement best practices;
- owners to see the financial benefits of these sustainable practices and therefore to invest further, leading the path to greener communities;
- the building industry to identify new business opportunities;
- financial and banking organizations to propose customize green loans schemes responding to actual needs;
- the authorities to measure and assess the effectiveness and efficiency of regulations and standards.

Data transparency would also go in the same direction as **increasing education and awareness** of all parties involved in greening developments. The following points should continuously be reminded:

- building green and engaging in maintenance as per green regulations and standards is not more expensive, and ROI are worth the initial investments;
- Saving resources on the individual level can positively affect the functioning of the community itself;
- horizontal community management, in the way occupants are actively engaged to support green practices, is beneficial to all, even beyond the community itself.

It was however acknowledged that much is still to be done to make these communication efforts meaningful, i.e. beyond green marketing and green washing only.

Conclusion

Extending FM principles and practices to individual villas and residences after they have been implemented, tested, and verified on vertical developments is one of the next steps to ensure that all types of facilities are taken into consideration within the “green building scheme” in the UAE. As this area of facility management has not been well developed but is now under market pressure, the need to identify and implement best practices on this level has become crucial. The opportunities of change are also unique based on the size and age of the community, and new designs give the best floor to implement “green” from the earliest stages of the project.

As part of its activities, Emirates Green Building Council aims at providing all involved stakeholders with the platform to design these best practices in an integrative manner, and to help disseminate them throughout the industry.

References | Recommendations for Further Reading

- Middle East Facility Management Association, Energy Management – Can FM capture the share of the GCC prize?
- Jones Lang Lassalle, Sustainability in the MENA Real Estate Market, 2013.

EmiratesGBC Technical Workshop #2015-3:

Building Integrated Photovoltaic Systems (BIPV): Where Architecture Meets Solar Energy

March 17, 2015

Facilitators:

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Tara Tariq, EmiratesGBC

Venue: Emirates Green Building Council Office, Dubai, UAE

Keywords: Photovoltaic Systems, PV, Renewable energy, BIPV, building-integrated photovoltaic systems

Introduction

In recent years, Photovoltaic (PV) technology has gained a noticeable and much needed foothold in the UAE construction market. A combination of local regulatory support and industry innovation is bringing out new and innovative solar systems into the market, such as Building Integrated Photovoltaic (BIPV) systems, which are designed to enhance existing onsite renewable energy options. BIPV systems take the place of conventional materials used for a building's facade and enable onsite generation of renewable energy. But how effective is BIPV? And how can BIPV systems best be integrated into a building's exterior façade?

In March 2015, the EmiratesGBC monthly Technical Workshop conducted an objective analysis of the BIPV technology's advantages and limitations.

Back to Basics: What is PV Technology

Photovoltaic technology is a method of using the sun's energy to produce electricity. The technology uses solar cells which take energy from the sun – also known as light photons - and convert them into flowing electrons. These cells serve as conduits which carry the charge for an electric current. More than 95% of the worldwide PV market is still under the "standard PV systems" category, these being broken down into ground and roof installations.

Conventional solar panels are divided into the following technologies:

- Crystalline Silicone: represent 90% of the market.
  - Mono Crystalline - can achieve 19% efficiency
  - Poly Crystalline – can achieve 13% - 15% efficiency
- Thin film: **α Si** (amorphous silicon) – **CdTe** (cadmium telluride) – **CIGS** (copper indium gallium selenide) – **CIS** (copper indium selenide)
  - As a reaction to the high price of crystalline panels, necessity led to the invention of thin film solar technology which has become a successful discipline itself in the PV domain.
- New technologies include: dye sensitized – multi junction – organic,
  - The above are fairly new technologies and represent the formulation of the solar panels themselves. Many have not yet entered the market.

Mono Crystalline - © Alibaba

CIGS Thin film- © accustrata.com

Background

Conventional PV technology is typically considered to be very beneficial for its energy generating abilities; however aesthetically, PV systems are usually perceived as an eye-sore and are often strategically placed - in addition to maximum solar exposure - as either camouflaged on a structure or hidden away from end-users' vision. The latter has not always been a problem as most PV systems are installed on the top of built structures such as roofs, parking shades, and general shading structures, and away from normal view.

However, BIPV systems, which were first developed in the early 90s, are shifting the norm. The technology's growth is influencing designers to rethink applications of PV systems in built

structures as demand for sustainable construction and onsite renewable energy sources continue to grow.

PV Installations

Conventional installation are either:

1) Ground installations
    a. In ground systems you have **fixed installation,** which are typically used for large areas where the PV panels are oriented for optimal solar exposure, and
    b. Some ground Installations are equipped with **tracking systems**, where the PV panels follow the sun throughout its apparent movement in the sky.
2) Rooftop installation
    a. Panels that are **fixed and parallel** to the roof
    b. Panels that are titled at a different angle than the roof – if the original angle fo the roof is not optimal for installation.

All conventional PV systems, regardless of type, are placed on mounting structures.

PV System

A simple PV system consists of the following components which balance the power generated into usable electricity and :

1) The PV modules which generate DC power
2) An inverter which converts the Direct Current (DC) to Alternating Current (AC) for household use.
3) Fusebox which recieves the AC from the solar module as opposed to the off-site grid and channels electricity to outlets throughout the property.
4) A meter which injects the surplus AC and directs it to the grid for net-metering.

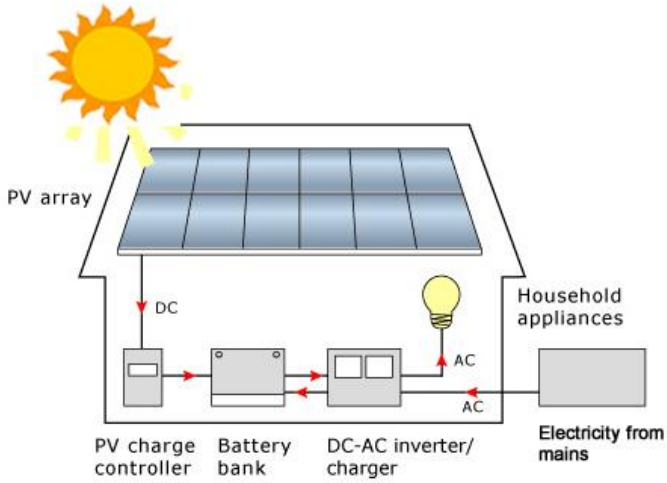


Figure 4 A simplified schematic diagram of a residential PV system. Source: http://www.shirshenergy.com/

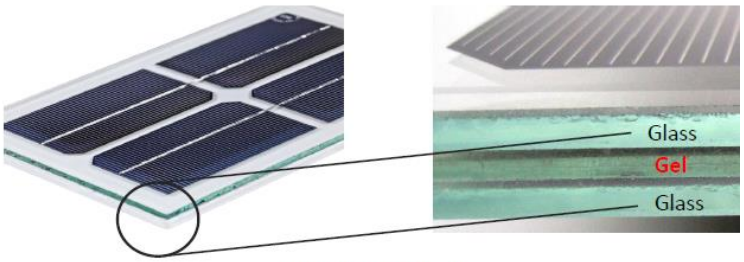
What are Building Integrated Photovoltaic Systems - BIPV?

Building Integrated Photovoltaic Systems represent a small share of the PV market – approximately 3%. Due to their functional versatility, they are also categorized as a building material. This feature opens the door to a large number of applications that were not considered with installed conventional PV systems. In other words, BIPV systems are not installed – BIPV panels are part of the building itself and they are there to stay. At the same time, this additional function can also help them fulfill specific requirements as mentioned later.

Projects that integrate BIPV to an existing element of a building such as a roof or a wall are not taking full advantage of system.

Types of BIPV

Glass Solar Panels: Also known as G2G (glass to glass) have solar cells encapsulated between two layers of glass when crystalline silicone is used or frameless thin film panels. Thin film panels are more suited to the GCC region as they are less sensitive to temperature fluctuations. It should be noted that their relatively lower efficiency is made up for by their longevity and relatively greater output over a longer lifespan.



G2G Construction © Sunovation

Roof Integrated Solar Panels: These range from **thin film**. Flexible thin film is a relatively new product with easy installation features. A drawback again is low efficiency compared to crystalline panels, but this can be offset with the eliminated cost of needed mounting structures which can take up to 5% of an installation project, and more for rooftop.

Solar Tiles: Offer full integration as a building material than roof rack-mounted systems. These are also composed of thin film technology and subsequently have low power generation capacity. The system in the image can generate up to 12W/ft2. An advantage to this technology is zero mounting costs and a negligible load on roofing structures.


© US Tile

PV Technology in the Local News

A recent announcement by the Dubai Electricity and Water Authority (DEWA) has given PV and possibly BIPV a much needed market boost in Dubai. Residents, governments and commercial entities can now reduce their energy bills significantly by submitting applications to DEWA and purchasing PV systems. The application is free of cost. The only fee they would have to pay is a 1500 AED meter fee (Abbas, 2015). **Net metering** would allow residents to pump surplus energy back to the DEWA grid and generate more savings over time.

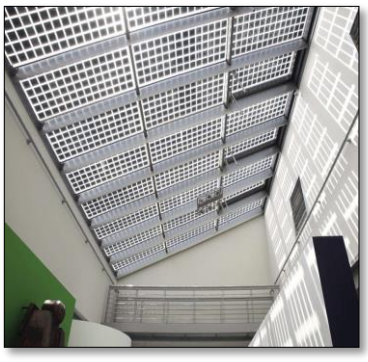
Nota bene: DEWA's application also requires input from a qualified consultant and a contractor which represents a hidden cost to an installation project in the form of consultant and installer fees.

PV Technology and Rating Systems

Both LEED and the local Estidama rating system provide points for installation of onsite renewable energy which includes solar power. This qualifies BIPV installations; however as both LEED and Estidama points are accrued based on the percentage of renewable energy provided by the PV panels, measured against the baseline, this makes BIPV efficiency a critical design goal for higher sustainability ratings.

Challenges, Solutions and Benefits

Benefits to BIPV



- Availability of different colors and patterns and the ability to print on glass,
- Available in a vast range of shapes and sizes,
- Versatility – energy generating capacity and use as building material,
- Can increase indoor daylight factor and save on lighting costs,
- A source of renewable energy,
- Improves thermal and sound insulation of buildings,
- Aesthetic and functional replacement for ceramic fritting which are used in commercial applications to prevent glare.

Challenges to BIPV Technology

Inefficiency – BIPV lower output is due to the following reasons:

1) Module Level – cell color, glass thickness, and age of solar cells.
2) Array (system) level – angle, orientation, and proximate shading.

Given the number of variables that affect the power output of solar panels, BIPV systems are relatively less efficient than conventional PV systems. A limitation of PV technology which often occurs in BIPV systems is when a module string becomes less efficient if one part of it is shaded. See Figure 2 below, which depicts how one shaded cell in a panel string can create a bias and reduce the current through the unshaded cells. The unshaded cells reverse the bias by producing higher voltages and dissipating it to the shaded cell. This can result in hot spots which lead to overheating and possibly glass breakage.

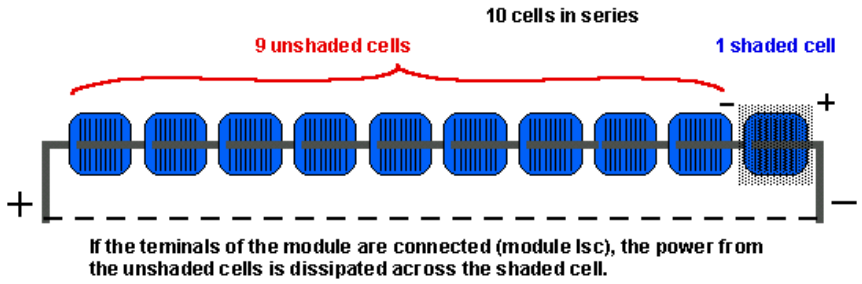


Figure 5 Example of hot spot heating due to power dissipation. Source: pveducation.org

Power optimizers mitigate this limitation. They isolate the shaded cells and can maintain the production capacity at the rate of the higher producing cells. Many PV manufacturers create power optimizers as a standard feature of their solar panels. It is however, preferred to not use power optimizers and instead design the cells uniformly based on the exact climate and sun/shade specifications of the site where they will be located.

