

Emirates Green Building Council

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Technical Workshops 2014 Briefs

Emirates Green Building Council (EGBC) Technical Workshops are intended to gather EGBC 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 EGBC 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 EGBC objectives to be an active and pro-active knowledge center to its members.



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.

Address: PO Box 121838, Dubai, U.A.E.

Tel: +971 4 346 8244

Fax: +71 4 346 8248

E-mail: info@emiratesgbc.org

Website: www.emiratesgbc.org

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Disclaimer:

This paper provides overall guidance on principles only, and needs to be read in conjunction with the references given below. All projects have individual and differing requirements, and the contents of this paper are generic. The contents of this paper need to be interpreted to suit the individual project requirements.

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EGBC Technical Workshop #2014-1:

“Learning from nature: biomimicry in the green building industry”

21 January 2014

Facilitators:

Steven Pratt, Interface

Marie-Helene Westholm-Knebel, EGBC

Venue: Emirates Green Building Council Office, Dubai, UAE

Keywords: environment, biomimicry, sustainability, design, materials.

An introduction to biomimicry

If the term *biomimicry* has only been used in contemporary literature since the late 1970s, the idea to get inspired from nature itself is far from new. Already in the 15th century, Leonardo Da Vinci for instance carefully studied the anatomy of birds and the way they fly to sketch his own “flying machine” which later on inspired the design and mechanics behind modern aircrafts.

In January, the workshop’s participants were invited to share their **understanding of biomimicry and discuss the existing possibilities to apply innovative solutions into the local building industry.**

What to learn from biomimicry

Back to basics: defining biomimicry

Biomimicry, also called biomimetics, can be defined as the study of learning from nature to solve problems in design, in business and in life, keeping as a core principle that nature offers a sustainable solution to human problems.

Did you know...

The word Biomimetics comes from ancient Greek as a combination of *bios* = life, and *mimesis* = imitate

Janine Benyus, a U.S. biological scientist, popularized the concept in 1997 in her book *Biomimicry: Innovation Inspired by Nature*, emphasizing that nature should be considered “a **model**” (biomimicry is the science that tries to imitate or get inspiration from natural designs and processes), “a **measure**” (long-lasting ecological standards should guide us to design the right products and processes) and “a **mentor**” (nature is a constant source of learning and progressing).

During the workshop, the participants were asked to use their personal and private experience to define the concept and its benefits. Two main points were highlighted in the discussions:

- Biomimicry imitates well-structured systems in nature to solve complex real-life challenges in engineering, product design,... and allows us to innovate.
- Biomimicry allows us to understand how nature works, and how to emulate it. It involves to a certain level that we let nature lead the way and learn from it.

Important factors to get inspired from

- **Time, adaptation and optimization:** with more than 3.8 billion years of existence, nature has had sufficient time to adapt its various (eco)systems to reach the right level of perfection, optimizing the use of resources to function while minimizing waste. Proportions, scales and shapes are as they should be based on these resources.
- **Randomness:** natural diversity shows that nothing in the environment is absolutely perfect or identical, and even if shapes and colours are diverse they still generate harmony.
- **Learning from the past:** for centuries our habitats were designed to adapt to natural conditions (available resources, climatic conditions) and therefore considered as “living organisms” to respect as such. The impact on the environment was not significant, and buildings/settlements could identify cultures and traditions.
- **Systemic approach:** elements in nature work in symbiosis and need each other to function optimally. Sustainability should emphasize the need to consider the built environment in a most systemic way.

Intentional and serendipitous achievements

Many examples of discoveries and achievements directly inspired by nature, intentionally or by chance, can be discussed; the following have been addressed during the workshop:

- Design and mechanics of planes inspired by the observation of birds;
- Velcro and other sticking mechanisms inspired from plants, bugs, seashells;
- Telephone receiver designed by Alexander Graham Bell based on how the human ear functions;
- Sonar systems inspired by whales, dolphins and bats;
- Speedo swimwear that mimics shark skin to reduce body resistance in the water.

The workshop participants agreed that despite the best sources of inspirations and modern/technological innovations, nature can only be used as a “design guide”: we can only “try to imitate” it but it is nearly impossible to replicate it. Humans are technically able to create new systems/items “from scratch” and “mix and match” designs to apply one concept to a completely

different purpose; however one cannot expect to achieve the same optimal results as with natural products and processes that have taken millions/billions of years of evolution!

Biomimicry in the built environment

Inspirations for architecture and materials/products

Using nature as model and design guide for buildings, industrial process and new products can give us great insights on how to enrich the urban landscape without compromising the environment. It can also positively change our understanding of the purpose of buildings and more generally of urban planning, leading to better/more harmonized infrastructures and facilities that will respect nature, its eco-systems and human health and comfort.

- **Architecture:** many examples of buildings in the world showcase how biomimicry can be implemented in design and technical set-ups. A 33 story building in Harare, Zimbabwe, mimics for instance termite mounds to maintain a natural ventilation flow and guarantee comfortable temperatures to its occupants. Since its completion, the building saved 3.5 USD and realizes 10% energy savings annually. The 2008 Beijing Olympics sport facilities (i.e. the [Beijing National Stadium](#), nicknamed "The Bird's Nest" and the [Beijing National Aquatics Center](#) also called the "Watercube") have also been designed to mimic nature while guaranteeing the core purpose of the infrastructures.
- **Products and materials:** many new industrial products used in the building industry have been inspired by natural systems and living organisms:
 - Paint: water repellent texture inspired by lotus leaves to create new paints that do not retain dust; polychromatic light-reflecting materials inspired by peacock feathers;
 - Glass: manufacturing with UV reflectors to prevent birds from crashing in glass, inspired by spider web silk whose components reflect light in a special way that birds do not crash in them;
 - Resins and glues inspired by blue mussel mollusks and other seashells who stick to rocks;
 - Polycarbonates and plastics: certain plants turn CO₂ into long chain starch and glucose, process that could support the research on industrial production of polycarbonates and plastics.

By using biomimicry while considering local factors and challenges including access to daylight, air quality and ventilation, thermo-comfort, humidity, etc., one can expect to revolutionize the building industry and give an important share to green innovation.

Challenges and opportunities

Despite nature's infinite source of inspiration, challenges do exist in terms of impacts of the building industry on the environment as well as of overall awareness on biomimicry's benefits:

- **Industrial processes do not respect natural systems:** with more resources wasted than used in any manufacturing process (with a ratio of 96% waste for 4% net results), our activities are particularly aggressive to the environment, and the need for change is critical to guarantee natural conservation as well as our survival. Modern time discoveries inspired from nature could help develop new ranges of innovations, processes and rules that would make industrial activities more harmonic with the environment.
- **Despite a general interest in biomimicry, market forces still relate the concept to the initial financial investments of developing new products and processes rather than to its obvious long-term benefits:** on the same level as "green" materials it is still expected that production and distribution costs are much higher than conventional/traditional materials. To counter this, raising awareness on the benefits, both in terms of financial returns and environmental concerns, should become a stronger priority. A better understanding of the biosphere and sustainability would trigger stronger interest and positive reactions.

Conclusion

Using nature as a "model", a "measure" and a "mentor" can support green innovations and research, while creating a greater relationship between our activities, urban development and the environment. It provides us with an infinite source of inspiration, long-lasting knowledge and resources that need to be carefully protected and emulated to guarantee the survival of eco-systems.

12 challenges for the built environment, [Biomimicry Guild](#) and the [Rocky Mountain Institute](#)

- 1- colour
- 2- adhesion
- 3- deshumidification
- 4- foundations
- 5- building materials
- 6- protection from disasters
- 7- protection from elements
- 8- seasonal response to environmental conditions
- 9- sand
- 10- light
- 11- building skin
- 12- service distribution

These challenges apply to any location, but should be prioritized to local conditions in order to tailor the most relevant and efficient solutions to existing problems.

The Biomimicry Guild and the Rocky Mountain Institute have developed a database in which nature's solutions to these challenges are compiled.

References, tools and articles:

- Benyus J.M., *Biomimicry: Innovation Inspired by Nature*, 1997.
- Dunbar B., [Biomimicry: Generous, cool ideas for a hotter and flatter world](#), Institute for the Built Environment, Colorado State University.
- Eggermont M., [Biomimetics as problem-solving, creativity and innovation tool](#), University of Calgary.
- El Ahmar S.A.S, [Biomimicry as a tool for sustainable architectural design](#), Alexandria University, January 2011.
- Elghawaby M., [Biomimicry: A New Approach to Enhance the Efficiency of Natural Ventilation Systems in Hot Climate](#), Marseille School of Architecture, June 2010.
- McGregor S.L.T., [Transdisciplinarity and Biomimicry](#), *The Atlas*, Vol. 4, pp. 57-65, 2013.
- San Diego Zoological Society, [Global Biomimicry efforts, an economic game changer](#), 2010.
- Skidmore, Owings & Merrill LLP, [Nature-Structure. Structural Efficiency Through Natural Geometrics](#).
- [TED Talks about biomimicry](#).
- The Biomimicry Institute, [Innovation by Nature](#), presentation given on the IBE Annual Conference, March 2008.
- Watson S., [Learning from Nature](#), *Implications*, Vol. 2 Issue 4.

EGBC Technical Workshop #2014-2:

“Materials and systems contributing to Energy Efficiency: building envelopes”

31 March 2014

Facilitators:

