MANIFESTO

CITIES/ HUMAN FACTOR/ IDEAS/ INTERVENTION/ STRART IT RIGHT

-2020

grfn

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MA N I FEST O

/2020

ABOUT THIS **PUBLI-CATION**

Review by **Dalal Awadallah**
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AYAH HALAWANI / Juxtaposition fanatic, forager.

AYESHA NABEELA / An ecofreak, engineering life to be responsible, sustainable and eco-friendly.

HASSAN YOUNES / Innovative engineering and ethics are the answers to our planet's problems.

MOHAMMAD DANISH / Earth provides enough to satisfy every man's need, but not every man's greed.

OMAR DARWISH / Engineering is about the impact you have on the environment and people.

OMNIA HALAWANI / Innovation is attributed to the non-adapters.

SYED ASHRAF / Sustainability delineates resources that are always ongoing in nature. Let's be sustainable.

CONTRIBU-TERS

FOREWORD

As always, GRFN proved to be an agile and capable service provider for a wide array of clients and has emerged to be a regional leader in the area of the sustainable built environment. We provide state-of-the-art consulting services, support national and regional policy-making activities, and engage with progressive real-estate developers and building owners to meet their target energy performance.

GRFN has evolved as a powerhouse capable of providing comprehensive design consulting services, managing and supervising mega projects from design to commissioning, performing detailed energy conservation studies, performing independent commissioning, benchmarking buildings' performance, and providing strategic research services related to the built environment. GRFN has developed systematic procedures for integrating the building energy simulations with the MEP design to ensure accuracy, cost effectiveness, and improved indoor air quality. Furthermore, GRFN has developed key expertise in district cooling and as such, we were engaged with DC policy makers, providers, and clients to aid with expanded market penetration, improve billing, mitigate low delta T syndrome and improve DC effectiveness.

GRFN is a for-good business, we were privileged to participate in the design of a community center for 300 orphaned and under-privileged children in Tanzania pro bono. We also believe that there is need for continued education and as such provide various internship opportunities for engineering students and fresh graduates to provide them with hands-on experience and get them more prepared for the demanding market. GRFN's leadership is actively engaged with ASHRAE, CIBSE, and AEE. We aspire to provide sustainable solutions and lead the regional efforts to meet the UN sustainable development goals (SDGs) as you can see throughout this manifesto – highlighted on the top-left corner of each page.

This manifesto is a testament of GRFN's growth and showcases our achievements, activities, and position on various issues related to the built environment.

Omar Abdelaziz, Ph.D.
R&D Director at GRFN
Assistant Professor at Zewail City of Science and Technology

about
GRFN

GRFN is a progressive consultancy with a mission to realize clients' visions while sustaining the built environment through innovative New and Intervention Projects as well as Policy Shaping and Studies.

In New Construction, the firm provides contemporary concept architecture, full fledge MEP and interior design services, and construction management.

Through Intervention Projects, the firm specializes in identifying inefficiencies and opportunities for optimization in existing spaces, buildings, or communities in the sectors of energy efficiency, sustainability, and indoor environmental quality as well as interior design and concept architecture.

In Policy Making and Studies, the firm is a go-to name in the fields of energy efficiency, district cooling, and building codes having been the technical advisor for multiple local and regional governmental entities and international standardizing bodies.

We actively associate how our projects can be delivered using the UN Sustainable Development Goals as drivers for improvement. Through this alignment, we are able to better identify innovative solutions and actions that we can implement in our projects that resonate with our clients' targets all while ticking the UN SDGs.

We are building a reputation that attracts forward-looking clients and employees who will help us in realizing the difference we aim at; towards social impact and sustainable cities.

reach
us

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Omnia Halawani

/

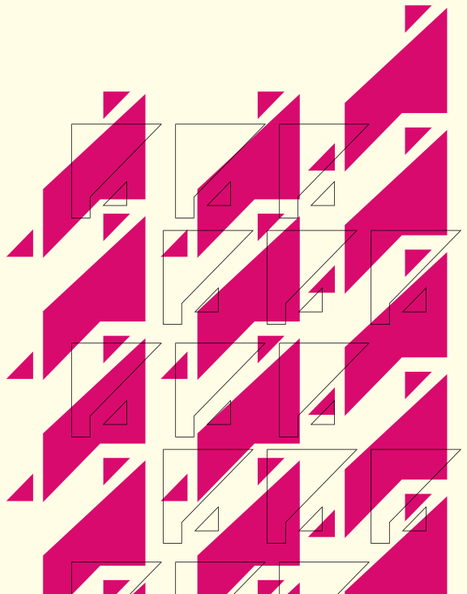
director & co-founder

The notion of “doing-good” has always been associated with volunteering time and money into social causes. I still recall my very first interview after I had graduated from university and being asked the trivial question of “where do you see yourself in five years?” My immediate answer was to be associated with an NGO. It was an aspiration that I had carried but never really formulated a solid path for its realization. And as commonly as it is, that goal was not associated with my field of study and eventually experience. Not many years had passed and I realized that I have been slowly deviating away and this is when the idea of GRFN was born. I will not claim that everything was clear and set; it was rather a path that uncovered as I grew through experience.

GRFN added a new dimension to my understanding of “doing-good” by revolving my day-to-day job and bread winner around the pursuit to solve some of the world's most pressing issues. For us it has always been climate crisis and energy efficiency as well as having a positive impact to the communities where we live. Making a living out of an impact centered, profit minded, and market driven business empowers us to have a greater impact.

GRFN is a "for-good for-profit” company! We aim to make a difference towards social impact and more sustainable cities.

This manifesto lays out what we have accomplished over the past seven years setting the ground for a transformational 2020 and the years ahead of us. Enjoy the read and stay tuned for the annual updates.



Hassan Younes

/

director & co-founder

GRFN was born out of necessity for consultancies that strive for excellence and impact rather than a mere focus on making profits.

When I suggested the company’s name, it was inspired by the Griffin which is a mythical creature with the body of a lion and the head of an eagle. The lion‘s strength and the eagle‘s vision suggest the union of strength with wisdom, the firm basis on which the company was established and has grown. As we enter 2020, Griffin Consultants has evolved into a modernized version- grfn. The vision stands unchanged, the values remain the same, and the strength and wisdom are fortified.

This Manifesto captures bits and pieces of our story so far and is a statement that this consultancy will continue on the path to achieving our unwavering mission of feasibly making the built environment more sustainable. In a world that is highly digitized, the built environment compass, from design to construction to energy management to retrofits, requires a lot of improvements and progression to realize the aspirations and targets of smart and zero carbon buildings. Integration is key, not only disciplinary wise but also the integration of advanced digitization and data analytics into the design and the execution processes.

GRFN enters 2020 with a set mind to take on research and development in the field of digitization to provide our clients with state-of-the-art integrated solutions and approaches.

Ayah Halawani

/

head of design & partner

The process of putting the Manifesto together made it clear what it is really about. It is a collection of lessons learnt, a summary of rigorous investigating, a reminder of the long hours and a celebration of the little victories. But, most importantly, it is a view of the big picture and a turning point to re-strategize and gear up for the challenges ahead.

The way that the book is structured embodies our belief that the approach to building sustainable environments is a holistic one. From energy saving techniques and down to the selection of interior materials, we plan to amplify the notion of social impact to span all what we currently do and beyond. Our built environments don’t only impact the resources on our planet; how we experience spaces and perceive our surroundings affects our collective psyche and our communities.

It’s been a long time coming, but 2019 witnessed a global longing for change in policy, practice and attitude towards the pressing issues of climate change. This publication is a reminder that the sustainable practice course we’ve embarked on is no longer a choice, but is the only way forward.

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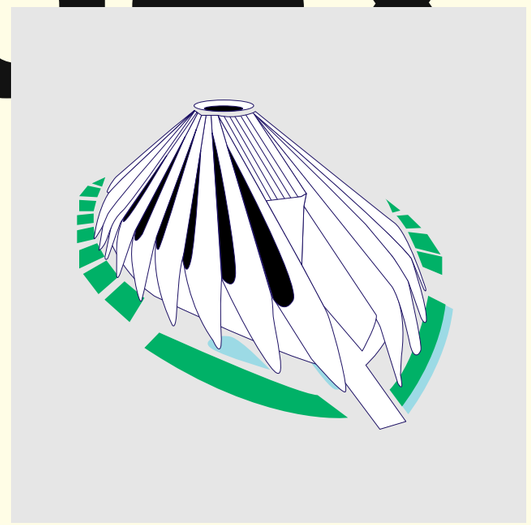

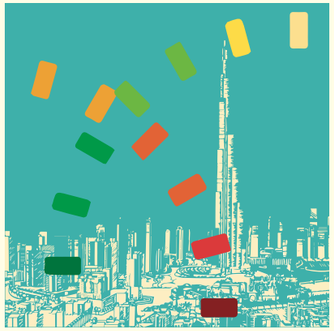

Start it right

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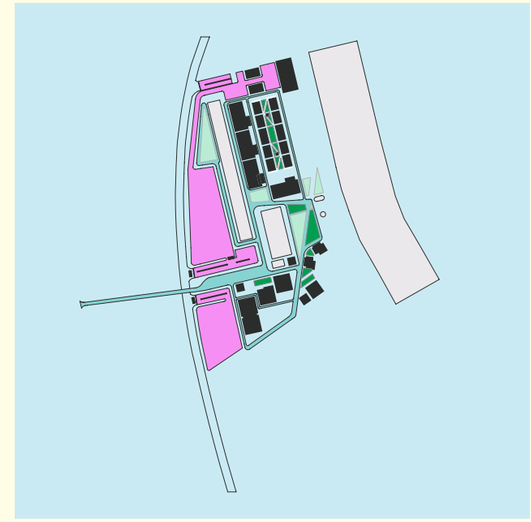

Cities

town; *civitas*;
smart cities;
infrastructure;
مدن; metropolis;
resilience;
urban
sustainability

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DUBAI'S BUILDING ENERGY & WATER RATING SCHEME

"The rating scheme is an important step towards **making energy and water efficiency more visible** and enabling the real estate markets to begin to truly value building energy and water performance and to **provide tenants with a clear indication to the energy and water efficiency of their building.**"

“These regulatory initiatives are intended to support Dubai’s building retrofit program, **one of 8 programs under the DSM strategy.”**

As part of the Dubai Integrated Energy Strategy 2030 (DIES 2030), a Demand Side Management (DSM) strategy was developed by the Dubai Supreme Council of Energy in 2013, which, amongst other things, identified regulatory requirements in the area of mandatory building audits, sub-metering, and disclosure of energy performance in property transactions. These regulatory initiatives are intended to support Dubai’s building retrofit program, one of 8 programs under the DSM strategy. The DSM study reported a stock of 120,000 existing buildings in Dubai, of which 80,000 are addressable by building retrofit. The DSM strategy targets 30,000 buildings to be retrofitted by 2030.

The Regulatory and Supervisory Bureau (RSB) commissioned a building energy and water rating scheme for the city of Dubai. The rating scheme is an important step towards making energy and water efficiency more visible and enabling the real estate markets to begin to truly value building energy and water performance and to provide tenants with a clear indication to the energy and water efficiency of their building. It is intended that this scheme will help drive the market towards building energy retrofits and to the development of higher efficiency building systems designs; all pouring towards the achievement of the DIES2030 goals.

“It is intended that this scheme will help drive the market towards building energy retrofits **and to the development of** higher efficiency **building systems designs”**

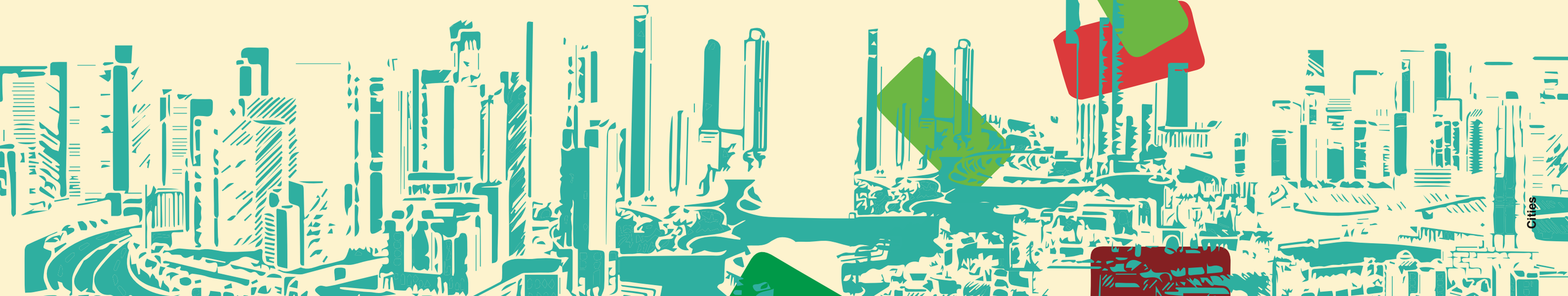
We were commissioned to benchmark for the designed rating scheme to determine the formulas that will be used per building type under the scheme: residential, offices, and hotels.

Our role involved end-to-end consultancy services and advanced statistical analyses to establish the benchmark and convert it into a rating, including **identification of data sources, liaison with data custodians to obtain data, and compiling and validating the data.**

A detailed and accurate tool for benchmarking based on advanced statistical and engineering methodologies was delivered and a rating of 1 to 5 was developed for the range of lowest to highest energy and water consumers.

We provided the stakeholders with the potential improvement in their ratings to help them understand where they stand and encourage them to commission energy conservation measures.

Once mandatory disclosure is regulated, the building energy and water rating scheme will prove instrumental to achieve the UAE’s energy performance and sustainability development goals. ■



More Local Efficiency Benchmarks Required

Omnia Halawani – 2015
Future Cities ME

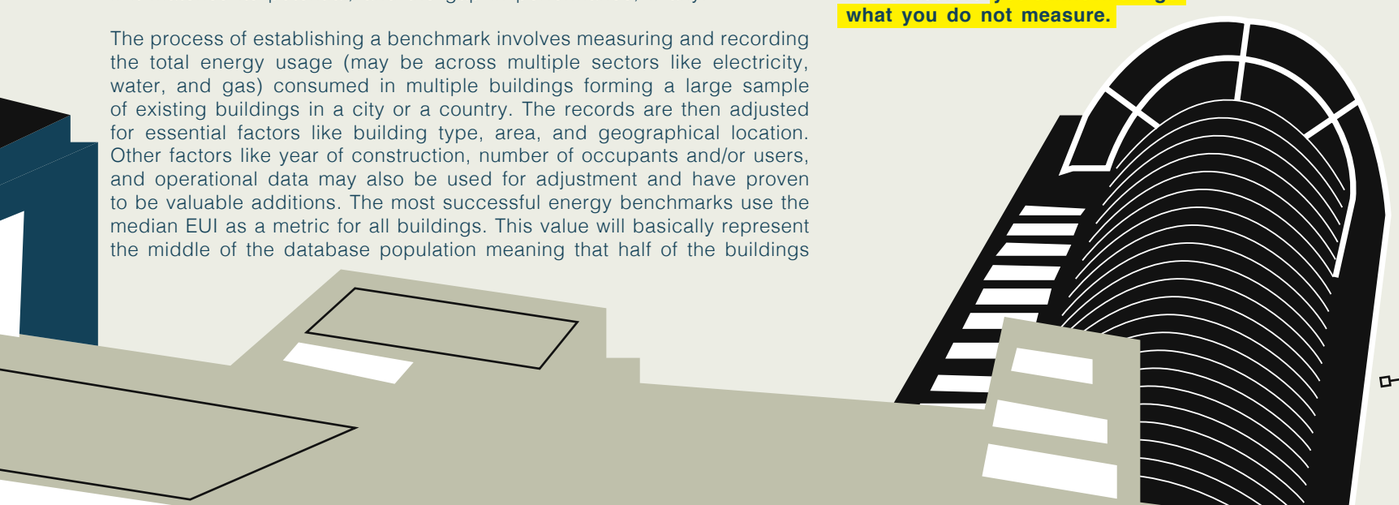
“Any successful energy reduction **implementation strategy that aims to lead to a** sustainable green economy **should be based on an integrated and data-driven approach.”**

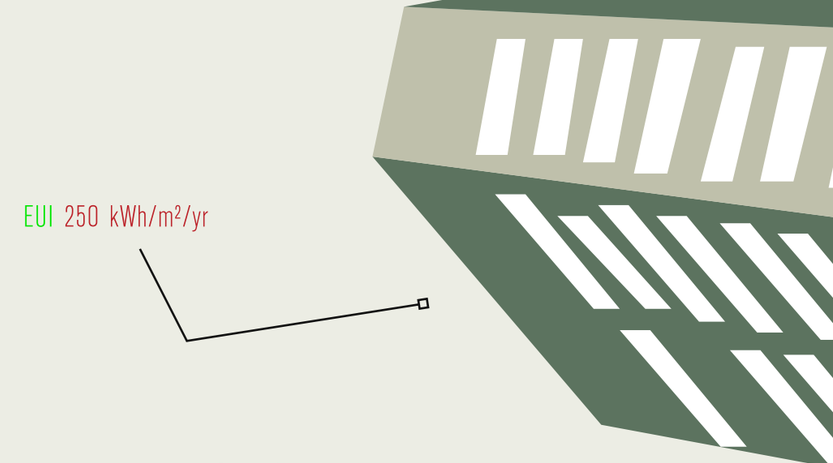
When you are looking to improve anything, two basic questions are always asked: “How are you doing?” and “How do you know?” When it comes to improving buildings energy performance, you ought to assess how your building is doing and how its performance compares to other similar buildings.

Any successful energy reduction implementation strategy that aims to lead to a sustainable green economy should be based on an integrated and data-driven approach. Assessing a building’s need for an energy audit starts with calculating the Energy Utilization Index (EUI), which is basically an indicator of the annual energy usage per unit area (kWh/m²/year) as derived from utility bills and the area of the building. But this figure alone serves no purpose if not compared to the energy usage in other buildings with similar use. From here arises the need to establish a benchmark metric. A high EUI, when compared to the benchmark, will mean that there is room for improvement and that a building energy audit should be sought to determine the energy conservation measures required and the savings anticipated. A successful benchmark database helps identify how a building’s energy performance compares to other buildings of its type, if it matches its potential, and the gap in performance, if any.

The process of establishing a benchmark involves measuring and recording the total energy usage (may be across multiple sectors like electricity, water, and gas) consumed in multiple buildings forming a large sample of existing buildings in a city or a country. The records are then adjusted for essential factors like building type, area, and geographical location. Other factors like year of construction, number of occupants and/or users, and operational data may also be used for adjustment and have proven to be valuable additions. The most successful energy benchmarks use the median EUI as a metric for all buildings. This value will basically represent the middle of the database population meaning that half of the buildings use more energy and the other half uses less.

Ideally, a benchmarking database is accompanied by a tool to provide an easy, fast and consistent way to benchmark any facility. A user would be required to enter basic information on the building as well as energy usage data over a period of time to generate the benchmarking report associated with the building under study. Facility owners and managers are always encouraged to consistently benchmark their buildings. A benchmark measurement at a single point of time is not going to drive the optimum energy reduction plan. After all, and you’ve definitely heard it before: you cannot manage what you do not measure.





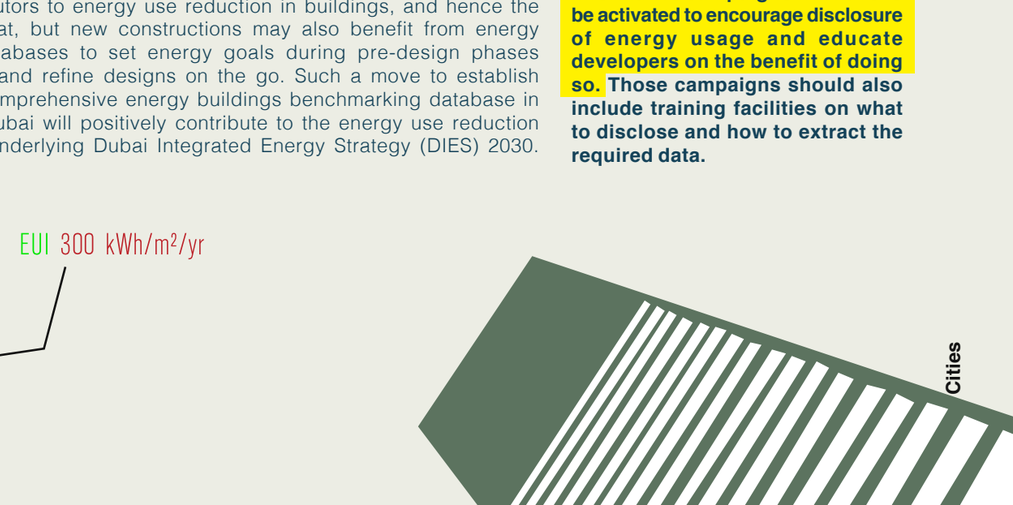
Benchmarking Dubai

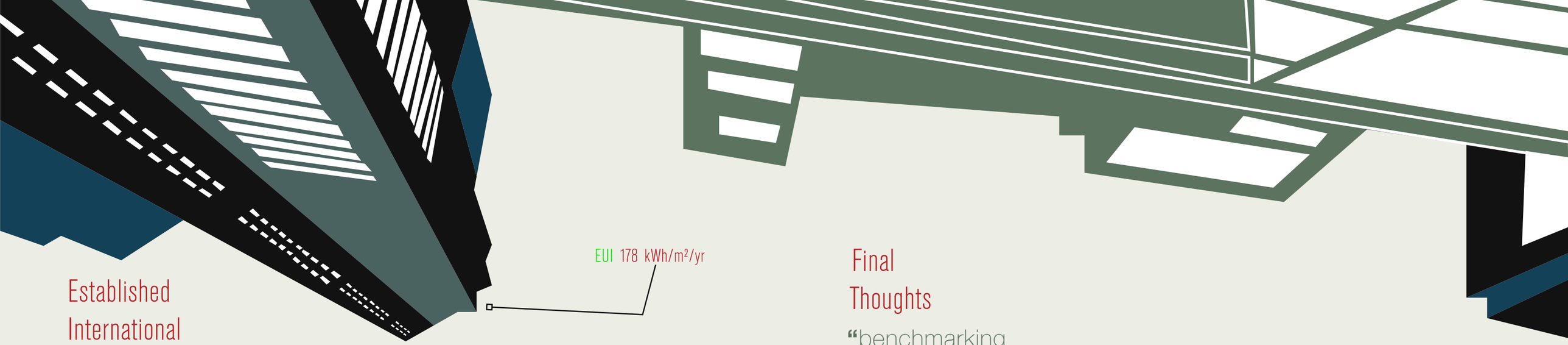
In today’s marketplace and given Dubai’s aspiration to be the Green Economy Capital of the World, there is an immense need for a comprehensive and local benchmark that can act as the reliable source for assessing buildings’ performances in the UAE and the region. So far, such a database that is made available to public is non-existent with undocumented and publicized efforts to get it created. In some cases, where the energy audit is conducted for large developers who naturally have access to the energy data on all of their developments, internal benchmarks comparing buildings of different ages and similar types have been used to gauge the value of the energy retrofits being studied. But generally speaking, energy experts have been relying on benchmarking data that are established in the USA and the UK; being the ones generally endorsed by international specifying organizations and certifying agencies.

A locally generated benchmark will better capture the buildings performance in the unique local and regional weather conditions of the UAE and the GCC as well as being adapted to the regional buildings construction practices. With the ongoing buildings energy retrofits efforts and by constantly updating the benchmarking data, the median of the database will continue to change raising the performance expectancy and injecting more pressure on the low performing buildings to improve their operations. A successful benchmarking strategy will also help prioritize energy audits and retrofits, monitor buildings performances over time, improve operations and maintenance, and assess retro-commissioning activities; all of which are main contributors to energy use reduction in buildings, and hence the city. Not only that, but new constructions may also benefit from energy performance databases to set energy goals during pre-design phases and to evaluate and refine designs on the go. Such a move to establish a reliable and comprehensive energy buildings benchmarking database in the Emirate of Dubai will positively contribute to the energy use reduction efforts and the underlying Dubai Integrated Energy Strategy (DIES) 2030.

Etihad ESCO, which is a DEWA venture whose mission is to “make the Dubai built environment a leading example of energy efficiency for the region and the world”, has taken it onto their responsibility to analyze energy data and create an energy benchmark for selected buildings in Dubai to which they have an agreement with the owners/facility managers to study. This database is, however, not made public (up to the date of this article).

The need to establish a public and reliable buildings energy benchmark will involve a number of key success factors. A disclosure policy needs to be put in place that identifies the frequency of disclosure and, if made mandatory by authorities, the phasing of buildings types and areas to disclose their usage. Informative campaigns will have to be activated to encourage disclosure of energy usage and educate developers on the benefit of doing so. Those campaigns should also include training facilities on what to disclose and how to extract the required data.





Established International Benchmarks

Several international benchmarking efforts and movements have been performed and done successfully.

The US Department of Energy (DOE) has developed benchmarks for commercial buildings based in sixteen climate zones covering the United States of America. The commercial buildings covered are of sixteen types like schools (primary and secondary), large to medium offices, retail, restaurants, warehouses, healthcare facilities, hotels, and supermarkets. They are separated into pre-1980 construction and post-1980 construction. The database is compiled under CBECS, which stands for “Commercial Buildings Energy Consumption Survey”. The survey to update CBECS is conducted on a quadrennial basis. This benchmark was complemented by a benchmarking tool created by the US Environmental Protection Agency: EPA’s Portfolio Manager. The Portfolio Manager relies on the data gathered by the CBECS and is an online tool to measure, benchmark, and track energy and water consumptions. It is said to be the leading benchmarking tool for commercial buildings in the USA with 40% of the commercial buildings space already benchmarked on it. The Canadian government, spearheaded by “Natural Resources Canada”, is also now using the Portfolio Manager for a national energy benchmarking initiative. The EPA Portfolio Manager has its own building rating labeling system called the ENERGY STAR. The ENERGY STAR recognition label is awarded by the US EPA for top performers in the commercial buildings energy consumption sector when benchmarked and assessed using the Portfolio Manager.

On a smaller scale, in 2009, New York City adopted a set of energy efficiency requirements for existing buildings as a part of the city’s plan “PlaNYC”, to reduce greenhouse gas emissions by 30% by the year 2017. A vital component of the plan is a requirement for public buildings over 10,000 square feet (929 square meters) and private buildings over 50,000 square feet (4,645 square meters) to benchmark their energy use on an annual basis. In 2011, NYC had already benchmarked over 2,700 buildings of multiple types and usages including healthcare facilities, educational facilities, community centers, police and fire stations, libraries, courts, and offices. This is considered a vital part of and contributor to the city’s adopted Greener Greater Buildings Plan (GGBP); a plan created to help the city achieve its aggressive sustainability goals.