Systems Costs and Life Cycle Costs – for BIPV systems, the two elements of costs should be looked at in conjunction. These costs are most commonly offset by looking at savings, which come through the production of electricity and also by the offsetting of surplus energy back into the grid. Additional savings occur through the reduction in material and labor requirements as BIPV function as both.

Capital costs for BIPV depending on the technology used can be similar to conventional PV systems and include, in addition to the price of the BIPV panels, the cost of cleaning and the cost associated with electrical equipment maintainance and/or replacement, for instance invertors need to be replaced every 5 – 10 years. Cleaning costs can be problematic if the BIPV systems are installed in inaccessible locations.

Installation costs for solar panels is typically split into module cost which includes the panels and system cost which includes the additional components that make up the solar array. System costs include electrical equipment with cabling, invertors, connectors, which at a minimum increases cost by $1.7/panel. BIPV installations include estimates also generating from the designers and architects and it should be noted that they represent an important decision-making role in the purchase and placement of onsite renewable energy systems.

Given the above, it is widely known that the technology used to generate solar power is advancing at a rapid pace. Technological and production breakthroughs can also shift the economies of scale, and as figure 3 indicates, have resulted in a reduction in the price of the panels as a function of their power output. Latest rates shared during the workshop placed the cost at $1/watt for poly-crystalline on G2G panels.

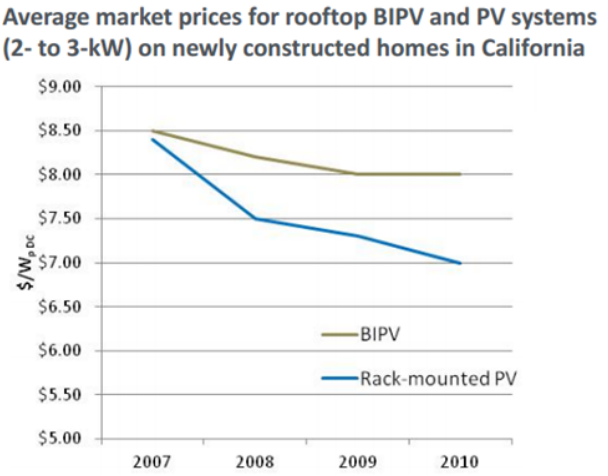


Figure 6: Building-Integrated Photovoltaics (BIPV) in the Residential Section: An Analysis of Installed Rooftop Prices. Source: http://www.nrel.gov/docs/fy12osti/55027.pdf

Discussion Points

Percentage of degradation in PV efficiency?

Efficiency does degrade over time due to several conditions, and in most cases it is reversible. Inefficiency is mostly brought about by climatic conditions such as dust and heat which similarly comprise the quality and efficiency of other building systems. Meanwhile efficiency degradation testing is standard procedure for all new manufactured systems, where PV panel testing is routinely checked and tested under normal conditions, however, leveling the testing field has not been very fruitful in bringing concrete guarantees within the PV industry.

Meanwhile, degradation of PV panels typically occurs on the cellular level and many studies place the rate at 0.5-0.7% annually. As a result, some manufacturers of solar panels now offer a 25 year warranty with 82% of the nominal output right after.

Cleaning

Regular cleaning of PV panels is a certain limitation. Recommended cleaning for roof-top panels is 2 – 3 weeks and for near or on the ground panels are once every 10 days due to proximity to vehicular traffic.

Flammability

PV panels are flammable and in case of fire, they will burn, despite being largely composed of silicon. Fire risk mitigation is typically carried out during the design phase where the panel strings are laid out in a series which limits voltage to not more than a 600 or 1000V. This is an industry standard set for optimum efficiency and safety.

Monitored Maintenance

The suggestion of a monitoring and reporting scheme with existing clients was shared as a possible solution to the dearth of data from the region; however, when it comes to BIPV, a clear limitation to the process is the fact that there is no such thing as a standard BIPV application. The number of variables related to glass color, thicknesses, as well as placement and orientation are unquantifiable and the associated costs would make the process of establishing any set standard which can be used to measure efficacy nearly impossible.

Recycling of old solar panels to complete a sustainable life-cycle…

Silicon based solar panels can have 80% of their weight recovered for reuse (Wambach, 1999).

Do you think BIPV systems will be used more superficially, as a luxury feature, than for their power generation capabilities?

This is certainly coming out as an interesting toss-up to the technology; where the versatility of the product tends to influence usage in ways that mean certain features may not be used for their intended purpose. In this case, given the orientation of a building, the aesthetic features of thin film panels in for a vertical installation project, may trump their power generation capacity.

Each industry has its own values for a number of financial indicators. In your opinion what is an acceptable Return on Investment (ROI) for a BIPV system in Dubai?

An optimal PV installation – with the right orientation and placement – has a payback period of 4-5 years. Studies on BIPV systems show an ROI of 15-20 years, which is usually a result of aesthetic application taking precedence over energy generation; a choice ultimately made by the building owner, who wants to highlight the presence of the sustainable feature on the building but is not concerned with an immediate ROI.

Conclusion

BIPV clearly has its limitations, but its advantages in architectural applications if implemented practically and cost-effectively can bring in positive benefits that take advantage of several features which the technology can provide: as building material, weather barrier, shade source, aesthetic feature, and most importantly, and finally, as a source of onsite renewable energy.

References | Recommendations for Further Reading

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EmiratesGBC Technical Workshop #2015-4:

Addressing the challenges to ensure safety, quality, performance and uniformity in insulation materials used for construction projects

April 14, 2015

Facilitators:
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Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: Abu Dhabi QCC, conformity, certification scheme, insulation, materials, testing

Introduction

Insulation products are widely used in conjunction with other components of building materials to provide thermal, acoustic, fire and impact resistant properties for buildings. In order to improve the quality and sustainability performance of these products, ADQCC is in the process of developing a certification scheme that address compliance to both Abu Dhabi construction material regulations (Estidama Pearl Rating System and the Department of Municipal Affairs Abu Dhabi Building Code) and the various international standards applied throughout the United Arab Emirates. This scheme would ensure the quality of the insulation materials and allow the industry and authorities to fully access the benefits of green building standards and performance of insulation materials.

In April 2015, the EmiratesGBC monthly Technical Workshop asked participants to provide ADQCC with feedback regarding the existing thermal insulation's testing regimes and international standards. The purpose of this stakeholder engagement session was to further define a common set of specifications to ensure safety, quality, performance and uniformity of insulation materials. This session was mainly an introduction of ADQCC program, with the main objective to collect comments from the industry that would complement the preliminary technical report (which at the time of the workshop was in the final stages).

Discussions' Background

Abu Dhabi QCC

The Abu Dhabi QCC was launched in 2009 by the Abu Dhabi government in response to Abu Dhabi Vision 2030 which includes a mandate to diversify the Emirate's oil-based economy and achieve effective integration in the global trade system as a leading manufacturer of quality, sustainable products. An important aspect to achieving this goal includes the establishment of reputable local manufacturing standards for the government to build a supporting quality infrastructure around.

Currently The Product Conformity Scheme Services Sector of ADQCC offers two main services:

1) **Conformity scheme development**: a conformity scheme is a technical document that outlines requirements for products, systems or personnel to meet specified standards under certain inspection and testing regimes. Conformity assessment is therefore the process of assuring that products, systems and personnel meet the requirements outlined in a conformity scheme that is specified by industry and regulators
2) **Certification issuance**: certification of products is the result of a successful conformity assessment; The complying products, personnel and services receive a certificate of conformity from the QCC and are given the right to bear the Abu Dhabi Environmental Performance Trustmark.

While the Abu Dhabi Urban Planning Council (UPC) is responsible for the implementation of the Estidama mandate (including amongst other items regulation points, criteria for compliance and permit delivery), ADQCC can be considered the mediator agent which help certify products (materials or assembly of materials) to Estidama standards, and help find consensus between what the industry can actually produce and what Estidama requires.

Existing Specifications set by the Building Codes

Estidama Pearl Building and Villa Rating Systems (Abu Dhabi Urban Planning Council): Includes several credits for insulation performance:

- RE-R1, Minimum Energy Performance: U-value requirements for envelope elements depending on the building type and the compliance pathway.

- SM-1: Non-Polluting Materials
  - For insulation products that use a blowing agent (either in the manufacturing or installation), the material shall demonstrate an Ozone Depleting Potential of zero (ODP=0) and a Global Warming Potential of less than five (GWP ≤ 5)

The existing Estidama Villa Products Database (EVPD) will transition to QCC's product certification database where suppliers of insulation products must re-apply to obtain Environmental Performance Trustmark certification. Once the certification scheme for Insulation materials has been launched, application for certification based on the requirements of the Product Certification Scheme must be performed through QCC's online Jawdah system.

Dubai Green Building Regulations and Specifications (Dubai Municipality): Dubai Regulations provide criteria on insulation materials and assembly covering:

- Acoustical control (Section 4 Building Vitality - Chapter 3 Acoustic Comfort) for sound insulation and noise reduction
- Thermal attributes (Section 5 Resource Effectiveness: Energy – Chapter 1 Conservation and Efficiency: Building Fabric) with maximum average thermal transmittance (U Value) set to 0.3W/m^2K for roof and 0.57W/m^2K for external walls.

Insulation materials need to: be accredited and certified by Dubai Central Laboratory; achieve all the requirements of the approved specifications by Dubai Municipality; and be fire resistant as per the requirements set by Dubai Civil Defense.

International standards for materials and assembly testing - quality conformity for insulation:

	Thermal Performance	**Air permeability**	**Fire Performance**
Material	ASTM C518 ASTM C177	ASTM E283 ASTM E2178	ASTM E84 - surface burning characteristics ASTM E1354 - heat and visible smoke release rates NFPA 259 – heat of combustion
Assembly	ASTM C1363	ASTM E2578	ASTM E119 - fire resistance) NFPA 285 - flame spread

			NFPA 268 - ignition properties NFPA 286 - flame spread

Discussion Points

Scope of the Certification scheme and discussions

The discussions for the Technical Workshop looked into the future of the proposed Certification Scheme for Insulation. Participants were invited to share their feedback on the existing specifications, performance standards and processes related to insulation materials' testing and certification, as per the following scope and questions:

ADQCC proposed Conformity Scheme for Insulation:

Demonstration of overall product quality should be based on the following requirements:

- Physical properties
- Fire performance
- Energy performance
- Sustainable properties
- Quality assurance

The detailed scope of applicable requirements includes:

- Physical properties – compliance with a published international standard (e.g., ASTM, EN, AS/NZS, etc.)
- Fire performance based on ADIBC requirements
- Thermal resistance based on ADIBC requirements
- Sustainable attributes – single attributes defining desired sustainable properties
- Optional recognition for performance attributes such as air permeability, vapor permeance, recycled content and bio-based material content
- Quality assurance established through manufacturing plant inspections, and/or field sampling with comparison to baseline physical properties.

"Are the specifications asked by the building codes appropriate?"

To start the feedback session, participants were asked to comment on the challenges they experience in applying for certification standards and implementing the requirements set by the existing regulatory body in the UAE. The following points were addressed:

Role of AD QCC in ensuring testing standards, quality and similarity: the QCC scheme is planned to help ensure that the quality of products and materials is identical when used as when they are manufactured, tested and certified. The scheme also includes the review, assessment and validation of local testing facilities as well as the provision of criteria and requirements to guarantee the similarity, standardization and calibration of testing methodologies. These processes would help unify the market and reduce the suppliers' confusion linked to the number of existing standards imported to the UAE from all over the world.