Brown Joseph, DOW Chemicals

Marie-Helene Westholm-Knebel, EGBC

Venue: Emirates Green Building Council Office, Dubai, UAE

Keywords: energy efficiency, building envelope, insulation

Introduction

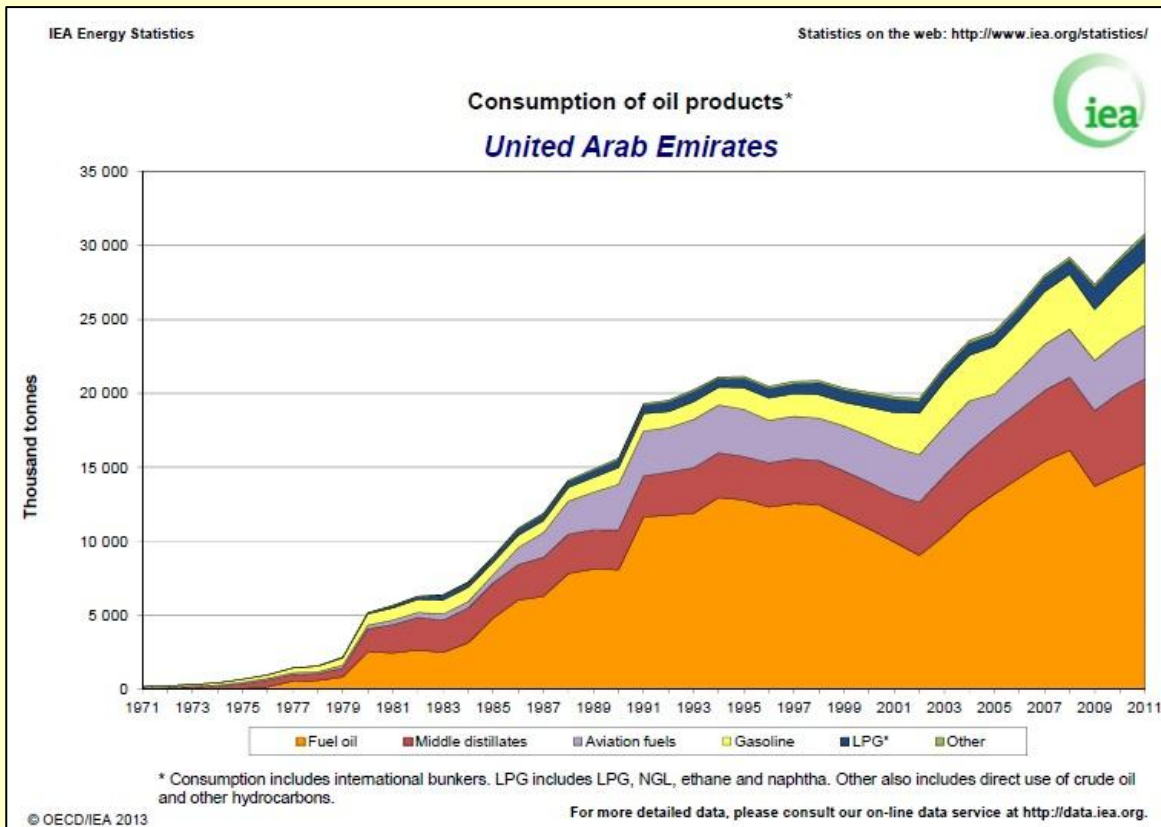
With global and regional trends indicating a continuous increase in energy demand and a still-growing dependency on fossil fuels (International Energy Agency, 2013), the need to consider energy efficiency as a priority for the authorities and the industry increases accordingly. With residential and commercial buildings accountable for 70 to 80% of the overall use of generated electricity in the GCC region, applying sustainable building practices appears as the quickest and most effective way to reduce energy consumption and therefore better manage resources.

In March, the workshop’s participants were invited to discuss the efficiency of building envelopes and insulation systems available on the market as well as address the effectiveness of existing standards and regulations in the region.

Energy challenges in the region and impacts on energy demand

Back to basics: Energy demand in the UAE/GCC region

To cover the country’s increasing demand for energy/electricity whose generation mainly depends on fossil fuels, the UAE has reached a point where consumption and demand for natural gas exceeds the production and continues to increase (U.S. Energy Information Administration – see following table on the evolution of consumption of oil products 1971-2011).



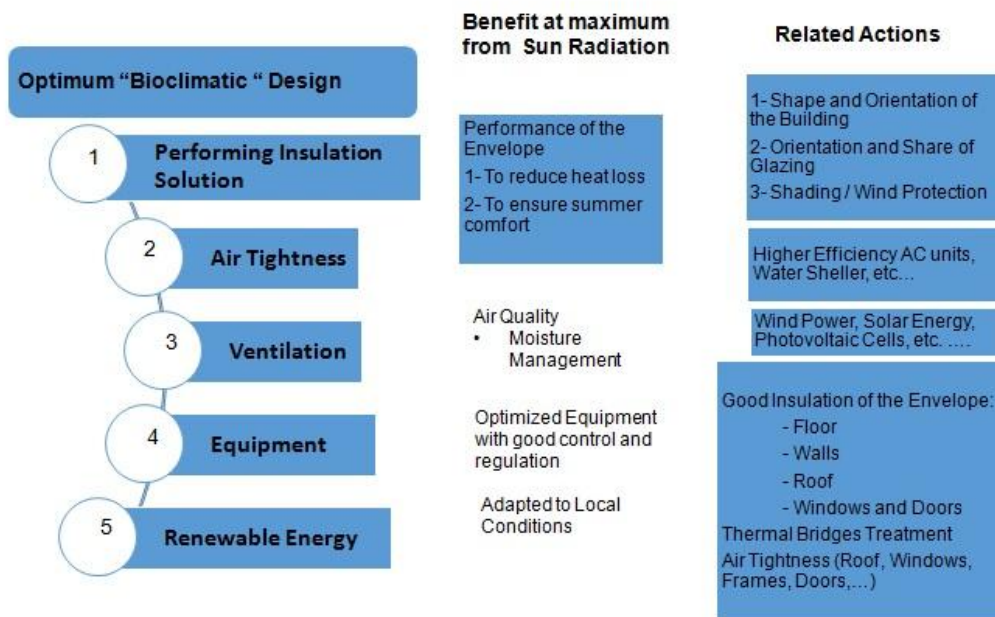
In view of the local climatic context and past construction standards, residential and commercial buildings in the UAE are accountable for 70 to 80% of energy demand, out of which 60-70% directly relate to the need for climate and temperature control (i.e. HVAC). **Various factors** have been identified to explain such a high consumption: climate and temperatures (particularly in the summer period), lack of buildings that have been properly designed to conserve energy (i.e. presence of thermal bridges, energy leakages...), and weak awareness and habits of consumers and building occupants (i.e. uneconomical settings of thermostats, misuse of lights and equipments). The potential for energy savings is therefore tremendous and can easily be addressed through an improvement of the building's envelopes and insulation methods.

Air tightness and thermal bridging

Combined with a comprehensive set of measures to improve the energy efficiency of a building, insulation of the building's envelope is one of the key steps to improve its performance and quickly contribute to a decrease in energy consumption.

Ways to Energy Efficiency

Insulation of the envelope is the first step to improve Energy Efficiency



Slide produced by workshop facilitator and used during the session

During the workshop, the participants were invited to review examples of building facades and envelopes for which thermal and air tightness tests have been conducted. These tests have highlighted the **presence of thermal bridging and obvious lack of insulation** (for instance no continuous insulation membranes), which made these buildings prone to energy wastage. Other factors, such as positive pressurization of the building, system depressurization, wind pressurization, stack effect and AC system imbalance have been identified as common causes of building air leakage which should be addressed to reach energy efficiency.

Did you know...?

Bioclimatic Architecture: Takes into account climate and environmental conditions to help achieve thermal and visual comfort inside. Appropriate techniques are applied to the external envelope and it's openings to protect the building from solar heat

Thermal Insulation: A Low cost, widely available, proven technology that begins saving energy and money, and reducing emissions, well installed insulation ensures Energy Efficiency in every part of the building envelope including ground decks, roof lofts, walls and facades.

The way forward

Products and processes leading to energy efficiency

Various building envelope materials and systems widely available on the market can easily contribute to improving the building's energy performances – see page 6 for examples of the most common materials in use in the UAE.

Some of these materials, such as reflective **white roof coatings or TPO membranes**, do not replace proper insulation materials, but apply concepts (high reflectivity, high emissivity) that can limit the absorption of heat through the roof structure. Some others such as **green roofs** are very fashionable in Western cities, but might be harder to apply in the UAE climatic context while necessitating good roof insulation to prevent water-related damages. **Insulation systems** such as the **Exterior Thermal Insulation Composite System (ETICS)** and **Exterior Insulation and Finishing System (EIFS)** have also commonly been used in the region as a combination of materials and coatings (cladding) to guarantee insulation and waterproofing of a structure.

Constraints and limitations

The workshop's participants were invited to share their impressions on these materials and systems in view of their respective industries and projects. A first comment highlighted the fact that even though building envelopes contribute to greening a building and achieving green ratings' criteria, information **regarding the production and procurement of the raw materials and system components are generally not disclosed or assessed**, which can bias the concept of "green building".

Moreover, it was agreed that even though green regulations and standards should be strictly applied, it remains critical for suppliers and contractors **to focus efforts on other regulations for health and safety** such as combustion risks or VOC's.

Green regulations and market forces: challenges and possible solutions

When addressing the impacts of green regulations and standards on the market, on the quality of available products and more generally on the energy usage, the workshop's participants have highlighted the following challenges:

- **energy rates** in the region are imposed by each emirate and cannot be negotiated, and no incentives are proposed to invite users to reduce their consumption through energy retrofits and technological innovations;
- the **enforcement of green standards and regulations** as well as the supervision and verification mechanisms are not considered sufficient to ensure that materials and systems are properly used and installed to guarantee correct insulation and energy savings;

- Green standards set in the regulations are understood as sufficient as such, while they are actually **minimum values that can be positively exceeded**;
- It often appears that clients, owners and developers do not understand the new regulations and how they can actually benefit from them: they seem more interested in **short ROI for their assets** rather than taking into account the “big picture” (long-term reduction of energy demand and energy costs, reduction of carbon footprint etc...)

The following suggestions have been made to improve the response of the market and ensure that building envelopes are used as relevant tools to reach energy efficiency:

- **clients and owners’ education awareness** remains a key factor to improve, as the regulations and standards (i.e. U Value level) are considered not sufficient to have an actual impact onto the market and more generally onto the energy demand and consumption;
- **the visibility of energy efficient goods, materials and systems should be increased** by disclosing their technical specs to better inform the market.
- on the same level, proper **energy labeling of buildings** should allow customers to be informed on the facilities they purchase and the potential energy and financial savings they can benefit from by investing responsibly, where long-term quality exceeds short-terms ROI.

Materials and systems contributing to Energy Efficiency – building envelopes options

Please note that the below list is not exhaustive and mainly reflects products and processes that are commonly used in the GCC region. Other energy efficient alternatives are available on the market and should also be considered when designing/refurbishing a building.

Plastic foams

Coatings

Mineral wool

Reflective materials

Cool roofs membranes

White roofs/cool roofs based on acrylic elastomeric coatings, TPO membranes

Green roofs

Spray polyurethane foam and polystyrene foam insulation (including inverted roof insulation)

Insulated blocks

Sandwich panels

Insulated concrete forms

Glasswool and rockwool insulation

Exterior Thermal Insulation Composite System – ETICS or Exterior Insulation and Finishing System – EIFS

Conclusion

While green regulations in the UAE address the need for energy efficiency through better standards and materials, the workshop highlighted the need for further improvements on the regulatory side but also for more education to the market and its various parties. Efforts of the local authorities to raise awareness towards better infrastructures (and in general towards sustainability) have been commended, but short-term business mentalities and the lack of overview and visibility of efficient materials and buildings actually slow down the effectiveness of these regulations.