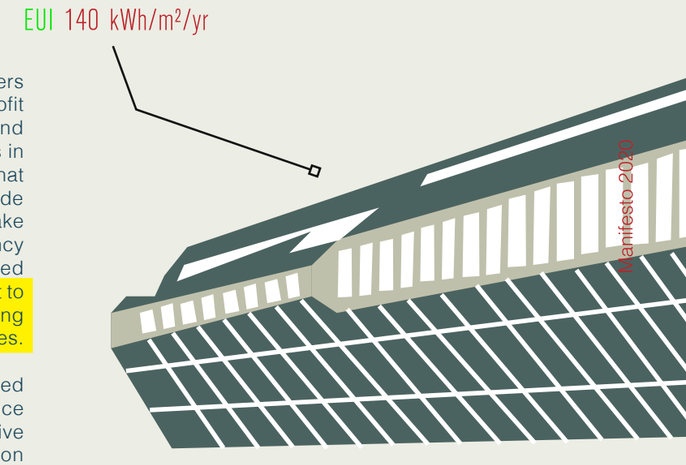
In the UK, the most relied on benchmark database is the CIBSE Guide F- Energy Efficiency in Buildings, after which its publication in 2004, the UK government has set targets for reducing energy usage and associated greenhouse gas emissions that are legally binding. The Guide’s latest edition in 2012 includes a section on developing energy strategies to reflect the changes in the governmental planning policies. A related publication by CIBSE is TM46: 2008- Energy Benchmarks. It was published to complement a governmental move named “Display Energy Certificates” which requires public or institutional buildings that are greater than 1000 square meters to display, in a prominent position, the grade rating which reflects the actual carbon dioxide emissions generated by the building. The benchmark covers 29 building categories for electrical and fossil fuel energy use.

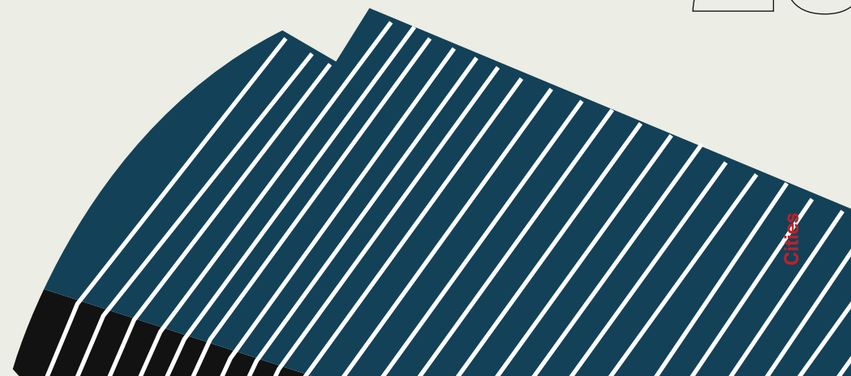
Final Thoughts

“benchmarking **will drive** action.”

One of the most common barriers facing building owners and developers to invest in energy efficiency and retrofit projects is the lack of accountable information and benchmarks to assist energy experts and consultants in creating a clear-cut financial case to demonstrate that investing in energy reduction measures can provide profitable growth. It is difficult for developers to make the right decisions when it comes to energy efficiency projects as long as established and widely adopted benchmarks are not in place. Developers are reluctant to invest in energy efficiency projects in the fear of missing out on other more straightforward growth opportunities.

Benchmarking is a key tool that cannot be overlooked when adopting a city or nation wide energy performance improvement plan. Not only is it necessary for effective planning for energy retrofits and carbon emission reductions, but a readily available benchmarking tool would encourage the private sector to assess the performance of their buildings, engage in energy efficiency projects, and to positively contribute to the overall reduction in energy usage. If anything, benchmarking will drive action.





Why benchmark your energy?

Emaar: a leader in the tribe

Whilst energy benchmarking is not a new practice, it is becoming more mainstream as the UAE has taken strides to achieve its energy efficiency goals and as consumers are becoming more aware of their energy budgets and environmental impacts. Energy benchmarking enables building owners to assess how their annual energy use intensity (EUI) stacks up against comparable buildings — in the same climatic regions. Simply, EUI is the measure of the total energy consumed in a building through a certain time period (commonly a year); and is calculated by normalizing the building's annual energy use to the building's area.

Energy benchmarking is rooted in common sense, you cannot control what you do not measure. Energy benchmarking allows you to determine how well you perform compared to others, enable a mindset of continuous improvements and set performance expectations.

Large edifices track their energy management progress by performing energy benchmarking on their own buildings, comparing older buildings to newer ones and also comparing each building's energy performance throughout the years.

One of those progressive organizations is EMAAR Properties; where in 2016 and 2019, we were commissioned to perform an energy benchmarking task covering most of their properties in Dubai. The benchmarking task covered different types of buildings including residential, offices, hotels and malls. In 2016, EMAAR buildings were compared to their peers in Dubai and the energy conservation potential was identified.

Three years later, we were asked to carry out another benchmarking for the same buildings and newer ones and compare the results to the recent average in Dubai and to their previous standings. This helped EMAAR to understand how their own buildings perform, the progress against their targets, and what improvements can be applied for better energy consumption. ■

Calibrating the Dubai DSM Strategy

The Dubai Demand Side Management (DSM) Strategy was developed by the Dubai Supreme Council of Energy as part of the Dubai Integrated Energy Strategy 2030 which aims to reduce energy and water expenditure in the city by 30% by the year 2030.

The savings from each program are estimated and reported on an annual basis. The client, representing the city, required consultancy services to improve the accuracy of savings reported from each of the program's pillars as the previously adopted methods needed enhancement and calibration.

The strategy is composed of eight programs contributing to the projected savings:

p1
Buildings Regulations

p2
Buildings Retrofits

p3
District Cooling

p4
Standards & Labels for Appliances & Equipment

p5
Water Reuse & Efficient Irrigation

p6
Outdoor lighting

p7
Power & Water Tariff rates

p8
Shams Dubai (rooftop solar)

Our methodology and proposal for baseline validation/ adjustments and for enhanced methodologies for savings calculations were accepted and work commenced on this mega task shaping the city's energy policy.

Three main buildings codes were identified as drivers in change in the energy use in buildings in Dubai: (1) Decree no. 66 (2003) which issued regulations on new buildings' insulation, (2) the Dubai Green Building Regulations (DGBR, 2011) which was the new buildings code in Dubai following an improved energy performance target across all construction materials and methods, and (3) Al Sa'fat which is the new credit points-based local buildings rating system which rates buildings from Bronze to Platinum.

Common buildings typologies in the city were studied and we were able to divide the buildings into multiple common typologies: Labor Housing, Educational Facility, Retail Outlet (4 sub-typologies), Office Building, Expat Villa, National Villa, Hotel, Hospital, Residential Flat, Worship House, Shopping Malls, Warehouses.

Up to three different window-to-wall ratios were modeled for each building: 20%, 50%, and 70%. Furthermore, up **to four different HVAC systems were modeled: DX, air cooled chillers, water cooler chillers, and district cooling.** Other elements modeled included **plug loads, interior lighting, elevator loads, solar panels, and solar hot water.**

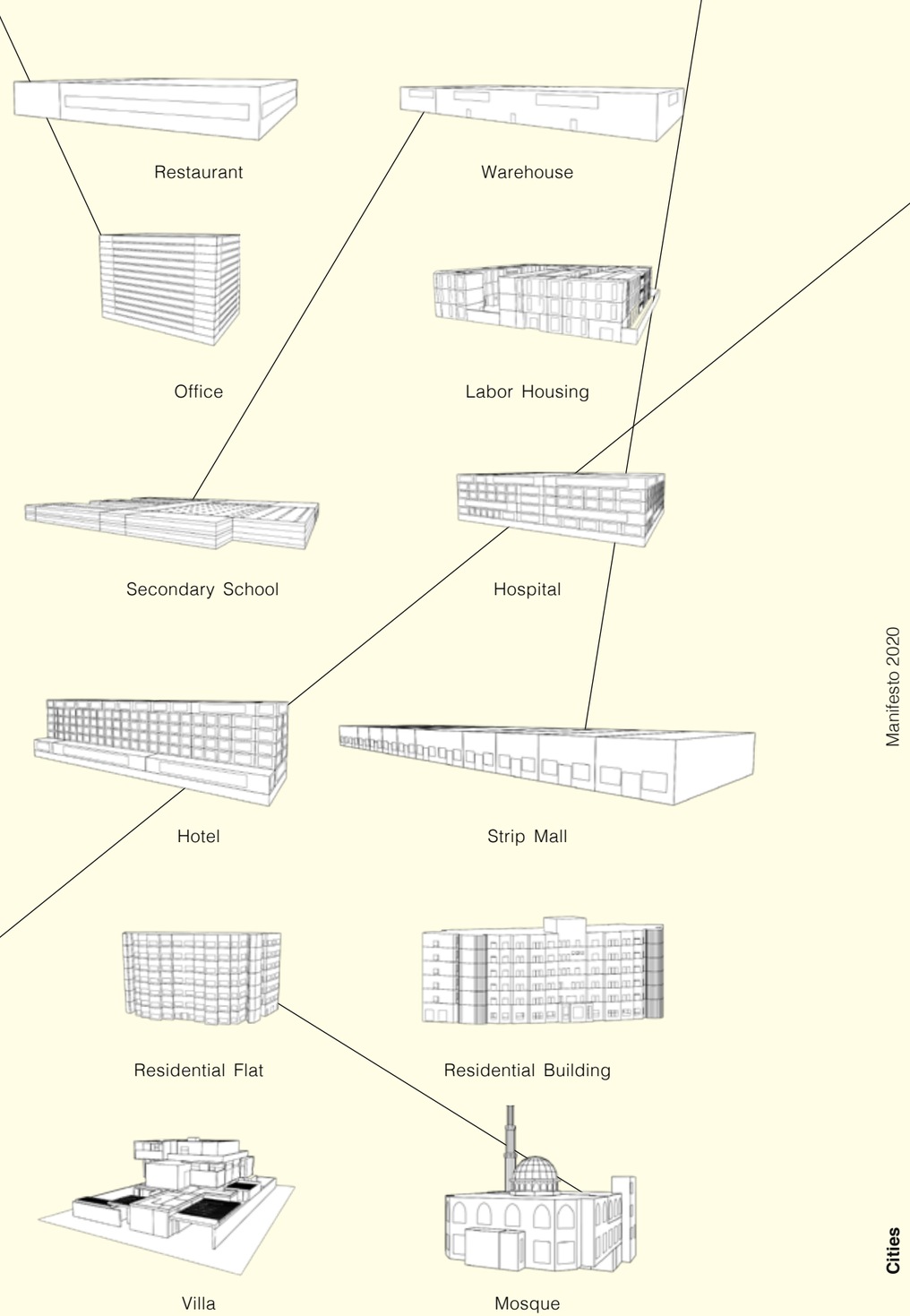
The study assessed the energy saving impacts of the three identified influential building codes on different buildings typologies with varying characteristics and systems. The task resulted in:

- 41 baseline code compliant energy models
- Overall 242 code compliant models
- 201 models where conservation measures from succeeding codes were applied.

Simulation results estimate that a 100 m² rooftop monocrystalline PV in Dubai generates **21.47 MWh/yr.**

The benefits delivered included:

- Improved model accuracy to identify claimed savings from each program.
- Introduction of additional contributors to savings in some programs- ex: Treated Sewage Effluent savings from District Cooling in addition to irrigation.
- Detailed and exhaustive energy models for all possible influencers on buildings performances to assess the effect of building regulations on energy savings.■



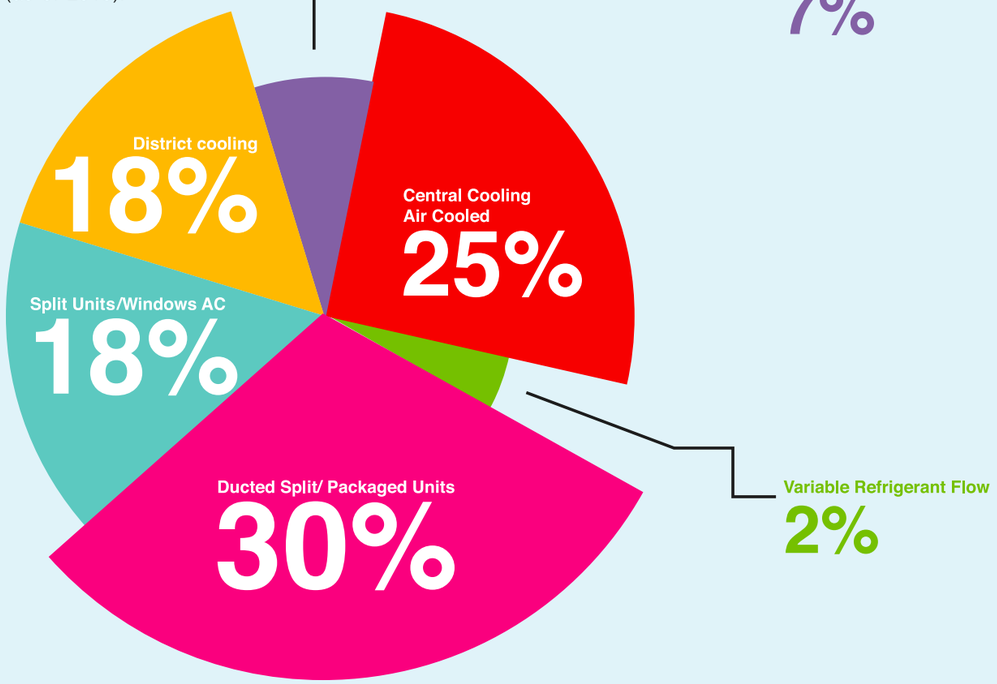
Dubai's Cooling Market

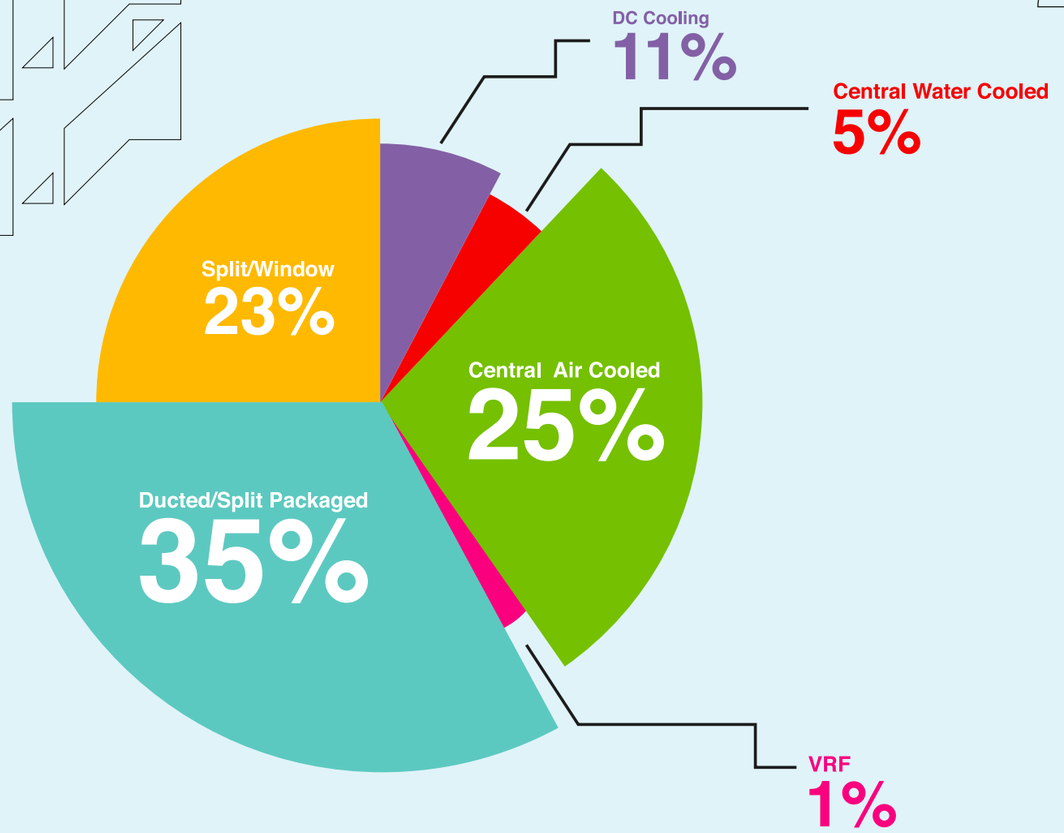
Overall Cooling Technology Market Share

One of the programs of the Dubai Demand Side Management (DSM) Strategy requires significantly increasing the market penetration of efficient District Cooling systems by 2030. To measure progress against this target, a study was commissioned by the Dubai Regulatory and Supervisory Bureau (RSB) to assess the current market share of all cooling loads in Dubai. The study comes in line with the objectives of the Dubai Integrated Energy Strategy 2030 to help achieve the overall energy demand reduction target of Dubai.

Within a JV, we delivered the project, results of which are published on the Dubai RSB's website.

The cooling technology market share study identified ducted Split systems to have the largest share of the market at 30% and VRF systems to be the lowest with only 2% (as of 2016).





Electrical Consumption

Via statistical methods to determine an informative sample size to achieve 95% confidence rate, the relative efficiency of each cooling technology was determined via in-situ measurements. The samples were chosen allowing the impact of age, maintenance practices and weather conditions to be reflected in the study.

Combined, the market share and the efficiencies study allowed us to identify the impact of each technology on the DEWA grid. Together, split systems (ducted and non-ducted) occupy 48% of the market share but drive 58% of the total cooling electrical load. Alternatively, District Cooling and central water cooled technologies offer a much more efficient alternative by imposing a mere 16% of the electrical load while occupying a 25% of the market share. ■

Dubai's Cooling Study on Dubai RSB's website

Spotlight on District Cooling

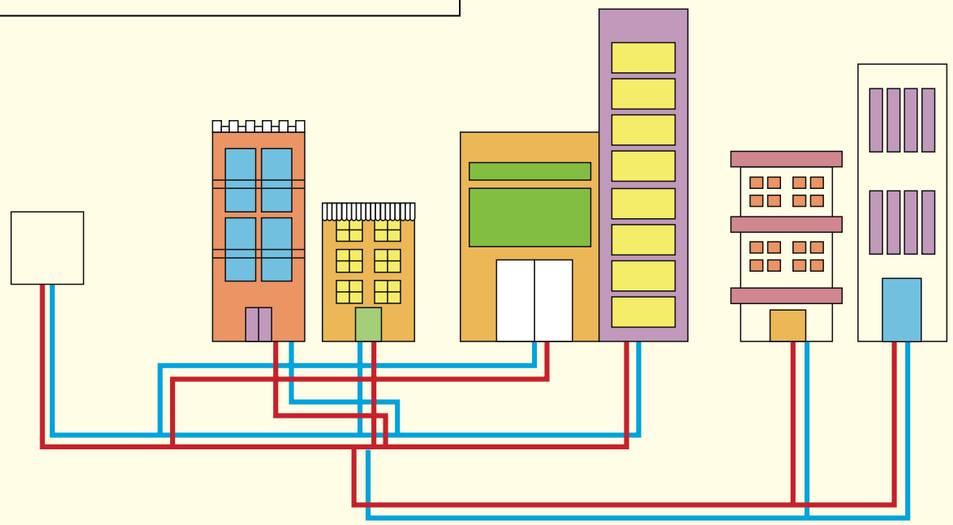
Omnia Halawani - 2016
Climate Control ME Magazine

The spotlight is once again on District Cooling, thanks to various government initiatives promoting it, bringing to fore challenges utility providers and end-users have to combat. Omnia Halawani analyses them and offers solutions, while making a plea for a streamlined sector.

"It would be a major aid to the market to have a more transparent industry, where actual buildings' peak loads **are published by the District Cooling providers."**

There is no doubt that District Cooling can be an integral part of cities aiming to achieve sustainable development. In Abu Dhabi, the new utility rates by Abu Dhabi Distribution Company (ADDC) are regarded to be in favour of District Cooling and central cooling systems. In Dubai, the Dubai Supreme Council of Energy has positioned District Cooling as the third pillar in its governance framework to rationalise energy use in the emirate of Dubai, known as the Demand Side Management (DSM) Strategy. The strategy looks into means of increasing the penetration of District Cooling in the market through new schemes and Existing Buildings retrofits.

One of the outcomes of a study that was concluded by GRFN (within a consortium) for the Dubai Regulatory and Supervision Bureau (RSB) calculated the current District Cooling penetration in Dubai at 17.7%. The study was commissioned out of an understanding that "any strategy intended to raise energy efficiency will have to tackle cooling – both efficiency in its supply and in its use".



The low ΔT syndrome

The ultimate goal of any District Cooling utility is to minimise the total energy and equipment costs, while keeping end-users comfortable. Perhaps the lingering and most common issue facing District Cooling is low chilled water temperature differential (low ΔT), which takes its toll on lost cooling capacities, increased energy consumption, added costs and system complexities. Incentive-based chilled water rates that are lowered with higher ΔT have been adopted by some global District Energy schemes. Locally, some District Cooling providers have taken the step to enforce low ΔT penalties on end-users failing to return chilled water at the required minimum temperature. The go-to solution by many DCPs to combat ΔT is reducing the flow on the network, which can simply shift issues from the DCP to the buildings themselves.

We have been approached on multiple occasions by both District Cooling providers and customers, for advice on solutions to combat the low ΔT syndrome. On most cases, we have found that the root cause (and solution) to low ΔT lie in the selection of building cooling coils and the performance of control valves. Both issues entail high retrofit costs (more prevalent in the case of wrong cooling coil selections), unfeasible payback periods and prolonged implementation durations.

Another contributor to the ΔT syndrome is the oversizing of buildings' cooling load requirements, which also takes its toll in the form of increased charges, as will be discussed in the next section. All of these emphasise the importance of sound engineering design and adopting integrated design strategies that bring all stakeholders to the table at the design stages.

Bloated capacities & costs

The other issue, which becomes more prevalent with the public and end-users, is the general consensus that District Cooling costs more than other conventional cooling systems. District Cooling is generally perceived as being artificially expensive. And this flatters the conventional cooling techniques. A lot of the hype targets the District Cooling providers themselves. While this perception might hold true in some aspects, it is often overseen that in-building cooling capital is factored into purchase price or rental payments. DCP involves recurrent capacity charges + metered usage, which is a continuous reminder to the end-user of the costs incurred.

It is true that the District Cooling industry is yet to see the benefits of reduced electricity rates (in Abu Dhabi, for example) and lowered costs associated with the use of treated sewage effluent (TSE) water passed on to the end-users. However, placing the entire solution/blame in the court of the District Cooling providers alone is improper. It is a fact that a majority of the buildings' cooling capacities here are oversized. Chronologically speaking, the number one solution stems out of this fact. If building owners were more conscious in this aspect, requiring their consultants to ditch the unrealistic safety factors, which I like to call "ignorance" factors, when calculating cooling loads, they can save thousands in District Cooling capacity charges.

Capacity charges are normally within the range of AED 750-900 per tonne enforced through a contract that typically extends up to 20 years. A mere oversizing of 500 tonnes, which is not uncommon, will cost the building's owner, and eventually the building's occupants, up to AED 450,000 a year, translating into AED 9,000,000 over the course of 20 years.

We have been faced with incidents where our clients were reluctant to approve our cooling load calculations, as the load was significantly lower than their previously designed similar buildings. It would be a major aid to the market to have a more transparent industry, where actual buildings' peak loads are published by the District Cooling providers. It would help tune the expectations of the developers and building owners of the adequate square metre per tonne for their buildings, and will also exert the much-needed pressure on consultants to improve their performance and design approaches.

In conclusion...

To sum up, governmental efforts have started to move in favour of District Cooling and more efficient cooling systems. This move has to be welcomed with relayed costs reduction to the end-customers. The construction design industry needs an overhaul to abide by best practices and sound engineering design approaches. A lot of the issues facing building owners, like penalties and high District Cooling charges, are issues that can be taken into their own hands by raising their expectations of the design consultants. Finally, a more transparent District Cooling industry with published actual peak loads would aid the drive towards a more sustainable construction industry as a whole. ■

Talk to each other

“GRFN’s scope was to expand the installed capacity at the plants to cater for the additional loads planned at the development.”

The District Cooling scheme at Jumeirah Heights is composed of two plants feeding into a single network of combined low rise and mid rise buildings and villas. While the villas are directly fed, each building is fed via heat exchangers located in the Energy Transfer Stations. GRFN’s scope was to expand the installed capacity at the plants to cater for the additional loads planned at the development. The expansion included the addition of electrically driven centrifugal chillers as well as thermal energy storage.

While at work, we set a target to tackle the challenging scheme control and migrate it from a manual legacy control to a modern system that is automated and optimized in a seamless process not to jeopardize or interrupt the existing plants operation.

We have designed a system in which each one of the two plants had its own complete industrial-based control and monitoring system, based on a Programmable Logic Control (PLC) and Supervisory Control and Data Acquisition (SCADA) system, that is fully monitored by the other plant. The designed control system enables the operation in “island” and in “connected” modes while retaining full control and monitoring of the chilled water distribution equipment, systems and components. The proposed integration and means of communication among the plants, energy transfer stations, and other distribution network components was based on Multiprotocol Label Switching (MPLS).

A modern and optimized control and monitoring system is vital for the efficient operation of District Cooling schemes. ■

Nodes of Connection

Al Raha Beach is a premium mixed-use development by Al Dar located in Abu Dhabi. The development is served by a District Cooling scheme by Tabreed feeding some 250 buildings via Energy Transfer Stations; for which we are the consultants. We facilitate and coordinate the interface between Tabreed and each individual building designing the system and ensuring that Tabreed's requirements are abided by for an optimized overall scheme.

Making District Cooling a Utility

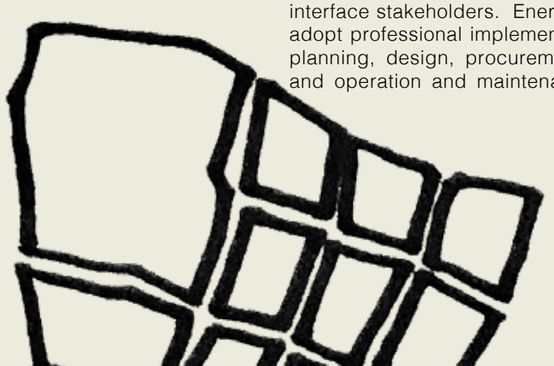
Under the right conditions, district cooling becomes the most efficient and feasible cooling option over other conventional cooling technologies. In high density and diverse use developments, deploying a district-cooling scheme will generally offer the developer numerous advantages in terms of long term cost efficiency, reliability, resilience, energy use reduction, and environmental impact.