UAE standardization: While the discussions reflected the need from the industry for a country-wide standardized approach on certification, testing and more generally on regulations, ADQCC can be seen as the mediation body between the authorities and the industry to design a scheme that can be understood by all and relevant to its final purpose. This scheme should be understood as the obligations to local industry to have their products positioned on the local market and reach the same levels of quality as for international markets. Once the scheme is considered successful in the Abu Dhabi Emirate first it could then be shared and applied to the other Emirates.

Educating the market: To prevent confusion and enhance the materials' and products' standards, it was suggested to "change and simplify the language" currently used to describe regulations, standards and testing requirements. Architects and consultants should have the same access to technical information and specifications as the suppliers and regulatory bodies, while the market should continuously be informed of any change in requirements requested by the testing centers and certification bodies. It was, for instance, suggested to modify mention in project documents which currently allow manufacturers to present testing results and certifications issued from various origins and schemes to instead require formally that the products meet the intent and requirements in terms of exact standardized processes and values set by the authorities.

"Do the current standards and specifications adequately reflect the present and future advantages of the technology?"

Value of third party testing and certification: The high number of testing requirements and more generally of testing bodies was mentioned as creating confusion within the industry. At the moment suppliers/manufacturers can have their products tested by bodies from other countries/regions, making it almost impossible for the local authorities to verify the reliability of the results, as these testing facilities cannot be audited and validated. This point was used for instance to address a product's life-cycle and embedded carbon emissions, for which a third party review from organizations like ADQCC or specialized institutes would guarantee the reliability of provided data and certificates.

Materials' and products' database: With more than 1,000 products listed, the EVPD database

already provides a rich source of information for new projects while providing great visibility to manufacturers and suppliers. The workshop's participants however reaffirmed their challenges to have their items re-tested and re-certified as the processes in place in the Abu Dhabi and Dubai Emirates were mentioned as long, stringent and costly. It was therefore suggested ADQCC addresses the issue with the regulators with the suggestion that the participation to the database of an already-certified product with the Council would automatically be renewed. It was also suggested that the final certification scheme requests and thus discloses even more specific information from the manufacturers (including, for instance, further details on environmental aspects, health and safety, fire safety, compliance with specific building codes and regulations…). Such a detailed disclosure would remove the risks currently taken by the project developers, while guaranteeing the quality of the enlisted products and materials.

Conclusion

ADQCC representatives took note of the participants' concerns and suggestions regarding the certification as a whole. With the development of a scheme dedicated to insulation materials and systems, ADQCC is responding the industry's need by identifying the products' key specifications, aligning international testing and control standards, and connecting the market's stakeholders with the authorities' requirements.

References | Recommendations for Further Reading

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EmiratesGBC Technical Workshop #2015-5:

Green concrete and construction materials in Dubai

May 25, 2015

Facilitators:
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Davide Terrone, Grace
Marie-Helene Westholm-Knebel, EmiratesGBC
Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: Dubai Municipality, construction materials, cement/concrete, regulations

Introduction

At the end of 2014, Dubai Municipality initiated a circular mandating the use of sustainable concrete for all new projects, made mandatory as of April 1st, 2015. In this circular, the authorities shared a table providing contractors, consultants, concrete factories and suppliers with environment-friendly supplementary cementitious materials ratios and the list of components to be used in concrete mixtures in order to reduce carbon emissions, and to strategically position the Emirate on the green building and urban planning scenes.

In May 2015, the EmiratesGBC monthly Technical Workshop discussed the challenges and best practices around green concrete and construction materials in the UAE, using the circular as a base for discussion.

Discussions' Background

How to define sustainable construction materials?

As part of the workshop's introduction, participants were asked to provide definitions of the concept of "sustainable construction materials" based on their respective backgrounds and professional usage.

"It is maybe time to rebrand "green" into "efficient"

The discussions have highlighted that the understanding of "sustainability in construction" has

moved from the traditional application of “green” or “sustainable development” to the building industry to relatively more applications which include components related to energy efficiency, carbon emissions management and products’ and buildings’ lifecycle.

The production of cement and concrete also generates a large amount of carbon emissions (energy use and heating of raw materials), to be added onto the emissions related to international transportation of materials and finished products; it has been discussed therefore to increase the of alternative and/or recycled materials and highlight the role of designers, architects and consultants as the first key actors of a sustainable construction project.

Dubai Municipality Circular Nr. 202

Throughout 2014 Dubai Municipality Building Department (Building Researches and Studies Unit – see references) organized a series of events involving professionals of the UAE cement factories to understand the existing market and the potential of alternative eco-friendly cementitious materials to be used as substitute to Portland cement. Workshops, seminars and questionnaires addressed to cement and ready-mix concrete factories, consultants and contractors…have:

- highlighted the negative impacts of the production of Portland cement to the environment and human health;
- confirmed the interest and availability of the industry to respond to the demand; and
- allowed the authorities to prioritize areas of actions and set relevant values as mandatory requirements.

Taking these aspects into consideration Dubai Municipality issued in November 2014 the Circular Nr. 202 “announcing all consultants, contractors, suppliers and ready mixed concrete factories to use Fly Ash and GGBS as substitutes for Portland cement” with specific percentages of usage for each of these substitutes. The Circular was shared among professionals, giving them six months to transition their activities as per its requirements until it turned mandatory to all new construction projects as of April 1st, 2015.

Green cementitious products and specifications

Following these consultations, four specific materials have been identified as eco-friendly alternatives: Ground Granulated Blast-Furnace Slag (GGBS), Fly Ash, Silica Fume and Fiberglass, with the first two being the ones to be incorporated as mandatory requirements in the circular:

Ground Granulated Blast-furnace Slag – GGBS

By-product of the steel industry from the manufacture of iron in a blast-furnace, commonly used as a partial substitute for Portland cement at a replacement of up to 80%.

At about 1500 ° C, molten slag is collected and rapidly cooled with water

Grade 80 Slag with a low activity index (75%)

Grade 100 Slag with a moderate activity index (95%)

Grade 120 Slag with a high activity index (115%)

Hydraulic material, reacting directly with water to produce hydrates without calcium hydroxide

Hydration is slow, and accelerated when combined with Portland cement

Fly Ash

Finely divided residue, by-product of the burning of coal in electric power generation plants, commonly used as a partial substitute for 25 to 55% of Portland cement in concrete.

Class F—Fly ash with pozzolanic properties (SG = 2.40)

Class C—Fly ash with pozzolanic and cementitious properties (SG = 2.80)

Discussion Points

Is the market ready to implement Circular Nr. 202?

Following the background information provided by the Circular, the workshop participants were asked to critically review the Circular and share their feedback regarding their respective experience with green construction materials. The following points were discussed:

The UAE industry is ready! While the Circular has become mandatory as of April 2015, professionals from the cement/concrete industry have already been using GGBS and Fly Ash as partial substitute within their mix in the same rates as the ones mandated by the Circular. In some cases, and based on the nature of each project, design and deliverables, it also happens that the shares of GGBS or Fly Ash are even higher than the Circular's requirements, as long as the quality, durability and safety of the construction project are guaranteed. Overall, workshop participants agreed that the regulatory bodies properly align with the industry's ability to green materials processes and practices.

Costs implications are low! When enacting the Circular, the authorities informed the industry that introducing GGBS in cement mix would not impact project costs by more than 10%. However, and as mentioned previously, the fact that contractors have already been using green components within their mix have allowed the market to incorporate and balance costs without any negative impact onto the overall project budgeting. The importance of integrating key stakeholders from the project's early phases was also discussed, and consultants and contractors have been identified as the main knowledge holders who can educate the owners on the long-term benefits green construction materials.

The authorities' approach is the right one! The interactive approach chosen by Dubai Municipality to consult the cement and construction professionals (whether consultants, contracts or suppliers) has been highly commended during the workshop. The Circular's technical requirements have been identified and decided upon based on direct feedback, which makes it a relevant and applicable regulatory document. Continuous consultations have allowed the authorities to understand but also take part in construction trends and in market change, showing all stakeholders that greening the UAE built environment by cooperating is absolutely possible.

What future for green construction in the UAE?

Concluding the workshop, participants were asked to provide feedback on the role of EmiratesGBC to raise awareness on green construction materials and on their future expectations for this sector in the UAE. The following points were mentioned:

There are new markets to explore: While large scale projects (i.e. high rises, commercial buildings…) might already have sustainable components embedded in design and planning, residential developments (including villas, low rises…) could benefit from stricter regulations and increasing technical requirements. Greening individual housing has become a new area of action from the authorities but also for architects, designers, developers, contractors and consultants to play an active educative and technical role. Along with this point and coming back to the definition of sustainability in construction, participants suggested that "design durability" of projects gets more attention from all stakeholders to make design and project deliverables more efficient and eco-friendly.

Controls should be increased: even if the public-private consultations have been commended, the workshop participants have expressed the need for more quality controls to ensure that the cement mix comply with the Circular but also with health and safety requirements. Thorough quality and performance tests should for instance be engaged in factories to ensure that the green components are properly handled (i.e. used as per the Circular's measurements). Controls should be applied also to the origins of the products in order to strategically reduce the materials' and projects' embedded carbon emissions.

Educating the market remains a priority: Regulations are necessary to set a baseline and ensure that the local authorities understand the genuine market's needs and limitations. However, the demand to educate all stakeholders remains high and Emirates Green Building Council has been identified as a key organization to proceed. Participants were invited to share data, case studies and other success stories and therefore contribute to building a stronger relationship with local authorities.

Conclusion

The workshop discussions highlighted the enthusiasm of the industry towards Circular 202 and in general towards the greater involvement of the local authorities to define strict and ambitious regulations for a greener built environment. Participants commended the efforts of Dubai Municipality to consult building professionals in order to understand the market and design a circular which addresses opportunities and challenges in a relevant manner.

As a platform for the UAE stakeholders to share best practices and technical solutions Emirates Green Building Council remains a catalyst to educate the market as well as collect feedback to the authorities. The Council invites its members to send comments and case studies to further develop this cooperation between public and private sectors and help the country reach its green objectives as part of its Vision 2021.

References | Recommendations for Further Reading

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EmiratesGBC Technical Workshop #2015-6:

Refurbishment of Commercial Buildings – Challenges and Strategies

June 9, 2015

Facilitators:
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Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: Refurbishment, commercial buildings,

Introduction

In 2014, Dubai Municipality mandated their Green Building Regulations and Specifications (GBR&S) for all new buildings within the Emirate of Dubai, to ensure minimum sustainability targets. Similarly, Abu Dhabi Urban Planning Council has mandated minimum sustainability requirements under the Pearl Rating Systems for new construction since 2010.

These initiatives and frameworks support the vision for a sustainable built environment in the UAE. However, they were mandated only recently, which means that the majority of the existing building stock is still operating inefficiently. It is estimated that only 2% of the existing buildings in the UAE would pass the current green building regulations, which puts great emphasis on the need to retrofit existing buildings to reduce their carbon footprint.

In June 2015, the EmiratesGBC monthly Technical Workshop discussed the existing commercial refurbishment strategies and its imminent challenges.

Background

In 2014, Dubai Municipality mandated their Green Building Regulations and Specifications (GBR&S) for all new buildings within the Emirate of Dubai, to ensure minimum sustainability

targets. Similarly, Abu Dhabi Urban Planning Council has mandated minimum sustainability requirements under the Pearl Rating Systems for new construction since 2010. These initiatives and frameworks support the vision for a sustainable built environment in the UAE. However, they were mandated only recently, which means that the majority of the existing building stock is still operating inefficiently. It is estimated that only 2% of the existing buildings in the UAE would pass the current green building regulations, which puts great emphasis on the need to retrofit existing buildings to reduce their carbon footprint.

This workshop intended to discuss the challenges and opportunities in retrofitting existing buildings with a focus on commercial buildings. Topics covered during the workshop looked at identifying opportunities, stakeholder's engagement, retrofitting strategies and levels of refurbishment. Retrofitting strategies and case studies were also presented which looked at best practices in design and sustainable strategies and the support of the MECO Best Practice Guide.