References, tools and articles

- Basarir B., Diri B.S., Diri C., [Energy efficient retrofit methods at the building envelopes of the school buildings](#), Mimar Sinan Fine Arts University.
- Erhorn-Kluttig H., Erhorn H., Lahmidi H., Anderson R., “Air tightness Requirements for High Performance Building Envelopes”, 2009.
- Gowri K., Winiarski D., Jarnagin R., [Infiltration Modeling Guidelines for Commercial](#)
EmiratesGBC Technical Workshops 2014 Brief

- [Building Energy Analysis](#), Pacific Northwest National Laboratory, September 2009.
- International Energy Agency, [Technology Roadmap, Energy efficient building envelopes](#), 2013.
 - International Energy Agency, [IEA Energy Statistics, UAE Consumption of oil products](#), 2013
 - Jaggs M., Scivyer C., “Achieving air tightness: General principles”, *Good Building Guide*, GG 67, Part 1, January 2006.
 - Kadlubowski R.P., Yates D.W., [The Building envelope: Energy efficiency and economics](#), *Hoffmann Architects Journal*, Issue 4/2009, Volume 26, Number 4, 2009.
 - LEED Reference Guide for Green Building Design & Construction, 2009 edition ASTM E779 – 10: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization Report
 - Maneeh A., AlNaqbi W., Kazim A., Abu-Hijleh B., Economic Assessment of Refurbishment of Federal Public Housing in the UAE, SB13 Dubai Paper, 2013.
 - Professional Engineers and Geoscientists of BC, [Building Envelope Practice - Roles and Responsibilities](#), February 2002.
 - U.S. Department of Energy, [Building Envelope – Technology Roadmap, a 20-year industry plan for building envelopes](#)
 - U.S. Energy Information Administration, [United Arab Emirates](#), December 2013.
 - Zhivov A., Anis W., “Building Air Tightness and Air Barrier Continuity Requirements”, *USACE Engineer Research and Development Center*, 2009.

The use of chemicals at work has also been defined in the same Convention as “any work activity which may expose a worker to a chemical, including: (a) the production of chemicals; (b) the handling of chemicals; (c) the storage of chemicals; (d) the transport of chemicals; (e) the disposal and treatment of waste chemicals; (f) the release of chemicals resulting from work activities; (g) the maintenance, repair and cleaning of equipment and containers for chemicals”.

Chemicals in the private environment and in the workplace: presence and impacts

As part of both our lifestyles and professional requirements, exposure to chemicals cannot be avoided. Any over-exposure, mismanagement and accident can however surely be prevented through the implementation of clear and thorough management systems and safety measures to be followed by each of the employees.

If some chemicals mixtures are used for their positive impacts on human health and the environment (cleaning products, pharmaceuticals, pesticides...) – of course if properly handled - others can have major negative impacts that might not have been well documented yet¹: occupational diseases (comparable to sick-building-syndrome), injuries, inability to work, death. The lack of long-term research and analysis in the UAE specific context makes it also challenging to assess the situation on the local workforce and better prioritize areas of actions and decisions on the political level (policies, regulations, controls and reporting mechanisms...) in terms of use, storage, transportation and end-of-use disposal.

Classifications and existing tools to assess chemicals hazards

In work environments that are exposed to possibly hazardous mixtures, values to classify chemicals and identify the risks to handle them have been developed and generally accepted worldwide. Occupational exposure limits values (OEL), threshold limit values (TLV), permissible exposure limits, recommended exposure limits, maximum allowable concentrations (MACs) and other technical specifications are generally available on the Material Safety Data Sheet of a product to describe its classification, storage conditions and handling precautions to respect.

International organization such as the United Nations Economic Commission for Europe, the International Labour Organization or the World Health Organizations have also cooperated to develop global frameworks to harmonize the knowledge and communications (labels, data sheets) around chemicals management. The [Globally Harmonized System of Classification and Labelling of Chemicals \(GHS\)](#) was first published in 2003 and continuously updated to address new challenges:

¹ The workshop focused on chemicals impacts in the work environment; however ILO covers also impacts on the environment and surrounding communities.

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)



Description of the GHS – ILO presentation, 2014

Safe chemicals management on the corporate level

Corporate processes and certifications

Environmental management systems such as ISO 14001, or internal Health, Safety and Environment (HSE) policies have the advantages to set a framework and specific processes and requirements to guarantee the safety of the workforce and limit the human and environmental risks associated with chemicals management. The advantages of implementing such policies and complying with such standards are as follows, amongst others:

Advantages for the company:

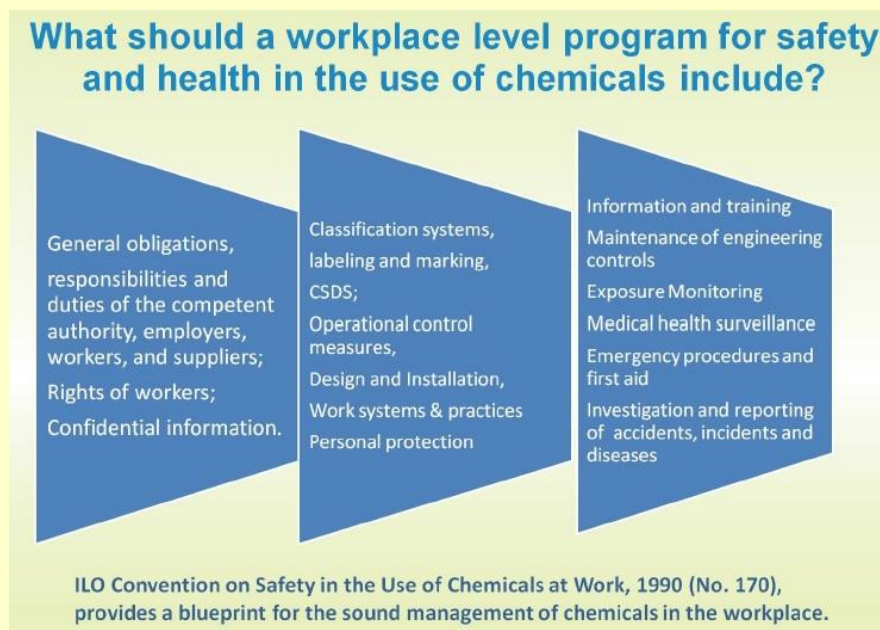
- Reduction of energy consumption, raw material usage and waste disposal
- Recoverable resources
- Reduction of penalties and insurance costs
- Continuity of operations with higher performance and efficiency
- Better risk management and minimization of accidents/incidents

Advantages for the workforce:

- Cleaner, safer and more controlled work environment
- Better job security as the company reduces waste and costs associated to risk management, health and environmental issues
- Lower impacts on personal health
- “Big picture” considerations: positive impact on the environment/the planet

To start engaging management and workforce and developing internal policies and procedures to achieve the sound management of chemicals on a constant basis, ILO suggests a step-by-step approach to ensure that all aspects and stakeholders are taken into account. This approach includes:

- the identification of chemicals to be handled and their classification in terms of risks/hazards and their labelling accordingly;
- the determination of potential exposure in the workplace and related risk assessment;
- the identification and implementation of control measures and the continuous evaluation of their effectiveness (including the possibility to revise them).



Step-by-step approach to include safety and health in workplace mindset – ILO presentation, 2014

This general step-by-step approach needs then to be complemented by a set of internal policies, administrative procedures and forms that will support the implementation and the design of long-term objectives including significant health, safety and environment considerations into the company's operations.

Awareness, education and internal culture of safety

During the workshop, the participants were asked to share their experience with regard to the management of chemicals in their respective industries and areas of activities. They were for instance asked whether the internal policies and procedures in place are well-communicated throughout their organization in view of the chemicals and risks they are exposed to. The following requirements were highlighted:

- To be fully efficient, the concepts of health, safety and environment need to be strongly incorporated into the company's corporate culture and embraced throughout the different levels of hierarchy. When well integrated, HSE actually adds value to the workspace.
- Sound chemicals management as well as other HSE concerns need to be aligned with long-term objectives towards sustainability and safety. Results, best practices and lessons learned should be properly communicated throughout the organization.
- If eco-friendly alternatives to chemicals mixtures cannot be identified or used, time should be allocated to the preparation of data sheets for new products that clearly detail handling instructions, traceability of the products and components, safety measures to implement.
- Policies and processes should be thoroughly communicated to the workforce, and continuous training (i.e. not only as an induction) should be conducted to ensure that standards and safety measures are not only well understood but also updated on a regular basis.
- Trainings and controls can help motivate the workforce to feel engaged and empowered by the company, possibly leading to better performance and fewer turn-over.

Internal challenges

A few challenges however have been identified, some of which are associated with the local perspective of work environment, regulations and multi-cultural understanding of safety:

- Despite internal policies and management systems, it can sometimes be challenging to have all staff members continuously engaged in implementing safety measures at all times while providing them with training and equipments to be used to guarantee their safety. Cultural factors were agreed to be a contributing challenge as well as the lack of penalties in the case of breaches in health and safety.
- Internal inspections and third-party controls are often not stringent enough in terms of frequency, feedback and reporting, and potential fines to be given to companies that do not respect the HSE standards and place their workforce in risky situations.
- Other corporate priorities and motivations from owners and landlords tend to bring safety to a secondary level, even if the company has implemented a proper HSE policy. Often, staff or departments accountable to handle HSE and chemicals management as part of their terms of reference are not sufficiently trained and therefore do not give these issues the right visibility.
- Focus is generally put on toxic chemicals that are harmful for human health and the environment. However, non-toxic products also carry high risks if they are not handled

properly (spills, ground and water contamination...) for which the company and workforce will be accountable for.

Conclusion

Chemicals are intrinsically connected to the activities in any organization; their safe management and continuous education of the workforce about their associated risks are keys to ensure safety for the workspace and the environment.

The possible lack of training to address all risks on human health and the environment has been associated with the need to prioritize chemicals management against other corporate requirements, as well as the need to make safety a core aspect of internal processes and standards.

Despite these existing challenges that were addressed by the participants, a lot has been made in the UAE to improve HSE regulations and control mechanisms and thus guarantee the safety of the workforce. Local authorities have made more resources available to guide companies and individuals as well as to support staff training and education environment to encourage best corporate practices. Reinforced communications campaigns have also allowed for a better understanding of the regulations and standards in place in the country.

References, tools and articles

- Abu Dhabi Global Environmental Data Initiative, [Wastes and Pollution sources of Abu Dhabi Emirate](#), 2008.
- Abu Dhabi Environment, Health and Safety Center – [OSHAD main page](#).
- [Dubai Municipality portal](#) and approved training providers.
- International Labour Organization, [Chemicals Safety and the Environment](#), reference page.
- International Labour Organization, Safety and Health in the use of Chemicals at Work, [official 2014 presentation](#) and [official report](#).
- Kamakura Y., with the International Labour Organization, [Corporate structural change and social dialogue in the chemical industry, Working papers are preliminary documents circulated to stimulate discussion and obtain comments](#), 2006.
- Safe Work Australia, [Managing Risks of Hazardous Chemicals in the Workplace](#), July 2012.
- United Nations Economic Commission for Europe, [Globally Harmonized System of Classification and Labelling of Chemicals \(GHS\)](#).
- United Nations Environment Programme, [Strategic Approach to International Chemicals Management](#), 2006.