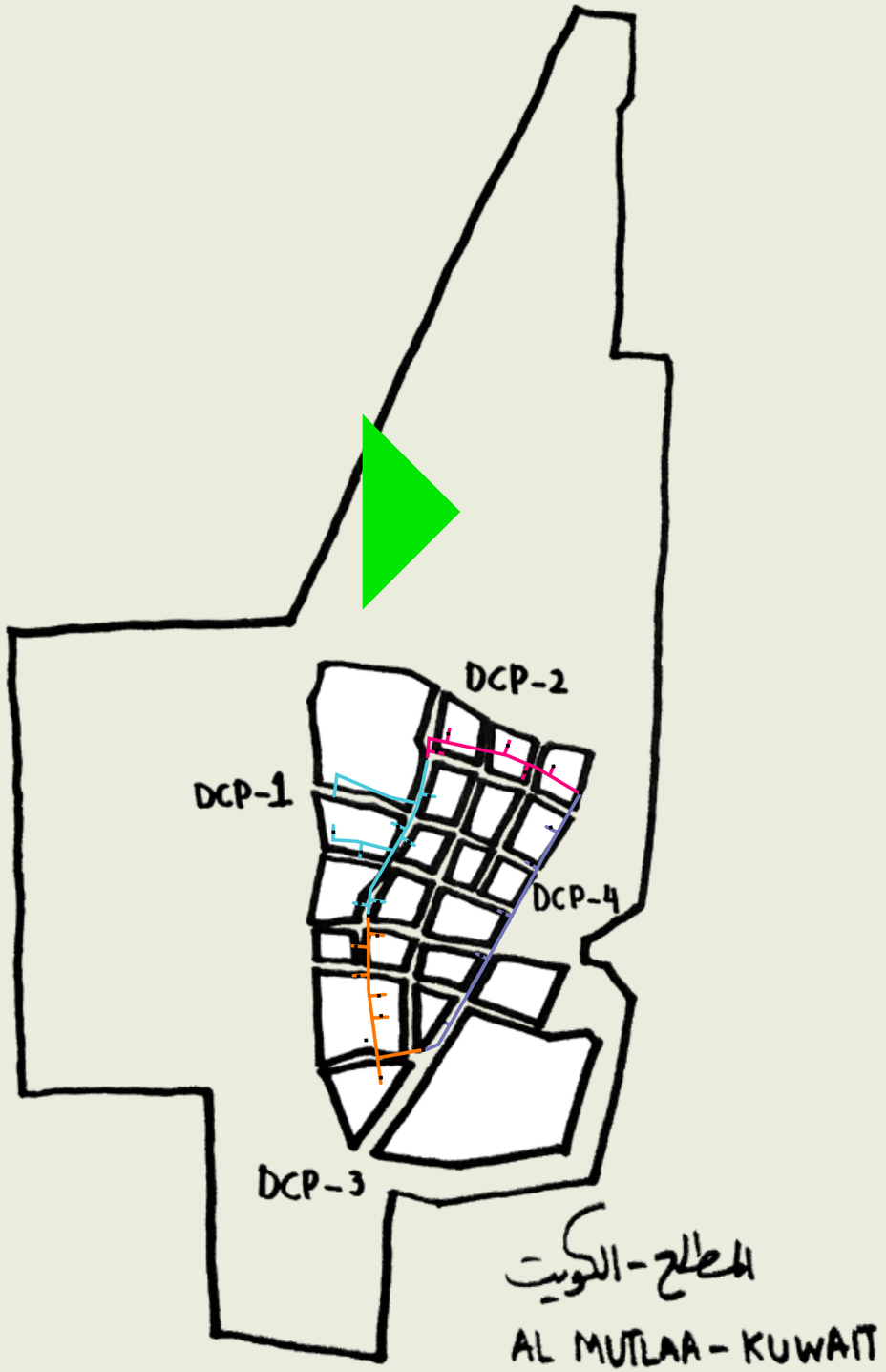
Often, developers are wary of the technology due to unfamiliarity with the system, mistrust in the billing strategy, or high initial investments requirements. It is definite that district cooling has seen its greatest success when backed up by policies and governmental support via codes, designated zoning, and supporting enablers. Treating District Cooling as a utility is a sure way to ensure proper integration into new developments and the success of the model.

Integration of infrastructure planning for district cooling with the development planning is required to ensure the adequacy of the infrastructure, the suitability of the buildings mix, and sufficient attention to cooling load build up during phasing. Also, creating design criteria for developers and investors to create district cooling-ready buildings is essential.

In the feasibility study that we conducted for the Public Authority for Housing and Welfare in Kuwait, we detailed the role of governments in enabling a modern district cooling scheme across the country. One of our recommendations was to treat district cooling as a utility via designing new cities that are district cooling ready at their high density centers. An enabling framework was set inclusive of technical, financial, legal, and operational aspects. We also listed success factors, common mistakes and lessons learnt from the regional and international scenes to enable a successful model in the country.

District Cooling requires a great deal of planning and integration of interface stakeholders. Energy-efficient and feasible district cooling should adopt professional implementation along the project value chain, including planning, design, procurement, construction, installation, commissioning, and operation and maintenance.





Billing for DC

A District Cooling bill has multiple elements; two of which are the most prominent recurring charges:

(1) DEMAND CHARGE:

This is a recurring annual fixed charge calculated based on connected tonnage basis and peak demand. It doesn't depend on the tenant hourly use of air-conditioning. Demand charges are generally the source of many disputes (read more in the next topic: Calibrating for DC)

(2) CONSUMPTION CHARGES:

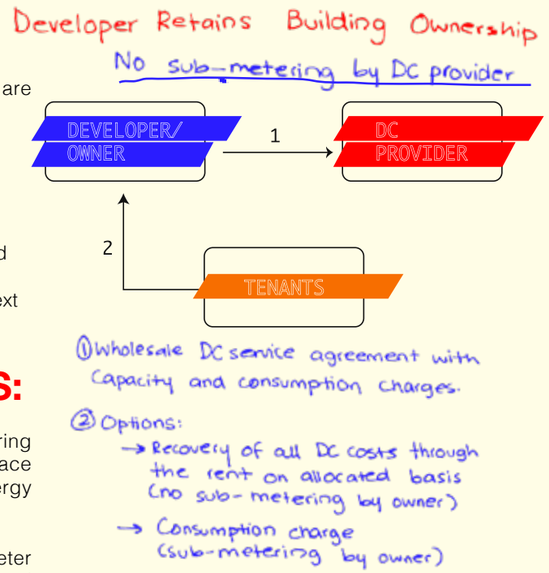
Billed against the use of district cooling either via metering or based on a service charge relevant to the user's space area. It is a reflection of the monthly volume of cooling energy consumed by the end user.

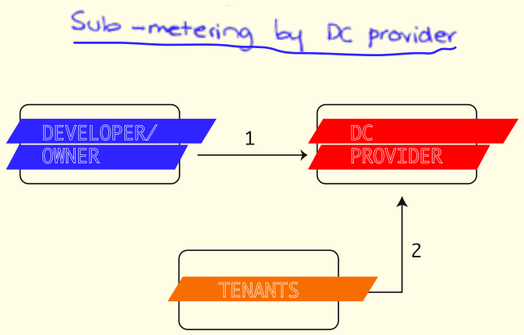
Additional charges include fuel and water surcharges, meter maintenance, administration charges, meter testing fees, and connection/ disconnection charges.

The bulk charges from district cooling are the capacity and consumption charges.

The figures describe the different roles of the developer, DC provider, and tenant for the collection or payment of bills. The first and second scenarios consider that the developer retains the building ownership. The third and fourth scenarios consider the developer has sold the individual units.

"a possible midway solution is a combination of flat annual charges and building bulk metering with adjustments of bills.**"**



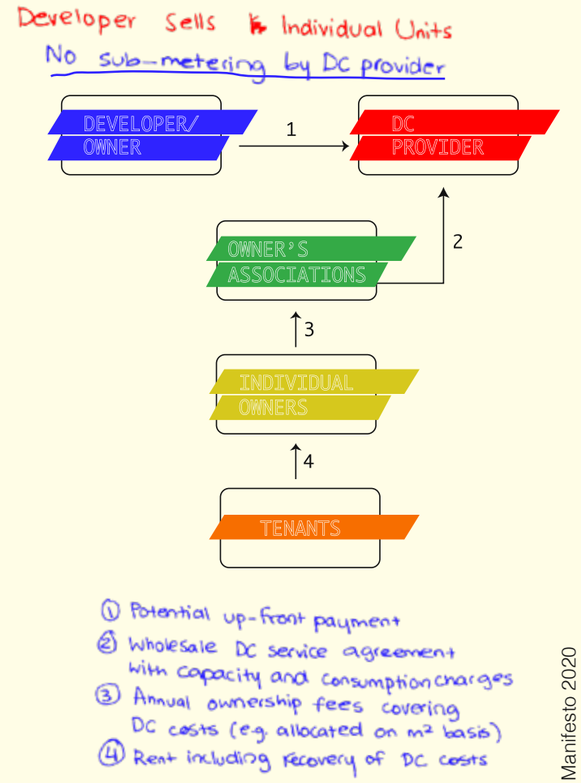


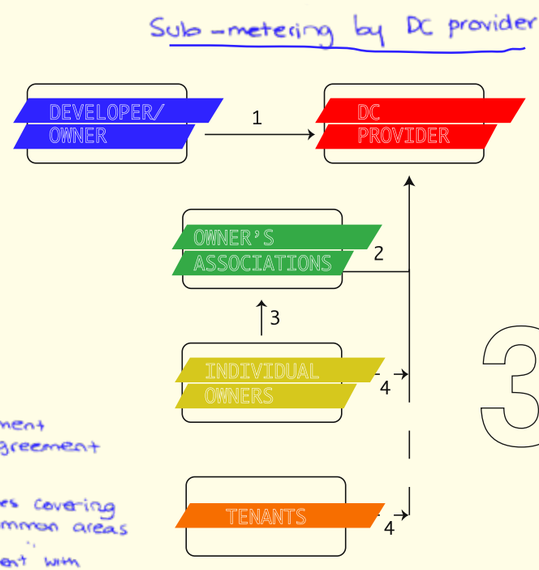
The World Bank recommends sub-metering as it typically lowers cooling energy consumption by an estimated 20% due to the "use-as-needed" factor by the end-users. The challenge that faces DC service provider is the incremental capital cost and administration cost to install, maintain, calibrate and read thousands of individual meters. Sub-metering typically leads to additional charges of around 10-13%. The other challenge is the accuracy and reliability for these meters inclusive of the flow meter, the two chilled water temperature sensors, BTU calculator and the communication to a central server via wired or wireless network. Furthermore, the break-up of charges into three components such as demand charges and direct meter charges and a third from facility management is a complex pricing scenario that is beyond the comprehension of most end-users who are used to pay against one single metered element.

It is recommended by many to adopt a flat annual charge, as opposed to sub-metering, as a more cost effective strategy. The advantages are uncomplicated billing and eliminated sub-metering associated costs. But this too has drawbacks mainly with respect to the accuracy of predicting the annual cooling usage: if underestimated, it would result in a loss for the facility management/DC Provider. If overestimated: it is unfair to the end users. A possible solution is to charge 10% more per square foot that can be debated and adjusted at year-end, for example. Another challenge lies in the sense of end users who have low utilization of their premises that they are paying unfair share of the charges. This strategy also presents no incentives for end-users to conserve energy and rationalize their use of cooling.

Both of the above models have been used successfully while absorbing the disadvantages.

However, a possible midway solution is a combination of flat annual charges and building bulk metering with adjustments of bills against district cooling electrical bills. Every tenant pays a fixed demand charge per square feet per year plus energy rate per square feet per year which is calculated proportional to the building bulk BTU meter x total area and adjusted quarterly by comparing with electrical bills for cooling so there will be an additional quarterly variable adjustment factor to make billing fair and proper.■





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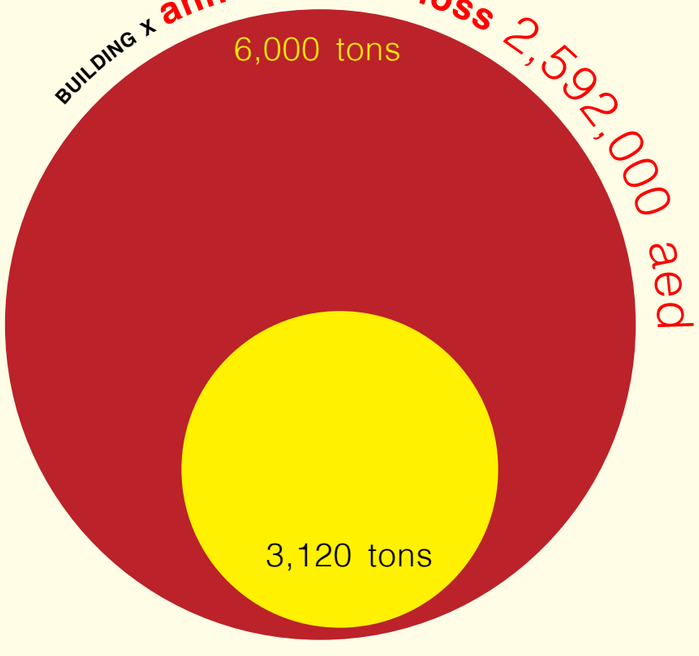
Calibrating for DC

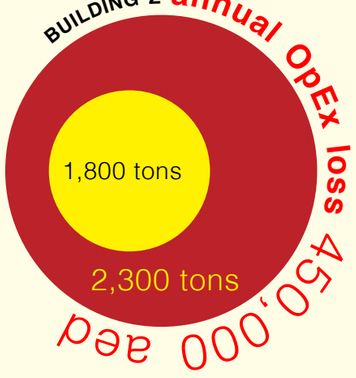
Demand Charges, a.k.a Capacity Charges, are the source of many disputes in the District Cooling field. The building owner rarely pays attention to the accuracy of the cooling load calculation done and presented by his consultant/designer. The developer then enters a binding contract with the district cooling service provider based on the peak figure calculated by the designer only to discover, during operation, that the building peaks at a much lower value than the contracted one. With the contracts lasting for as long as 20 years and little contractual flexibility, the dispute arises between the two parties.

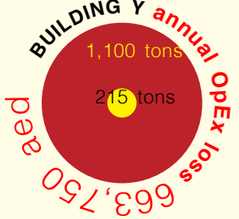
A simple 3rd party review of design cooling loads, before entering district cooling contracts with the service providers, would save developers a substantial amount of unnecessary, and unused, operational expenses.

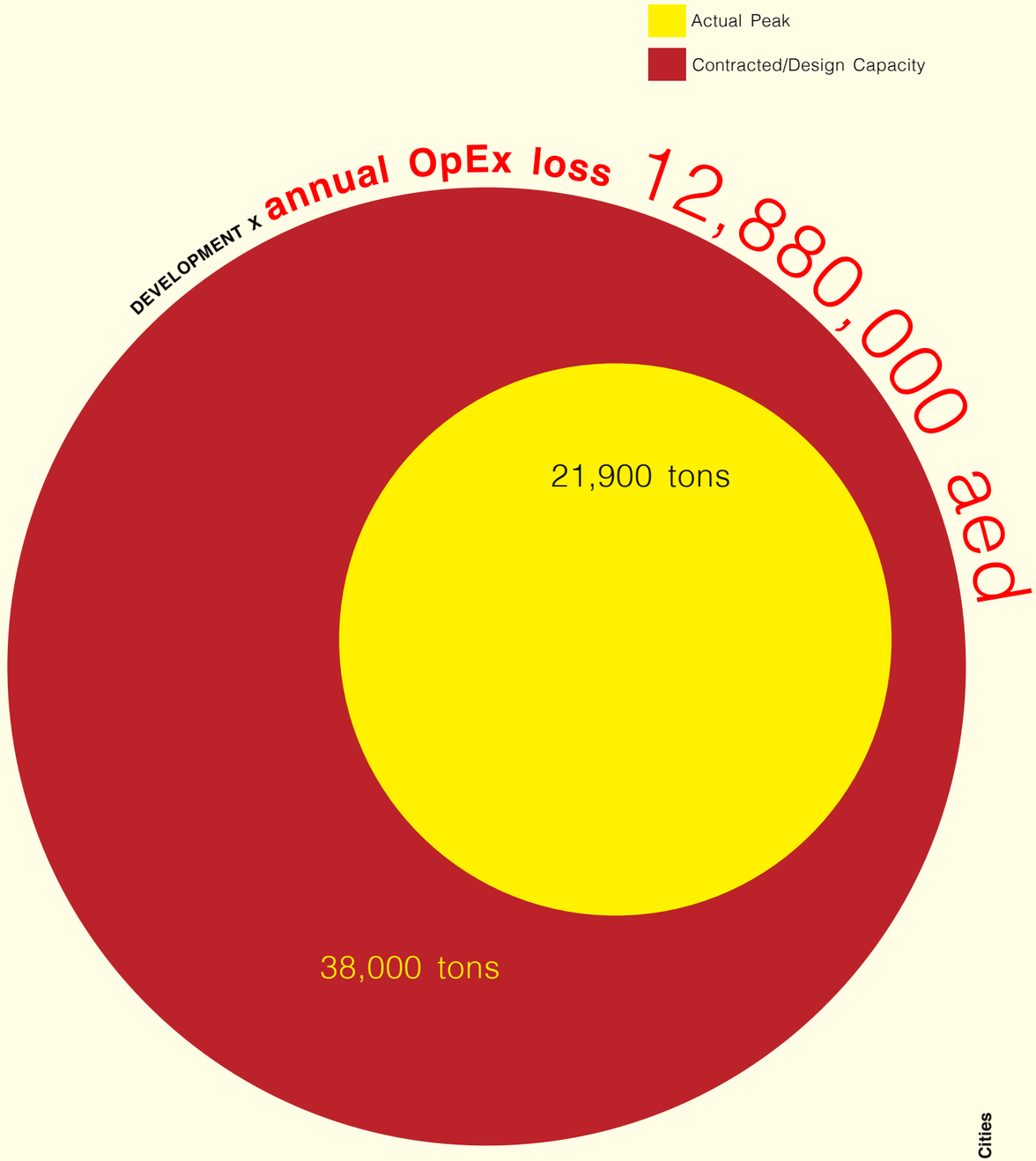
This infograph represents actual figures from projects that GRFN consulted on. In many cases, the district cooling contract was not yet in effect and we managed to save our clients hefty potential OpEx losses.

Side note:
A typical capacity charge rate in the UAE ranges between 750-900 AED/annum/cooling ton.









START IT

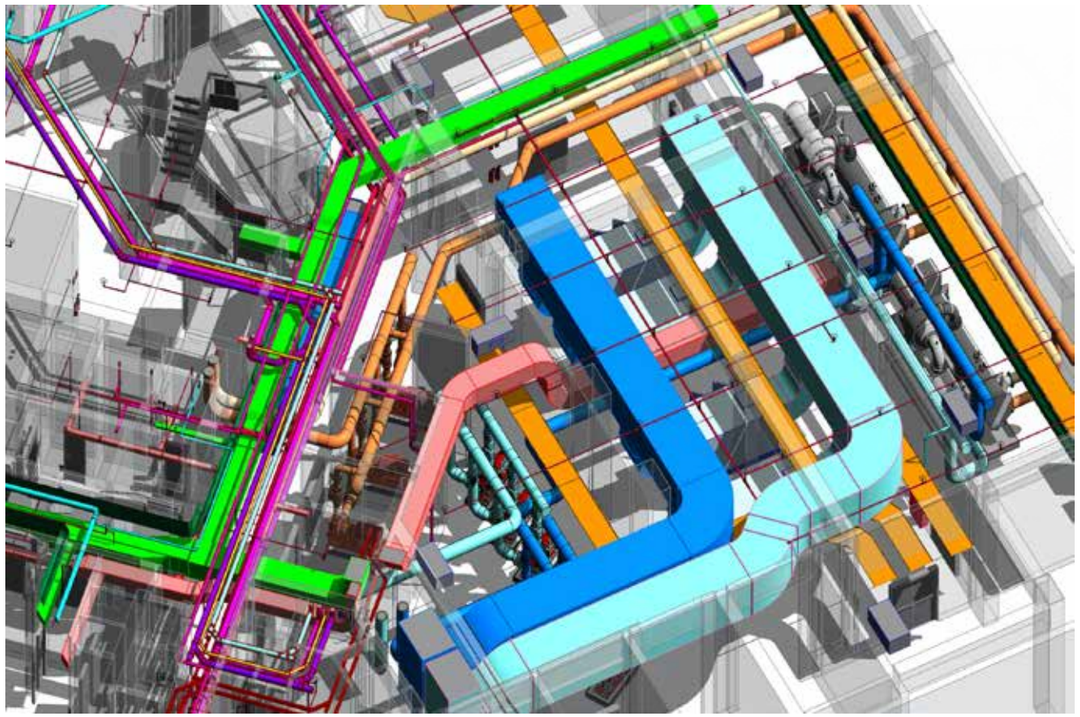
efficient;
feasible; reliable;
resilient;
sustainable

RIGHT

Design to maximize usable space

The project is a five star landmark in Sobha Hartland overlooking the Burj Khalifa. It consists of a basement, ground floor, 4 podiums, and 30 floors with a penthouse occupying the top 2 floors. The tower includes multiple high end restaurants, two swimming pools, fitness centers, and a spa.

We were engaged in the MEPF design of this development to solve two main challenges that stood out among others: the limited connected power allowance granted to the plot and the extremely limited space allowable by the architect for MEP services. The initial concept design done by the previous designer did not cater to both challenges.



After right-sizing, reducing and optimizing the cooling load calculation, we changed the concept of the HVAC services to water cooled chillers- based system with high efficiency to optimize the electrical demand requirement. The same strategy, of first reducing demand then selecting efficient systems to cater for that optimized demand, was applied to all energy consuming systems resulting in an efficient overall building that fell within the available power allowance without any compromise on the client's functional requirements of the high end hotel.

At GRFN, we strive to utilize the full potential of Building Information Management (BIM) as a collaborative tool for information management from project visualization, detailing, planning, and project management to using it further for buildings operations. In this project, our integral use of BIM as a 3D tool enabled us to optimize the use of limited services space while ensuring the constructability of the design via clash resolution and planning for adequate construction processes. Not only that, but the use of BIM assisted our client to conceptualize the MEP spaces and to collectively **optimize the design for operational efficiency assurance.** It is a given that buildings are for people and their use. Translating this integral belief into how MEP systems are designed to utilize less space, and hence maximizing usable space, is a practice seldom followed by MEP designers. ■

"It is a given that buildings are for people and their use. Translating this integral belief into how MEP systems are designed to utilize less space, and hence maximizing usable space, **is a practice seldom followed by MEP designers."**

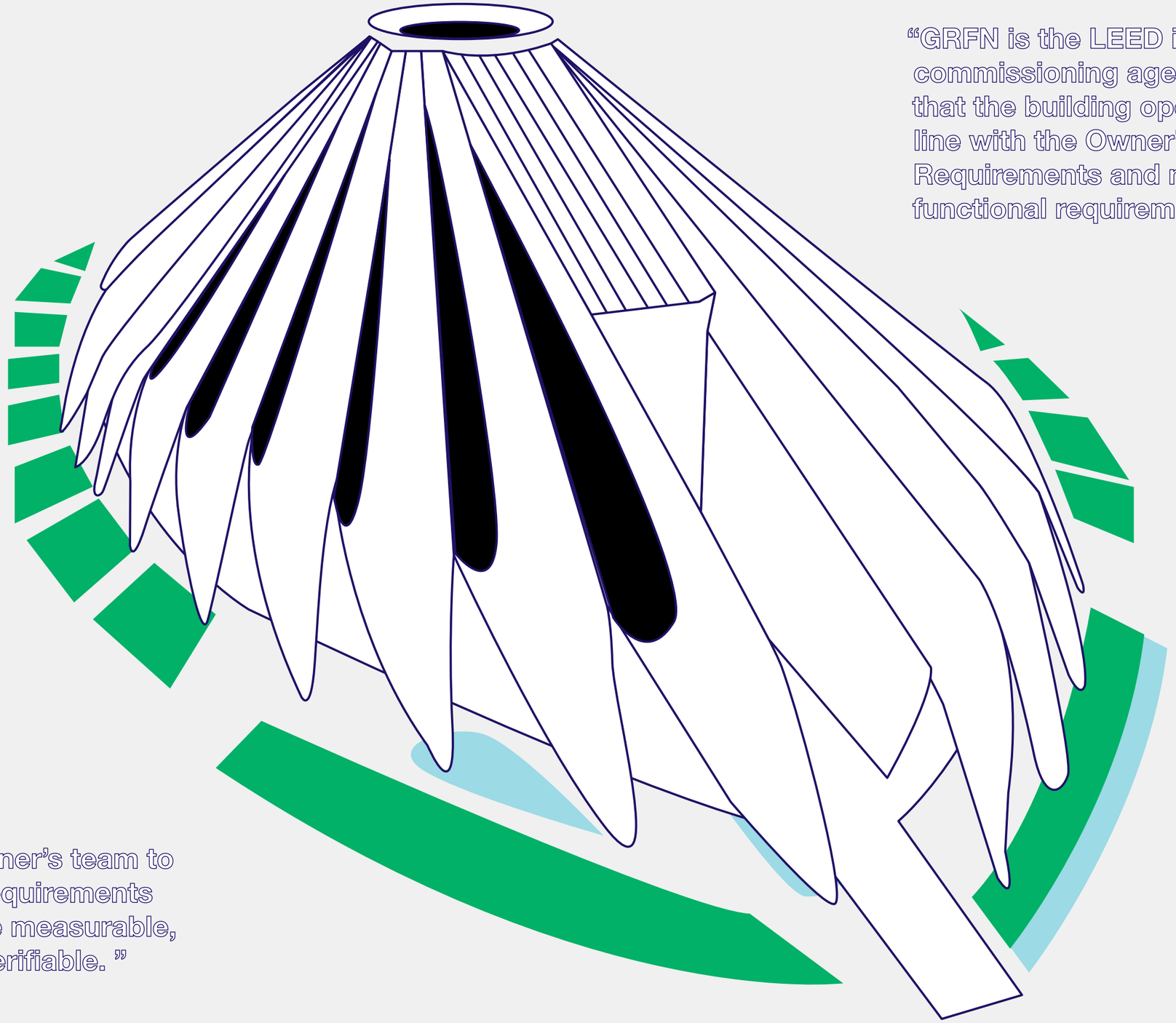
Worthy of the EXPO

The UAE Pavilion at the Dubai World Expo 2020 is designed by Santiago Calatrava, is inspired by falcons at flight and targets ambitious sustainability features and ratings. The monument will be seen by the roughly 25 million visitors and participants who are expected to visit the Expo from October 2020 to April 2021.

GRFN is the LEED independent commissioning agent ensuring that the building operates in line with the Owner's Project Requirements and meets the functional requirements of the project in the most cost effective way.

A well thought of commissioning process results in a better building: one that is operationally ready for the post-occupancy stage, meets the Owner's requirements, and operates efficiently. GRFN focuses on three key performance indicators for any commissioning project:

- In accordance with the Owner's requirements
- Reducing energy waste
- Full documentation of processes



"we work with the Owner's team to define the project's requirements ensuring that they are measurable, documentable, and verifiable. "

"GRFN is the LEED independent commissioning agent ensuring that the building operates in line with the Owner's Project Requirements and meets the functional requirements "

Commissioning Management ideally plays a role at all stages of construction; and our approach to commissioning management is aligned with that.