The Challenge

The workshop started off with an introduction to the problem and its extent. Global population growth rates are only expected to grow, but if we continue to consume natural resources at our current rates, then by 2050, we would need three earths to help cope with the demand. And that is a scenario that is extremely unlikely to happen if not impossible. The current consumption statistics are sobering, but they get compounded when we insert buildings into the equation. According to leading estimates, buildings consume nearly 60% of the worlds energy, 12% of its water, 40% of its raw materials, and expend enough GHG emissions to take up 33% of the total that is already spewed by other sources. Given that buildings are integral to humanity's basic need for survival, it is extremely important that the topic is addressed at all levels.

Solutions

A recent initiative that focuses on energy efficiency comes through the Dubai Supreme Council of Energy's Directive 1 which targets 20% energy savings in government buildings by 2021. It will also call for mandatory audits in buildings and retrofits for buildings with floor area larger than 1000 m2. The Dubai Integrated Energy Strategy 2030 aims to reduce energy demand by 30% by 2030. Energy efficiency programs have focused on such targets such as the Emirates Energy Star Program, the EmiratesGBC Energy Efficiency Program (EEP) and the EmiratesGBC Technical Guidelines for Retrofitting Existing Buildings. It is expected that benchmarking programs that will follow from these initiatives will influence the market as an effective tool that educates building owners and end users/tenants on the financial benefits of owning and living inside an energy and water efficient building. Plus, it will bring more transparency to the market on the inefficient money wasters.

Discussion - Concern about the different testing methodologies in the region

Currently the building industry is swamped with different sustainability related regulations and platforms, both international and local that vie for dominance or importance. Meanwhile existing and new regulations are expected to tighten enforcement which will likely increase operational and maintenance costs. Europe has similar different methodologies that are not easy to transport to other countries. The MENA region has the same. Ultimately it comes down to maintenance and operational costs and the rating system which offers the most immediate tangible benefits that will likely lead in the region.

Performance Gap

The performance gap is the discrepancy in a building's performance between post occupancy conditions and what the building was designed to achieve.

Reasons for Performance Gaps

Design Decisions: Insulation and glazing for instance all impact the efficiency of a building.

Minor oversights such as gaps between wall covers and insulation detailing can cost negatively due to high energy usage. These can usually be picked up during the construction phase.

Construction Quality: Damaged ductwork, insulation gaps, or poorly constructed chilled water coolers which have dirt going in them can affect the life expectancy of the systems installed. Thermal bridging of a building is also extremely important to look at. Dubai looks at thermal bridging more critically than Estidama as inefficient heat transfer can impact U Values by a factor of five.

Figure 1: Common examples of design decisions or oversights that can impact the performance gap in a building.

Operational Decisions: These are the low hanging fruit and can easily reverse a negative trend in energy and water usage. Switching of lights and turning down HVAC systems when not in use; regular cleaning of filters are simple measures that help a building operate as it was intended. Recycling and providing choices with proper facilities also help to narrow these gaps.

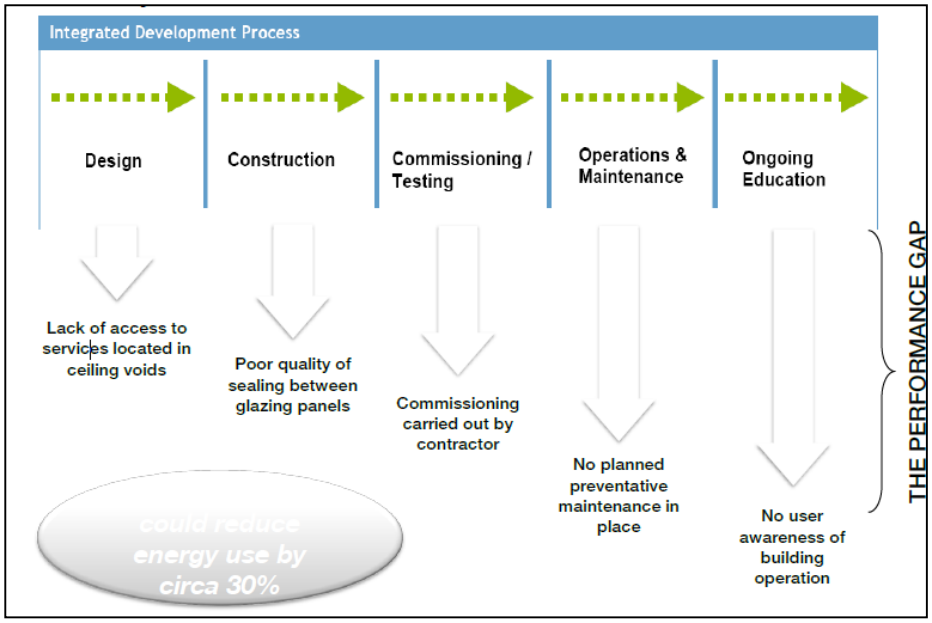

Figure 2: A look at performance gaps and how they worsen if unaddressed from the initial stages.

If these issues are neglected a buildings performance gap can be as large as 30%. Hence the reason why most buildings have the potential to increase efficiency by 30% by simply narrowing their performance gaps which are typically done through energy efficiency retrofits. This is a far more effective method of retrofit versus creating new design changes and installing new systems that do not mitigate the original cause of inefficiency.

Currently no other sustainable building rating system checks for the operational discrepancy of a building. A resource that has not been as well adapted in the UAE region is the BSRIA Soft Landings guidance and framework from the UK which checks for future discrepancies right from the design and construction stages. The Estidama Independent Commissioning Agent requirement is the closest that comes with narrowing that gap. The BSRIA framework has a lot to offer the region however, the nature of construction with contractors having very little accountability on the final operation of the building means the incentives simple don't exist.

Discussion

A workshop participant with extensive experience in construction noted that it is extremely important that the Facilities Management (FM) team be involved before the handover. There should be good interaction between the design team and the FM personnel so that they understand the different features and building systems that will be handed over to them and what they have to be operating on. A possible solution is this sort of inclusion to be written into the RFP itself from the outset and deeply ingrained in the project scope, rather than having it as an add-on cost.

The developer should also allow the contractor the room to provide post-occupancy after-care. A developer having a more integrated sustainability team which branches over to tenant awareness and education is also an effective strategy. A retrofit guideline written in or an existing one considered at the very beginning of the project can also benefit the life cycle.

Another idea also raised was the possibility to leverage the role of the client and their capacity to integrate the work that the contractors do with that of the developers, by being proactively involved in the design stage. Clients can also ensure the training of qualified system handlers at the handover phase – a successful soft landing.

Levels of Refurbishment

BRE (2002) identifies levels of refurbishment based on existing conditions at the time of assessment;

- Level 1: requires minimal intervention such as addition of internal blinds, repainting of the building interior, replacement of low-energy IT solutions
- Level 2: is an intermediate level of refurbishment beyond what is identified in the previous level. This level is expected to incorporate lighting and systems control integration or replacement
- Level 3: represent major refurbishment applications such as raising floors, external walls, addition of external solar applications, etc.
- Level 4: is when the building requires demolition or redevelopment due to very poor conditions.

A retrofit begins with first understanding the different levels of intervention that can take place. From a simple change of lighting, to building controls to a higher level audit which changes a buildings envelope itself, means that these interventions must be carefully assessed in order to ensure they are needed and will bring in the desired changes. Participants shared retrofit stories where simple measures helped achieve savings of 16%.

Best Design Practices

Workshop facilitators shared some guidelines taken from their study where they looked at issues that can be addressed through simple design methods. The discussion revolved around how managing shading, introducing skylights, placing films on windows and assessing thermal bridging can be done with occupants in situ.

The features are mentioned in the MECO 2014 guide published by Woods Bagot.

The best practices discussed looked at achieving energy efficiency through the following design features:

- Daylight & Glare
- Shading Strategy
- Building envelope performance (thermal)
- Efficient Lighting
- Livable Indoors
- Design flexibility and adaptability
- Design compactness

Other Discussion Points

Audits vs. Retrofits

Clients should focus more on conducting audits first and then looking into retrofits. An initial audit can pinpoint several operational flaws that can easily be rectified and would not require an overhaul of a system. An example that was given was how a specific mall in Dubai had a tremendous air infiltration problem simply because the air handling units were functioning at different speeds then the exhaust units causing a pressure discrepancy. An energy audit solved the problem fairly inexpensively.

Energy Performance Index

Optimizing energy consumption using the EPI could be more beneficial than simply placing a goal of 20% improvement in energy efficiency through refurbishment. This however is most effective if energy management practices are implemented at the design stage. However, it needs to be noted that despite slated energy efficiency through a retrofit, a building can still have a high EPI and that is always a factor to consider in proper energy management.

Construction Sourcing

A sustainable supply chain should never be underestimated. This includes looking at recycle and reuse programs, for instance recycling cementitious products and purchasing products that are labelled as green, with the aim to reduce embodied energy in the refurbishment process.

Concern about the different testing methodologies in the region

Currently the building industry is swamped with different sustainability related regulations and platforms, both international and local that vie for dominance or importance. Meanwhile existing and new regulations are expected to tighten enforcement which will likely increase operational and maintenance costs. Europe has similar different methodologies that are not easy to transport to other countries. The MENA region has the same. Ultimately it comes down to maintenance

and operational costs and the rating system which offers the most immediate tangible benefits that will likely lead in the region.

Overarching regulatory overhaul

An immediate concern among participants was the lack of benchmarks in the region and taking a step back in the process, there is also a lack of confidence in the qualification of building facility managers. How would a building owner know that the costly BMS installed will actually achieve more savings than installing a simple timer that shuts down the system when not in use? How can the owner of a sustainable LEED certified building know that the building is operating more efficiently then the neighbouring uncertified building? A future audit regime and benchmarking incentives presided by the Dubai RSB was introduced to participants as addressing these current issues faced by the industry.

This topic was also tied in with including more criteria that measure the improvement in a building such as occupant wellbeing. The MECO 2014 guide and the World GBC report on health, wellbeing and productivity were mentioned as specific guidance that provide metrics on how these variables can be measured.

Conclusion

It is important to put a value on time. With different levels of retrofitting, it is important to evidence cost savings through programs which also look into minimizing down time. It is important to improve the. With new regulations

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EmiratesGBC Technical Workshop #2015-7:

HVAC Optimization Strategies

September 15, 2015

Facilitators:

Tharun Thomas, Smart4Power

Tara Tariq, EmiratesGBC

Venue: Emirates Green Building Council Office, Dubai, UAE

Keywords: HVAC, AC – Units, local regulations, VRF technology, audits, district cooling

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Introduction

In the UAE, air conditioning systems and equipment, including chillers, air handling units and fan coil units can contribute anywhere between 60 to 70% of the total energy consumption and operational costs of a building. It is therefore critical to implement energy efficiency strategies which include the installation of high-quality equipment and regular maintenance by experts to ensure the best performance and the lowest energy consumption.

In September 2015, the EmiratesGBC monthly Technical Workshop discussed the optimization of HVAC systems in buildings and how they can contribute to extensive savings in energy.

Background

In the UAE, air conditioning systems and equipment, including chillers, air handling units and fan coil units can contribute anywhere between 60 to 70% of the total energy consumption and operational costs of a building during peak season. It is therefore critical to implement energy efficiency strategies which include the installation of high-quality equipment and regular maintenance by experts to ensure the best performance and the lowest energy consumption.

The Challenge

According to figures provided by the EmiratesGBC workshop facilitators, the average energy use intensity of buildings in the UAE is 350kWh/m^2/yr. This is a dismal statistic and far below local

regulations for new buildings such as the Dubai Green Building Regulations & Specifications and Estidama which call for an annual EUI of 160 -260 kWh/m^2/yr and existing local best practices which have attained on average an EUI range of 110 – 160 kWh/m^2/yr. See figure 1 and 2.