EGBC Technical Workshop #2014-4:

“Passive Measures in Façade Design and Construction – Abu Dhabi example”

25 June 2014

Facilitators:

Edwin Young, Abu Dhabi Urban Planning Council - Estidama

Marie-Helene Westholm-Knebel, EGBC

Venue: Eastern Mangroves Hotel, Abu Dhabi

Keywords: lighting, standards, UAE

Introduction

In view of the regional climatic conditions, considering passive design as an approach to build energy efficient buildings and sustainable communities is surely appropriate. Beyond its environmental benefits it also contributes to obvious financial savings by taking into account from the early design stage all factors which will make a building consume less energy and water.

In June, the EGBC Technical Workshop was jointly facilitated with Abu Dhabi Urban Planning Council. Using Abu Dhabi as example, it addressed the key parameters in facade design and construction methods that impact the passive performance of a building.

“Passive design refers to a design approach that uses natural elements, often sunlight, to heat, cool, or light a building. Passive solar or passive cooling designs take advantage of the sun’s energy to maximize heating or cooling based on a building’s sun exposure.

Systems that employ passive design require very little maintenance and reduce a building’s energy consumption by minimizing or eliminating mechanical systems used to regulate indoor temperature and lighting.”

[Ecopedia Website](#)

The key parameters of passive design

Key parameters for efficient passive design

Many parameters are to be taken into account to increase the physical and financial benefits of heat avoidance, passive cooling and mechanical cooling and renewable, including amongst

others:

- the building's structure;
- its orientation;
- the placement of windows and their specifications;
- the possible installation of skylight;
- the insulation and building materials;
- air leakage avoidance.

Applying passive design to heat, cool or light a building can help reduce this building's energy consumption, considering that the modeling has been made in an **integrated manner** and each step in the process properly assessed.

As such, a **“shoe box” step-by-step approach** should be used to analyze a number of parameters (building's shape, orientation, glazing ratio, glazing SHGC, external shading, air leakage, envelope conductive performance) to inform all parts involved in the project, shape the design at the concept stage and proactively identify the potential energy savings of the design itself. The Estidama methodology also strongly emphasizes the need for **continuous stage monitoring** during design, construction and operational phases to assess the efficacy of the applied approach and if required apply corrective measures as soon as possible.

Beyond integrating the “shoe box” approach into the building systems, it remains crucial to ensure that the project planning and the above-mentioned parameters still keep in mind the **clients' expectations as well as the final product to be delivered** (purpose, operations and occupants).

The **Estidama RE-2 credit** refers to determining “the most effective solution to reduce a building's cooling demand by incorporating passive design strategies as a priority”.

Case Studies in Abu Dhabi: Masdar Siemens and the Imperial College London Diabetes Centre

To illustrate the importance of monitoring these key parameters, two cases studies of buildings located in Abu Dhabi have been presented:

- **Case study 1, Siemens Headquarters in Masdar – example of passive design study:**
The new office of Siemens in Masdar has been designed and built to the highest green standards, and is the first building in Abu Dhabi to hold the LEED Platinum certification in the Emirate. The emphasis on passive design elements has helped reduce the estimated overall annual energy consumption of the building by up to 44%, making this building a green landmark in the Emirate.

- **Case study 2, Imperial College London Diabetes Centre (ICLDC), Al Ain and Abu Dhabi premises – example of operational study:** Following the successful completion of its first phase in Abu Dhabi, the Imperial College London Diabetes Centre opened its second premises (Phase 2) in Al Ain. While it is obviously critical that the design of medical premises keeps the patients' interest and health as first priority, it was decided that the ICLDC Al Ain design integrates passive features in the shape of efficient glazing and skylight to provide additional light and landscape views to the patients. Amongst other initiatives, energy efficient equipments for cooling have been installed and renewables have been used for hot water production, allowing the premises to dramatically reduce water and energy consumption compared to the Abu Dhabi facilities. With such achievements, the ICLDC Al Ain is the first construction project to achieve the 2 Pearl Estidama Rating.

Discussion points

Using these two case studies as well as their respective experience in the fields of passive design and energy efficiency, the participants were invited to discuss the advantages related to these key parameters and the challenges that their implementation might trigger.

Is passive design enough?

If passive design features help make a building efficient in terms of water and energy consumption, they are **not the only explanatory factors** that need to be considered. In the ICLDC case study, the benefits of passive design were for instance combined with the installation of highly efficient fixture and better water pressure equipments which also justified the difference of 60% of water daily consumption between the Abu Dhabi and Al Ain new facilities.

The way the building is operated is also a key factor that cannot be neglected to understand energy and water consumption: if the tenants do not understand how their behaviours can affect the building's performances, energy and water waste can easily cancel the benefits generated by efficient design and equipments. As such **behavioural change and education to tenants towards green practices** are crucial and considered the easiest way to reach the "low fruits" of energy efficiency. On the other hand, **involving green professionals** throughout the project conduction is an absolute necessity to ensure compliance between design and final product, proper handover/commissioning, relevant modelling and monitoring of consumption.

Regulations/standards and energy modelling

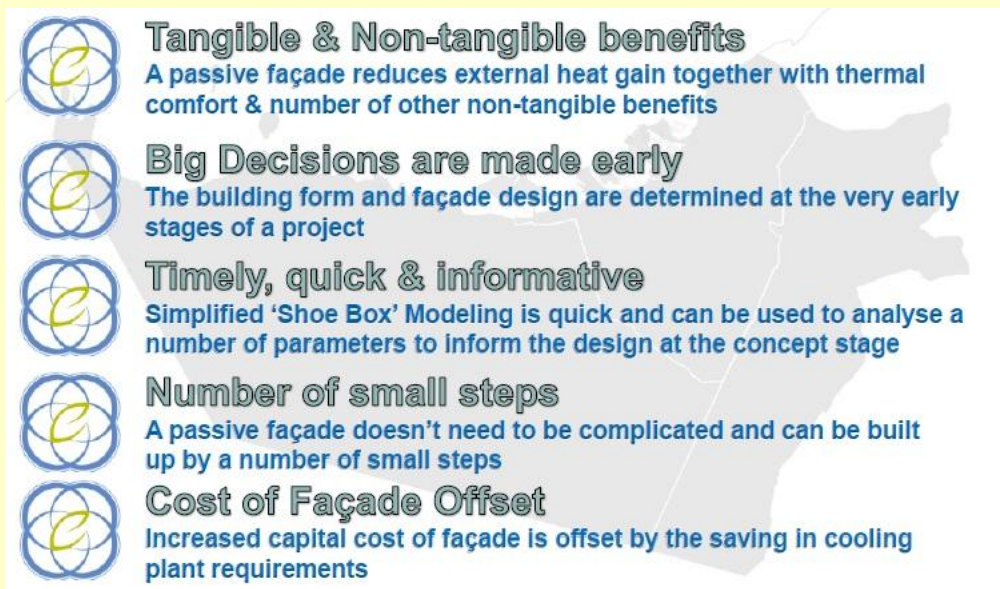
The efficacy of **energy modelling** to complement passive design parameters has then been discussed as a potential tool to ensure the building's design is appropriate in view of the expected consumption demand.

However, it was agreed among the participants that **modelling should not be used as a “compliance tool”** for owners and projects managers to achieve a specific green building standard or certification level: it should be used as an early tool to help plan the project from the design stage and liaise the various teams under an interdisciplinary approach to ensure sustainability is guaranteed at all time.

At last, the question **whether passive design features should be made mandatory through regulations** was discussed and not ruled out as a possibility for the future of green buildings in the U.A.E. However, the current regulations in Abu Dhabi and Dubai and the existing rating systems (Estidama Pearl and LEED) already provide project owners and managers with stringent requirements and targets inviting them to implement the highest standards in terms of design, construction materials and equipments.

Conclusion

The benefits to implement passive design parameters throughout a construction project are not only numerous but also fairly easy to reach, with the obvious conditions that all teams work hand-in-hand to fulfil the requirements. The following points from Estidama Pearl Rating System properly summarize the importance and benefits of passive design:



Existing regulations and rating systems in the U.A.E. such as Estidama Pearl already provide a

detailed framework for a project to be conducted in a sustainable manner way, suggesting implementing integrated modelling and step-by-step measurements to reach best results. However, these recommendations should not be used as minimum targets only, but they should instead incite project owners and managers to reach excellence and continuously promote sustainability.

References, tools and articles

- Abu Dhabi Urban Planning Council - Estidama, [a Unique Approach to Sustainable Urban Development](#)
- Abu Dhabi Urban Planning Council – Estidama, [Passive Design, Facades Study against Estidama credit RE-2](#), presentation of David Warwick at the 2013 EmiratesGBC Annual Congress.
- ArchCorp Architectural Engineering, [Case Study for Heroes of the U.A.E.](#), 2013.
- Ayyad T. M., [The impact of building orientation, opening to wall ratio, aspect ratio and the envelope materials on buildings energy consumption in the tropics](#), The British University in Dubai, October 2011.
- Emirates Green Building Council, [Regulatory mechanisms to improve the energy efficiency and sustainability of the building stock](#), presentation from Saeed Al Abbar.
- Haggag M.A., [The use of green walls in sustainable urban context: with reference to Dubai, U.A.E.](#)
- Masdar, [Siemens strengthens Middle East presence with new headquarters at Masdar City.](#)
- St Clair P., [Low-Energy Design in the United Arab Emirates – Building Design Principles](#), BEDP Environment Design Guide, DES 30, February 2009.
- Yassine W., Elgendy K, [Passive Cooling, Responding to Electricity Demand in the U.A.E.](#), Caroun Middle East, Sustainable Cities

EGBC Technical Workshop #2014-5 & 7: “ESCO Principles and Mechanism” 19 August 2014 and 14 October 2014

Facilitators:

Khaled Bushnaq, EMS

Marie-Helene Westholm-Knebel, EGBC (Workshop One - August)

Tara Tariq, EGBC (Workshop Two - October)

Keywords: energy efficiency, ESCO, mechanisms

Introduction

Energy efficiency has been gaining momentum in the U.A.E., particularly in the Emirate of Dubai where governmental authorities have engaged in a vast program of retrofitting 30,000 buildings by 2030.

While various mechanisms such as Energy Performance Contracting (EPC) or the establishment of financial and technical procedures promote energy efficiency in a building at low cost/no cost to the owner, the establishment and accreditation of energy service companies (ESCOs) can help drive the market.

In August and October, two monthly EGBC Technical Workshops addressed the basic concepts related to the ESCO movement in the U.A.E. The presence of representatives from the Dubai Regulatory and Supervisory Bureau (RSB) allowed the participants to share questions, express their challenges and assess the ESCO development in the Emirate.

The following summary brief combines the content and discussion of both workshops for a comprehensive look at the ESCO accreditation scheme and how it's gaining a foothold in the growing energy efficiency market in the UAE.