Initially, we work with the Owner's team to define the project's requirements ensuring that they are measurable, documentable, and verifiable. Those are then integrated into the initial commissioning plan; which is updated throughout the construction process. In the design stage, we are normally involved in focused design reviews by assuring design documents are in line with the Owner's Project Requirements. At the construction stage, it is vital to ensure the incorporation of the commissioning requirements into the construction documents, to commence commissioning workshops, and review submittals. It is at this stage that the commissioning plan, procedures, method statements, and guidelines are finalized. During the commissioning period, systems testing and acceptance tests take place. A final commissioning report is issued at the end of this stage. And prior to handover, all commissioning documentation is collated and filed within the O&M manuals. During occupancy, we observe and review the operation of the building to ensure that the initial operations intent and Owner's requirements are abided by.

Design with minimal resources

We are enthusiastic about projects that improve the lives of people and their communities. And when we were approached by Open Source Architecture and Professor Katodrytis of the American University of Sharjah to collaborate on the design of a community center for 300 orphaned children in Tanzania, we jumped at the opportunity.

GRFN is a for-good business. We aim to make a difference towards social impact and more sustainable cities and have been employing Corporate Social Responsibility within our operations as a means to give back.

This was the first initiative that we pursued on a pro-bono basis and involved the design of a multi-use community center for 300 orphaned and under-privileged children in Mkuranga district, Tanzania, East Africa. The facility housed children's homes, a school, a sports center, and a community place.

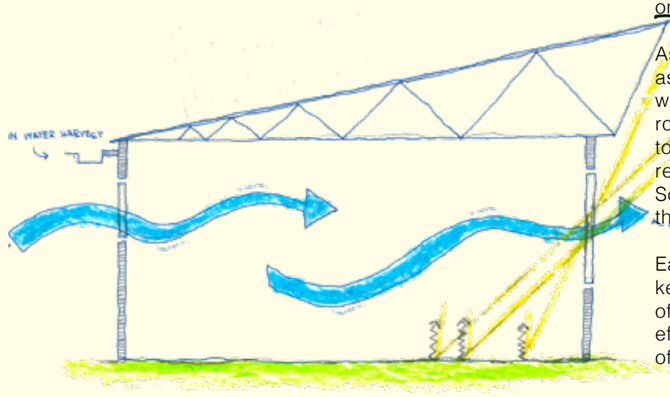
Credits to: Open Source Architects & Dr. George Katodrytis
Larchfield Charity Organization

The Mkuranga Children's Home & School

The design of the facility primarily aimed to provide sustainable engineered solutions to face the limited resources available including power and water; yet feasible enough to ensure that the project secures the needed funding to see light.

We collaborated with architects, master planners, and structural engineers from various entities in an integrated design process. The collective efforts of all involved gave the desired momentum through to completion of the project.

Passive design is the first and foremost step to sustainable design. We studied natural ventilation strategies by conducting thermal modeling and simulations using industry-leading state-of-the-art software tool. By working closely with the architects, we eliminated the reliance on mechanical air-conditioning altogether. This was essential to deliver a low-demand power design due to the scarcity of electricity supply. The climatic variations of Mkuranga, Tanzania did not limit us from providing suitable recommendations for the thermal comfort of occupants without AC. We also deliberated our efforts in attending to daylighting simulations to reduce dependence on artificial lighting when not needed during daytime.



As Tanzania receives an ample amount of rainfall and as the site was situated on a hill, we designed a rain water harvesting system that relied on gravity to collect, route, and store rain water for non-potable use such as toilet flushing. Not only was the demand for water use reduced, but the pumping energy was also diminished. Solar water heaters were specified for restrooms and the kitchen to cater the demand for hot water.

Each strategy proposed individually and collectively played key part towards sustainability. It was the compendium of all strategies that made a major impact and proved effective in terms of sustainable design development of the Mkuranga Children's Home. ■

Near - Zero

Chalabi Architekten & Partner

Chalabi Architekten and Partner (CAP) were commissioned by the Abu Dhabi Housing Authority (ADHA) to design a sustainable villa as a pilot project on an unspecified plot of land located anywhere within the emirate of Abu Dhabi.

Respectful of the cultural attitude towards privacy within the UAE, the villa and its outdoor areas were subdivided into four distinct zones on the ground floor, offering diverse gradients of privacy. The first floor is an exclusively private family zone. Doors in this five bedroom villa can be opened and closed to combine or divide adjacent rooms and allow flexible and interchangeable use of interior and exterior spaces. The open courtyard and breezeway link to the back garden define a comfortable outdoor area that enjoys a constant breeze. Interior spaces were arranged around and open out onto the courtyard to provide extended, liveable areas. In addition, the variety of depth between the building and the boundary wall creates shaded outdoor rooms on all four sides of the villa all with water features and indigenous plants that contribute to a cool, pleasant ambiance.

“This system helps the occupant to target and achieve the desired energy and water consumption **without compromising the** comfort level.**”**

We designed a Sustainable Villa Prototype for the Abu Dhabi Housing Authority in collaboration with Chalabi Architekten and Partner to achieve a nearly net-zero energy villa and to comply with Abu Dhabi‘s Estidama 4 pearls requirements.
The design utilized an air cooled air-conditioning system with the highest feasible efficiency available in the market. The outside air handling unit is fitted with a double energy recovery mechanics that reduced the outside air cooling load by 65%.

We specified low flow water fixtures to reduce the overall villa water consumption. The hot water requirement in the villa was met by a highly efficient rooftop central solar thermal system.

Generous glazing elements were provided for ample daylighting in the interior spaces; considerably reducing the dependency on, the otherwise highly efficient LED, artificial lighting.

On-site installed photovoltaic cells offset a major portion of villa energy usage as well as feeding to grid through a net-metering system.

The Villa was provided with increased outdoor air supply over the minimum code requirements via a dedicated fresh air handling unit equipped with high efficiency filters to minimize particulate matter and dust. This design ensures optimum wellbeing for the occupants and reduces infiltration into the villa.

Each bedroom is served by an individual AC unit to guarantee comfort and customized controllability by each occupant.

We added advanced occupant sensors that automatically control lighting and air conditioning units to reduce energy consumption while maintaining optimum indoor thermal comfort.

The Villa is provided with a digital occupant feedback mechanism integrated with electric and water sub-meters which facilitate the villa occupant to obtain the immediate updates and feedback on the villa's energy usage & water usage pattern, consumption, local weather reporting and air conditioning units set-points. This system helps the occupant to target and achieve the desired energy and water consumption without compromising the comfort level. ■

*renders by CAP

sustainability

ecological

52

COOLING LOAD REVIEW

It is widely reported that the building industry is accountable for about 40% of global energy consumption. The end-use statistics keep changing year on year but the energy consumed by the building sector largely remains the same with slight increments due to ever expanding urbanization. The energy outlook today portrays great emphasis on energy production to meet the increasing demand for consumption, and a much greater emphasis on savings and nexus between both.

Energy performance and budgets of buildings largely depend on the primary equipment installed to cool or heat the occupied spaces. We specialize in providing cost effective solutions in reducing the ecological footprint of the built environment and strive to promote sustainability through our operations and consultancy services. We have demonstrated great savings potential through our technical studies, design, project management, energy efficiency and sustainability consultancy services.

One of the projects that we were involved in as a client representative: 'a third party reviewer cum site supervisor' is a mid-sized multi-story mixed-use residential/ commercial development located in Dubai with retail spaces on the ground floor and residential blocks on higher floors. Our scope was to perform peer review of MEP design and evaluate cooling load in a bid to reduce the electrical demand load. By optimizing the cooling load calculations and proposing the use of air-cooled chiller technology over the originally designed DX systems, we demonstrated both time and monetary savings in addition to realizing the original target of electrical demand reduction. The savings mounted to about 28% reduction in electrical load and 18% reduction in MEP construction cost. The cooling load demand was reduced by 60%. ■

"We specialize in providing cost effective solutions in reducing the ecological footprint of the built environment and strive to promote sustainability through our operations and consultancy services."

environment

Manifesto 2020

Start It Right

Energy Thief

Hassan Younes – 2015
Climate Control - Middle East

Leaky ductwork is an energy hog that is hidden from view – or at least that's how Max Sherman, a Senior Scientist at Lawrence Berkeley National Laboratory, in the United States, describes the problem in his article, "Billions in Lost Energy Leaking Out of Home Heating & Cooling Ducts", which the laboratory published in March 20011.

Focusing his attention on California, Sherman states in his article that ducting systems typically leak 20% to 40% of the state's heating and cooling energy, before going on to claim: "Statewide, the potential savings from improving ducts is between 1 and 2 gigawatts (GW) of electricity alone. No single efficiency improvement has equivalent savings potential." Quantifying his claim, he says: "The potential savings from sealing residential ducts in California adds up to USD 1 to 2 billion per year."

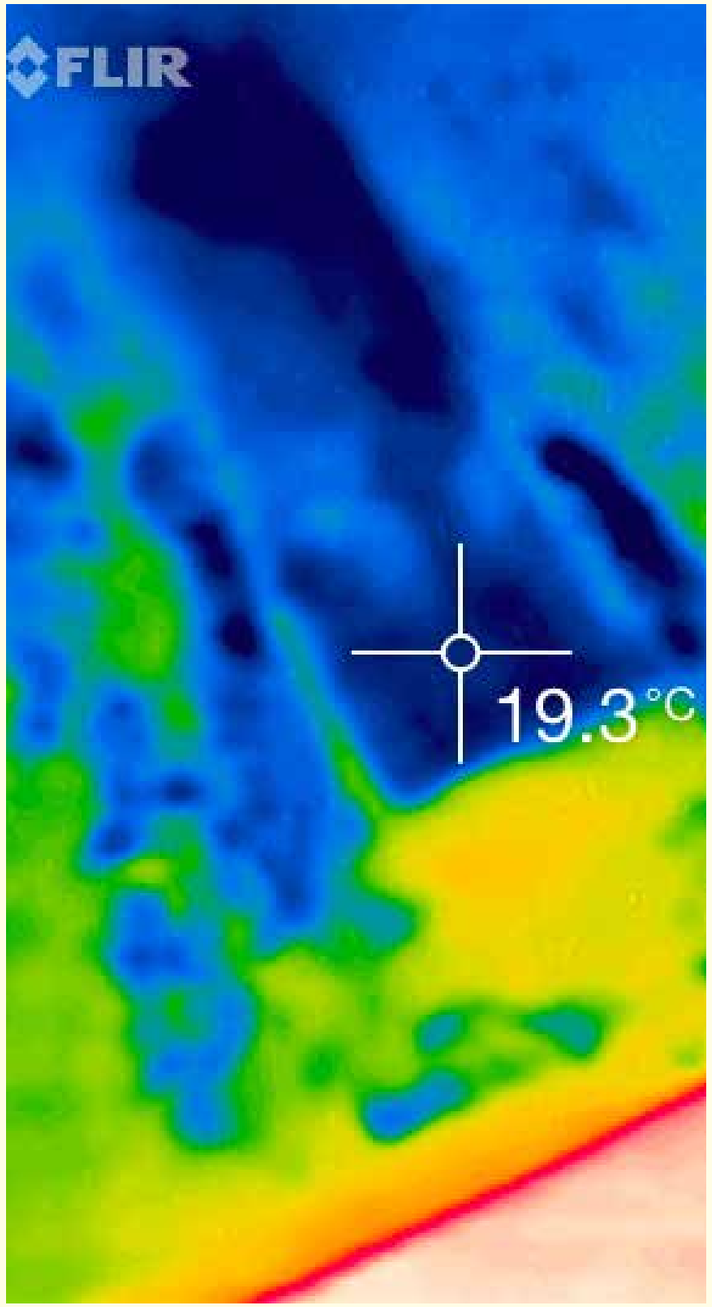
Sherman's article was published 14 years ago. However, the problem he examined persists, not only in California but in all of the United States, with the US EPA estimating that in an average American home, "about 20 per cent of the air that moves through the duct system is lost due to leaks and poorly sealed connections".

"about 20% of the air that moves through the duct system is lost due to leaks and poorly sealed connections**"**

But is it an issue that concerns only American homeowners?

GRFN's Say:

Mediocre workmanship is partly to blame for the region's defective HVAC ducting systems. A big factor is poor installation practices. Normally, duct leakages occur on transverse joints, longitudinal seams and duct penetrations. Poor facilities management (FM) is also a main contributor. In some cases, we have observed unqualified maintenance personnel using ducts as walkways, leaving testing holes and smoke dampers open and not checking holes that have developed due to rust. ■



Up To Standard

Hassan Younes – 2016
MEP Magazine ME

*True as of July 2016

ASHRAE ventilation standards 62.1 and 62.2 have been for many years the standards followed in many parts of the world for acceptable indoor air quality in the built-environment.

The purpose of ASHRAE 62.1, the most referred to ASHRAE standard in the UAE, is:

- To specify minimum ventilation rates and other measures intended to provide indoor air quality that is acceptable to human occupants and that minimizes adverse health effects.
- A regulatory application to new buildings, additions to existing buildings, and those changes to existing buildings that are identified in the body of the standard.
- To guide the improvement of indoor air quality in existing buildings.

Both Dubai and Abu Dhabi's municipality require compliance with ASHRAE ventilation standards for all new buildings.

Historically and until 2015, the scope of Standard 62.1; entitled "The Ventilation for Indoor Air Quality Standard"; was all commercial and residential buildings except low rise residential (3 stories and below). Standard 62.2 was the Ventilation and Acceptable Indoor Air Quality for Low-Rise Residential Buildings.

In the 2016th edition this has been changed. Residential buildings have been completely removed from 62.1's scope. Standard 62.2 will be the reference used for all residential buildings whether low-rise or high rise.

This change will impact the ventilation calculations that were used for high-rise residential buildings. For instance, toilets' continuous exhaust used to be 25 CFM and now, since 62.2 now applies to high-rise residential buildings, 20 CFM is the new norm.

Kitchen ventilation used to be 50 CFM as per 62.1 2013 and now, as per 62.2 2016, a continuous airflow of 5 ACH should be exhausted from the kitchen. A 4 m by 3 m kitchen would require a continuous exhaust of almost 100 CFM, double the amount required in ASHRAE 62.1 2013. The bigger the kitchen the higher the required continuous exhaust will be. Note that outside air requirements for residential buildings are normally driven by the exhaust flow, since most of the time the calculated exhaust value as per 62.2/62.1 is higher than the calculated outside air value. To keep the building under pressurisation to combat infiltration, designers normally provide 10% extra outside air to the calculated exhaust flow. So generally, in residential buildings, outside air, or fresh air as commonly known in the UAE, is calculated at 110% of the exhaust value that is in turn calculated to the standard requirement.

This will increase the ventilation system energy consumption especially in a climate like Dubai's and Abu Dhabi's. Buildings that have more studios and one bedrooms will be affected the most, compared to buildings where the majority of apartments are 3 bedrooms or more.

Other changes in ASHRAE 62.1 2016 include the following:

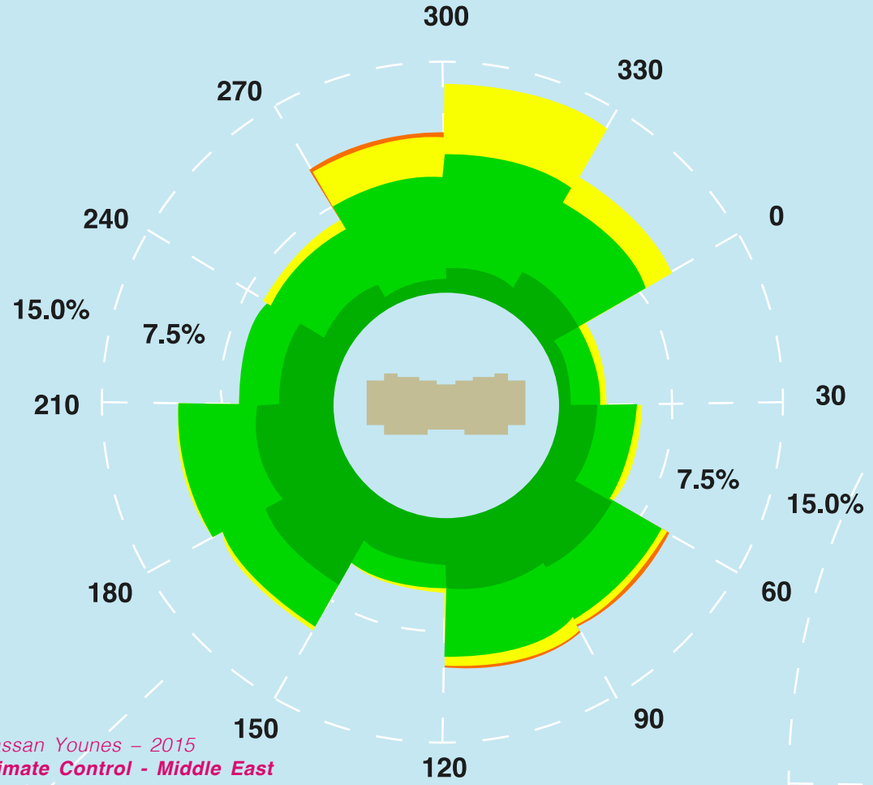
- The definition of environmental tobacco smoke has been revised to include emissions from electronic smoking devices
- Ventilation is allowed to be reduced to Zero through the use of occupancy sensors (not through contaminant of CO_2 sensors) for spaces of selected occupancy types provided that the ventilation is restored to the standard required value whenever occupancy is detected

Currently none of the UAE municipalities have adopted the 2016 version of the standards. The 2007 versions of both 62.1 and 62.2 are the currently referred-to ventilation standards in the UAE building regulations.

We will yet have to see if the new version will be adopted and the effects that it would have on the construction industry once implemented.

Update - Dubai Municipality now adopts the latest ASHRAE ventilation standards. ■

Energy Modeling / Need for a Revisit



Hassan Younes – 2015
Climate Control - Middle East

“it is easy to create a model, run a simulation and get flashy results. **But are those results correct?”**

Pointing out that energy modelling software simulation often yields results that do not necessarily reflect future or current operation and use of a building, Hassan Younes makes a cogent case for more accurate models that could not only give a realistic picture but also contribute to the calculation of a building’s lifecycle cost and energy conservation.

Prediction is something humans have always craved. Reinventing a city’s future into a sustainable one requires a data-driven approach and a vision that is supported by accurate predictions. The prime pillar of sustainable cities is low energy consumption and low environmental impact. And the main contributor to energy consumption and carbon emissions in a city is the built environment. No wonder then that building performance is an aspect that is most focused on when devising an urban sustainability road map.

Energy modelling of a building involves modelling of heat, air, moisture, light, electrical energy and mechanical energy, to come up with a prediction of energy use and building thermal and environmental conditions that could guide the designer or operator into the most cost-effective and efficient path to “greening” a building. Simulation of energy requires not only a description of a building’s geometry, construction materials, energy systems and equipment but also a characterisation of the building utilisation through occupancy, and equipment schedules. In addition, a specification of the building operation is necessary, commonly through a definition of setpoint schedules, HVAC system availability and sequencing of multiple devices of HVAC equipment like chillers staging and control loops.

Energy modelling has become an essential part of building standards and rating systems, thanks to advancement over the years, its widespread availability, significance and proven benefits in lowering a building’s energy consumption.

In today’s market, especially in the GCC region, energy modelling is mainly used for compliance with rating systems. Developers and building owners do not require energy modelling as a project design deliverable, unless required by a sought-after building rating or an urban authority. Therefore, in most cases, once the approving or certifying authority accepts the modelling results, the energy model perishes, with the owner satisfied by the number of points achieved or the bare minimum that the project can get away with to receive the building permit. In this context, a lot of energy modellers have surfaced in the market to cope with the energy modelling demand from LEED and Estidama. Most of those modellers have become familiar with the energy modelling rules that are set by ASHRAE standard 90.1 Appendix G. Yet, only a few have mastered the sound theoretical background that is much needed to arrive at correct results. With the currently available software, it is easy to create a model, run a simulation and get flashy results. But are those results correct? Do they truly reflect the future or current operation of the building? Such low quality, inherently incorrect and totally deceptive energy simulation results create hurdles in the way of energy modelling, proving its worth and convincing developers of its tremendous benefits that outweigh the relatively insignificant added design cost. This is also the very reason why organisations like ASHRAE have taken it upon themselves to produce standards and guides to energy modelling, and to list energy modelling certifications for professionals that provide assurances that the certified professional is well-versed in the skills required to build sound energy simulation models.

In addition to containing and limiting the operational energy consumptions, a well-developed, accurately built and fine-tuned energy simulation model could be an essential and major contributor to the calculation of a building’s lifecycle cost – an aspect that is indispensable to assessing the success of a development. Not only that, but a living model that evolves from design to construction, and construction to operation, being fine-tuned throughout the way, would help inform decisions of future retrofits, drive energy management, and help in measurement and verification, and reduce the lifecycle cost of a building.

Only a few consultants in the GCC region, and even worldwide, revisit buildings that they have modelled to compare the design modelling results with the actual figures from measured data and energy bills. Recent studies conducted on schools in the UK have attempted to determine the extent of the difference between predicted and actual energy use. An average energy consumption of 2.4 times the design value was reported for new schools. The worst case studied was 10 times the design figure. This clearly indicates that there is a disconnect between how the building has been designed to be used and how it is actually being used. Either that, or the problem lies in the methodology and correctness of how the design energy value has been calculated.

Moving forward, some developers worldwide have started asking for performance in use and energy use intensity (EUI) thresholds to be met by the designer/contractor. Ideally, designers and contractors could be held responsible for a wide discrepancy between actual energy use index and the one predicted during the design and construction stages. Such practices will raise the level of professionalism in the energy modelling sector and will help reduce the number of uninformed modellers, by distinguishing them from the experienced and certified ones.

It is also, however, vital to note that differences between predicted and actual energy usages are not always attributed to poor modelling practices. A design that shows adequate performance, when subjected to computer simulation at the design stage, may depend on assumptions that are not reflected in the actual use of the building. This is why it is important to revisit the building in the post-occupancy stage and update the model to reflect real operational patterns. By doing so, designers can defend their positions by noting operational behaviours that are different from the agreed assumptions during the design stage, like occupancy hours, or pinpointing wrong facility management operation of different energy consuming systems. This exercise would also help designers in adopting more realistic assumptions for their ensuing projects.

In a nutshell, and for the construction market to realise and reap the benefits of energy modelling, it will take knowledgeable and experienced modellers to showcase those benefits on the one hand, and well-versed developers and building owners, on the other, to insist on accurate and calibrated living models that would span the life of a building, and for those models to be developed by certified professionals. Only then can the sector evolve and prove its worth in the sustainability revolution of cities. ■

How efficient is your AC

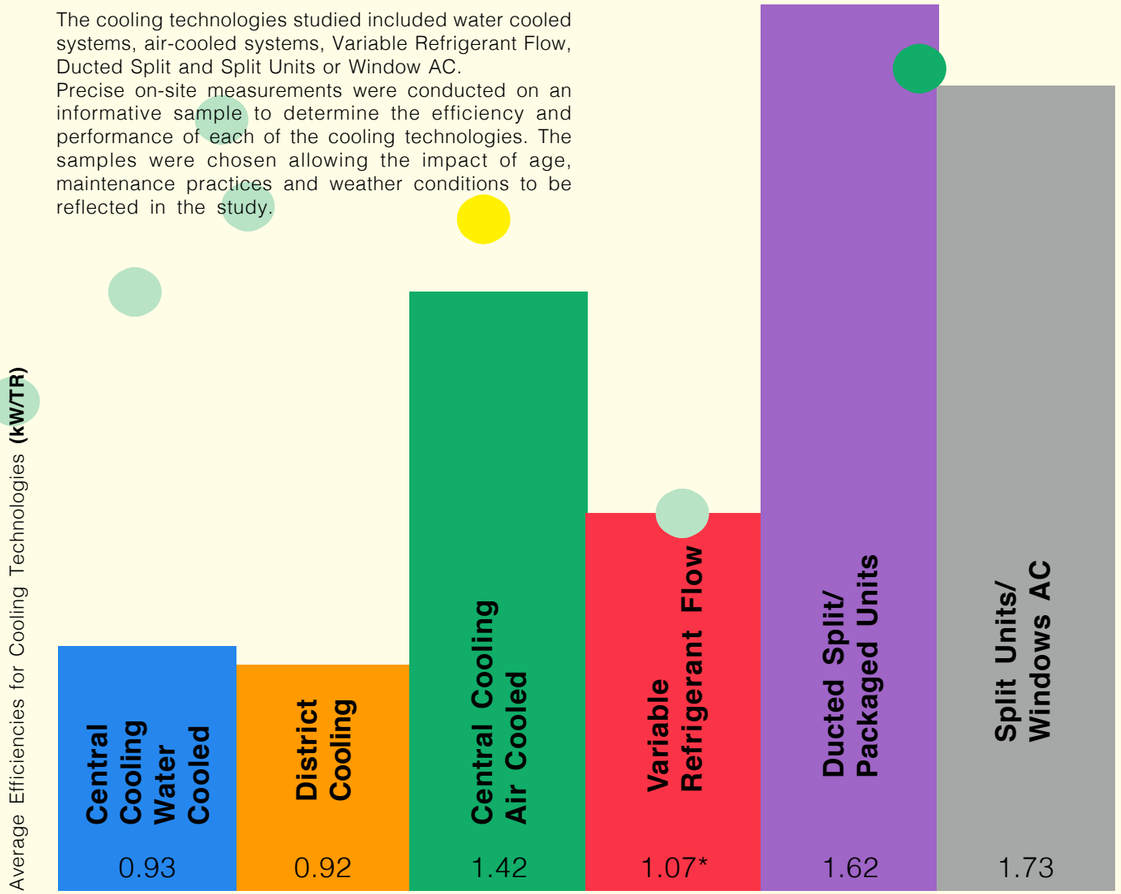
One of the programs of the Dubai Demand Side Management (DSM) Strategy requires doubling the market penetration of efficient District Cooling systems by 2030. To measure progress against this target, a study was commissioned by the Dubai Regulatory and Supervisory Bureau (RSB). One of aims of the study was to assess the efficiencies of the different cooling technologies available in the market.

Within a JV, we delivered the project, results of which are published on the RSB's website.