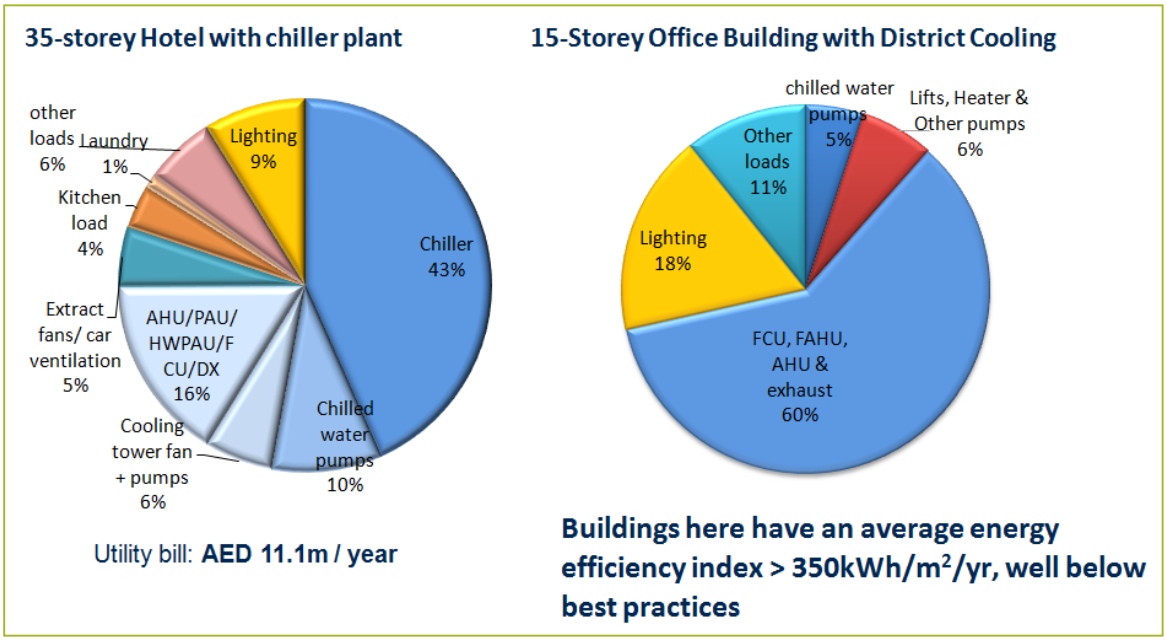

Figure 7 Energy use based on over 60 audits conducted in residential and commercial buildings.

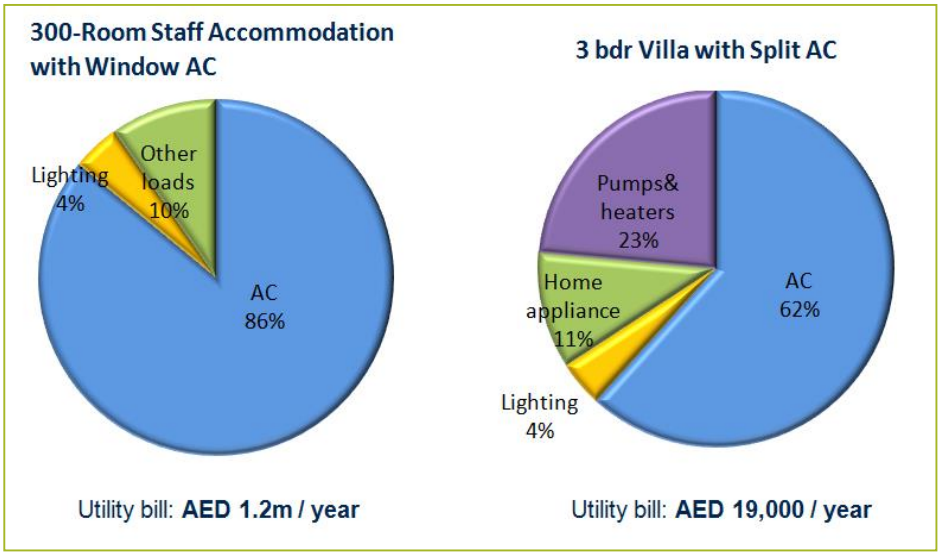

Figure 8. Current residential sector energy consumption rates based on over 60 audits

In Dubai alone the existing building stock is ridden with challenges that range from oversized HVAC systems, advanced BMS systems installed but working only in manual mode, inefficient fittings of fixtures and electrical systems, poor insulation materials, and consumption behavior that is marked by sheer ignorance of their ramifications or even knowledge of available solutions that can mitigate the damage done by this behavior.

This fact in turn is compounded by the Emirate's goal to improve the energy efficiency of 30,000 buildings by 2030. Where do we start?

Solutions

A recent initiative that focuses on energy efficiency comes through the Dubai Supreme Council of Energy's Directive 1 which targets 20% energy savings in government buildings by 2021. It will also call for mandatory audits in buildings and retrofits for buildings larger than 1000 m^2. The Dubai Integrated Energy Strategy 2030 aims to reduce energy consumption by 30% for 30,000 buildings by 2030.

These targets set by the government serve to bring about energy efficiency by facilitating awareness as well as the market. Another goal and related methods to achieve this are through aligning capacity and consumption to the actual demand within buildings. This typically involves upgrading and fully optimizing existing BMS systems in the building, retrofitting existing HVAC systems and improving building insulation to prevent leakage. The gains made by the private sector can only bring about responsible consumption.

Discussion Questions

Specific to Air-conditioning, what are the proven strategies available for us to improve energy efficiency, cost-effectiveness and reduce carbon footprint?

An interesting solution presented was to take control away from the users – let them never know the set points and take advantage of their benefit of raising the thermostat without occupants realizing the temperature difference. Of course this can't be applied in all indoor places and building typologies, but the most problematic example cited, which are housing accommodation facilities for labourers would benefit from these kinds of techniques.

Motion sensors also are a cost-effective strategy that brings in energy savings. Retrofit analyses (audit) can go a long way in pointing out egregious errors in building operation and maintenance practices such as leaking ducts, BMS offsets, and can determine a set course of action to take which would also draw in savings.

Leaking ducts can create a huge problem with inconsistencies in temperature as the ceiling area is cooler then the lower level which humans occupy, and this leads to HVAC systems running at 100% capacity.

HVAC zoning was also cited as a somewhat costlier retrofit strategy but one which can bring in savings in tandem with other technologies such as motion sensors.

How much have split systems and room AC units ramped up on efficiency? What is the future of VRF technology?

Single AC units and split units are notoriously inefficient and with an older building it does not make financial sense to tear down the roof structure and install an HVAC network. There is always a tossup with choosing to make structural changes versus technological changes. In an example cited, it was revealed that upgrading the AC systems with Variable Refrigerant Flow (VRF) technology was often a most cost effective.

With regards to VRF, industry representatives present at the workshop did not see much gains i the adoption of VRF in the UAE region. The general consensus was that VRF technology is new and most clients don't want to use it as they don't understand it or are unaware of its existence. The CAPEX and the energy saving goals involved determine if that technology will be used. A project at Masdar which sought 40% savings over baseline readily adopted VRF, but the Estidama requirement of 12% savings did not warrant the CAPEX for VRF, according to industry experience.

Given that VRF brings in proven efficiency – 15% just after installation only - the technology would need substantial policy backing before the market demand can grow. However, two things to consider are:

1) VRF technology is not required for every project.
2) To maximize cost effectiveness, tightening a building envelope, improving insulation is a priority task before VRF should be considered.

Putting things in perspective: owing to varying building profiles and affordability issues, is a plurality of cooling approaches a necessity for the region?

Plurality is essential and no one technology can be eliminated just because its inefficient in some circumstances. A good example shared involved a facility that kept their chiller on just to cool one IT room. A viable energy efficiency strategy was to shut down the chiller during non-operating hours and install a split unit which would keep the well-insulated room running efficiently.

HVAC Optimization Strategies

Aligning capacity and consumption to actual demand

Time, occupancy, and demand are important variables when considering energy efficiency strategies. Oftentimes energy audits reveal that a major portion of the energy consumed in a building occurs when the building is unoccupied during non-working hours.

> *HVAC Optimization is not an algorithm or an application. It is a continuous process. When implemented holistically, HVAC Optimization delivers sustained energy savings.*

Better Design Practices

The minimum that should be implemented in a facility:

- Energy Modeling analyses of site conditions
- Building envelope performance
- Thermal comfort ranges
- Selection of rights equipment
- ASHRAE verification and compliance

Retrofit Solutions

At a minimum a solution should always be based on a high ROI and also ease in installation. A retrofit should not disrupt regular functionality in a building.

- Retrofit solutions based on high ROI and ease of installation
- Improvement of Building Management Systems
- Improvement of Building Envelope
- Time, occupancy and demand based control systems
- Conversion of chillers, pumps, and cooling tower fans to Variable Frequency Drive (VFD).
- Heat recovery systems, CO_2, & CO based controls.

Measurement and Verification

- Real-time monitoring of energy consumption patterns,
- Effective preventive maintenance
- Comparison with baseline consumption and further improving the system
- Daily logs of system performance

Discussion Question

Is the current approach to District Cooling outdated and obsolete? Does the economics of DC plant operations still make it an attractive area for HVAC optimization?

With DC systems, the connective load is the main issue. Any project in its development stages can hook up with a local DC system and if this project is expected to grow the chances are great, however, if the project fails to grow for any reason, as in if developers exaggerate their goals, this can seriously backfire on the DC systems capacity to sustain itself.

What tools are being used by consultants to implement best practices while designing HVAC system?

Partial load responses are the most effective ways to optimize HVACs according to some consultants. Using and testing VFDs and programming the best set point has been very effective for some projects.

What are the major challenges in implementing retrofit solutions to improve HVAC efficiency?

Set points within BMS. A proposed solution is to set scheduling using time. Establish a pre-cooling mode which would bring temperatures down (cool) to the desired level before occupants enter. This issue is also addressed by the Dubai RSB framework where set points are established much earlier in the process. Facilities should make an effort to keep BMS from operating in manual mode and utilize the systems complex functionality to maintain smooth running HVAC systems.

Case Studies

Hotel Client

A hotel case study was presented where the client had a utility bill of 2.3 million AED paid to DEWA, and 0.95million AED paid for water expenses. Chilled water pumps, FCUs and exhaust fan units comprised 75% of the energy bill. The approach to optimize the HVAC system started with an energy audit to fix the baseline; further assessments provided to the client included the costs, the ROI, and the risks associated with the retrofit. The actual retrofit process was careful to minimize disruption to the hotel guests and M&V protocols were also carefully implemented.

Delta T: difference in temperature between supplied and returned chilled water.

The audit revealed that guest rooms were set at 20 degrees C even when the room was not occupied. The proposed solution was to install room automation systems which would adjust the room set point temperature. Sensor based control systems were used to vary the speed of the kitchen fans which were initially running at 24hrs. The hotel paid 1.18 million to the DC service but the delta T which was designed to run at 9 degrees was running at 4 degrees. They also tested the power consumption of the FCUs in power mode and energy saving mode to determine the differential. The flow was eventually reduced as it was found that the hotel was paying more to the DC company than was required. Testing done during the peak period (Eid break) revealed that the hotel had declared 28% extra tonnage to the DC. The client was advised to surrender extra tonnage and not many people know that after two years, clients can do that.

Eventually the hotel spent 150,000 AED and saved 319,000 AED achieved within a year. It was a classic example of design optimization and retrofit solution.

Lack of Proper Maintenance

Notable failures in O&M tasks related to HVAC systems that the retrofit survey revealed and were eventually corrected during the retrofit process:

Dirty filters – This increased resistance to air flow and reduced dehumidified CFM supplied to space.

Choked strainers – This prevented required amount of chilled water from entering to FCU/AHU coils.

Air purging – This created air bubbles in chilled water system and prevented cooling transfer from chilled water to air.