Back to Basics: Concepts and Potential

If a dollar investment in energy efficiency allows an owner to save four dollars of energy consumption per generation, on a yearly basis, then the overall potential of savings related to the retrofit of existing buildings cannot be disregarded. If one considers that sustainable measures and mechanisms, especially in the building sector, cannot be seen as fully sustainable unless economically viable, then it remains especially crucial for all parties to understand the basic concepts in order to see how they can take part and benefit from the ongoing trend.

Important Definitions

Energy Service / Savings Company –

ESCO: commercial business providing a broad range of energy solutions including:

- designs and implementation of energy savings projects,
- retrofitting,
- energy conservation,
- energy infrastructure outsourcing,
- power generation and energy supply, and
- risk management.

Newer breeds of ESCOs now focus more on innovative financing methods.

Baseline Energy Cost: the amount in Dirhams identified based on:

- a) the annual energy and water consumption levels *(i) at the Premises or (ii) in respect of the Systems* prior to the implementation of the energy savings mechanisms by the ESCO; and
- b) the applicable unit rates.

Adjusted Energy Usage: the volumes of energy and water consumed *(i) at the Premises or (ii) in respect of the Systems* verified and/or measured, adjusted to take into account the effect on consumption of any material change(s).

Energy Savings: in respect of a Guarantee Year, the Baseline Energy Cost minus the Energy Cost for that Guarantee Year. If the amount is less than zero, Energy Savings shall be zero.

Energy Savings Guarantee: in respect of a Guarantee Year, the guaranteed Energy Savings for that Guarantee Year.

Contract Price: the price to be paid by the Customer to the ESCO for the performance of the Works and all obligations set out in the Contract.

Two types of ESCO contracts:

- a) **Guaranteed savings**: the ESCO “guarantees a certain level of energy savings and in this way shields the client from any performance risk” (Dreessen 2003). The ESCO covers shortfalls if the expected savings are not achieved.
- b) **Shared savings**: the ESCO and owner share an agreed percentage of the actual energy savings over a predetermined time. An external third party might be involved to support financing process.

Energy savings from green building retrofits

“Energy efficiency is generally the largest, least expensive, most quickly deployable way to reduce expenses”
www.marketresearch.com

“Energy efficiency is a sleeping giant. We have (in USA) the Saudi Arabia-sized oil reserve under our feet through energy efficiency” – De Monte

The potential of financial savings associated with energy efficiency is obvious and relates to a set of measures that can easily be implemented at low cost/no cost for the owners:

- Thermal envelope improvements
- Heating and ventilation system upgrades
- Sub-metering
- Lighting upgrades
- Improved controls
- Water saving fittings and fixtures
- Renewable energy installations
- Mechanical system upgrades

To be fully efficient these measures need to be combined with 1) proper maintenance efforts, 2) continuous refurbishment initiatives, 3) active education of owners and tenants, and 4) the involvement of utility/facility management companies that can support the processes.

The need to properly define the baseline of the project is also necessary to identify:

- the strategy to be implemented;
- the above-mentioned measures to choose from;
- the financial model to apply;
- the stakeholders to be involved; and
- the choice of contract to be applied to the project.

Market Potential

The energy efficiency market is already well positioned in the public sector as the Dubai government has made calls to cut spending by 20 to 25% (Gulf News, 2011). In the private sector, it's a given that industry entities will go into sustainability only if it makes financial sense.

For any organization or building owner, savings through energy efficiency are in general quicker to deploy than by other means. This process has strong potential in the UAE where we have several opportunities present through savings made by energy efficient retrofitting of the existing building stock.

The potential for energy efficiency is in every building, and within a building, energy saving potential exists in every system including air and water systems. In addition to the speculated opportunities, there is also growing governmental support with the issuance of the Dubai Green Code and as of January 2014, the ESCO regulated framework through the Dubai Regulatory and Supervisory Bureau.

Other benefits to energy efficiency include reduced costs, maintenance and prolonged equipment life. Vendors also play an integral part in the energy management realm since all the energy saving technology in the market is proven and readily available such as efficient chillers, insulation and lighting, it is only a matter of connecting the right vendors with the right clients. For an ESCO, what is important is to find what product suits what specific application and then be able to measure the savings.

Discussion Points

Challenges and opportunities

ESCOs are to play an important part in the Dubai Integrated Energy Strategy's ambitious energy saving goal of 2030. In order to accomplish the goal, the government understands the need for a strong ESCO market in the city. According to RSB, their research on the barriers that prevent the flourishing of the ESCO market revealed the following:

- 1) A **Low profile** of current ESCOs in the country: there is zero to little awareness among clients of ESCOs and ESCOs themselves of the RSB regulation.
- 2) Clients who contract with ESCOs have difficulties due to a **lack of understanding** of the EPC contracting mechanism and **uncertainty** regarding later pay back periods; a delay which is inherent to the EPC process.
- 3) **Low perceived credibility** of energy savings presented by the ESCO after energy management solutions are implemented.
 - a. As a solution, RSB has created a tailored M&V protocol which helps ensure that savings are real and accepted.

- 4) **Costly disputation** has also been looked at as a barrier and hence, a dispute resolution methodology has been established by RSB to resolve any perceived discrepancies between client and contracting companies.

Following the review of basic definitions and processes that link various stakeholders within a project, the workshop's participants have been given the possibility to share questions and experiences. The following points were addressed:

- It often remains difficult to sell energy efficiency as a concept, since investors actually look for tangible results, assets, and products to comfort and guarantee their investments rapidly. As such, banks, insurance companies and other third parties might find it challenging to understand the nature of financial mechanisms and roles of the ESCOs, and therefore be reluctant to accept taking part in the processes.
- Having a good legal team in place in the company to support the review of contracts still appears as a necessity to ensure that the project terms are guaranteed from all parties. It is also still recommended to keep the communications strong and continuous with a designated focal point within the client's team to ensure good progression and confirm payment modalities.
- Understanding risks and motivations before engaging in an energy efficiency-related project still raises a lot of questions. Participants discussed, for instance, the need for trust, proof and verifications in the project, and mentioned existing doubts related to late payments and dispute mechanisms that can put into question the essence of a project itself.
- From the vendors and suppliers' side, the impression is that the general public does not understand the need to save energy and the benefits one can get from retrofitting remain high. The "big picture" (carbon footprint reduction, climate change mitigation) is often disregarded if not associated with financial savings or material inputs.
- Lack of communication between team members can create problems. Because the roles of a project's energy manager and a buildings facility manager are redundant, it can generate potential conflict. There should be a stronger relationship between ESCOs and facility managers, and better awareness among end users on how to document changes in systems. It was agreed that the maintenance contract between a facility manager and a building owner should be included in the ESCO contract itself.
- Vendors/suppliers play another important role in the maintenance of equipment. The gap in technical information between manufacturers and energy managers will have to be bridged for expediency of retrofit projects and also to overcome a conflict of interest between suppliers who want to keep supplying and building owners who want to enjoy prolonged life

of their energy saving equipment. Suppliers/vendors can learn to benefit by incorporating energy consultation measures into their products.

- Retrofit equipments which are readily available in the market lack requisite certification which would reduce risk and increase confidence between building owners. This necessary validation can be provided by Standard Organizations in the UAE.



Figure 1. The ideal regulatory hierarchy between EPC stakeholders.

Raising awareness and confidence in the market

To overcome the “crisis of confidence” that was often mentioned in the discussions, the ESCO scheme appears as the central catalyst to support and drive demand on the market:

- Accreditation frameworks such as the one implemented by RSB in Dubai, allows proper verification of the parties involved in energy efficiency projects, guaranteeing their liability and the nature of their involvement in the projects. The verification process covers for instance many disciplines and reviews different types of stakeholders (e.g. financiers, suppliers, insurers, and consultants), while providing these stakeholders with a comprehensive set of information, rules/protocols and simplified documentation (contracts, dispute mechanisms). This comprehensive approach makes the ESCO scheme an ideal catalyst to reinforce trust in the market.
- The involvement of governmental authorities highlights a clear interest to have the energy efficiency movement mainstreamed and controlled to the highest level. Having the

authorities onboard increases the legitimacy of the processes, and facilitates the implementation of large scale programs. Most importantly, a governed framework would ensure that successful results are reached in a timely manner.

- Raising the level of education and technical understanding of energy efficiency, financial mechanisms, and the life-cycle of equipment will also have a beneficial impact on the movement and help reinforce trust in stakeholders involved in the ESCO market. It will indeed provide all with the key concepts to understand the building's energy diagnostic and apply the most relevant solutions accordingly. Participants also suggested the authorities to share case studies of successful projects to incite stakeholders to actively get involved and showcase innovative products and solutions.
- Streamlining the measurement and verification process: Embedded in the energy service mechanism is the establishment of a proper baseline assessment methodology. As most buildings have different operating schedules and uses, measurement and verification has to accommodate the discrepancies accordingly; for instance, in shopping malls, hotels, hospitals or wherever occupancy fluctuates. The RSB has addressed M&V protocols by developing a protocol based on the existing IPMVP to match activity in Dubai. This M&V protocol defines:
 - 1) savings calculation options based on retrofit/system isolation, whole building approach, simulation, or deemed savings calculation;
 - 2) the rules for developing the baseline and the necessary adjustments to account for variations.
- Establishing a strong relationship between Facility Management and energy savings. FM service providers are the parties handling the equipment so their involvement and understanding of energy management measures is integral to successful EPC.
- Strengthening the financial model: This connection still remains weak but with the support of the government and through the establishment of Etihad ESCO, the financing channel has opened for accredited ESCOs and is expected to solidify over time as more successful EPCs are completed. Similarly, insurance still needs to be fully activated and companies have started submitting proposals to financial institutions who are in turn measuring their calculation methodology against their procedures. Insuring the returns of the project is a larger endeavour than insuring energy saving equipment, hence indemnity assurances will only establish over time and with successful completion of EPC projects.