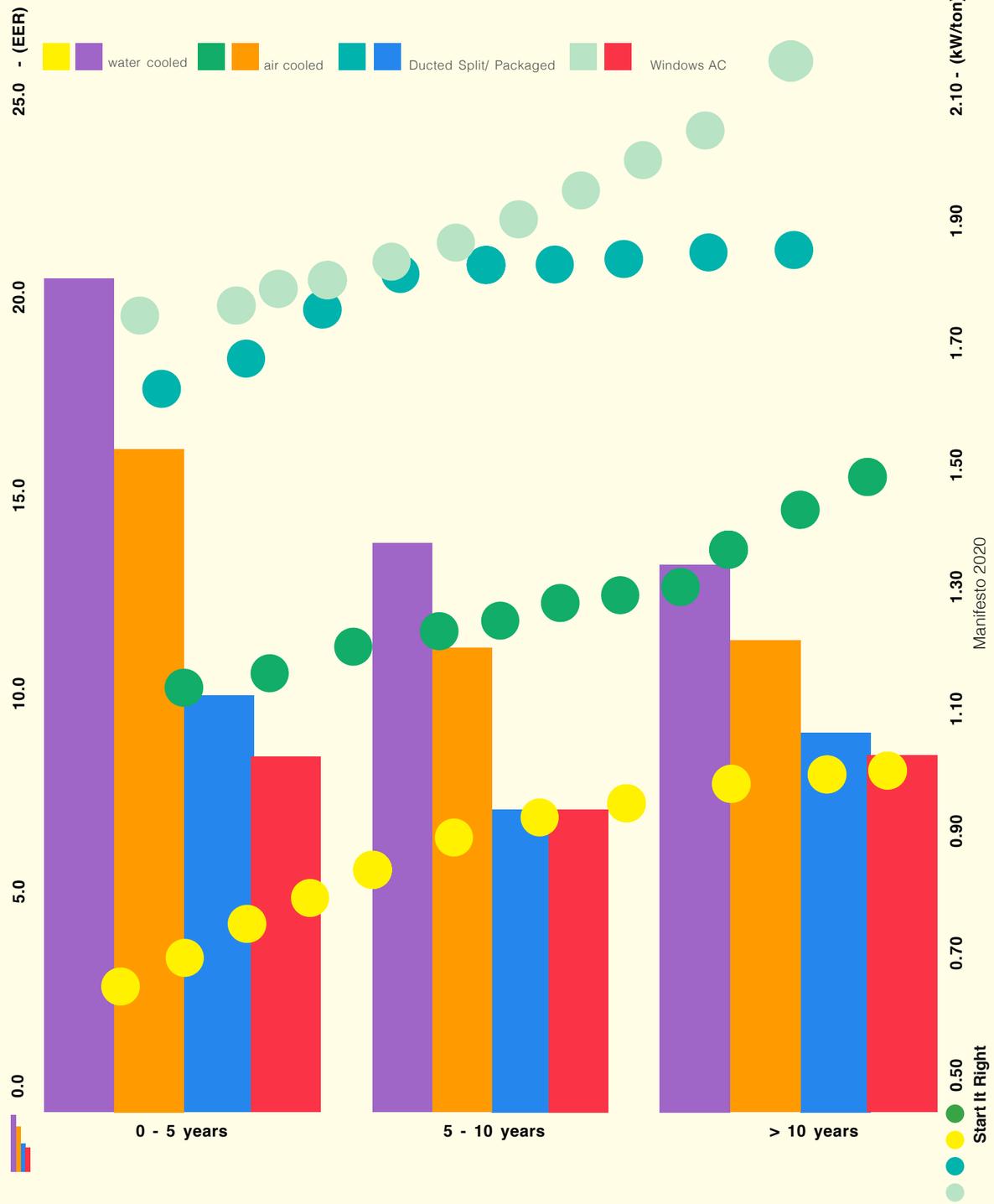
The cooling technologies studied included water cooled systems, air-cooled systems, Variable Refrigerant Flow, Ducted Split and Split Units or Window AC.
Precise on-site measurements were conducted on an informative sample to determine the efficiency and performance of each of the cooling technologies. The samples were chosen allowing the impact of age, maintenance practices and weather conditions to be reflected in the study.

Prior to conducting the measurements, the share of each of the technologies in the market was determined to aid the proper sampling exercise.

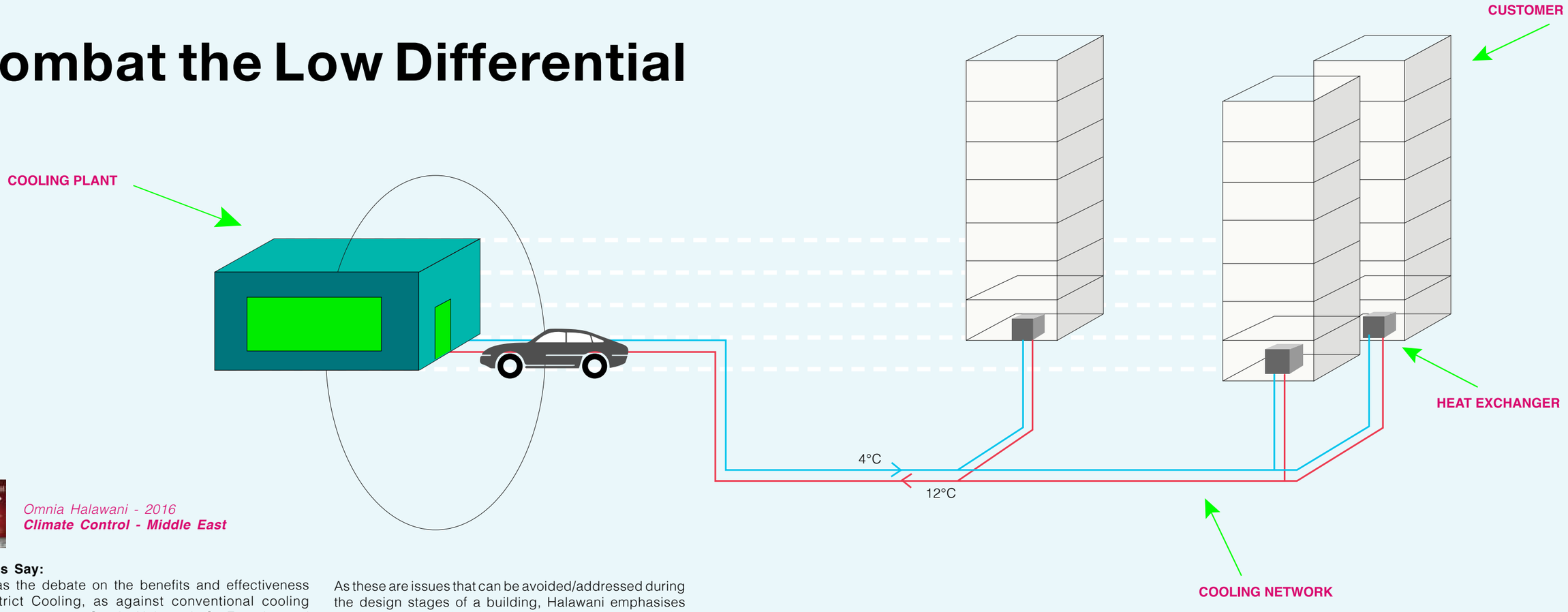
Water-cooled solutions proved to offer superior energy efficiencies compared to their air-cooled alternatives. The weighted average efficiency of cooling systems (other than district cooling) was assessed to be 1.51kW/TR, whilst district cooling efficiency calculated from data provided to the RSB by district cooling firms was found to be 0.92kW/TR. ■



*based on manufacturer data due to lack of measurements



Combat the Low Differential



Omnia Halawani - 2016
Climate Control - Middle East

GRFN's Say:
Even as the debate on the benefits and effectiveness of District Cooling, as against conventional cooling systems, rages on, Omnia Halawani, Co-Founder and Director of GRFN, highlights the most pressing issue that District Cooling providers and end-users are facing at present – the low chilled water temperature differential (low ΔT), or low ΔT syndrome.

Explaining that having a low ΔT has an effect on lost cooling capacities, increased energy consumption, increase in costs and system complexities, Halawani identifies three issues as the most common regionally — selection of building cooling coils, the performance of control valves and oversizing of buildings' cooling load requirements — as root causes of the problem.

As these are issues that can be avoided/addressed during the design stages of a building, Halawani emphasises on the need for all stakeholders to get together at the design stages to develop a "sound engineering design" and adopt "integrated design strategies".

Suggesting a solution to the oversizing of buildings' cooling capacity problem, Halawani says, "If building owners were more conscious in this aspect, requiring their consultants to ditch the unrealistic safety factors, which I like to call "ignorance" factors, when calculating cooling loads, they can save thousands in District Cooling capacity charges."

Lastly, she says that having a "more transparent District Cooling industry with published actual peak loads would aid the drive towards a more sustainable construction industry as a whole". ■

Delta T is the difference in the Chilled Supply Temperature
& the Chilled Water Return Temperature

A "Low Delta T Syndrome" occurs when the delta T is consistently lower than design conditions.

Inter-

Optimization;

Retrofit;

Audit; Efficiency;

Improvement

vention

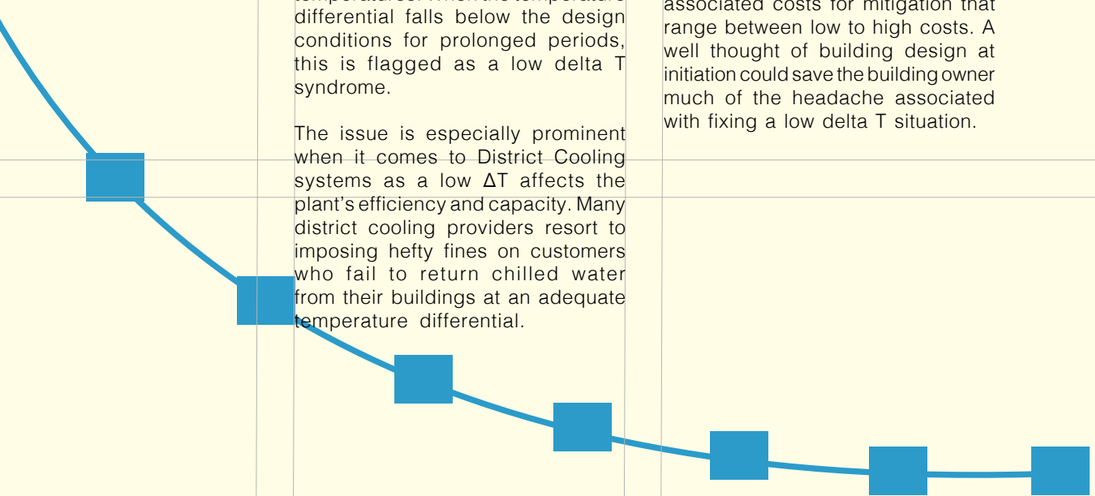
DELTA T SYNDROME

“A well-thought-of building design at initiation could save the building owner much of the headache associated with fixing a low delta T situation.”

DEFINITION

In a chilled water system, Delta T is defined as the difference between the Chilled Water Return and Supply temperatures. When the temperature differential falls below the design conditions for prolonged periods, this is flagged as a low delta T syndrome.

The issue is especially prominent when it comes to District Cooling systems as a low ΔT affects the plant’s efficiency and capacity. Many district cooling providers resort to imposing hefty fines on customers who fail to return chilled water from their buildings at an adequate temperature differential.

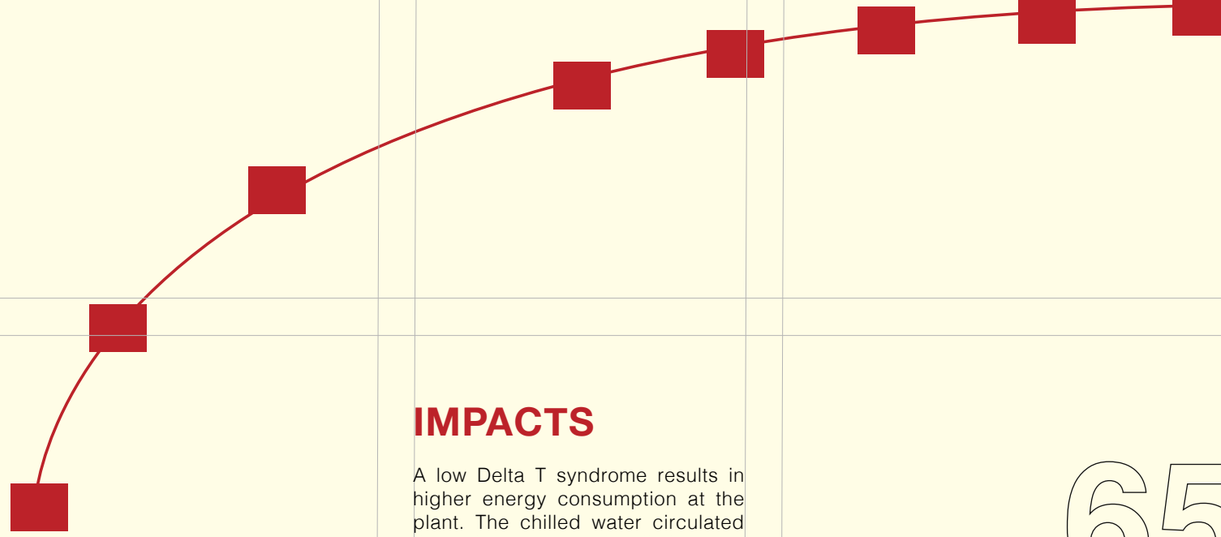


CAUSES

A low Delta T syndrome originates at the customers’ buildings and may be caused by many factors, collectively or separately. Generally, improper control of chilled water tertiary pumps causing over pumping is a frequent cause of low delta T. A common reason for this improper control of pumps is the non-optimum locations, setpoints and controls of differential pressure transmitters that control the flow on those pumps.

Sometimes the syndrome is attributed to wrong or outdated selections of equipment and components like the use of 3-way valves, wrong selection of control vales or improper cooling coils specification. A simple malfunction leaving bypasses on the system always open could also be a cause of the issue.

Each one of those causes come with associated costs for mitigation that range between low to high costs. A well thought of building design at initiation could save the building owner much of the headache associated with fixing a low delta T situation.



IMPACTS

A low Delta T syndrome results in higher energy consumption at the plant. The chilled water circulated through the network will have to be increased to be able to deliver the required amount of cooling. Remember that cooling is a function of ΔT and flow; if ΔT goes down then flow has to be increased. The increased energy usage is not only observed at the chilled water distribution pumps, but also on the chiller level, condenser water pumps and cooling tower fans.

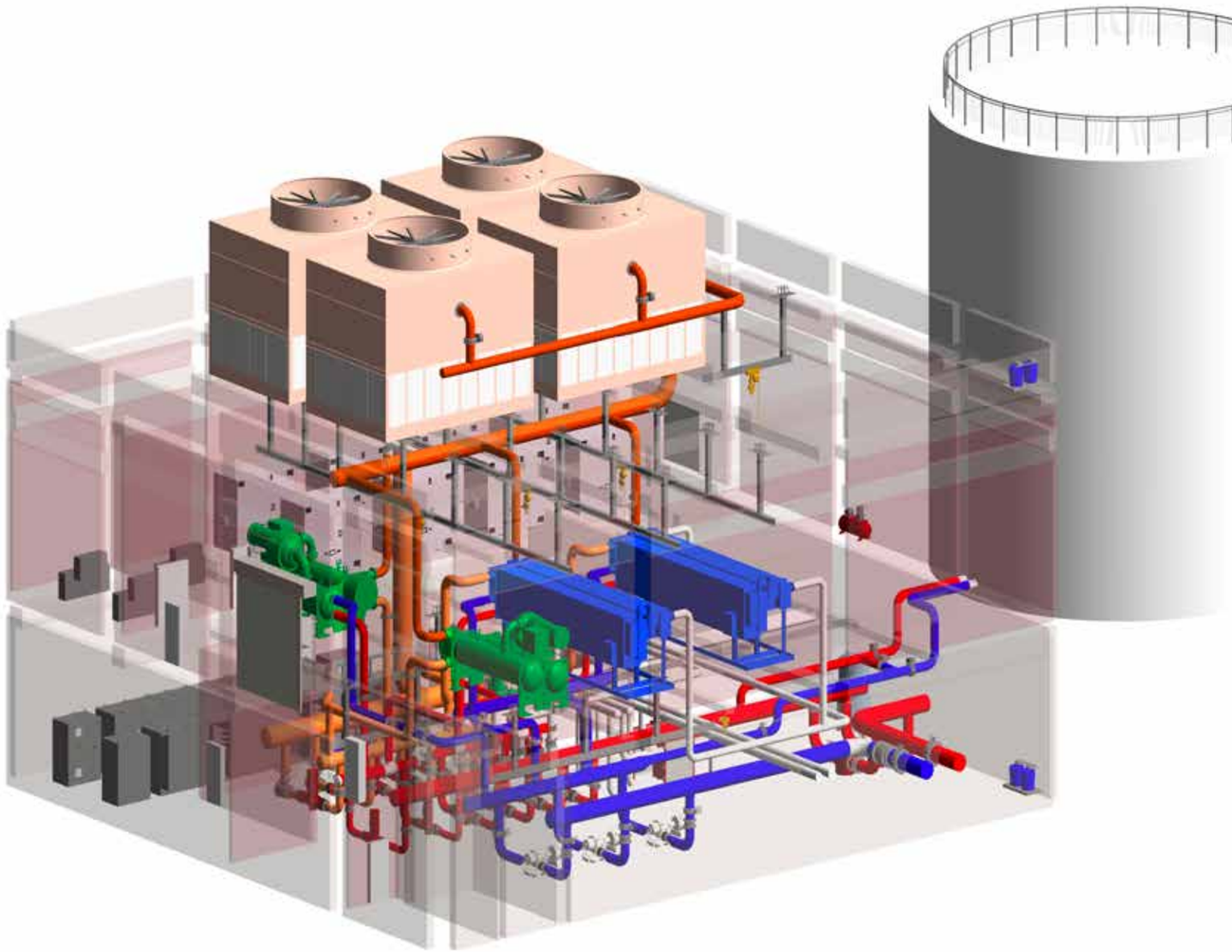
Another main impact of low ΔT is the reduction of the overall plant cooling capacity. A chiller capacity is optimized at design delta T and is reduced otherwise.

The above two impacts come with negative implications on the plant and the cooling provider in terms of increased utility bills and decreased capacity to deliver.

“Another main impact of low ΔT is the reduction of the overall plant cooling capacity.”

MITIGATION

A detailed study of the reasons behind a low delta T syndrome has to be conducted to identify the ideal route to mitigation. The corrective measures may be straight forward with minimal costs involved; in which case the client is advised to proceed with the changes. Other measures (normally related to inherent design errors) may be nearly impossible to implement, due to cost or technical limitations. There is no one solution to fit all scenarios nor do all identified measures have to be implemented at once. A selection of the quick-wins could achieve acceptable results. Generally, we would assess the costs required to alter the systems against the existing penalties or cost implication on the plant. An action plan is then devised along with the route and timeline for compliance.



*3D model by GRFN

The optimization of DC

“little effort is put in from the designers in the region to explore how the plants that they have designed, operate post-handover.”

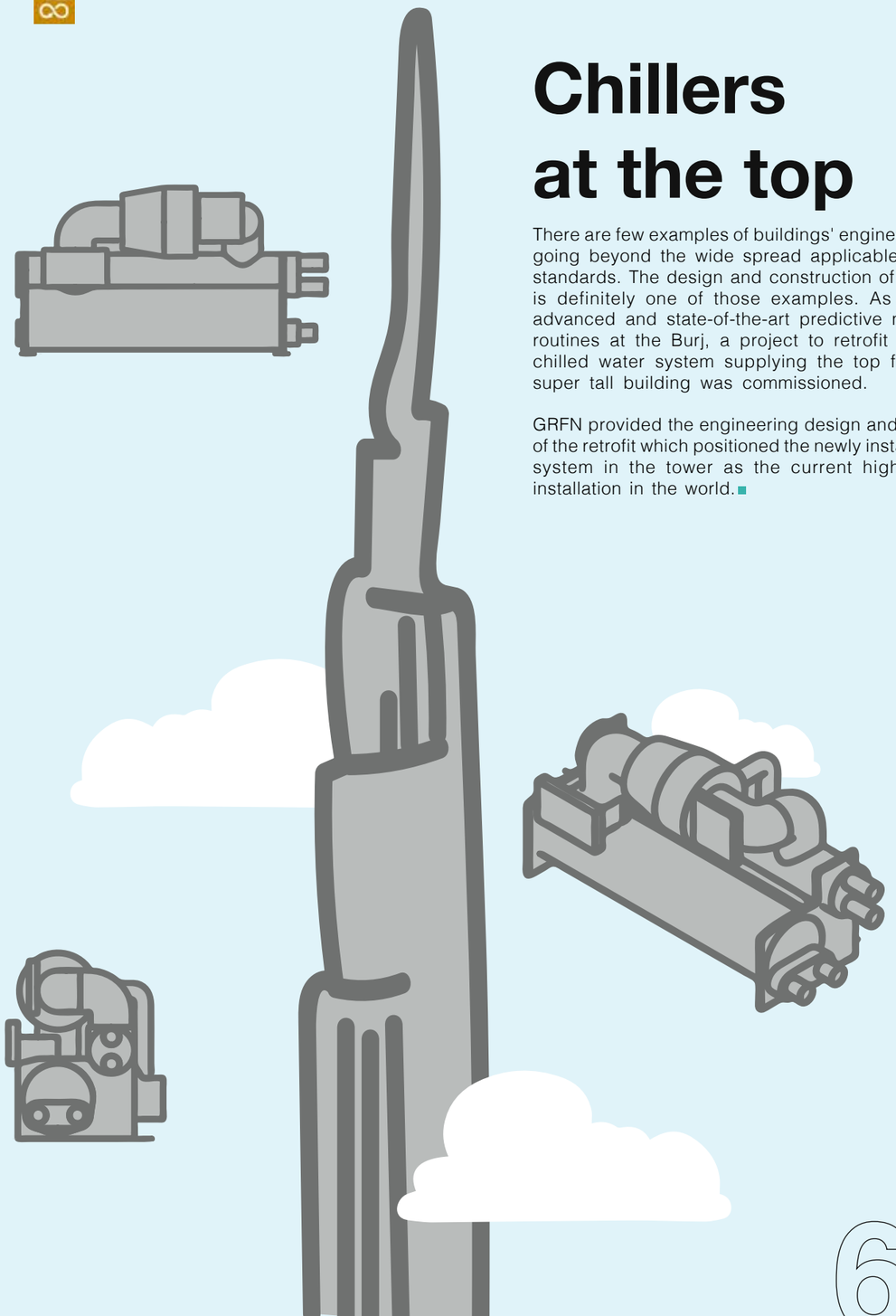
If we are to pick one major lesson learnt from our involvement in operational efficiency consultancy across the different construction sectors, it would be that design does not always flow downstream. Once a building is completed, the operational management of the assets could make or break the design intent.

The District Cooling sector is no different. While the optimization of new district cooling schemes designs has become the norm and is widespread knowledge, little effort is put in from the designers in the region to explore how the plants that they have designed, operate post-handover. GRFN has been involved in the operational optimization of multiple district cooling plants ranging from small to large schemes.

Perhaps one of the most common issues faced is the automation of the plants’ operations. While the majority of plants are designed with state-of-the-art industrial-grade controls and monitoring systems, seldom are those utilized in an optimum manner making use of their tremendous capabilities of control functionalities, data management and reporting. While designers may specify and claim a fully automated plant, and while they may, at times, commission it as such, the drop occurs during the handover with insufficient trainings and/or below par plant attendants and operators. Plant operators play an instrumental role in the success of any facility. They are on the front line observing and reporting the operating conditions and making key decisions and suggestions for improvements. And while the operations team may take the majority of the blame as to why a plant no longer operates as intended; but are the designers putting sufficient effort to identify potential root causes that can be solved via design measures or construction/commissioning practices?

Another major factor that affects the optimization of district cooling schemes is the maintenance regime adopted. Maintenance scopes should include preventive and predictive maintenance requirements. While allocating budgets for adequate maintenance processes is generally much more widely accepted in the district cooling sector than in the buildings sector, operations and maintenance contracts rarely include adequate monitoring clauses to ensure that the maintenance requirements are truly adhered to. It is imperative to base O&M contracts on performance output requirements and KPIs targeting equipment parameters of availability, maintainability, and energy utilization among other critical performance factors.
All of the above feed into the overall energy use in plants and the optimization of it. The plants’ automation system, demand flow controls, low delta T syndrome, and optimization of thermal energy storage are a few measures that we look into when auditing district cooling plants. We are currently consulting on the energy retrofitting of a few district cooling plants in the region.

With our balanced team of certified design professionals, detail-oriented construction engineers, and practical operational experts, we are able to encompass an integrated scope covering projects from inception to handover and beyond.■



Chillers at the top

There are few examples of buildings' engineering design going beyond the wide spread applicable codes and standards. The design and construction of Burj Khalifa is definitely one of those examples. As part of the advanced and state-of-the-art predictive maintenance routines at the Burj, a project to retrofit the existing chilled water system supplying the top floors of the super tall building was commissioned.

GRFN provided the engineering design and supervision of the retrofit which positioned the newly installed chillers system in the tower as the current highest chillers installation in the world.

Save the fish!

The Dubai Mall Aquarium is undoubtedly an attraction that is iconic to the city of Dubai and is one of the largest aquariums in the world.

In a bid to improve the livable conditions for the fish in the aquarium, and as part of their targeted continuous improvements year on year, Emaar commissioned a project to retrofit the chilled water system serving the aquarium with refined and advanced controls for better regulation of the aquarium water temperatures.

GRFN provided the engineering consultancy to achieve this target.