Defective Control valves – 2-way valves on FCUs were defective and stuck in one position. This was all hidden behind the false ceiling and neglected. As a result, instead of a variable flow, there was a constant chilled water flow to FCUs.

Defective actuators – Actuators were defective and were unable to control 2-way valves and were stuck in one position. This in turn provided constant chilled water flow to FCUs.

Defective Thermostats – Standalone thermostats were also defective and were not able to control the fan speed. The 2-way valve and FCUs were running at full speed with valves fully open. If they were designed to run at speed 2, they were functioning at speed 3. This in turn directed constant chilled water flow to FCUs.

Defective FCU controller – The units were not controlled properly and thus monitoring of space temperature in building management systems was not possible.

Faulty temperature sensors – These were the return temperature sensors which controlled the chilled water valve, and defective temperature sensors provide more chilled water to FCUs. A simple replacement of the sensor solved the problem.

Leakage – Leakage in chilled water pipes increased supply water temperature entering FCUs. As a result, the cooling load was not met which led to more chilled water flow into FCUs.

Conclusion

HVAC optimization is a continuous process, done best when it starts early in the process and is implemented holistically. A facility can have the best equipment but if it is not designed and installed properly or if it does not employ the right control strategies then it will fail. A facility can implement the best retrofit solution but if there is no measurement and verification done, the payback will be entirely unknown. Finally with the right level of concerted maintenance, HVAC systems can perform optimally and efficiently throughout their lifespan. The workshop provided a comprehensive list of best practices in HVAC optimization strategies and a frank discussion of what works and does not work.

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EmiratesGBC Technical Workshop #2015-8:

The Cradle-to-Cradle Design Philosophy

October 5, 2015

Facilitators:
Paul Murray, Shaw Industries
Marie-Helene Westholm-Knebel, EmiratesGBC
Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: design, materials, certification, sustainability, C2C

Introduction

The Cradle-to-Cradle (C2C) design philosophy and its five key components has often been considered the bedrock of sustainability. Yet nearly all environmental issues around the globe have been effectively linked to poor design methodologies. If manufacturers could design processes to mimic nature we would not have to worry about conservation, but rather could enjoy abundance as well as business growth.

In October 2015, the EmiratesGBC monthly Technical Workshop addressed the five pillars of this design philosophy (material health, renewable energy, water stewardship, material reutilization and social fairness) and allowed participants to see how these pillars apply to their UAE professional experience in the building industry.

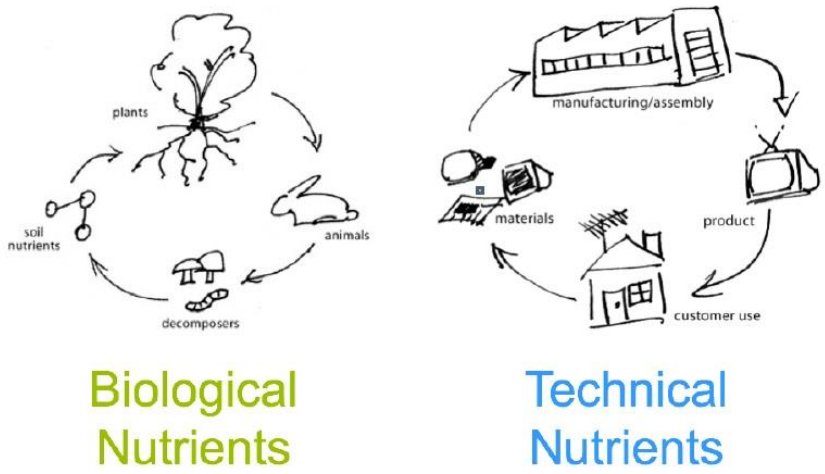
Background

What is Cradle-to-Cradle?

The motto "**Reduce, Reuse, Recycle**" is often used as a shortcut to summarize best practices in the environmental protection field, by referring to the need to assess the quality of materials involved in a production process, as well as the way these materials can be integrated in this process in a smart way in order to minimize waste while optimizing their usage.

The **Cradle-to-Cradle** (also named C2C) design philosophy brings these points to the next level. Developed by William McDonough and Michael Braungart in 2002 in their book "Cradle to Cradle:

Remaking the Way We Make Things", the C2C approach considers how materials are intrinsic parts of natural systems which can allow us to reconnect technical processes with natural ones: they can be conceived as "**biological nutrients**" that can be reintroduced into the natural cycles of water and soil without compromising the environment; they also need to be considered "**technical nutrients**" which can "nurture" a manufacturing process by circulating through a product's lifecycle without being recycled or wasted.



With such a model in place, it gets possible to sustainably redefine our conception of economic growth in a way that does not threaten our environment and natural resources.

The C2C certification

Under the authority and supervision of the **Cradle to Cradle Products Innovation Institute**, the certification scheme assesses products in a scorecard based on five categories (see below) and provides manufacturers/project owners with a third-party evaluation and certification with continuous product improvement as an objective. The certification revolves around a 6-steps process:

1. Confirmation that the product is appropriate for certification
2. Selection of an accredited assessment body for the testing, analysis and evaluation of the product
3. Compilation and Evaluation of data and documentation
4. Certification
5. Marketing and communications around innovation and product itself
6. Progress report to assess and communicate continuous improvement

Based on the achievements in the five categories and the efforts for continuous improvement in place, the product is either certified as Basic, Bronze, Silver, Gold or Platinum.

C2C certified products have been added into LEED v4 and can earn project teams up to 2 points for Materials & Resources Credit 4. The purpose behind this novelty is to educate and strategically position project teams towards the responsible inventory, purchase and usage of materials whose chemicals and other components would have the least negative impacts on the environment.

The C2C categories

Both the C2C philosophy and the certification process evolve around five key categories which challenge traditional industrial processes and ways to understand and manage our natural resources. During the certification process, the project team assesses its product and inventories its components around the following:

- **Material Health**: chemical components of a material/product are inventoried, screened and assessed against a continuously growing list of banned chemicals. Based on the risk attached to its possible hazard and exposure of the consumer, it can be asked to the product owner to consider changing the original design and innovate to remove the hazardous components and therefore improve the final deliverable to make it safe for human health and the environment.
- **Material Reutilization**: the product's design and materials are assessed against the notions of "biological and technical nutrients" to see how they can be reintegrated into the production chain or natural cycle and therefore how they minimize waste generation.
- **Renewable Energy**: the manufacturer of a material/product bases its production and business model on renewable energy instead of contributing to carbon emissions using conventional energy sources.
- **Water Stewardship**: the manufacturer of a material/product bases its production and business model with water conservation (including reduction of consumption, recycling and water treatment) as a priority.
- **Social Fairness**: the manufacturer of a material/product bases its production and business model on the strongest ethical standards for all stakeholders, including the supply chain and the environment.

How do we "put eco-effectiveness into practice?"[1]

While going through the description and purpose of each of the above-mentioned C2C categories, the workshop's participants were asked to discuss how they each apply to the UAE context and

[1] Braungart, M., McDonough W., 2002.

to their personal experience in the green building industry. The following points have been addressed:

Implementing "green" requires data and genuine commitment at all levels

Assessment and certification schemes such as C2C, or reporting frameworks like the Global Reporting Initiative (GRI) or the United Nations Global Compact, do require a genuine level of commitment, awareness understanding from the project teams. This however raises the question whether professionals are properly equipped with the knowledge to understand the scope and requirements of reporting, and whether the data to be produced, collected and submitted is available.

To tackle these questions, the involvement of all stakeholders from the project's early stages was emphasized, as well as the ability to provide the clients/project owner/company owner with relevant choices regarding the way to achieve the most sustainable deliverables with the triple-bottom line in mind in terms of social, economic and environmental aspects.

It was also suggested to systematically refer to the Environmental Product Declaration (EPD) of an item, if available, as a first reference to know more about the product's components and impacts of production and exposure to human health and the environment. This however should not be an end per se as the certification and reporting schemes are requesting an even more level of details while keeping a holistic understanding on the product's and its components' impacts.

Continuous education is required

Discussions also highlighted the need to maintain communications with the clients at all time to allow them to understand the benefits to proceed with such schemes. In the building industry as well as any other markets in which "green" has become a trend, if not a priority, it has remained a necessity to inform clients and owners that sustainable thinking does not imply higher costs but instead means positive returns on investments and long-term financial savings. Sustainability reporting allows for greater visibility on the market and has become the "way to go" to ensure companies and projects are compliant with the highest ethical and environmental standards.

The notion of continuous improvement supported by C2C is also critical to ensure all stakeholders are up-to-date with the latest technical and scientific achievements. The list for instance of banned chemicals is continuously growing along with the understanding of risks of exposure to the environment and to human health; it obliges manufacturers to continuously engage in R&D and make innovation a priority.

At last, the five categories mentioned in the previous section oblige stakeholders to approach sustainability in a more detailed and holistic way. Reporting and certification schemes set clear definitions and requirements to concepts that might not be easy to understand (EPD, Life Cycle Assessment, reutilization, systems…) and provide guidance to trigger positive change.

The market needs to be ready

During the workshop, participants discussed whether the UAE market is ready to implement such schemes and framework, or whether they should be made mandatory through regulations or incentives from the authorities. Regulations appeared as the key pillar to support positive change but as long as they are backed up with the relevant processes (third-party testing laboratories, onsite verifications, complaint mechanisms) and teams to ensure compliance.

Facilities, technologies and trainings however should be made available in the country to support the implementation of the regulations and best practices. While the reduction of waste generation in industrial processes would strongly reduce the economic and environmental pressure on landfills, the possibilities for both public and private sectors to implement “waste to energy” strategies are limited despite tremendous opportunities (this applies also to water stewardship).

The question whether sustainability should be made a prerequisite in procurement and project management through regulations rather than voluntary mechanisms has raised however concerns. For some, and in view of the pressures it pulls on projects’ management and budgeting, sustainability should remain a proactive choice that can be rewarded via certifications such as LEED. For others however, it has to be enforced and verified by the authorities until it is taken for granted as “business as usual” by the market’s stakeholders.

Conclusion

Performance, aesthetics and economic value used to be the primary triggers behind the design and production of a product. The Cradle-to-Cradle design approach however has provided the market with a certification scheme and methodology for manufacturers and project teams to implement eco-conscious decisions and business strategies without compromising their search for sustainable economic viability. Discussions have reinforced the importance to balance the three aspects that define sustainability (economic, environmental and social) and continuously search for innovation and improvement with the five C2C categories in mind. Continuous education of individuals has also been identified as a key requirement to ensure that we as a group / as a society can make the wisest choices to sustain economic growth (should it be the market’s main objective) while protecting our environment.

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EmiratesGBC Technical Workshop #2015-9:

Indoor Air Quality Controls

November 10, 2015

Facilitators:
Hassan Younes, Griffin Consultants
Marie-Helene Westholm-Knebel, EmiratesGBC
Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: IAQ, ventilation, fresh air handling unit

Introduction

In a country where sustainability is molding the buildings regulations, there comes a need for **controlling Indoor Air Quality (IAQ)**. If IAQ is to be prioritized, a higher focus should be put on controlling and minimizing the energy consumed by the ventilation system.

The trade-off between higher energy consumption due to increased ventilation rates and improved indoor environmental quality (IEQ) becomes the key question that designers and building operators need to answer.

In November, the EmiratesGBC Technical Workshop addressed proper IAQ controls as one of the main considerations to answering that question and how controls can be used as a means to provide optimum indoor air quality with the minimum associated energy consumption.