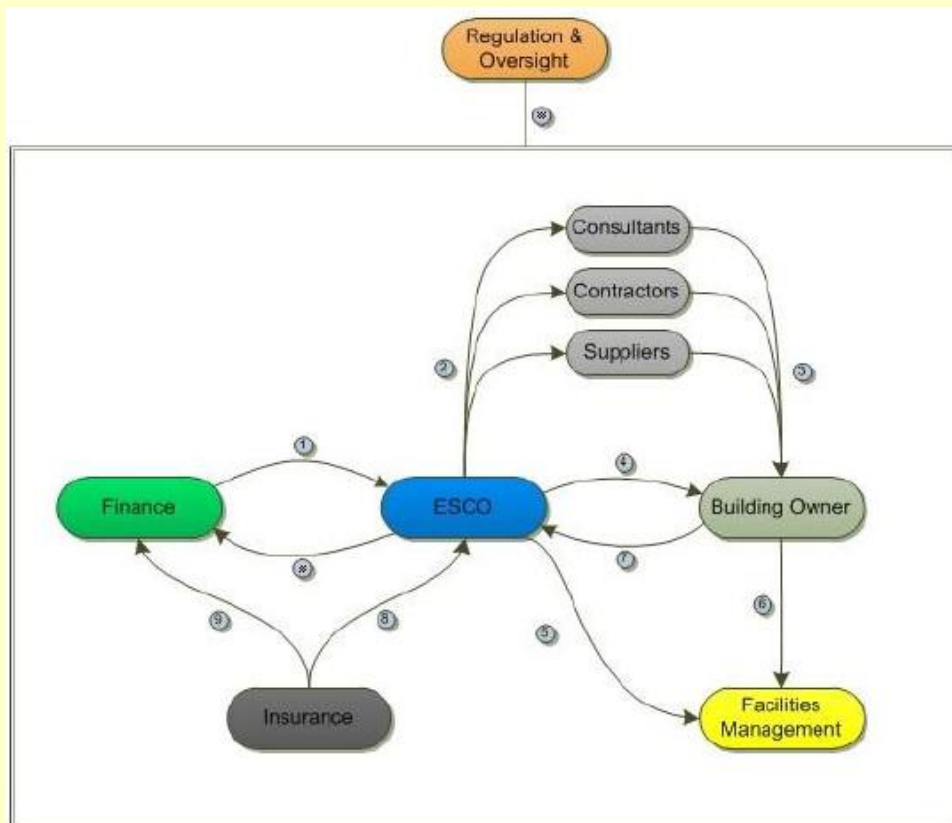


Figure 2. ESCO regulation and mechanism and its implementation - the ties that need to be unified and strengthened.

EmiratesGBC and Energy Efficiency

The final segment of the workshop introduced EGBC's involvement as an important private sector stakeholder in the energy efficiency market. There is strong support for EPCs, there is regulation and an interested market, but there is no unifying support. The Council's role as an established collaborative platform in the building industry which can unite the fragmented players in the energy efficiency market was discussed. It was agreed by nearly all participants that EGBC can serve the ESCO movement by implementing and enhancing its existing networking framework, by bringing the right stakeholders together and circuiting information among vendors, CEMs, specialists, and Certified Measurement and Verification Professionals (CMVP).

Participants were introduced to the EmiratesGBC Energy Efficiency Data Bank and shown how EGBC can play a pivotal role by:

- Unifying the emerging 20 ESCOs with the full spectrum of vendors, FMCs, and consultants.

- Creating a data bank of resources and vendors based on expertise and services.
- Highlighting the volumes in the market and creating a viable economy of scale for more competitive bids.
- Playing a supportive role to governmental agencies and national Authorities.

Conclusion

The workshops highlighted the obvious advantages for all stakeholders to take part in the energy efficiency movement which is currently gaining momentum in the U.A.E. These advantages are even more relevant now that the potential for energy savings in the country and the number of buildings that could benefit from retrofit have been identified as extremely high and easy to reach.

The ESCO framework in place in Dubai, including detailed processes and documentation for accreditation, financing or dispute mechanisms, is comprehensive enough to mitigate the usual risks one might encounter on the market. It has been, however, highlighted that more communications between all parties should be encouraged to showcase success stories and share best practices, and therefore raise confidence in the market and EmiratesGBC is poised to provide that service void.

Dubai Regulatory and Supervisory Bureau for Electricity and Water

Established in 2010 by the Executive Council as an independent regulatory body, the RSB supports Dubai Supreme Council of Energy (DSCE) in implementing the Emirate's ambitious vision to reduce its energy consumption by 30% by 2030.

As part of DSCE's Demand Side Management initiative, the RSB is encouraging energy efficiency retrofit projects by stimulating the ESCO market to deliver energy savings in a fast and transparent manner.

Through the creation of [Etihad ESCO](#) by DEWA, the Bureau has developed an ESCO accreditation framework (full or provisional scheme) as well as a set of other mechanisms and standard documents covering measurement and verification, contracts and dispute resolution.

RSB website: <http://www.rsbdubai.gov.ae/>

Tel: + 971 4 3072024

References, Tools, and Articles

- Bertoldi P., Boza-Kiss B., Rezssy S., [Latest Development of Energy Service Companies across Europe – A European ESCO Update](#), Institute for Environment and Sustainability, EUR 22927 EN, 2007.
- Etihad Energy Services, [A Guide to Energy Services Companies \(ESCOs\) on how to participate in the Dubai Buildings Retrofit Program](#), May 2014
- ICF International, National Association of Energy Services Companies, [Introduction to Energy Performance Contracting](#), October 2007.
- Regulatory & Supervisory Bureau Dubai – RSB: [official website](#) and [dedicated page to the ESCO market](#): ESCO accreditation, Measurement & Verification, Standards & Contracts and Dispute Resolution
- U.S. Department of Energy, Building Technologies Program, [A Guide to Performance Contracting with ESCOs](#), September 2011.
- Gulf News, Cut Spending 20 to 25%, Dubai Government asks all departments. May 2011.

EGBC Technical Workshop #2014-6: “Responsible Sourcing – Sustainability Scheme on the Supply Chain of Construction Steel”

9 September 2014

Facilitators:

Lee Brankley, UK CARES

Ayhan Tugrul, UK CARES

Tara Tariq, EmiratesGBC

Keywords: certification, conformity assessment, supply chain, steel, sustainable steel, construction materials, quality assured construction products, environmental product declaration reporting

Introduction

Over the past several years, the green movement has gained momentum throughout all sectors of the construction industry. While regulations and standards provide good guidance for green design and building systems, it remains crucial to ensure that construction materials also comply with the highest quality standards.

In September, the monthly EGBC workshop addressed sustainability in the supply chain and the benefits of certification of construction material, using steel as a case example of a responsibly sourced material.

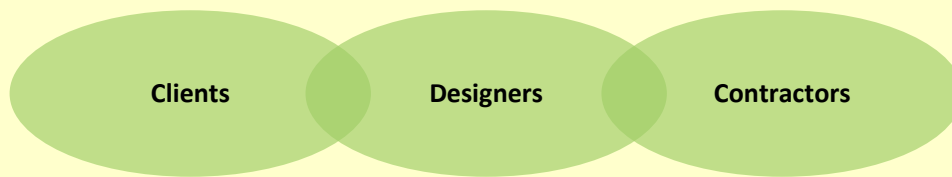
“Carbon is becoming a central design question. This will involve fundamental changes to the way we procure materials for projects. It will mean rewriting the rulebook so that carbon is integral.

The question we will ask first is “is it carbon critical?” not “is it cost efficient?”

If that requirement is not factored in, then the assets or the infrastructure we are creating will not be sustainable”.

-- Keith Clarke, CEO of Atkins

Key Players



In the sustainable construction and certification realm, the key players are clients, designers, and contractors; and the successful interplay of goals, procedures, and deliverables between these players inform the successful completion of a sustainable project. Most importantly, it all starts from the beginning with procurement of a strong supply chain.

Reasons to Choose Certified Products

Certification of products ensures that they consistently comply with relevant regulations and standards and meet customers' satisfaction. In addition they also provide:

Quality: because of the rigorous and repeated independent testing that is involved.

Sustainability: Certification entails product traceability through the entire process chain; this cradle-to-grave tracking mechanism is designed to prevent resource wastage, labour abuse, excessive mineral extraction, and CO2 emissions.

Price: Purchasers get their money's worth as consistent standard compliance prevents or reduces scenarios where additional testing might be needed.

Safety: This is tied with product consistency. Depending on the product, excessive variability in extraction methods, the production process, and the finished product, can be potentially hazardous if not controlled by standards.

ROI: In addition to savings through the avoidance of supplemental testing, purchasers/suppliers also gain added economic value by passing on the certification guarantee in the manufacturing or resale process and with the elimination of compliance issues.

The Drivers for Sustainable Product Certification

The following drivers are most applicable to the UAE:

- Regulation/Legislation

This is strongly the case for several countries in the world. In the UAE, existing regulations provided by the Dubai Green Building Code and Estidama provide adequate direction for the sourcing of sustainable construction material but aside from maintaining certification services provided by local laboratories, they do not reference other certification schemes.

- **Reputation:** A long-standing certification scheme with a strong client-base is testimony in itself that the construction material will meet or exceed expectations and project requirements.
- **Competitive advantage:** This especially pertains to high-profile projects - in light of the upcoming EXPO 2020, sustainable product certification is a viable option for the building industry.
- **Client requirements**
- **Corporate sustainability objectives and reporting purposes**
- **Market pull (end-user requirements):** The UAE has increased legislative activity mandating sustainable improvements to its new and existing building stock. Current mandated green rating tools such as Estidama's Pearl and the Green Building Code are clearly functioning as market influencers in the region.
- **Technological developments:** Product certification schemes are typically the first to verify and validate claims of technological improvement from the industry and manufacturers and clients usually prefer to test product satisfaction through that avenue.
- **Efficiency in construction:** Sustainability in the supply chain aims for transparency, which reduces risk such as a mismatch in specification and the product that is eventually delivered. This makes the process more efficient compared to other products that are not part of a collaborative supply chain.

The Relationship between Certification and Sustainability

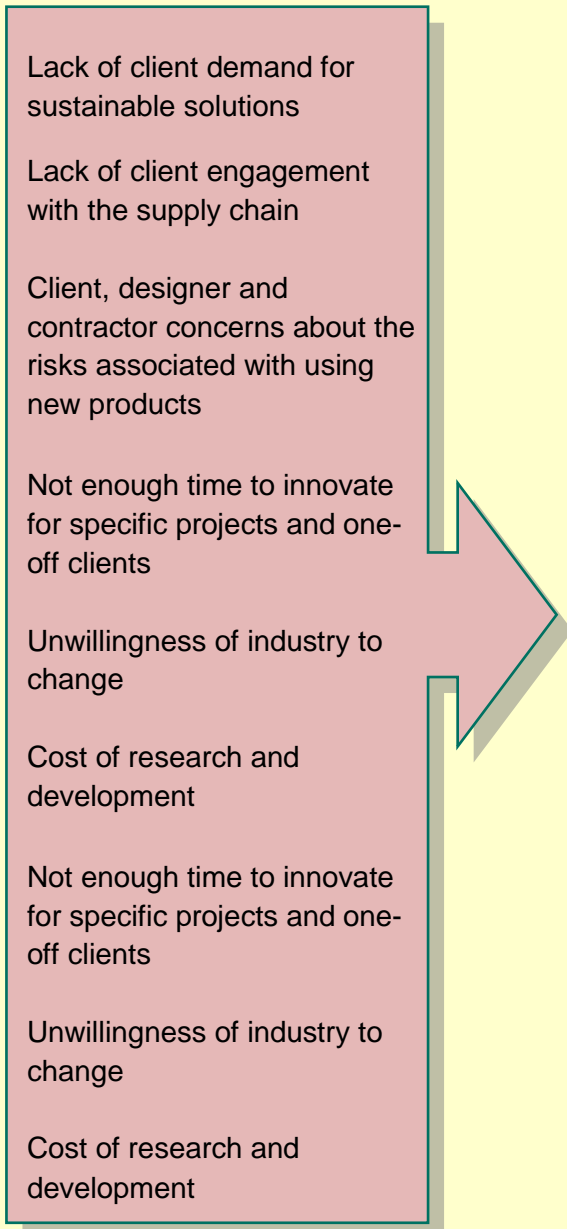
How does certification support the green building movement?