Harvest the Sun

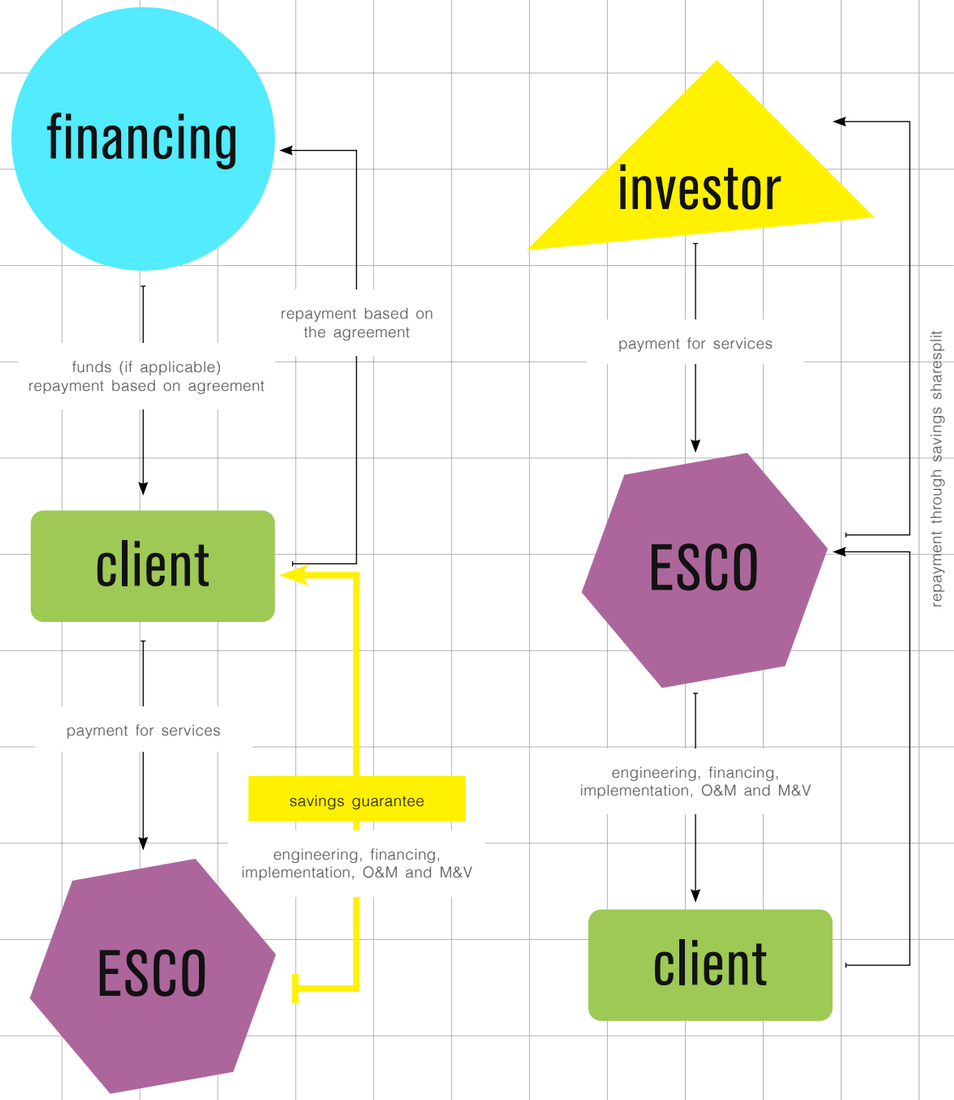
Project Solis is a Dutco Balfour Beatty initiative to install smart rooftop solar Photovoltaic systems at their labor camps in Jebel Ali, Dubai. The initiative makes use of the Shams Dubai initiative that encourages building owners to install PV panels to generate electricity by enabling direct connection to the utility grid via bi-directional metering enabling exporting surplus to the network.

Solis is a 1,000MWh per year on-grid Solar PV installation to reduce both utility costs and carbon emissions. The fully integrated on–grid PV System is installed, south oriented, on the roof of two buildings and six blocks of the labor compound buildings. The installed capacity is around 600 kWhp achieved via 1,814 PV panels.

The system is monitored via a cloud-based energy analysis and monitoring tool that integrates field devices into a single platform. This allows data to be collected in real-time and stored on a cloud where web-based software empowers operators and financial managers to make data driven decisions.

GRFN was the renewables consultant ensuring the integrity of the design and installation.

The ESCO Model



EPC-Guranteed Model

EPC-Shared Savings

Omnia Halawani – 2019
MEP Middle East

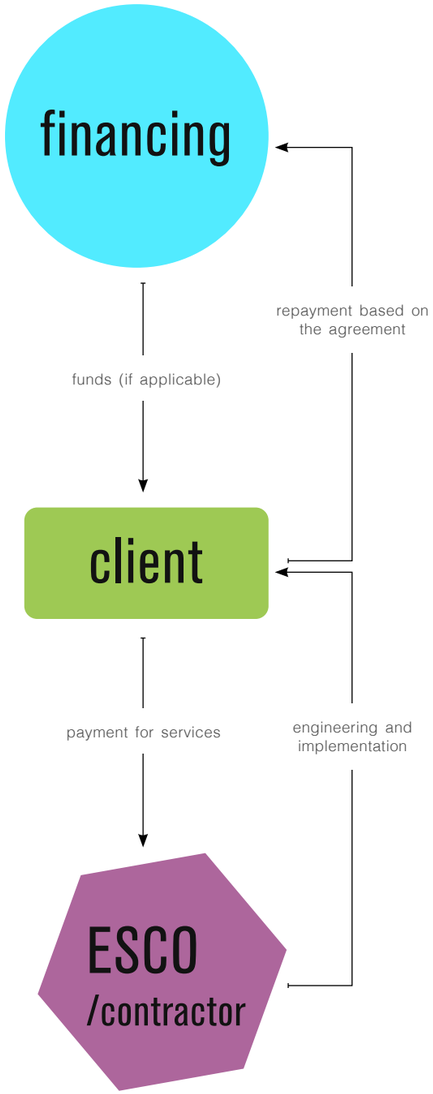
Energy Service Companies (ESCOs) and the models on which they operate are simple. Whether the model is being “paid from savings” or guaranteeing the proposed savings, the concept is very attractive. This deems the development of an energy services market one of the top demand side strategies for any policy maker to achieve energy targets. So why does the dialogue in most of the countries still revolve around scaling up the model to grasp the untapped potential of ESCOs?

We have 1000s of buildings eligible for energy retrofits and the potential is lost between customers’ lack of awareness, mistrust in the model, and the insufficient pool of capable service providers.

Lack of Awareness

It is becoming more common to hear about organizations that set targets for energy or carbon reduction. Some of those adopt a comprehensive culture of energy management assigning an internal champion or team who is held accountable for successful execution of energy efficiency projects. The majority, unfortunately, do not follow the same path leaving an important gap in the market to fill by educating customers about the importance of energy efficiency adoption both financially and out of environmental awareness.

On a separate yet connect note, in order to improve anything, two basic questions are ought to be asked: “How are we doing?” and “How do we know?” When it comes to improving buildings energy performance, one has to assess how the building is doing and how its performance compares to other similar buildings - the benchmark. One of the most common barriers facing the energy retrofit market is the lack of accountable information and benchmarks to assist energy experts and consultants in creating a clear-cut financial case to demonstrate that investing in energy reduction measures can provide profitable growth. A few governments in the region are starting to take the lead in this field.



Non-EPC Model

Mistrust in the Model

In other instances customers have heard of cases in which a project simply did not deliver results or, even worse, projects that have entered into embroiling litigation with ESCOs. This barrier is often harder to overcome.

The first most prominent reason for customers' mistrust is ending up with financial indicators that do not meet the initial study that was based on simplistic calculations. For performance guarantee, a retrofit proposal should include, in addition to supply, the costs associated with project management, installation, commissioning, operation, maintenance, and measurement & verification (M&V). The payback periods with such an approach are much more realistic than the simple payback method.

Second is misplacement of technologies. While a lighting retrofit is pretty straight forward whether in residential, commercial or industrial sectors, an HVAC retrofit requires a significant amount of technical expertise for selecting, installing, commissioning and operating the equipment. It is not a one solution fits all measure. Furthermore, the end user needs and behavior plays a great role in the success of the implemented measures. Think water conservation measures in labor camps or in ablution rooms in mosques for example.

The third and most controversial factor is the determination of the actual savings achieved. Implementing a simple yet rigorous M&V protocol, that is agreed on from the get go, and that is verified by an independent 3rd party is vital. The international Performance Measurement and Verification Protocol is a well adopted tool to ensure the transparency and accuracy of energy savings reporting.

Another factor is the perceived complexity of retrofits. It is important to realize that an energy performance contract can be as little or as much as a customer wants it to be. ESCOs differ in their project staging philosophies, customer services, financing capabilities, technical capabilities, and implementation approaches. Furthermore, retrofit projects ought to be customized in scope and terms based on the customer's targets and the physical characteristics of the building. One customer may choose to undergo the no-cost energy savings measures in-house to avoid "wasted" savings and skewed payback periods and limit ESCO involvement for the cost-intensive measures. Other customers may opt for a full ESCO model for all measures due to the quantity or complexity of the building(s).

The options are unlimited and performance contracting is a concept not a template. It can be adjusted to meet the needs of each project and customer. Having to deal with such diverse proposals and options could be overwhelming to customers and may compromise the launch and success of retrofit projects.

All of those barriers can be overcome by hiring a non-biased, third party, technical consultant that can simplify the process, streamline it, and ensure the success of the project. A consultant would typically set savings expectations, manage the tendering process, and help the customer with selecting the most feasible proposal both technically and financially. The consultant may also supervise the implementation of the retrofit project and engage as the 3rd party M&V professional.

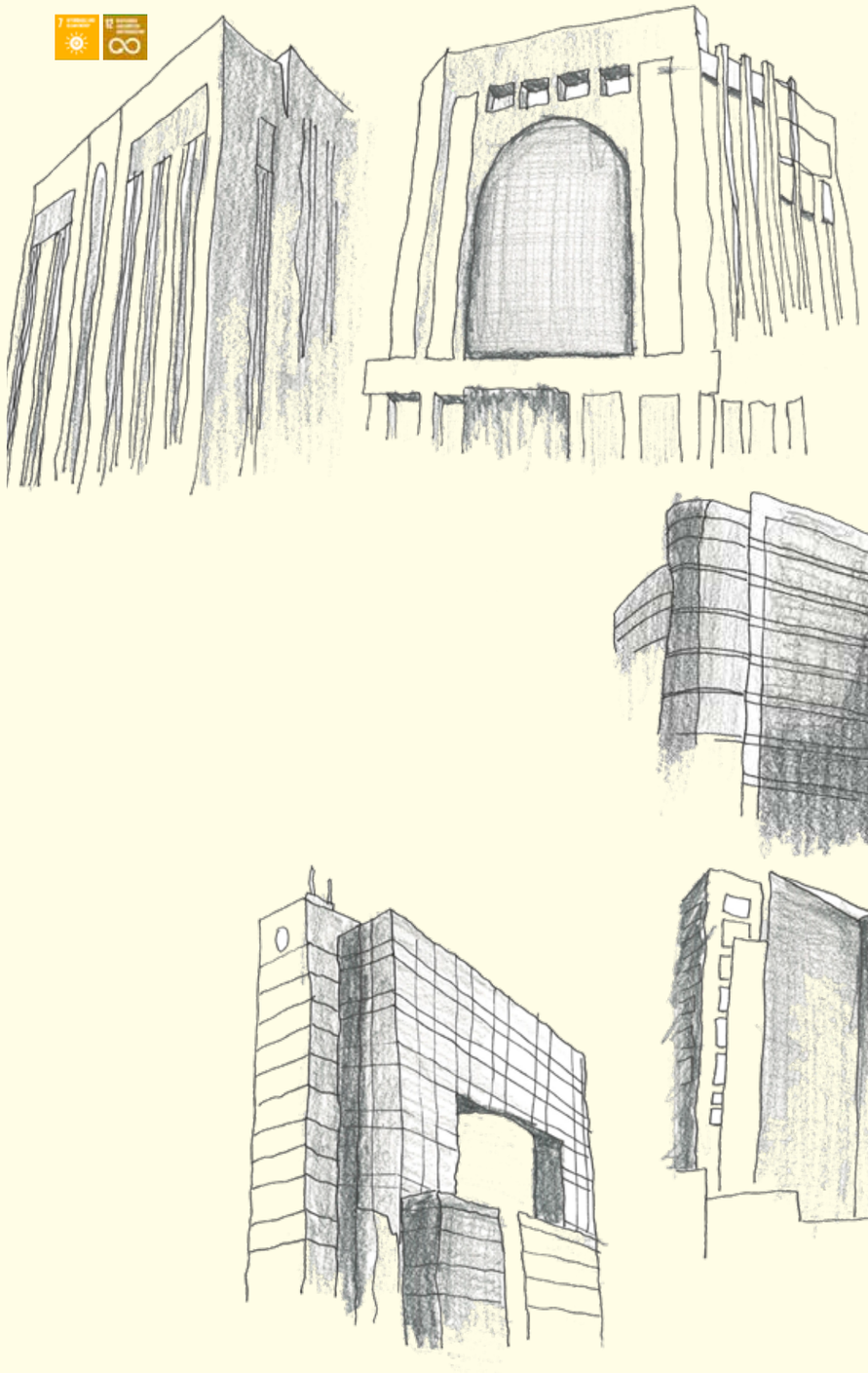
Capable ESCOs

Key policy mechanisms necessary to enable a sustainable and successful ESCO market are largely missing in many countries. For one, the absence of funding support for energy efficiency projects that is dedicated and programmatic is a disabling hurdle that very few ESCOs are able to overcome. In the US, a combination of federal and state-level legislation, commitments, and enablers has led to a billion dollar energy services market. The estimated industry's revenue in 2017 was $7.6 billion as reported by Lawrence Berkeley National Laboratory in a report funded by the US Department of Energy. In many developing nations, ESCOs are being largely supported by pilot projects and a very few were able to gain traction and sustain funding. This led to a small pool of capable ESCOs against a much larger pool of eligible buildings and a huge potential of untapped projects.

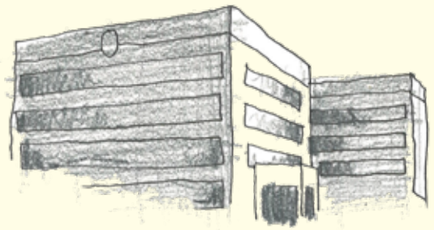
Concluding Thoughts

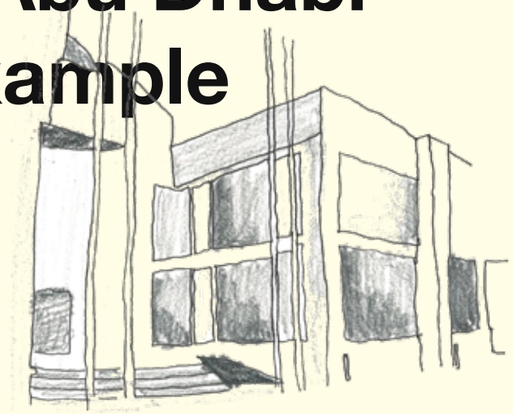
Whether you are looking to learn more about retrofits, have had or heard of past failed projects, or simply want to move forward with your retrofit project, hiring an independent and non-biased energy consultant will elevate the uncertainty involved by simplifying the process and aiding you with decision making.

The ESCO model will continue to grasp the attention of investors, customers and professionals for its great potential to generate revenue while stirring immense interest among researchers and policy makers to generate mechanisms that overcome its complexity tackling all elements and dimensions.■



أبوظبي
Leading Abu Dhabi by Example





“The prioritization task was to devise a five-year plan to retrofit all 150 buildings, with the first 20 buildings **being implemented in the first year.”**

The first governmental Energy Performance project in the Emirate of Abu Dhabi was initiated in 2017 to retrofit eight buildings owned by the Department of Energy (DoE) in Abu Dhabi and Al Ain. This pilot project targeted at least 30% reduction in energy through innovative energy management solutions is set to exceed this target.

GRFN’s role as the energy efficiency consultant of the project was to ensure the success of the pilot project via detailed involvement in the identification of successful energy conservation measures, supervision of the implementation of the retrofits, and the yearly measurement and verification over the performance period of 8 years.

The implemented measures included deep retrofits with large impact on energy usage as well as the deployment of renewables in the form of rooftop solar PVs on eligible buildings. A central energy control management system was implemented to allow for data analytics and optimization.

The project was labeled by Dr Saif Al Seiari, Director General at the Abu Dhabi Water and Electricity Authority, as “only the start of a much broader and ambitious Demand Side Management (DSM) Program across the Abu Dhabi Sector that will support long-term economic and energy management based goals”. It comes in line with the strategic objectives of the DoE and supports the Abu Dhabi 2030 Vision.

Our role was extended to cover a wider circle of buildings in Abu Dhabi. From a pool of 2,500 eligible buildings, we were tasked with narrowing down the selection, via Preliminary Energy Assessments and audits, to 150 buildings that display the highest potential of savings and the highest likeliness of retrofit success. The prioritization task was to devise a five-year plan to retrofit all 150 buildings with the first 20 buildings being implemented in the first year.

The extension project targets the acceleration of the deployment of energy and water efficiency programs for the public sector by developing a standard Energy Performance Contracting framework that is tailored to suit Abu Dhabi’s market and supporting data intelligence efforts on buildings to be further utilized in other DSM programs.

The Department of Energy in Abu Dhabi is leading the emirate by example to encourage and facilitate the spread of energy retrofits to aid the achievement of the overall Abu Dhabi and national targets of energy use reduction. ■

Slash the Bill

TYPE Residential
 # OF BUILDING 59
CLIENT MERAAS Holding

When we first approached our client about conducting an energy conservation study at their buildings in the Discovery Gardens, they were skeptical of the results due to prior unfavorable experiences. Nevertheless, they were convinced to have us started with auditing only one of the buildings to explore the potential. Upon seeing the calculated savings and impressive payback (less than 6 months), they agreed to extend the implementation scope from one building to four buildings of different types. The implementation was financed by the client and implemented via a contractor under the supervision of GRFN. With the success of the first 4 pilot buildings, Meraas extended our scope to cover all 59 buildings owned and operated by them at Discovery Gardens.

The project was concluded in May 2019 with **the total savings amounting to ~4,600 MWh or 3,250 equivalent Tons of CO_2.** The project also resulted in **significant improvement to the indoor air quality and humidity issues.**

ENGINEERING BEST PRACTICE

The exhaust air flows were found to be higher than the fresh air flows and also higher than ventilation rates as per ASHRAE 62.1 **resulting in:**

- Infiltration of outside air
- Higher cooling demand
- Humidity and thermal comfort issues

The measures worked on:

- Reducing exhaust rates
- Ensuring fresh air is at 10% higher than exhaust
- Maintain building under positive pressure
- Control algorithm adjustment for CHW pumps

The overall Indoor Air Quality and thermal comfort **of the occupants were improved.**

16%
overall savings
2,860,605 AED annually

<6
months
payback

15%
cooling savings
3,411,763 Ton-hr annually

25%
electricity savings
1,529,903 kWh annually

TECHNIQUES & TECHNOLOGY

The measures applied simple yet effective techniques to achieve the end result:

- Utilizing volume dampers on exhaust system
- Fan/motor pulley replacement on Fresh Air system
- Differential pressure setpoint adjustment

1,135
tons of waste recycled instead of landfilled

7,954,133
miles driven by an average passenger vehicle

INNOVATION

While a typical retrofit would have suggested the use of VFDs, the techniques used enabled us to:

- Achieve our client's budget without compromise on maximum savings
- Significantly reduce the project duration
- Achieve an impressive payback of 4.5 months!

Leading the Way to a Greener Tomorrow

Omnia Halawani – 2015
Future Cities ME

“improved human well-being & social equity, **while significantly** reducing environmental risks & ecological scarcities.**”**

“Lack of expertise, **lack of** innovation, **general** systems oversizing, **and out-of-date** practices **all constitute hurdles in producing new buildings that are energy efficient.”**

When the UAE Vision was announced stating that the country wants to be “among the best countries in the world by 2021”, green economy and energy consciousness were part of the plan. His Highness Sheikh Khalifa bin Zayed Al Nahyan, UAE President, and His Highness Sheikh Mohamed bin Rashid Al Maktoum, UAE Vice President and Prime Minister and Ruler of Dubai, have led the nation’s commitment to play its part in sustaining the environment, reducing the UAE’s ecological footprint, and pioneering a green revolution with multiple laws and initiatives that would drive the progress of an effective green economy. As defined by the United Nations Environment Programme (UNEP), a green economy is one that results in “improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.” It is expected to be “low carbon, resource efficient and socially inclusive.”

Dubai exemplifies this determination to take the lead in the region with initiatives like the Dubai Integrated Energy Strategy 2030 which promotes clean energy and seeks to significantly reduce buildings energy consumption in Dubai, the World Green Economy Summit that led to the Dubai Declaration to develop the city as the green economy capital of the world, and Etihad ESCO which is a DEWA venture whose mission is to “make the Dubai built environment a leading example of energy efficiency for the region and the world”. Such pro-active government initiatives to confidently drive the market is the only way to create a long term sustainable green revolution.

Buildings constitute a major energy consumer in any developing city like Dubai, which makes it a no wonder that a lot of those initiatives focus on reducing buildings energy usage and improving the indoor built environment. Multiple factors contribute to the amount of energy a building consumes. A lot of times, a building’s excess consumption of energy is attributed to inefficient designs or construction methods. Architectural design, building envelope, electromechanical systems, quality of installations, and systems commissioning all influence and drive the energy usage. Similarly, the way an existing building is being operated by facility managers and buildings occupants is another major factor of how energy is being consumed in a building.

Lack of expertise, lack of innovation, general systems oversizing, and out-of-date practices all constitute hurdles in producing new buildings that are energy efficient. While the “greening” efforts have managed to tighten the control over the new construction sector with stringent regulations and better industry awareness, the major obstacle remains to be the existing buildings sector.

Energy bills are frequently taken for granted, just like rent, despite the easiness of assessing how efficient a building is consuming energy. A simple indicator for measuring a building’s energy performance is the Energy Use Intensity (EUI), which calculates the annual energy usage per unit area (kWh/m²/year). It can be simply derived and calculated from the electricity bills and the area of the building. A high EUI, when compared to a benchmark, means that there is room for improvement and that return-on-investment could be very attractive; this is when a building energy audit should be sought.

An energy audit is an energy conservation study in which opportunities of energy reduction and carbon footprint optimization are identified in an existing building through an inspection and analysis of a building’s systems that are driving the energy usage. A number of energy efficiency measures are reported along with their financial feasibility and simple pay back calculations. If implemented, those measures would drive the energy usage down resulting in favorable reductions in the energy bills.

In many cases, a building’s owner is not responsible for paying the bills and these are normally borne by tenants. Also, in the majority of the cases, budgets are nonexistent for retrofits and improvements placing yet more hurdles in the way of creating a sustainable existing buildings sector. The emerging energy services contractors (ESCO) may be a promising solution to that where retrofit capitals are paid by the ESCO who in return take their pay through a percentage of the savings. While this model still faces hurdles to cover financing and reach contract terms acceptance with buildings owners, awareness is being spread via industry professionals and governmental initiatives like Etihad ESCO making it a promising approach.

A true transformation in energy structure will only be achievable through the contribution of the private sector. Thus, social inclusiveness is key to achieving sustainable development and green economies. ■

“Dubai exemplifies this determination **to take the lead in the region with** initiatives **like the Dubai Integrated Energy Strategy 2030 which** promotes **clean energy and** seeks **to significantly** reduce **buildings energy consumption...”**

Anti-aging

There is real return on investment in preventive and predictive maintenance. If you think about it, it is actually a practice that we all adopt in our daily routines from brushing our teeth to sending our vehicles for routine periodical service. It is no surprise that the same concept would apply to equipment and systems within buildings.

AC systems that are not energy efficient, fresh air handlers that do not deliver, aging systems, and leaky pipes and ducts are some of the common issues that our clients struggle with.

Proper management of systems within a building starts with the understanding that aging is more about how the system is being operated and maintained and less about the actual vintage of the equipment. It is non debatable that age of equipment matters - one might face difficulty getting spare parts or experience discontinued support for old equipment. However, those factors aside, it is the maintenance practice followed that would determine how much age will have of an impact on the functionality of your systems and how soon the equipment will actually “age”.

Factors like running hours, runs per day, environmental characteristics of space temperatures, humidity and dust, repairs, and upgrades are all instrumental in determining equipment life. Is the system run to failure or is there an adequate plan that is based on asset lifecycle information to address the maintenance plan of the equipment over its life? When a system is adequately designed and operated, a well-drafted comprehensive maintenance procedure that utilizes preventive and predictive practices will ensure a reliable and predictable performance from the services equipment and their related systems and processes.

It is imperative that buildings owners realize that allocating budgets for adequate maintenance practices today, could save them a lot of time and money in the future. We have helped many of our clients - in the commercial, hospitality, and district cooling sectors - to identify key areas of concern via condition assessments of their existing facilities and to develop comprehensive maintenance plans that are based on international standards and industry best practices.

Productivity & the Quality of Air

“Two strategies exist to keep indoor pollutants at bay: dilution and source control.”

The quality of the workplace environment has an elemental role in ensuring consistency and quality of output at an office. An overcooled or a warm workspace will have increasingly undesirable effects on productivity; the most sought after qualitative measure of a workforce success. People’s perception of comfort level is one of many factors that make up an adequate indoor environmental quality (IEQ). The concentrations of indoor pollutant levels such as VOCs and CO_2 are also determinants of the quality of the indoor environment and are highly related to the formation of odors.

GRFN has been commissioned by multiple clients to solve poor Indoor Environmental Quality issues. While some of the instances were attributed to poor or incomplete commissioning of building systems, a considerable amount was due to poor designs.

The mechanical Ventilation and Air Conditioning systems in any building should be designed to maximize users comfort and minimize indoor pollutants during occupancy. Two strategies exist to keep indoor pollutants at bay: dilution and source control.

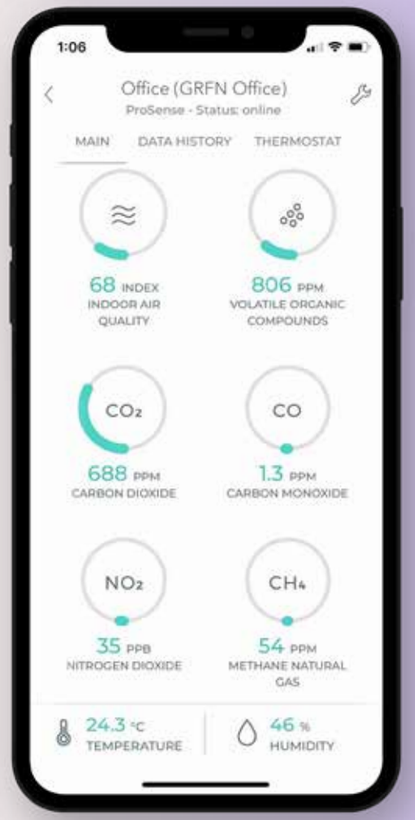
Dilution is the introduction of outside air and mixing it with the space. Source control is the direct exhaust of contaminants, where pollutants are directly expelled to the outside so the occupants are not affected by them.

The most common and recommended system today is a direct outside air system where outside air is centrally supplied to a building. The air is properly filtered, and dehumidified and sent to the occupied spaces. A central outside air delivery system is complemented by an exhaust system.

The best designed systems will fail if the operations and maintenance practices are not adequate. A clogged dirty filter will simply block outside air from being delivered to the building. A clogged cooling coil will lead to lower dehumidification capability. The operation and maintenance practices play a crucial role in ascertaining that a building performs as intended.

The role of the building’s skin or envelope depends a lot on the climate the building is situated in. For example, in the UAE the skin should be air-tight to reduce the transport of moisture and dust-laden outside air that could create condensation once it touches cold surfaces inside the building leading to mold formation.

Our completed projects, to name a few, include Abu Dhabi Crown Prince Court, a high-rise hotel building in Mamzar, Emirates Nuclear Energy Corporation offices in Irena headquarters, Masdar head office, and Honeywell offices.



We monitor air quality at our office to ensure optimum working conditions.