Background

Back to the standards: ASHRAE 62.1 - 2007

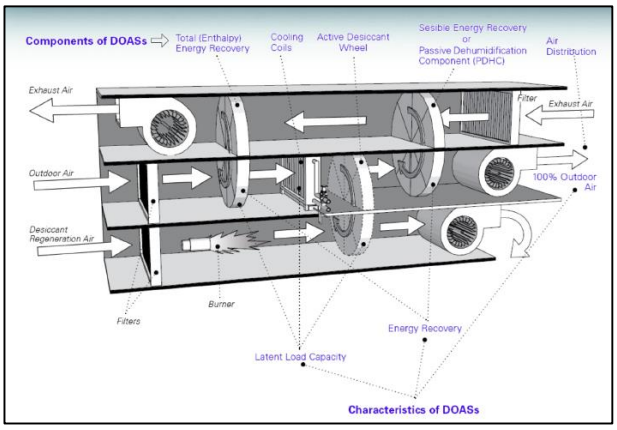
Following an introductory round of presentations during which participants were asked to share their experience in the topic, the content of ASHRAE 62.1 dedicated to Ventilation and Indoor Air Quality was reviewed in details (see References for information): "*The purpose of this standard is to specify minimum ventilation rates and other measures intended to provide indoor air quality that is acceptable to human health occupants and that minimizes adverse health effects*".

The standard is used and/or is a requirement for the following codes, regulations and rating systems by setting the minimum fresh air requirement (in Cfm) for offices:

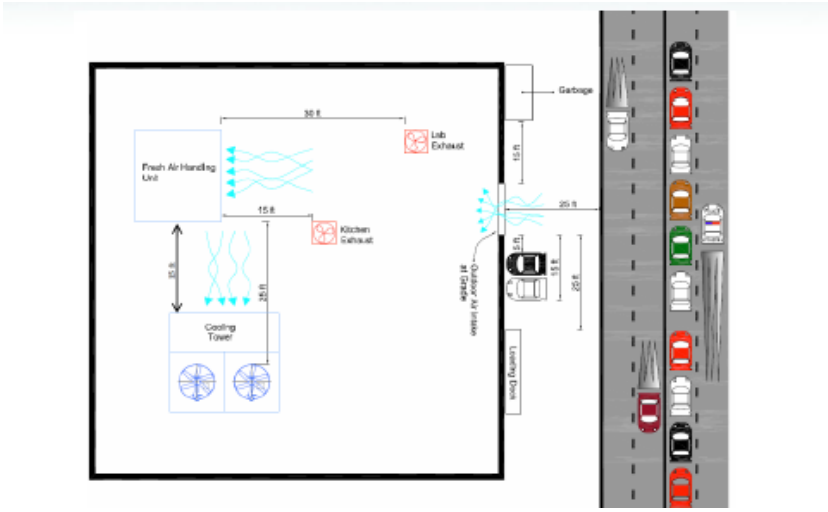
NFPA 5000 (Building Construction and Safety Code)	Sections 15.5.6.2 and 49.2.2.1
LEED (Leadership in Energy & Environmental Design)	IEQ Prerequisite 1, Credits 1 & 2
ESTIDAMA	LB r6, LB 12 , LB 15 , LB 23
IMC 2009 (International Mechanical Code)	Section 403.3.2.3.2
Dubai Green Building Regulations	401.01 401.03 502.02 502.14

The workshop then focused on Section 5 on the standard dealing with Systems and Equipment, including:

- Mechanical ventilation System Controls: all systems, whether manual or automatic (including sensors) which enable fresh air fan systems to operate whenever the space is occupied and to maintain the minimum flow required as per the standard. Based on the actual needs a fresh air handling unit (FAHU) might be requested.



- Outdoor Air Intakes: design, construction and installation of equipment ensuring that all outdoor air intakes are sufficiently far away from any exhaust outlets or areas that have harmful air.



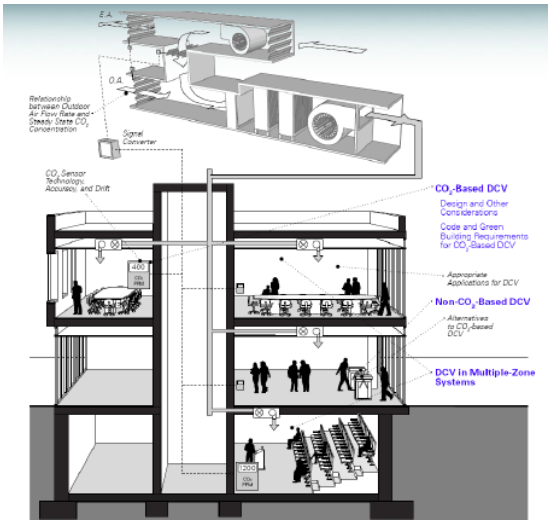
- Particulate Matter Removal: particulate filters or air cleaners with a minimum efficiency reporting value (MERV) or not less than 6 (ASHRAE 52.2) should be provided upstream of all cooling coil or other devices with wetted surfaces through which air is supplied to an occupied space. In the current 2013 edition the value has been changed to 8.
- Relative Humidity and Exfiltration: ASHRAE 62.1 specifies a 65% upper design limit on relative humidity for mechanical systems with dehumidifying capability; their served buildings shall have a positive pressure.
- Energy Recovery: energy recovery resulting in 10 % or less cross-contamination from class 2 (kitchens, toilets…) or 5% or less from class 3 (trash room) does not affect the classification of class 1 air.

Section 6 of the Standard details “how to determine the minimum required ventilation rates for various applications, building types and occupancies”, i.e. the amount of fresh air that should be supplied. Two procedures are indicated:

- Ventilation Rate Procedure (VRP) which helps determine the outdoor air intake rates based on the space type, the area and the number of occupants.
- Indoor Air Quality Procedure which aims at maintain concentration of specific contaminants below target concentration limits through source control, air testing and cleaning…

IAQ Contaminants to look and test for – *EmiratesGBC Technical Guidelines for Retrofitting Existing Buildings*, Chapter 3.3 Indoor Air Quality Testing

Acids
Aerosols
Allergen: Dust mites, pet dander, cockroach.
Asbestos
Carbon Dioxide (CO_2)
Carbon Monoxide (CO)
Formaldehyde and Aldehydes
Hydrocarbons
Fungi, Mold, and Bacteria
Nitrogen Dioxide (NO_2)
Pesticides
Respirable dust: pollen, dust, dead skin cells, airborne particulates, and
Volatile Organic Compounds (VOCs)



At last participants reviewed the principles of Demand Control Ventilation (DCV) which allows to detect occupancy levels of a space and calibrate the input of fresh air based on this level, and therefore avoid wasting cooling and ventilation energy.

CO2 based DCV and sensors can be tailored to ensure air quality in specific conditions, with a usually assumed CO2 set point of 1000 ppm (while outside CO2 concentration level is assumed at 400 ppm). It was however advised to ensure a set point of 90 % of the calculated amount in order to allow for control system response times and take into account the sensors' possible inaccuracy.

Design vs. equipment vs. usage: the systems' limitations

While the existing standards set levels with the aim to optimize IAQ based on the facilities' usage and number of occupants, a few limitations can be identified, which will negatively impact the system's efficacy and increase the need for energy, amongst others:

- Over-usage of fresh air systems, i.e. over ventilation compared to the space's actual need;
- Energy recovery devices are not used;
- Under-ventilation;
- Design conditions for cooling and not for dehumidification or evaporation.

Combined with a lack of maintenance, of accurate calibration, of proper design or installation of equipment and sensors, the above-mentioned points will have a negative impact on the air quality and possibly be harmful for human health by leading to the development of mold, sick building syndrome…

Due to the extreme weather conditions in the region (both in terms of temperature and humidity level) and the related building ventilation requirements, installing an Energy Recovery Ventilation (ERV) system (in the form of an enthalpy wheel coupled with a sensible wheel, a passive desiccant wheel, a heat pipe or a run-around coil) is strongly suggested to revert these negative impacts. The installation and proper usage of an ERV help pre-cool and de-humidify the outdoor air entering the building, ensuring air quality and reducing surface condensation while reducing the overall required cooling load.

Discussion points and the Way Forward

Connecting efficient controls with building performance

Following the review of definitions, sections and principles, the workshop's participants were invited to share comments based on their respective professional experience with ASHRAE 62.1. The following points were addressed:

- To optimize the usage of the equipment in terms of energy efficiency and guaranty the highest air quality standards for the facilities' occupants, continuous training of the professionals in charge in needed. This implies a strong upstream education as well as continuous understanding of key maintenance aspects.
- To complement training and education, it is critical to conduct onsite checks in order to verify measurements and correct calibrations. This is meant to prevent energy waste and ensure the standards are set to fit the occupants' actual needs for fresh air.
- Regulations and retrofit standards are meant to set baseline and create benchmark not only for the industry but also to support the authorities in reducing the carbon footprint of the UAE built environment.

The Way Forward

Facilities Management (FM) organizations have been identified as key stakeholders which need to have a more active role in educating professionals and tenants, amongst others, in the following areas:

- Development of guidelines, certification schemes and even regulations to mandate FM professionals to ensure quality, reliability and compliance with standards and regulations;

- Training of FM staff to ensure proper maintenance of the equipment and better understand the controls' calibration and other key concepts;
- Communications to and education of owners, clients and tenants to raise awareness on IAQ and its benefits on human health and cognitive performance.

During the discussions it was also suggested for all building professionals to proactively share data regarding their properties' IAQ, systems and equipment, and overall energy consumption and energy efficiency measures. Such data sharing will support the development of a benchmark which should help the industry identify key areas of action and investments.

Conclusion

It has been estimated that people in the region spend more or less 90 % of their time indoors in air conditioned space; focus on improving Indoor Air Quality should therefore remain a priority, not only for human health benefits but also in order to reduce the energy consumption related to ventilation and HVAC. Testing, training and when feasible installing energy efficient systems are keys to maintain an overall healthy indoor environment.

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EmiratesGBC Technical Workshop #2015-10:

ESCO Technologies

December 15, 2015

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Tara Tariq, EmiratesGBC
Venue: Emirates Green Building Council Office, Dubai, UAE
Keywords: ESCO, Software, energy, management,

Introduction

Technology is crucial for the completion of a successful energy performance contract. It is also utilized during the implementation period in order to measure and verify savings achieved and the optimization of operational parameters in a building. This process is key to obtaining accurate savings forecasts.

In addition, technology does not only result in scalable solutions, but is also important for effective energy management and a timely response to changes that can ultimately provide more savings and value to projects, customers and companies.

In December 2015, the EmiratesGBC monthly Technical Workshop discussed the different technologies that have permeated the energy efficiency market in the world; their pros and cons and how they stand to gain a share in the UAE market.

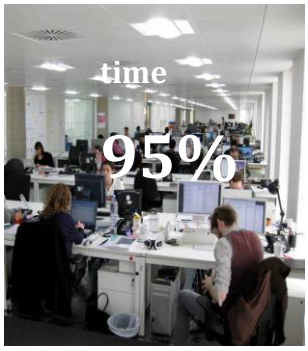
Background

There are a number of technologies that claim to promise ESCOs and buildings energy managers a streamlined process to achieving energy efficiency. The majority of them facilitate and/or expedite the auditing and M&V phase. However, despite these claims, the determining factors for selecting and choosing the right technology are knowledge and awareness of the choices and

options. A number of decision factors come into play and the workshop participants assembled to discuss these on a specific case by case basis.

The Challenge

Buildings are a part of our everyday lives, especially in the UAE. Research from the United States has found that people on average spend 90% of their time indoors. This percentage is as high as 95-96% in the UAE, largely due to the hot weather that lasts through most of the year. These buildings go on to consume 60-70% of energy generated to sustain their inhabitants. In the UAE this percentage can sometimes be as high as 80%. Indoor Air Quality (IAQ) also becomes a significant issue as we rely on mechanical air which is provided by the building. Building IAQ in the UAE has been repeatedly rated as poor.



HVAC mechanisms - whether to overcome hot temperatures or maintain healthy levels of CO2 - require a significant amount of energy. The upshot to that is that buildings, and even those that are certified as energy efficient, perform poorly and operate using extensive energy. A prominent example is the Bank of America Tower – the world's first LEED Platinum skyscraper, which ironically also happens to be the most energy intensive building in all of New York city. Critics tout 'easy' LEED points accrued as the reason for the buildings high certification, while operational misuse also takes a fair share of the blame.