The combination of product certification with sustainable goals reduces preferential selection of producers and increases market competitiveness based on product performance versus through industry connections alone. Choosing from a wider array of producers does introduce an element of risk but as case studies will show, a strong vision of sustainability coupled with contracting through a certification scheme can mitigate risk factors significantly and is worthwhile than avoiding the goal entirely. The process is nevertheless not without hurdles and a groundbreaking solution devised by the Olympic Park builders (see Case Study below) was to hire sustainability managers from the outset of the project.

Sustainability Managers are now widely used for a growing number of large and small sustainable construction projects. Sustainability managers are selected at the outset of a project and they function as team members who stay committed to the sustainability vision; supporting

the program by enforcing a strong auditing process and by ensuring sustainability targets are met consistently.

Barriers to Certification



Tried and Tested Solutions



Environmental Product Declaration (EPD)

An EPD provides a life cycle assessment of any particular product and has now become part and parcel of sustainable product certification schemes. An EPD provides a quantified assessment of the impact a product may have on the environment. EPDs include information on the several factors that go into the manufacturing of a product from raw material obtained,

energy used, material content of finished product, emission rates, and water and waste generated through the life cycle of the product.

EPDs ensure that certifiers and through them the producers are committed to responsible sourcing, product traceability, proper supply chain management, environmental stewardship, and continuous improvement in sustainability.

Life Cycle Analysis – LCA

LCA data is essential to the EPD. Typically LCAs are derived from:

1. Peer reviewed scholarly articles
2. Measured against ISO standards: 21930, 14025, 14040, 14044.
3. Data from Trade Associations

Based on the above, LCAs are updatable and flexible.

An EPD contributes to the **supply chain** by verifying generic data for the input materials, energy and waste processing associated with the manufacture of construction products. Thus EPD verification can cover the specific information provided by the supply chain as well as the product manufacturer to ensure the robustness of this approach.

EPD enable manufacturers to communicate credible product and company environmental performance in a transparent way and enable manufacturers to substantiate **marketing** claims and comparisons against similar products.

EPD is used as source information in the **procurement** and **purchase** of products. They provide buyers with the confidence of knowing that the environmental performance of a specific product has been reviewed and validated by an independent party with expertise in LCA. In addition EPD can provide **clients** with verified credible embodied carbon or greenhouse gas data for construction products.

Case Studies

Olympic Park, London, United Kingdom

In 2008, in preparation for the 2012 Summer Olympics, the Olympic Delivery Authority (ODA) decided to make the games the most “greenest” event in Olympic history. The question initially raised was, what does ‘green’ essentially mean and how do building supplies qualify as green, and how are companies capable of delivering “green”. To actualize their goal, the ODA set a new standard of sustainability. They understood it was imperative that they affect a new **culture** across the whole supply chain from the beginning, such that the producers, processors,

contractors, and the purchasers were aware of what exactly is required by the project team and those delivering for the games.

From the beginning, the ODA set a strong vision. From the outset, a team of sustainability managers was set up for the procurement process, and they developed a clear policy, guidelines and expectations for the supply chain. This step streamlined what is typically considered a very challenging aspect in the building and construction industry: securing a supply chain.

To expedite the process, lateral communication links were developed with Trade Associations such as the Construction Products Association who were tasked with informing the ODA of all green product suppliers in the industry.

Benefits: Starting early, they embedded sustainability into the project and established clear lines of communication with the supply chain. This way, the ODA avoided engaging with individual producers and averted any blame of preferential treatment. Instead, they observed their vision and focused on what was procurable based on that goal.

Due to its scale, the project left a legacy of innovation in the sustainable product industry generating several new producers to come to the market. With remarkable facilitation of the project and the effective delivery of their sustainability goals the Olympic Park project catalyzed a paradigm shift in the industry.

Cross Rail, London, United Kingdom

As a 15 billion pound project connecting East and West London, the Cross Rail team followed the ODA protocol closely by ensuring a stable supply chain from the outset. They were largely able to achieve that by setting a strong vision and by early engagement with the sustainable supply chain.

Nuclear New Build, United Kingdom

In order to ensure a growing supply of energy, the UK EDF has approached sustainability by instilling a sustainability culture in the supply chain of products used to build nuclear structures, and also in order to gain trust among UK residents. Transparency through a certification scheme also ensures that the trust factor carries through potential troubleshooting situations, and hopefully prevents them as when producers are contractually obligated to report defects early on in the manufacturing process.

Discussion points

Using these two case studies as well as their respective experience in the field, the participants were invited to discuss how sustainable certification schemes apply to the local region:

Any similarities in the objectives of the Summer Olympic Park project and the upcoming Dubai EXPO 2020?

The Dubai EXPO 2020 is slated as the greenest exhibition in the industry, with sustainability comprising an important theme of the event. It remains to be seen if the organizers and leaders behind the EXPO 2020 event will develop a similar procurement paradigm as the ODA achieved for the Olympic Park project. Further steps that were taken by the ODA to make the projects sustainable included carbon offsetting programs, and conformity with sustainable rating systems such as BREEAM; in all they were groundbreaking and unique steps and given the scale of the project, EXPO 2020 stands to gain from ODA's example and by building on their success, establishing environmental credentials and by engendering a collaborative supply chain.

Having every product have an independent EPD will be a challenge for the UAE. So the government would have to make sustainability objectives clear in order for them to cascade down to relative industries and influence the construction market accordingly.

What kind of management risks do designers and contractors need to focus on?

A key risk in the management process is putting in place accurate requirements in the procurement program such that product nonconformity with the requirement is known beforehand. In addition, sustainability also has to be coupled with social responsibility and so it is recommended to ensure producers of major construction materials such as reinforcing steel have management systems in place for ISO 9001 (management quality), 14001 for the environmental aspects and 18001 for health and safety.

How do we address a dearth of recycling contractors in the industry and a lack of product information? The Jebel Ali Free Zone Authority has a mandatory requirement that projects must recycle construction material such as concrete waste and/or obtain information regarding the recycled content in products; however, there is no local market for such material.

The sustainable certification scheme offered by UK CARES and their efforts to permeate the UAE market, functions as a case study of how sustainability schemes can evolve and how the methodology can be adopted by other product manufacturers. It only serves to promote efficiency in the delivery of products and expedites the completion of construction projects.

It was suggested that a central database where suppliers would provide product details pertinent to sustainability criteria would be a timely product in light of the coming EXPO and the new existing green building regulations within the industry. Certification schemes in this context ensure the reliability of this centrally accessed information.

Conclusion

In the realm of sustainable construction, sustainable certification of products in the supply chain goes hand in hand with efficiency, transparency, and quality. Several challenges remain which designers, producers, and contractors will continue to face and resolve, but they are generally managerial, regulatory, and process related challenges that are similarly experienced by non sustainable construction projects.

The ODA case study provides a good example of sustainable and responsible sourcing in the supply chain and the industry rising to the challenge. With no industry predecessors to fall back on, they devised and streamlined the most important and challenging aspect of an effective sustainable construction project which was to establish a strong supply procurement process, streamline the process by hiring sustainability managers and effectively completed a major internally recognized project.

References, tools and articles

- UK CARES [3rd party BRE-verified EPD](#)
- [CARES Sustainability Report 2012-2013](#)
- [Dubai EXPO 2020, sustainability theme](#)
- UK CARES [technical documents](#)
- UK CARES Guide to Reinforcing Steel

EGBC Technical Workshop #2014-8: “Solar Reflective Index Specifications and Testing Methods”

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Facilitators:

Simon Hugh Miller, Abu Dhabi Quality Control Council (ADQCC)

Francis Ciampa, KEO

Tara Tariq, EmiratesGBC

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Introduction

The UAE has specific climatic conditions which affect the reflective properties of paints and coatings applied to its building surfaces. Roofs are often the main building feature where these products are applied extensively giving way to the industry term “cool roof”. These reflective properties brought about by the paints and coatings are known to reduce heat gain and can substantially reduce the energy load of a building as it tries to cool down during hot and dry weather.

The Abu Dhabi Quality Conformity Council (ADQCC), in its role in the development of quality infrastructure of the manufacturing industry in Abu Dhabi, is addressing the challenge to ensure the quality and performance of paint and coating materials with solar reflective properties, to ensure the products continue to improve indoor comfort and energy efficiency to the benefit of consumers and government regulatory authorities.

A number of local building codes, such as Dubai Green Building Regulations, Abu Dhabi International Energy Conservation Code and Estidama, promote the use of solar reflective coatings primarily due to their benefit in reducing energy use associated with air conditioning. However, not all reflective coatings are created equally, and in order to introduce and enforce some of the best green building practices in the world, the UAE must be able to recognize and assess new technologies for reflective coatings which will drive the industry in the right direction.

On December 10th, at the EGBC monthly Technical Workshop, industry representatives and members of the Abu Dhabi QCC gathered to discuss the challenges to creating a new certification scheme that could effectively address the local conditions. The workshop presentation outlined some of the current requirements regarding solar reflective index

specifications and testing methods present in the Emirates and explored how products are currently tested against these requirements. The ensuing discussion looked into:

- a) future efforts by the Government to meet current and future sustainability needs and if current regulations sufficiently meet these requirements,
- b) whether reflective (cool) coating products conform to the existing standards in place, and
- c) how paint manufacturers can contribute to the discussion and influence a policy that maintains quality and welcomes innovation without compromising the bottom-line.

Background

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

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

- ADQCC

The paint and coating industry in the UAE has taken root by establishing a growing manufacturing base in the country. As part of the Emirate's Vision 2030, ADQCC now aims to target this sector to ensure its conformity with international standards. In addition, the Council is taking a step further and addressing the potential of adding local testing capabilities to bolster the current set of regulations commonly used by the local manufacturers.

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

- 1) Certification scheme development and
- 2) Certification issuance.