“The best designed systems will fail if the operations and maintenance practices are not adequate”

Human

Productivity; thrift; صحة; people; experience; health wellness; happiness;

Factor

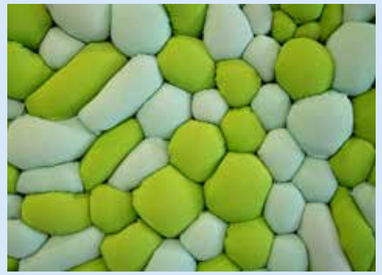
‘Play is the new remedy’ is the moto of Adventure ParX + café for which we provided conceptualization, branding, and detailed interior and MEP design and supervision. ParX promotes the importance of physical play and the involvement of kids early on in challenging activities such as climbing for babies and overcoming an obstacle rope-course as well as getting through an exciting vertical maze for the older kids. The use of bright colors creates a stimulating environment for the children and highlights the notion of adventurous play and physicality.

play is the new remedy

Interior design: Ayah Halawani
Branding & Artworks: Aman Darwish


Juxtaposing textures mimic
the contrast in urban settings:
PARX
CAFE
* Environmentally responsible
OSB panels


RESTROOMS

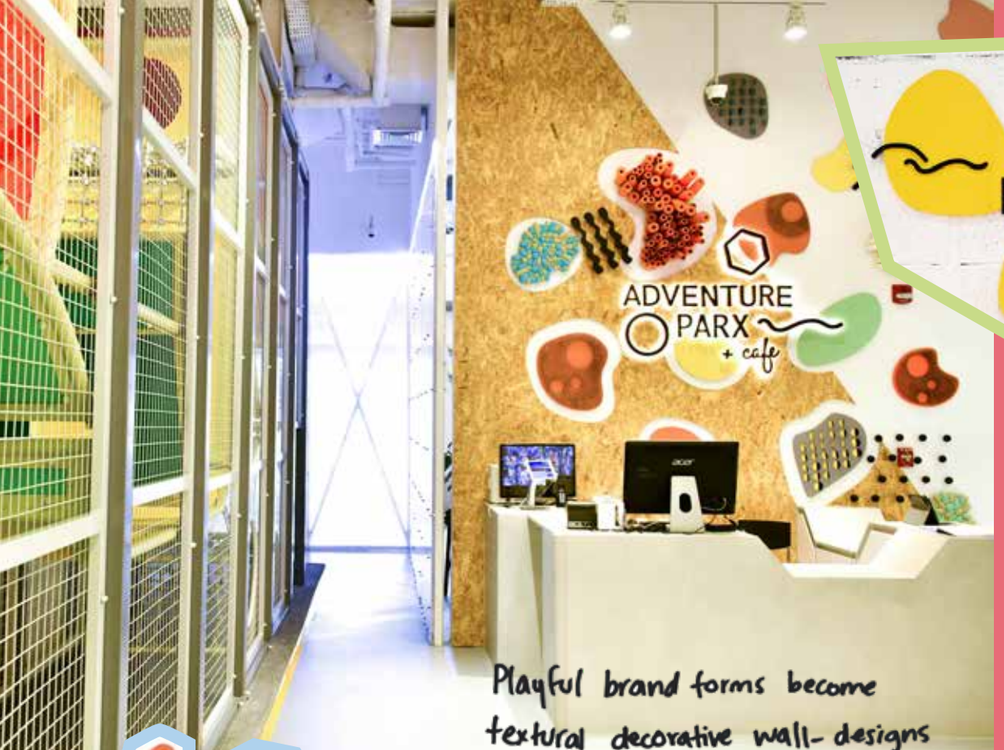



herringbone
the pattern

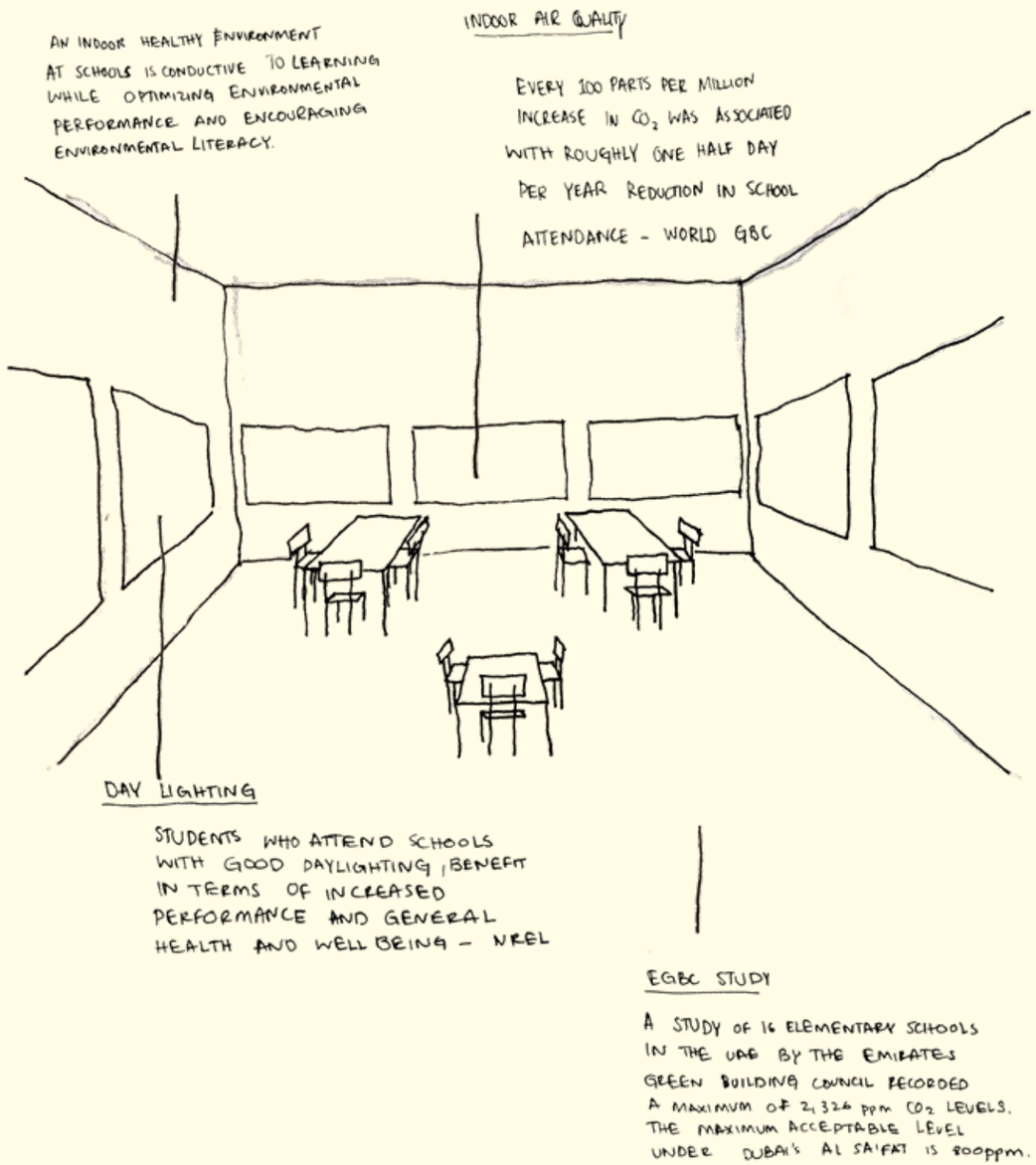

ADVENTURE
PARX
+ cafe


* micro concrete surface finish

* Translucent polycarbonate



Materiality and quality of experience were at the center of the design process. Environmentally responsible OSB panels were selected as decorative paneling for their environmental impact. Real time monitoring of indoor air quality is implemented to ensure a safe environment for the children. The devices monitor VOCs and CO_2 among other indicators and notify the administrators when limits are exceeded. The CO_2 levels are used to modulate the fresh air supply into the space for a more energy efficient performance. ■



Indoor Air Quality at our schools

“we have committed to actively improve indoor environmental and air quality **in existing kindergarten and primary schools in the UAE”**

Promoting a healthy learning environment for children at schools is of utmost importance and should be better communicated and relayed to school administrators and education providers. With this in mind, we have committed to actively improve indoor environmental and air quality in existing kindergarten and primary schools in the UAE, through measurements and consultancy, as well as actively seeking an agreement with a leading education provider to deliver training on air quality for education stakeholders.

A survey done by the US Environmental Protection Agency (EPA) suggests that more than 40,000 schools across the United States have poor Indoor Air Quality (IAQ) increasing rates of absenteeism as well as resulting in reduced comfort of students causing stress, depression and affecting their performance in class. EPA identifies that long-term exposures of children to indoor pollution and mold can converge to become a major factor in developing asthma, coughing, eye irritation, headaches, and severe allergic reactions.

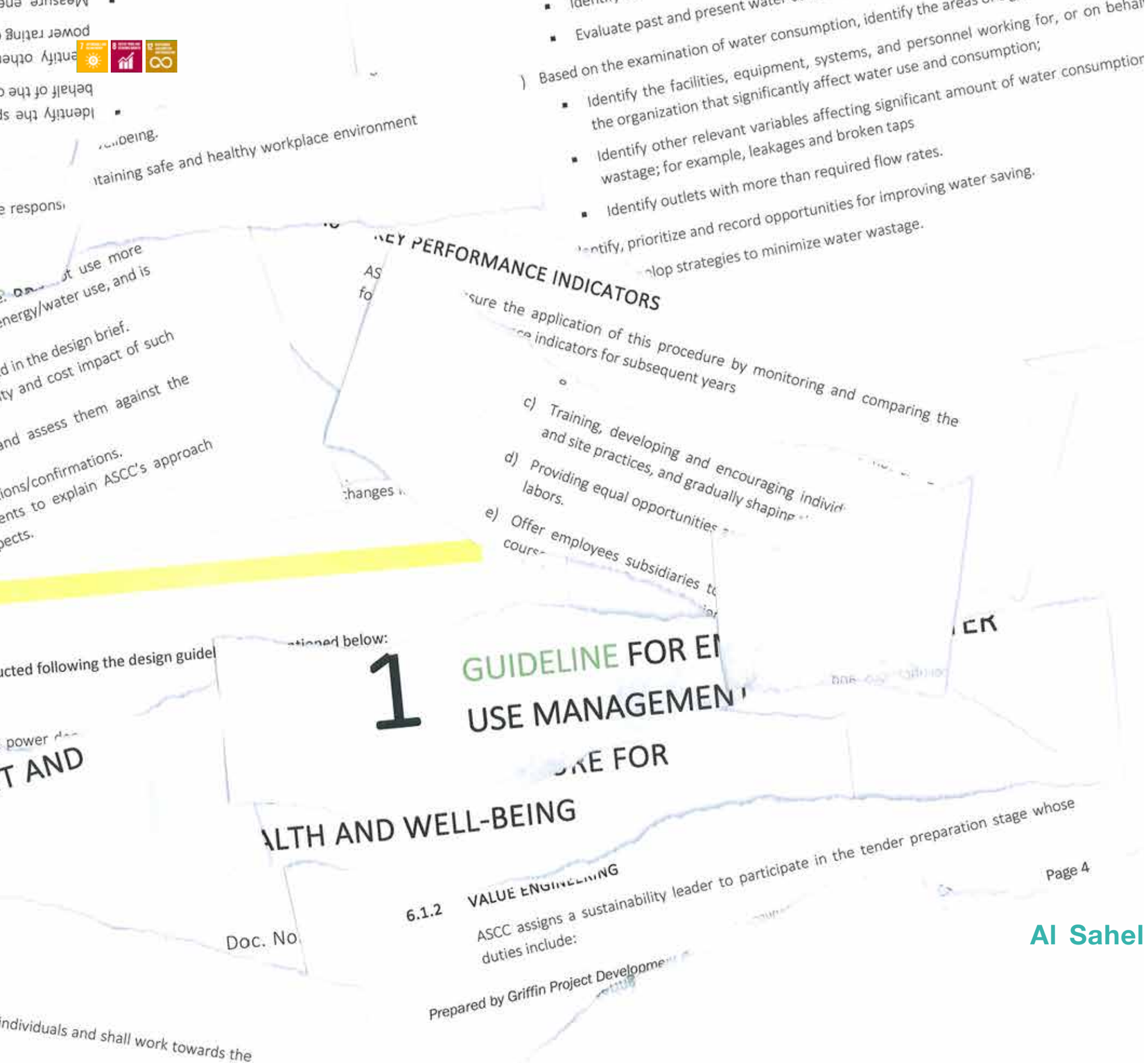
On a local level, a study by the Emirates Green Building Council of 16 public and private elementary schools in Dubai and Fujairah found that average TVOC, CO_2, O_3, CO and particulate concentration, temperature, relative humidity, sound and lighting were outside of the recommended ranges for classroom environments. The maximum recorded levels in the schools were 2,326 ppm and 3,131 mg/m³ for carbon dioxide and VOC, respectively. To put these figures in context, maximum acceptable levels under Al Sa'fat is 800 ppm and 300 mg/m3 for carbon dioxide and TVOC, respectively.

International standards for buildings design and construction specify active and passive building design strategies for educational institutions to support high levels of Indoor Environmental and Air Quality and to eliminate or reduce pollutions sources. For example, the WELL standard recommends that educational institutions should aim for minimum thresholds for harmful particulate matter and organic or inorganic contaminants that are often found in high concentration across different school environments. Simple architectural elements, such as operable windows in classrooms, are recommended to provide access to fresh air. In addition, providing educational seminars that promote IAQ improvement methods can help optimize design and operation of buildings, and also provide a platform for students to discuss their symptoms and conditions.

Indoor Air Quality is only one element of an overall indoor environmental quality. Other factors include daylighting, thermal comfort, acoustic performance, and low emitting materials. All factors combined promote a healthier and more productive learning environment for our children and students.

Our commitment to better indoor environments in schools is unwavering and we will continue to seek every opportunity that would result in a better educational setting for our children, be it as an intervention project or through design for construction of new schools.

In 2016, we undertook a pro-bono initiative to measure and report Indoor Air Quality levels in select Kindergarten and primary schools in Dubai.



Sustainable Corporates

The construction industry has seen an outburst of sustainability awareness in the past decade or two, and now the market holds one too many companies that are passionate about ‘sustainability’ in the real sense.

According to Corporate Knights’ list of the 2019 Global 100 Most Sustainable Corporations, a Sustainable Corporation is one which encompasses carbon and waste reduction, gender equality in leadership and even revenues derived from clean products. Companies like Cisco Corporations, Ericson, Siemens AG and LG Electronics have got themselves a rank on the World’s 100 Most Sustainable Corporations. As of today, the list has no company born in the UAE, or within the GCC as a matter of fact, which both heightens the need for awareness and emphasizes the opportunity for impact.

Sustainability has been high on the national agenda in the UAE and the government is enthusiastically finding ways to facilitate green initiatives through enablers, policies, incentives and financial support. With the growing mindfulness amongst corporates, many companies have by now taken the step by means of executing or developing a sustainability policy within their business. They have, at the least, identified and advanced their CSR goals, and have fostered the need for the sustainable application.

Al Sahel Contracting Company is one such company in the UAE that is determined to shift their mission and vision towards building and operating sustainably. They approached GRFN to support their objective and drive them to set and meet sustainability targets. Five priorities were outlined and built upon for Al Sahel:

- Energy & water use
- Waste management
- Sustainable procurement and construction
- Health and well-being, and
- Awareness and capacity building

Each of the above addresses both their construction and operations through a detailed set of policies, procedures, and action plans. The policy was developed in 2018 and is being implemented within the structure via trainings, procedure upgrades, and regular audits/ measurements.

Implementing sustainability into construction is challenging in terms of client requirements and restrictions, quality of works, and impact on project cost. With more initiatives on the way and a high level of commitment, we foresee our partnership with Al Sahel a long term one; through which we will strive to help them pioneer sustainable initiatives through educational reach, innovative approaches, and practical excellence. ■

Al Sahel is steering to the greener side, will you**?**

24°N 55°E

"Continuity of color **was key to create a sense of** flow from outdoors to indoors**. The design adopted a palette inspired from context. Colors and textures were drawn from** elements of the wilderness landscape."

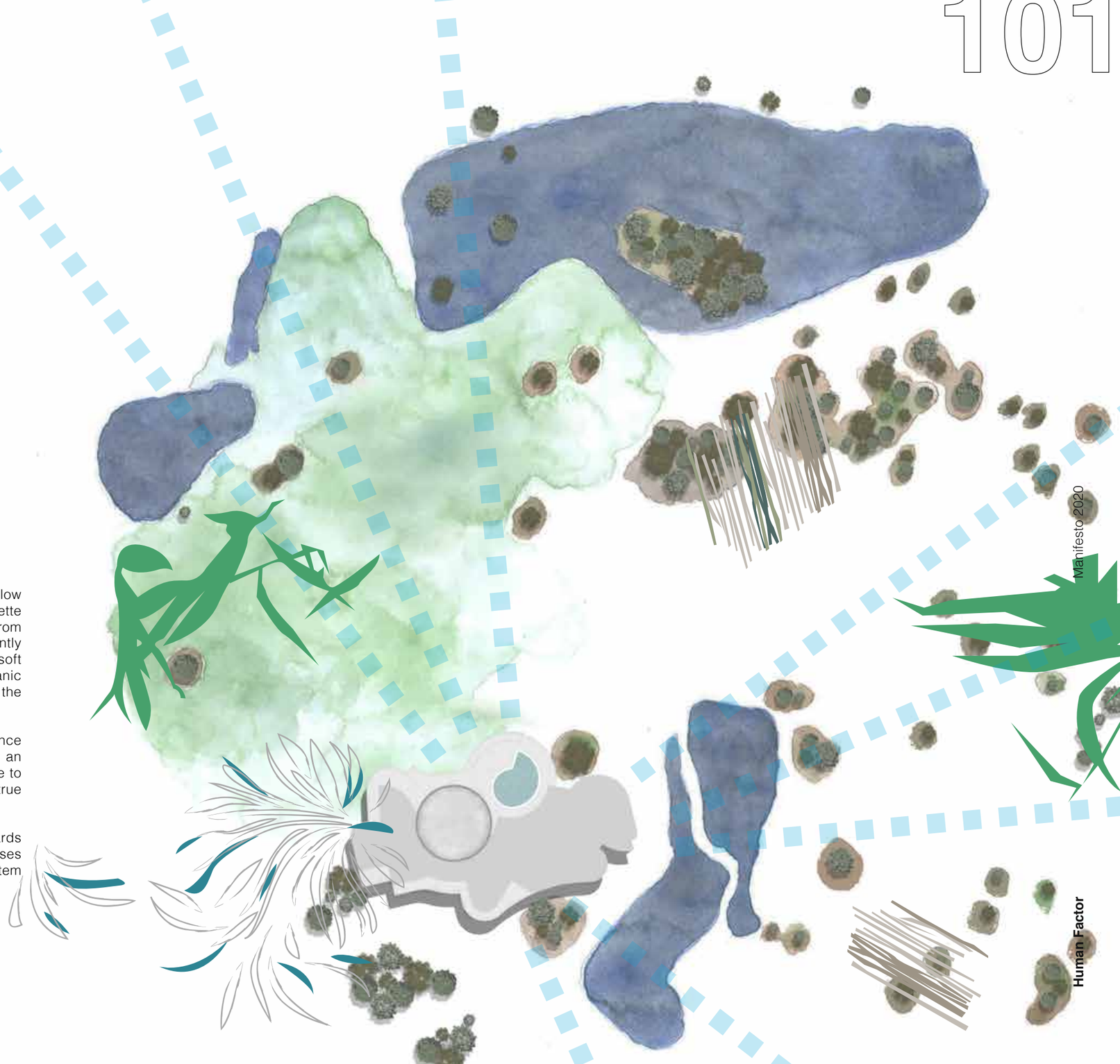
24°N 55°E is a renovation project of a winter getaway located within the exceptional context of a desert conversation reserve. With a background of rolling red dunes dotted with desert plants and free-roaming animals, the design intent was to create seamless transitions between the luxury of indoor living and the rawness of the outdoors.

Opening up the view was a primary objective, and was achieved through adjustments to the existing architecture. This involved swapping walls for full-height windows and using mullion-less glazing throughout the property to provide unobstructed views.

Continuity of color was key to create a sense of flow from outdoors to indoors. The design adopted a palette inspired from context. Colors and textures were drawn from elements of the wilderness landscape. The predominantly beige and brown palette was complimented by soft blue and green textural elements mimicking the organic patterns of sand, plants and water, and following the radial form of the building.

An immersive experience is the truest way to experience the desert. By creating an outdoor cooking area as an extension to the existing kitchen, the family was able to enjoy more time outside and entertain in light of true Bedouin culture.

The location posed construction challenges with regards to storage and waste collection, and special processes had to be adopted to not disrupt the thriving ecosystem of flora and fauna.



Winds of Change

Hassan Younes– 2016
ME Consultant

Across the globe, people spend most of the day in buildings, be it at school or at the workplace. Maintaining a clean indoor environment, in terms of air quality and keeping the temperature at a comfortable level in a building, is crucial for the health and efficient functioning of its occupants.

Naturally, this involves having a good ventilation system that ensures a constant supply of fresh air and which helps keep CO_2 levels in check.

GRFN's Say:
Hassan Younes points out that CO_2 levels are most of the time a direct measurement of indoor air quality. Some practitioners consider CO_2 to be a direct indicator of the pollutant that the ventilation system is trying to control, like bio-effluents generated by people. Since bio-effluent is impossible to measure CO_2 is measured instead and high values of CO_2 for an occupied space normally means that the ventilation of that space is poor. Note however that CO_2 concentration is not a good indicator of the concentration and occupant acceptance of other indoor contaminants, such as volatile organic compounds off-gassing from furnishings and building materials. Thus CO_2 concentration is not always a reliable indicator of overall building air quality. Another fact should also be highlighted is that only CO_2 levels above 5000 PPM are considered as a health hazard. These values are seldom found in a building.

In the Middle East people spend most of their time inside buildings. Therefore it is crucial to maintain an adequate indoor air quality. Also during summer, outside air is at high temperatures and contains a lot of moisture that needs to be cooled and dehumidified before being introduced into the building.

Q- What are the challenges involved with maintaining good indoor air-quality in a building in the Middle East?

Different issues arise through the different life stages of a building, from design through installation, commissioning and finally operation and maintenance.

A wrong supply of outside air humidity content is one of the most common design mistakes we see, which reduces indoor thermal comfort and indoor air quality.

Wrong installations where exhaust air louvres are placed close to an outside air louvre is one of the common mistakes we see on site.

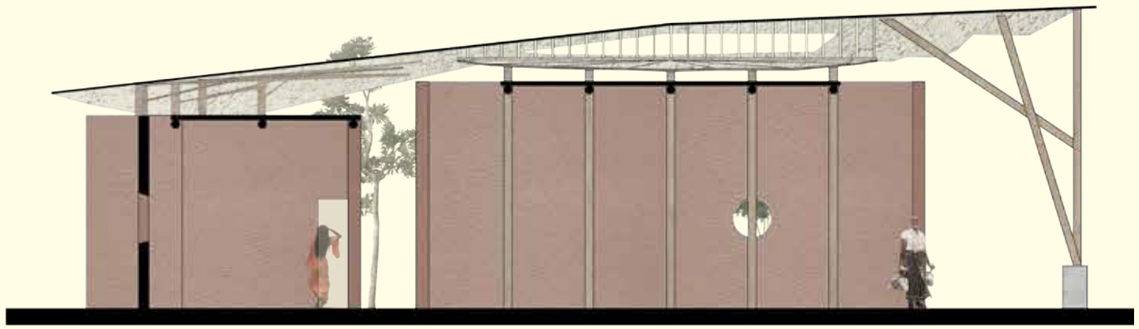
Improper commissioning where sensors and sequence of operation of ventilation systems are not properly configured is also a very common problem we face in many existing buildings.

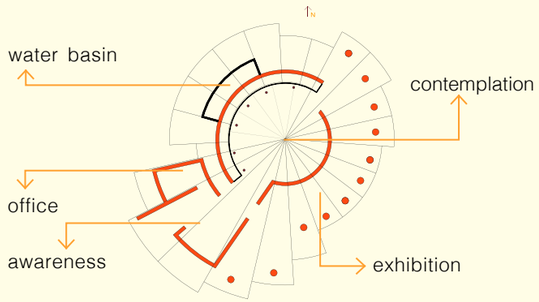
Last but not least is operation and maintenance where uninformed technicians sitting behind building management systems stations override controls which normally lead to lower indoor thermal and air quality. Poor maintenance of filters and not replacing broken filters are also a very common practices that lead to lower indoor air quality.■

Ideas

Design; Inspiration; goals; فكرة ; notion; concepts; plan; layout

ceremony





Through learning we understand .. our differences.

There is no better way to fully understand opposing concepts than by juxtaposing them. Through noise, we understand silence. Through darkness we appreciate light. Ceremony, architecturally juxtaposes enclosed and exposed spaces to conceptually enhance our understanding of war and celebration of peace. The exploration of 'Ceremony' stems from the belief that the journey to peace begins with a personal process of learning and acceptance, and then becomes an externalized expression of sharing and co-existing.

The project is developed as an entry to the peace pavilion architectural competition Kaira Looro 2019 edition, for the city of Sedihiou, Senegal; and is meant to become a reference point for local and international communities in raising awareness and fostering peace in the previously war-torn Casamance region.

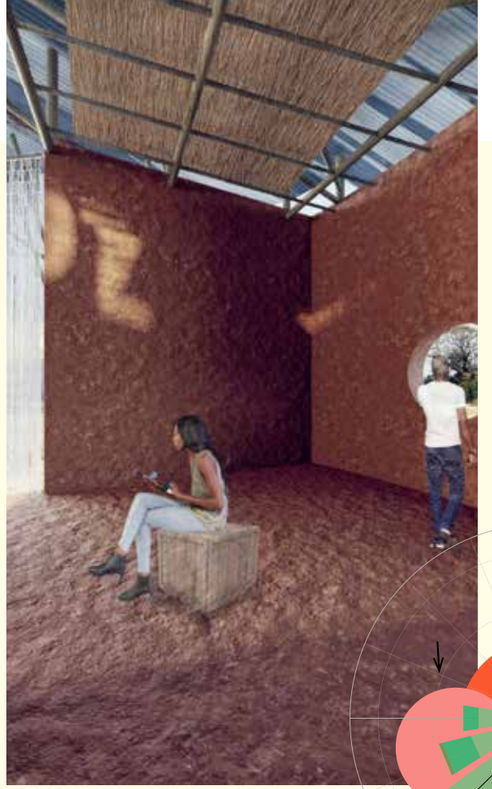
space experience

Space Experience

The experience of the space is designed around crafting a feeling of association, connection and relief for the lost ones. As visitors process through the building, we want them to understand the war at first and later rejoice the end of war.

The prolog space is designed to be enclosed with dim lighting. The main circulation through the space is through the diagonal axis of the wind tunnel. As one enters the **"awareness"** space they see the tree through the opening and they are now placed on the main axis of circulation.