In the UAE, building performance fares even more poorly. This has resulted in the creation of a growing energy efficiency market which seeks to square this imbalance between demand and wastage.

The Car Analogy

"Designing the world's fastest car does not win the race" … if you have an inept driver behind the wheel. Similarly, designing the most energy efficient building will not cut energy costs if building operators are clueless as to the methods and procedures that can be utilized and/or adopted to save energy.

Opportunity

In the UAE specifically, which has one of the highest ecological footprints in the world, the opportunity to mitigate the problem of inefficient buildings by far lies within the existing building stock. Nearly 30,000 buildings in Dubai have already been targeted by the government sanctioned energy service company Etihad ESCO as ideal retrofit candidates.

Thousands of buildings in the UAE still cool interiors using antiquated split units. These structures if retrofitted properly have an energy saving potential of 25%, where much of the work involves simply having them comply with baseline code such as that issued by the Dubai Green Building Regulations and Specifications and/or even ASHRAE 90.1 specifications.

New regulations in place in the UAE coupled with global aspirations signed during the Paris COP 21 Conference have galvanized the movement to lower CO2 levels around the world, with building energy efficiency highlighted as ideal for affecting immediate change as coincidentally, energy savings also impart money savings and a reduced burden on utilities and resources to manufacture the power.

Filling the Gap – Streamlining the process

The performance gap, which is how a building should perform versus how it is performing needs to be closed and currently building retrofit methods are the best ways to achieve this goal. The issue is to streamline the process using the right technology to make it easier, faster, cheaper, deployable and scalable.

Technology and software

While building equipment, design and engineering play an important role in the O&M aspects of a facility, the role of technology cannot be underestimated. Software has transformed all aspects of our lives…except our buildings. This is despite the fact that technology has a proven success record of calculating the precise energy used in a building as well as making reliable assessments of historic and future consumption rates.

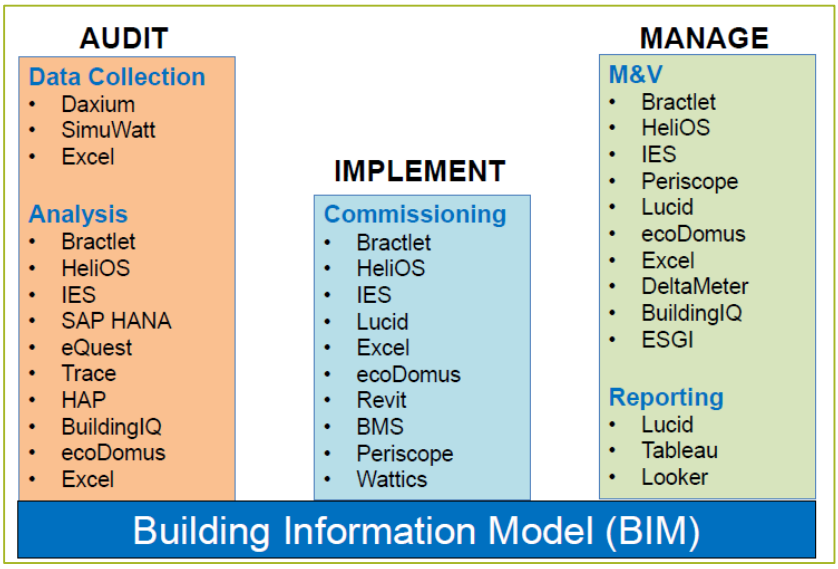
Current Technologies

Core Technologies for Building Efficiency

- **Building Management Systems –** used extensively by ESCOs and Energy Managers around the world yet the potential for the UAE has yet to be realized.
    - Real time energy data
    - Automation of building systems and consumption
    - Remote monitoring and control
- **Building Information Modeling (BIM)** – As BIM technologies provide accurate syntheses and analyses of data, they can provide a lot of benefit and value to a project and building owner. This type of technology is likely to grow in the future as more buildings are designed using BIM and carried over the lifecycle of the building. BIM facilitates:
    - Accurate building data
    - Centralized information portal
    - Efficient energy and facility management
- **Energy Modeling** – a vital yet most underutilized technology in the ESCO market, globally. They provide:
    - Precise forecasts of energy and cost
    - Sensitivity analysis for variables
    - Help choosing the most profitable measure

Technology Options at Each Stage

There is a wide selection of software that are gaining buyer confidence in the global ESCO/energy efficiency market as they prove their utility. The tables below list an extensive selection of software that are used during various phases in a building's energy management process. It is by no means a comprehensive list as more technologies keep entering the market:



Each software listed above has its own strengths and weaknesses. Memory cloud computing can accomplish about 10,000 energy simulation models in a day whereas HAP can do only one. Many of these software are significantly powerful and have a lot of potential, such as DeltaMeter. All technologies have functional gaps though and most are not programmed for the middle east region. For example, SimuWatt, based out of Denver Colorado, do not provide input options for district cooling. Other limitations that also hold are initial cost amount, as well as the cost of training personnel to run the software – some software are very expensive for smaller companies. There is a growing trend toward open source modelling engines vs. proprietary fare.

However, what is important to note is that no one software can do all the tasks, though a keen eye will note that MS Excel certainly excels as the most versatile and flexible data analyses software so far.

Discussion Questions and Response Narrative

Are you (the industry) aware of these tools? Are these technologies useful? Is it easy to integrate and use these technologies?

Participants noted that cost was certainly a deterrent, especially when companies are broken into subgroups with varying budgets and don't want to look at an ROI of more than three years.

Another matter raised was the lack of a need for complexity: Energy audits occur at varying levels and in the UAE, and the majority of audits are walk-through (level One audits) which do not require more complex software capabilities than that already provided by MS Excel. However, some cloud computing software claim to provide a complete investment grade audit (IGA) without a site walk through. This however only applies to newer buildings which have readily available data, but

the savings in time and cost do stand out in this case. Another related point is that often with their ability to run several statistical models, technology alone is able to project higher savings than when the process is done manually. However, the risk of having a third-party audit (hands-off audit) must be emphasized as sometimes technology limitations can be overlooked due to regional differences.

Technologies for Analysis

Data collection is perhaps the biggest issue that surfaces during an audit process, before any other processes come into place. In fact, all processes that comprise an audit including cost-estimation and savings, are as good as the data collected.

Software

- *Daxium* – A French company and a mobile application software that allows standard data collection (images, nameplates etc) with ease in sharing – used by larger FMCs in the UAE. **Claim:** Enable Energy Auditors, Facility Managers, etc. to spend less time going back and forth for data. **Problem**: No programmed algorithms for analytics. You're on your own to assess what that data means.
- *Simuwatt* – Similar to Daxium – another mobile application for data collection which also contains future support for energy modeling and auditing (with ePLUS). **Claim:** simplification of data collection with the ability to simulate building energy performance via energy models. **Problem:** does not support calculations for district cooling, however once it does, it is a very suitable audit tool.
- *Bractlet* – Data collection and analytics via on-site meter data with full auditing capabilities such as savings, cost and payback identification. More statistical than monitoring-based, but provide a full IGA. **Claim:** reduce the operational costs of energy audits while providing accurate savings and cost analysis. **Problem:** third-party audit risks apply.
- *HELiOS* – provides savings, cost and payback analysis. **Claim:** usually surpass ESCO estimates on energy savings.
- *IES* – Integrated Environmental Solutions – energy modeling software that enables simulation of different scenarios. Its unique and more advanced than REVIT. However, its only as good as the data.
- *Lucid* – Useful in the post-audit reporting process. It helps with management, benchmarking and analysis tool for connected buildings. The reporting process is important and lucid provides a good tool for that. Lucid also provides another product which serves to standardize the operating systems of BMS all over the world.

- *Ecodomus* – A relatively new software, used by FM within facilities to aid in retrofits and link real time facility operations via data acquired through meters and sensor (BMS). **Claim:** ability to integrate BMS, sensors, operational parameters, control and include Computer Aided Facilities Management (CAFM). Also allows real time modeling of energy use which enables precise identification of problems.

Discussion Questions and Response Narrative

Are these software being adequately used in buildings? How adequately can they be integrated into processes. Do they yield more savings or more accurate results?

It was noted that CAD was more relevant than Revit in the region. Another issue in the region is that there is very little building data available. As-built BIM models are typically par for the course in new construction projects but older buildings typically have zero drawings to incorporate onto BIM. Another issue with BIM models may be that they are built for the design and construction phase only and lack elements that would come into use during the operational phase.

A lot of inefficiencies are resulting in ESCOs creating BIM models through as-built drawings. The question is how can this gap be bridged? How can existing assets be made available for more streamlined energy management processes. Estimation is risky, especially for historic data, so the quest is always to generate the right BIM models with as much accurate data as possible.

It essentially boils down to education and awareness; knowing the right code that applies to the specific building system, knowledge of precautionary measures, technical know-how of industry standard operational parameters – these take time to learn, understand and specialize. Couple this fact with building owner misconceptions on the complexities of M&V processes and the issue is compounded further. Nevertheless, these are not unsolvable issues, and most importantly, the status quo of poorly managed buildings in the UAE has to change.

A suggestion that surfaced was simply honing in asset management through the FM sector or at the operational stage, at the least and as a start. It was agreed to be a workable solution as ESCOs simultaneously establish themselves further in the region.

Technologies for M&V and Reporting

This is a process where guessing and estimating is foolhardy. Precise data is critical and energy models are needed to understand why energy consumption has changed overtime. The following software link well with the M&V process:

- *Deltameter* – Automated M&V: The Deltameter is a relatively new and is by far the most advanced technology in the market for accurate M&V. The company that created it is part of

the MEETS (Metered Energy Efficiency Transaction Structure) coalition. Energy efficiency in this spectrum is turned into a similar contract procedure as a solar PPA – which entails shared energy performance contract (EPC) with on-bill financing. The Deltameter ensures that the utility company signs up with the ESCO/investor over an agreed PPA of energy purchase. It also provides simultaneous and consistent calculations on consumption and savings over time.

- *Bractlet* – Data collection and analytics via on-site meter data with full auditing capabilities such as savings, cost and payback identification.
- *HELiOS* – Savings, cost and payback analysis. Similar to Deltameter but the interface aligns better with the traditional EPC format.
- *IES* – Provide a new field software that performs M&V with energy modeling support.
- *Periscope* – Built on the Niagara platform. Provides real-time and historical data analysis for M&V of savings. Similar to Lucid.
- *Lucid* – Management, benchmarking and analysis tool for connected buildings.

Technologies for Reporting

With a plethora of data streams on hand, via excel spreadsheets, audit procedures, energy management, or BMS, the following software serve as great analytic and reporting tools which provide insight that gets companies on the path to saving energy.

- Tableau – Business intelligence and data analytics cloud-based software for real-time data visualization.
- Looker – Multiple data source for data visualization and reporting. Works on an open platform.
- Lucid – Management, benchmarking and analysis tool for connected buildings. Good for integrating within FMCs.

Conclusion

The number of building technologies available in the market are growing with several different companies laterally integrating into the energy efficiency sector, such as Dell and Cisco Systems which are primarily IT companies – spurring a phenomenon known as the Internet of Things (IOT). The future is welcoming hyper integration of monitoring systems within buildings to ensure data is accurate and available. The better the data, the lesser the risk.

When it comes to capturing this market, the UAE still lags behind despite the potential within the existing building stock and the political will to make the change. Questions abound on the cost-effectiveness of all these technologies. Will customers buy-in and sign up? Will banks get involved in this systematic automated process backed up by robust technology? Will ROI periods shrink?

So far technology is promising but its propagation in the local market boils down to the ESCO companies and not the client. Clients want the end product which is guaranteed savings, but they are not ready to make the investment unless they see real value come out the other end. The technologies that were highlighted during the technical workshop are proving to facilitate energy management. Given the new regulatory incentives such as Etihad ESCO and the push to retrofit (including audit and M&V) 30,000 buildings in Dubai alone, makes the adoption of technology an imperative need.

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