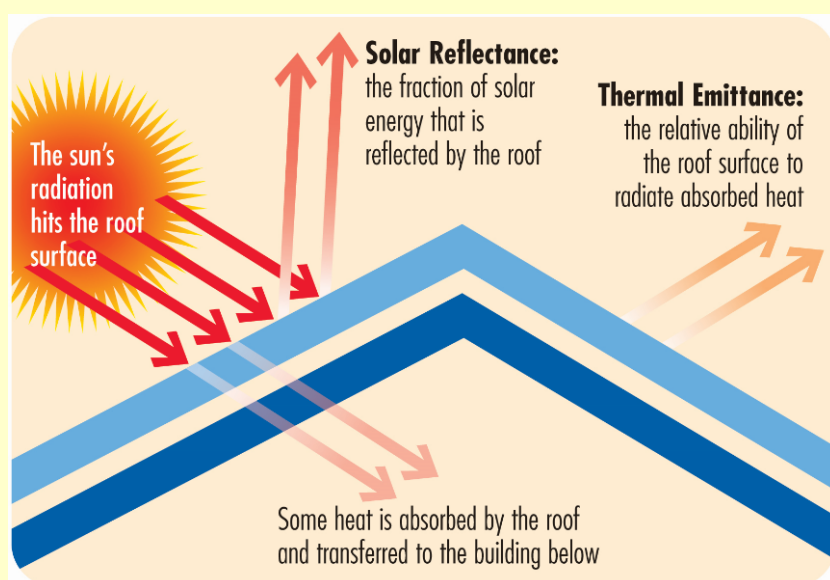
A certification scheme is already offered for paint products to ensure low VOC content and absence of heavy metals. Over the past year, feedback from the industry has also called for a certification scheme to identify quality paint products with Solar Reflective Index (SRI) properties. Since the ADQCC is not a regulatory authority; any scheme issued would be voluntary. The steps in creating a voluntary certification scheme require:

- a) conducting an Economic, Social and Environmental impact assessment of the scheme introduction and,

- b) exploring the issues around the product that would come in the way of introducing a certification scheme.

Advantages of using paints and coatings with high solar reflectance and thermal emittance

The following benefits highlight the reasons why SRI values are important to the UAE. The environmental benefits cannot be overlooked.



Direct Benefits:

- Reduced energy bills.
- Improved Indoor environment comfort.
- Prolonged life of A/C equipment.
- Prolonged life of building exterior surfaces/finishes.
- Negation of urban heat island effects.

Indirect Benefits

- Reduced green house gas emissions from energy generation.
- Reduced smog through reduction of photochemical reaction of pollutants.

Existing Specifications set by the Building Codes

Estidama (Abu Dhabi Urban Planning Council): Provides several credits for coatings that provide a high solar reflective index. The requirements are basic and the rating system lists several ASTM methods to demonstrate that the product meets requirement. The Urban Planning Council has a database of products that can be used in Estidama projects, and paints are not included. This is where ADQCC is coming in to help develop Estidama's database, by providing certification schemes for products.

Dubai Green Building Regulations (Dubai Municipality): Dubai’s Regulations provide basic SRI targets to negate urban heat island effects, and provide credit for the use of light colors giving reflective values for each product. Testing standards are identical to Estidama and a small product database has also been provided.

Solar Reflectance of Products

Abu Dhabi has mainly adopted American building codes into its own building code where SRI values are referenced as well as other sustainable building standards. The adoption of codes from the International Energy Conservation Code provides roof solar reflectance and thermal emittance standards for products. ASTM is the recommended testing method. However, both Dubai and Abu Dhabi only require initial SRI values of products whereas the ASTM also require aged solar reflectance values of products.

There is some testing capability for local products which provides basic calculation and measurement of SRI values but no testing capability for products in the long term.

Table 1. International certification program product assessment tests.

1) Cool Roof Rating Council (North America)	Initial Solar Reflectance measurement and,	ASTM E903 or ASTM C1549 or CRRC-1 test method 1
	Emissivity measurement	ASTM C1371-04a
2) European Cool Roof Council	Aged 3 year testing	<i>In situ:</i> ASTM E1918-06 or ASTM C1549-09
3) Energy Star		<ul style="list-style-type: none"> • Laboratory tests on <i>in situ</i> samples: ASTM E903-96 or ASTM C1549 • Laboratory tests on artificially aged samples: As above using sample from an accredited weather farm using Environmental exposure practice ASTM G7-05

Discussion Points

The discussion for the Technical Workshop looked into how a local conformity scheme can be tailored to test aged SRI values of products given local environmental conditions and still meet green building specifications, i.e. if local environmental codes can be modified or amended given product specifications and available technology.

Testing capacity and capability in the Emirates to meet supplier demands

In light of existing SRI specifications, ADQCC could continue to recognize testing assessments from other jurisdictions, or, the Council could create its own testing methods. Company representatives provided examples of paint and coating SRI tests conducted in other parts of the world. In the US, the Cool Roof Council (CRC) test methods include different climate zones: hot/dry, dry, cold, and hot/humid.

The testing capabilities of ADQCC would have to figure and budget for the following:

- a) If product testing would have to be conducted in a controlled outdoor situation, a “Weathering farm” needs to be created where climatic conditions are replicated. At the moment there are none in the UAE or in the GCC region.
 - a. Will outside labs continue to be commissioned as they are currently for this process?
 - b. Longitudinal testing: at least 3 years of collected data increases the operational cost of a “weathering farm” over time.
- b) If weathering farms are not considered, and existing buildings are tested, then testing for SRI values typically involves the cost of a good quality solar reflectometer, and this method could be simply adopted. However, a testing methodology would need to be decided.
- c) Technology – a new accelerated QUVB testing method was brought up by the participants. The product is exposed to 2000 hours of UV radiation and if it does not yellow/deteriorate, it is expected to last well for 3 years. This test could be used to overcome the time constraints, but this method does not factor in the other environmental conditions which can impact long-term SRI values (eg dust/dirt accumulation).
- d) One paint manufacturer has already started testing their products at a local material testing lab in Al Quoz. They claimed their product has achieved significant heat resistance as they have addressed other product specifications such as Light Reflectance Value which affects the thermoplasticity (‘stickiness’) of a product.
- e) Dynamic Thermal Modelling with the use of a software: this suggestion steps outside ADQCC’s testing scope. Thermal modelling of a buildings surface coatings includes an entire assessment of a building’s design. This includes the introduction of several external design factors that are precluded in a typical product certification process.

Local climatic and environmental conditions that were addressed by paint manufacturers and which can substantially impact SRI values include:

- a) UV exposure
- b) Salinity due to coastal proximity,
- c) Humidity and,
- d) Sand storm damage

Potential Case Studies

At the moment, there is little knowledge of the long-term weathering effects of products on existing buildings in the UAE. Given the hypothesis that SRI values of applied products in the UAE decline over time, the first logical step is to locate potential case studies in the field and test SRI values to determine whether the hypothesis stands. Participants volunteered two projects that could be tested to determine the baseline:

- 1) Warehouses that were built to green building specifications in the Dubai Airport Free Zone which are nearly 3 years old. The manufacturer agreed that long term efficacy should be tested.
- 2) 45,000m² of surface area on a 4 year old structure in Jebel Ali was coated with a high-reflective product.

Challenges and Opportunities towards a successful SRI conformity scheme

- SRI values can be compromised at the very outset due to lack of certified applicators. Often a paint or coating product would conform to standards and boast high SRI values; however an applicator can botch the product's ability due to poor application methods, for example by not meeting thickness requirements. Applicator training and certification could be introduced into the conformity scheme.
- ISO Certification, more specifically ISO 9001, is imperative for quality control in the production process.
- Comparing products can be hard, and there needs to be a methodical approach to product testing.
- A product specified for the project can be different then that product that is actually applied, and there should be adequate policing of such discrepancies which are often common.

- The Cool Roof Councils based in the US and Europe can provide an adequate template that local manufacturers can follow, however this again addresses the issue of testing and standard-setting that satisfactorily addresses local climatic conditions.
- However, international (external) testing should not be excluded, especially for warranty purposes and for international manufacturers who are trying to break into the local market.
- Testing and certification of products will only be used only as a tool and not as a 'gateway'. Certain designers and consultants may exclude uncertified products; however the ADQCC scheme does not aim for product exclusivity.
- To establish a credible 3rd party certification process, ADQCC would need to look into developing a local weathering farm.
- In lieu of achieving adequate SRI values (due to technology limitations), strengthening of a product's emissivity can also be targeted.
- Better understanding of SRI values among industry players such as consultants and engineers. Many confuse SRI with U-Value and the two are not equitable though they are relatable.

Potential ADQCC Testing Scheme Requirements

Product Registration

- 1) In line with the guidance provided by the European Cool Roof Council (ECRC):
 - a. Registration of products after initial compliance with ADQCC SRI requirement.
 - b. Manufacturer involvement in the program for three years – involvement with a surveillance body for product tracking.
 - c. At the end of three years of weathering, product will be tested again to determine compliance and registration will depend on the result of the test.

Quality Control

- 2) Strict control on the application process – applicator certification.
- 3) ISO 9001 certification of all manufacturers.
- 4) Further QC testing which includes testing the manufacturing of each product.
- 5) In situ testing of products after application.
- 6) ASTM D68

Other factors that were suggested to be included in the Conformity Scheme

- 1) Thermal Insulation permeability of coating products - UV value of paint coating and/or underlying building materials could be translated into the SRI. One product manufacturer has used ISO 1934 (for masonry) as an experimental way of determining U-Value in relation to the SRI.
- 2) An addition to the Solar Reflective Index: In addition to TSR (Total Solar Reflectance), the Light Reflectance Value (LRV) could also be considered. TSR values consider the shade and color of the coatings used and a minimum suggested LRV of 50 can potentially overcome heat build up due to reduced thermoplasticity of the coating.
- 3) Consider product application tests on other hardscapes such as parking structures and roads.
- 4) Albedo levels.
- 5) A more 'holistic' approach to heat island gain: looking at U-Value considering that heat can come in from other sources such as nearby buildings, cars, and structures.
- 6) Other factors such as annual Carbon dioxide emission, peak cooling load, annual energy consumption, and annual energy savings cost to give the total benefit of a coating product: These can only be calculated when the following variables are known:
 - How the paint will be used (roof or walls)
 - Number of coats applied
 - Type of undercoat used
 - The existing cooling system in the building
- 7) In relation to the previous point, the one possibility would be to define a 'standard' building/roof system, to which the characteristics of the paint can be applied and output a standardized result in terms of energy cost savings, allowing comparison between the different paint products. The difficulty here is that such a model can exclude a number of factors which will sway the results to benefit a particular product (such as self-cleaning ability, paint ageing in UAE conditions etc), so such an approach would have to be taken with caution.

Current standards reflect the future of the technology?

The initial reaction from participants was that current standards provide enough room for product development in the achievement of high SRI Values.

Conclusion

Coatings and their properties have long term environmental implications. Current testing capabilities that look at VOC content have raised the bar for product manufacturers in the UAE; however, high SRI Values provide another spectrum of both direct and indirect benefits to buildings, building occupants and the environment. Local environmental conditions can deteriorate a product's ability to meet with its own specifications as well as green building requirements.

The consensus at the workshop was that current international standards do not adequately address the conditions in the UAE, however, for ADQCC's purposes of developing a successful conformity scheme with sufficient market uptake, ADQCC could start by establishing Quality Control mechanisms first and Solar Reflectance values that mirror global requirements. These standard requirements can then be scaled up as product tests are submitted and technology progresses.

References, Tools and Articles

- Lawrence Berkeley National Laboratory, [Definition and Terms](#)
- RIBA, [U Values and Definitions](#).