This space, by means of a semi-covered walkway, leads to the **"contemplation"** space, a serene arena dedicated for prayers and remembrance, befitting as the core of the pavilion. It is of a circular design, signifying non-polarity and unity and welcoming to all religions and ethnicities. The retracted ceiling and the tilted roof above



allow for indirect light to shine through, or for rainwater to fall through the space along the wall, and into the water filtration channel in the ground. The falling water also serves as an acoustical, soothing element in the space, washing out any outside noises.

The contemplation space then connects to an outdoor open **"exhibition"** space for permanent and temporary artistic works. The exhibition area is open with the structure exposed, suited to the celebratory experience of self-expression, sharing and co- existing. With the structure of this space is exposed and with no boundary walls, it allows for open views and multiple uses of the space. The structural elements holding the roof resemble trees and can be adorned with the local fabrics to provide shading, or dresses from the dressmaking craft of the city of Sedhiou. The space is intentionally linear as is the experience of walking through an exhibition space. At the end, it opens up allowing for gathering, perhaps around a musician of the Kora.

In addition to the exhibition space, a rainwater collecting basin placed at the exterior of the building also commemorates the valuable notion of giving back to the community.

The secondary circulation is at the transitional space between the awareness and contemplation spaces. One side takes the visitors to the water-collecting basin, and the other may be used to facilitate access from the office, located at the awareness space, into the exhibition space.

Through contemplation we learn compassion, acceptance .. and gratitude.

Orientation and thermal comfort

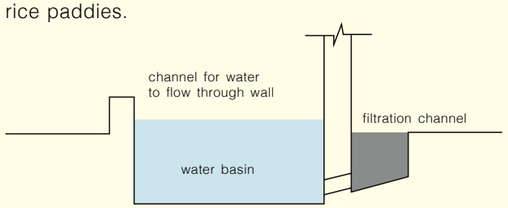
The position and orientation of the project on site are dictated by contextual factors of access and regress and wind direction. The structure is placed close to the existing street to facilitate arrival to the site and the construction process. The ceremonial circulation through the building begins and ends in the same area to provide a sense of orientation.

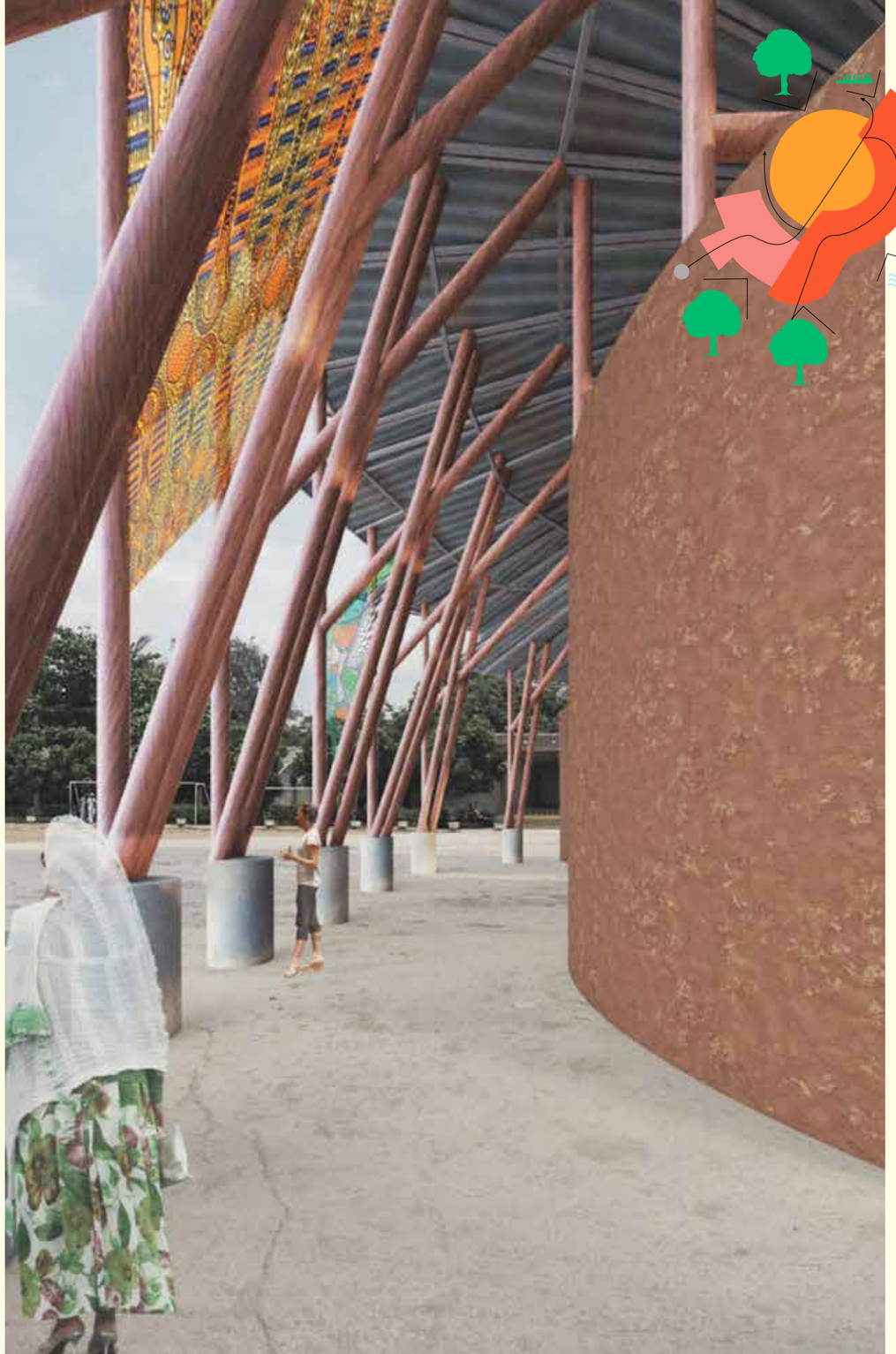
With no possibility for mechanical cooling in the humid and quite warm climate of Sedihiou, we resorted to passive design elements to improve the thermal comfort of visitors. Prevailing winds flow from North East to South West. The structure was oriented to align with the flow of wind to allow ample breeze to enter the space for sufficient ventilation. The use of a dual roofing system and adequate selection of materials helped further improve the thermal comfort. The metal roof with a high solar reflectance index acts as solar radiation deflector and reduces the solar load on the building. The openings at the high level of the structure allows cross flow ventilation to elevate the indoor environmental quality.

Rain collection

The roof also acts as a shield to the space from rain and its tilt and retracted section function as a rainwater harvesting mechanism. The roof is comprised of two parts: one runs around the periphery of the building, and one sunken below. The outer part collects the rainwater - in some parts drains it outside the building and in other parts converges it onto the sunken panel. The sunken panel creates an indoor fall of the water into the water filtration channel inside the contemplation space, to be then used as drinking water.

Rainwater is directed towards a simple filtration passage made primarily of rocks and stones which then channels the filtered water to the basin that is accessible to the public. The water basin is oriented in the North West side of the building so when the water over flows, it is directed through ground channels towards adjacent rice paddies.





Through self-expression we learn to come together and celebrate .. our differences.

Views

Views also play an important role in the positioning of the building and openings. The exhibition space overlooks the river, accentuating the feeling of openness and freedom. Openings in the awareness and contemplation spaces direct views towards the old Kapok trees that stand out in the landscape. Visitors of the space will also spot the third large Kapok tree as they exit the building. The repetitive view of the tree provides visual guidance as one moves through the space, and it is also a metaphor of continuous remembrance for the ones lost in the war, and the reasons we need to persevere in our journey to peace.

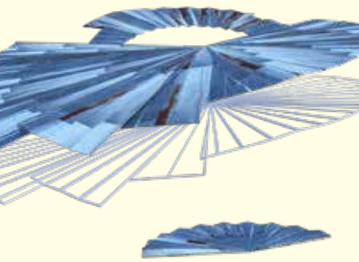
Use of Materials and Construction Process

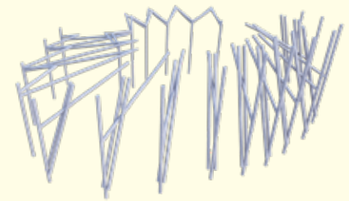
Materials selected for the development of the project are contextual and conceptualized with the goal of sustainable operation and construction. The main considerations while selecting the materials were functionality, user experience, constructability and cost efficiency. The selection of all material was bound to a set budget and limited to being sustainable and primarily local.

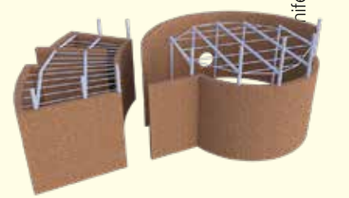
The walls are designed to be built primarily of red clay bricks. The walls will also incorporate collected waste plastic bottles filed with waste and arranged side by side. These would then be tied together and plastered on. The more waste collected, the less the need to use bricks and therefore the lower the cost. The choice of material for the ceiling is straw for its water resistance qualities.

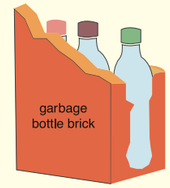
The exhibition space and the roof structure are comprised of red wood columns and beams that are anchored in a concrete base. The roof itself is made of radial framed iron panels available locally and used often in residential homes, creating a feeling of familiarity. The panels change in size and orientation depending on their location over the building

The water basin is designed in laterite for its water proofing qualities and the water filtration channel is filled with rocks and stones of varying sizes. ■









Old vs New

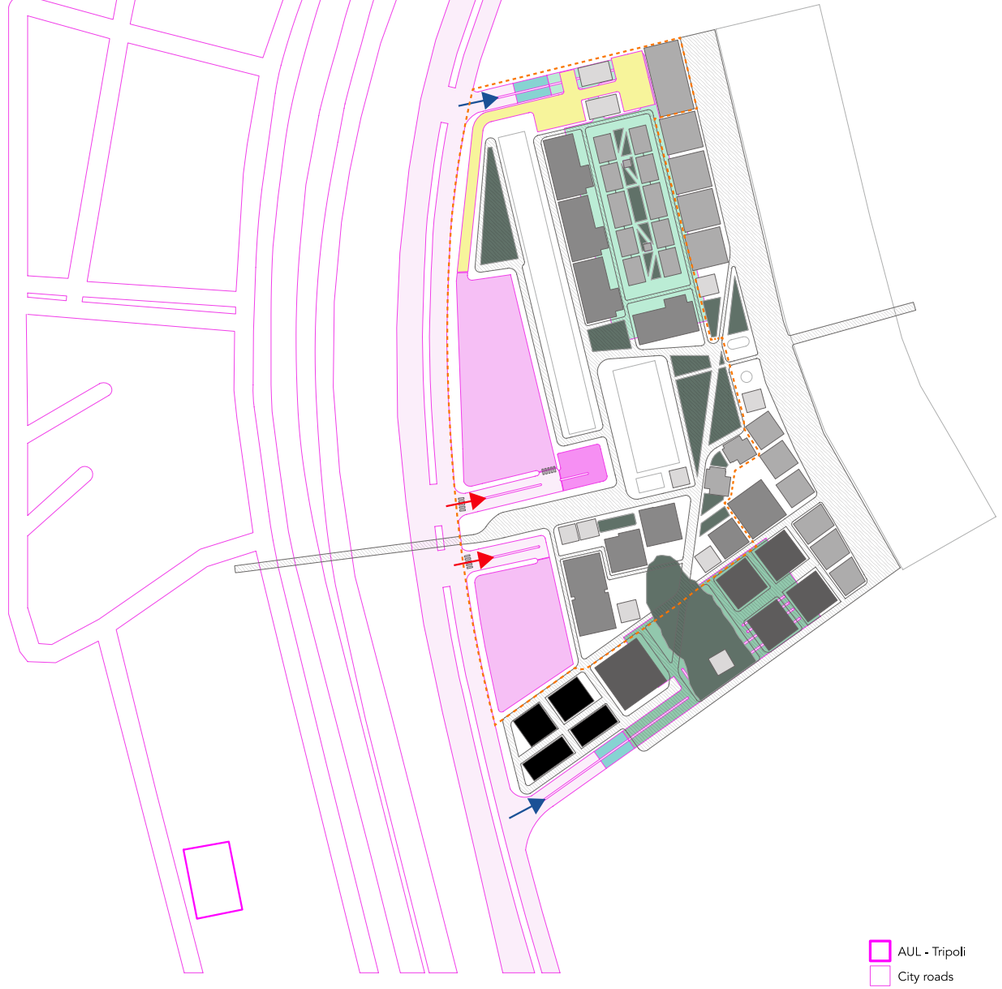
Tripoli Special Economic Zone (TSEZ) launched an urban and architectural competition for the sectional development of the Rachid Karami International Fair Grounds, previously designed by Oscar Niemeyer. The intention was to develop within the fairgrounds a Knowledge and Innovation Center (KIC) that would encourage collaborative experiences and attract entrepreneurial activities. Start-ups and SMEs are targeted with the KIC's progressive facilities, open space and shared offices, and dynamic growth environment. The development will attempt to contribute to Tripoli's hindered economy and attract local and foreign investments.

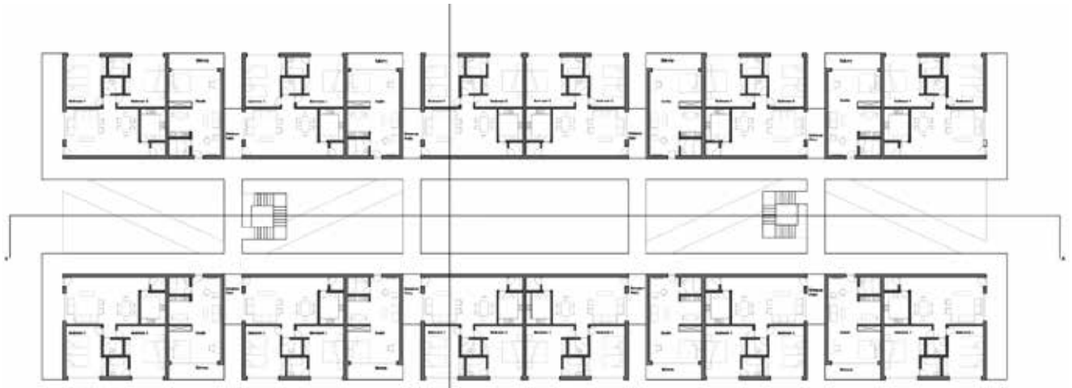
Planning and Links to the Community

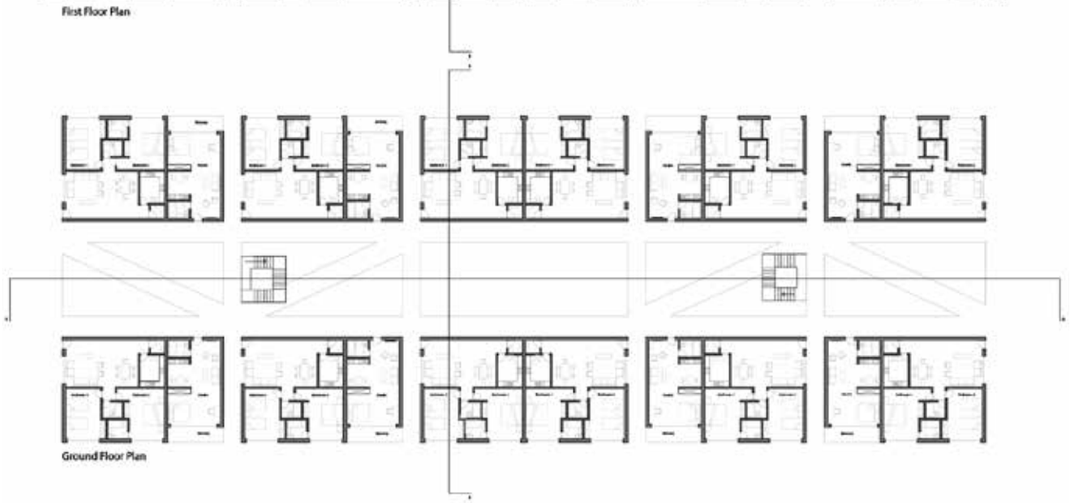
The master plan is developed for the entire site area, approximately 60,000 m², with 30,000 m² architecturally designed for the first phase of development. The program includes roads and infrastructure, leasable small and core-and shell offices, admin offices and support services, 40-unit housing complex, utility buildings, underground and covered parking and retail and F&B facilities. The design also incorporates the use of the two existing Oscar Niemeyer buildings that are within the site limits.

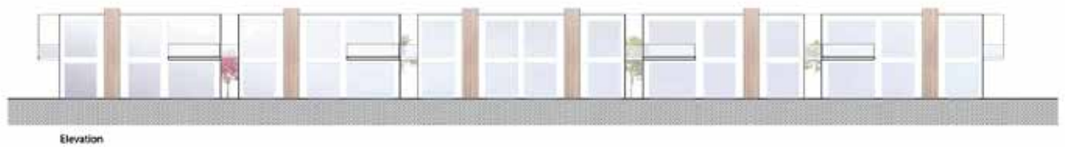
The design is based on concepts of flow, interaction and links with the neighboring community. The development conceptualized is primarily pedestrian and is very cycle-friendly, with vehicular access and parking placed on the site's periphery and underground. Connection to the rest of the fairground is maintained via the existing pedestrian path, and an additional link to the opposite side of the highway is added bringing the city and neighboring universities to the KIC.

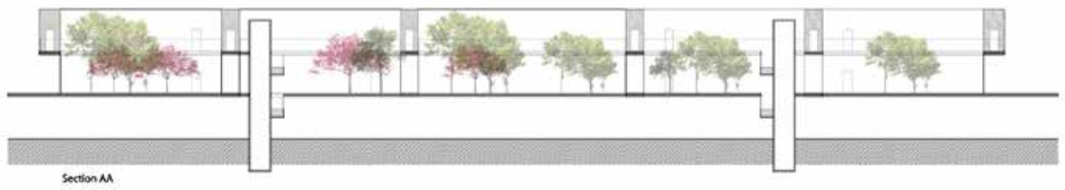
The main access and egress points and the covered parking sit west of the site neighboring the city. The wide bridge/walkway leads to the public facilities of the KIC such as the admin offices, conference halls, an open-air exhibition area and the flex desk office spaces.

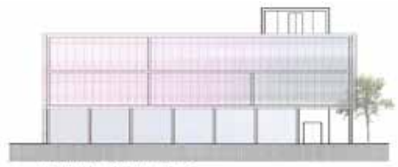

Phase 1
Pedestrian/cycle circulation
Existing buildings
G
G+1
G+2
G+3
G+4
AUL - Tripoli
City roads
RKIF roads
Public vehicular entrance/exit
Private vehicular entrance/exit
Covered parking
Drop-off area
Restricted access
1L underground parking
2L underground parking
Public space/park
Service access

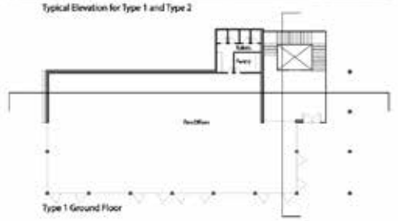

First Floor Plan

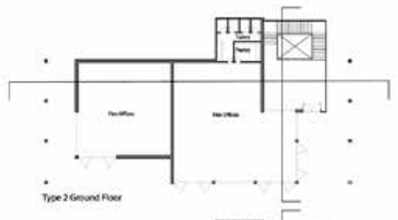

Ground Floor Plan

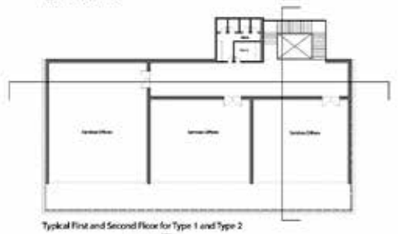

Elevation


Section AA

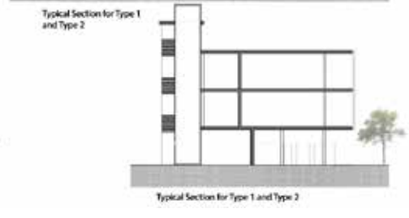

Typical Elevation for Type 1 and Type 2


Type 1 Ground Floor


Type 2 Ground Floor


Typical First and Second Floor for Type 1 and Type 2


Typical Section for Type 1 and Type 2


Typical Section for Type 1 and Type 2


Type 3 Ground Floor Plan


Type 3 Section 1


Type 3 First Floor Plan

Type 3 Section 2


Type 4 Ground Floor Plan


Type 3 Elevation

Flexible Phasing and Negative Space

The phasing plan places the negative and outdoor spaces at the forefront, and the architecture is all developed in a modular manner to allow for expansion as the project requires. As the project grows, more public spaces are created that are relevant to the architecture surrounding it.

The areas around the two existing buildings are developed first, creating a central plaza surrounded by retail facilities. The plaza serves as the main communal space, and is also conceptualized as an open-air auditorium for potential performances that can take place on the roof of the firefighting building. The Oscar Niemeyer building is at 3m height, and the roof can be accessed using a cherry picker as to not disrupt the architecture.

A pop-up space is created at the intersection of the admin, firefighting and the new office buildings. The area enclosed by the Oscar Niemeyer admin building and the site periphery hosts an open-air event space as an extension to the support services within the building.

The area along the boomerang organically grows into a promenade as the project expands. This serves as a separation between the existing building and the new development and provides prime leasable office space for the developer. Furthermore, and preserving the tree cluster existing on site, a park is conceptualized in the same location. Both the park and the promenade provide opportunity for extension should the project develop further south in the future. An open-air sports court and a two-level underground parking are also developed within the second phase.

Architecture and Materials

Designing as an infill on the prominent Oscar Niemeyer site mandates that the new buildings form meaningful compositions of space and architecture with the existing ones. The brutalist architecture of Niemeyer is juxtaposed with a translucent and transparent palette of material that almost floats around the existing monolithic structures, highlighting them rather than competing with them.

Operable polycarbonate sheets and perforated metal are chosen for their translucent qualities on levels above ground for privacy of the office spaces. The materials are versatile and can change with a play on façade lighting. Their configuration also changes on each façade with the orientation and sun direction. Recessed operable glass is chosen for the lower levels for easy accessibility to the public spaces surrounding each building, and to encourage interaction between space users. Wood is used for cladding and is selected for its social impact and as a tribute to the local wood crafting community, in attempt to help revive the dying craft. ■

Future Schools

What would a non-site-specific school design process look like? Considering all schools have the same basic programmatic requirements, is there a flexible universal system that can be designed? Can we work with a set of basic parameters to generate a form that can be adapted to new contexts? How will future schools look like? With the universal access to education issue in mind, these are the questions that we asked ourselves when we took on this exercise.

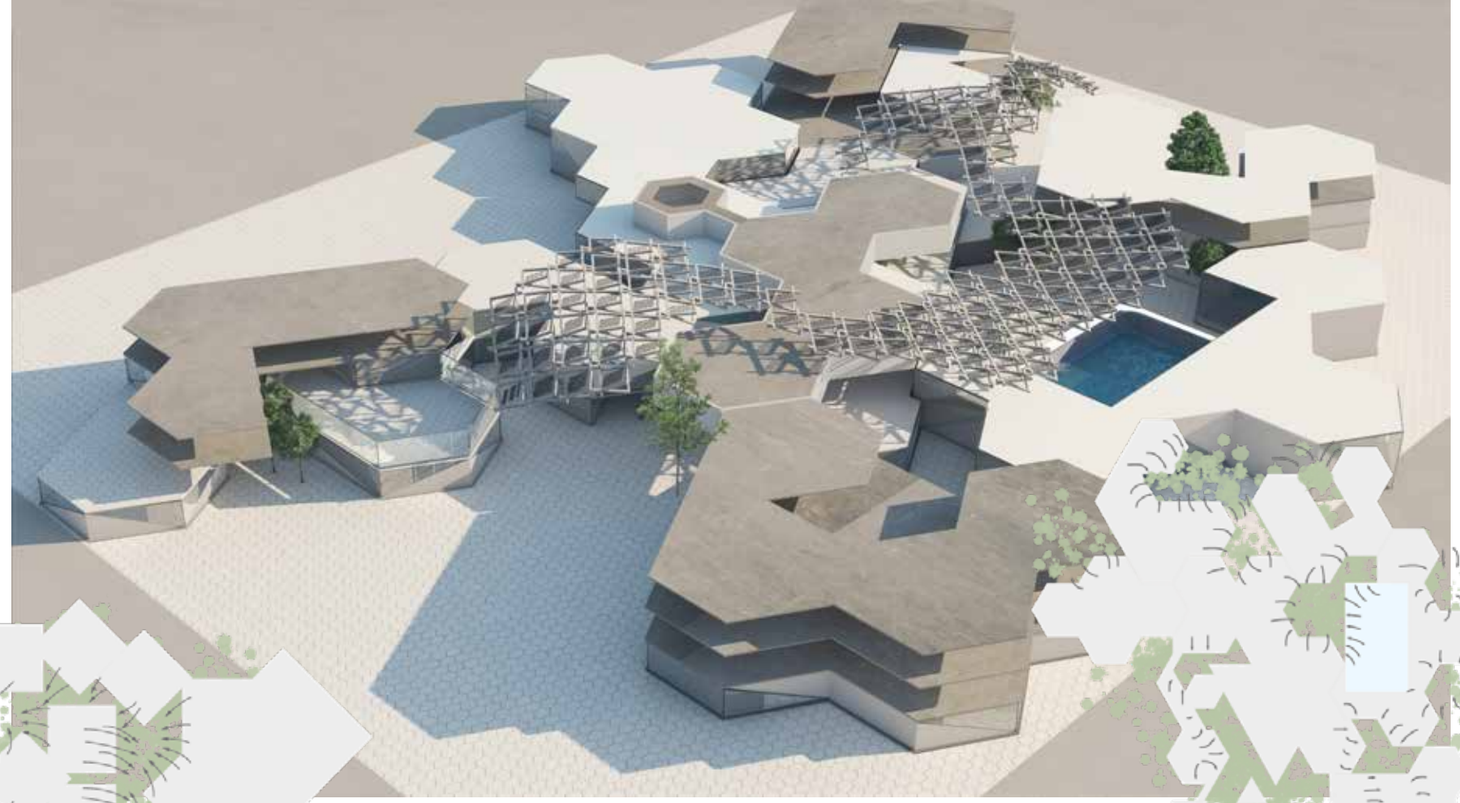
MODULARITY

The concept of modularity was instrumental to develop a design with an ambiguous site. We used the cube and the hexagonal prism as the base of this experiment. The module can be independently created, repeated, and connected to the other modules offering ultimate flexibility to suit various plots and different construction phasing requirements. Future phases are simple additions of the base “building block” to the existing structure.

The modules are repeatedly stacked, rotated and connected, sometimes directly and in other instances via ‘connectors’ to create different and interesting spaces around the school campus. Outdoor spaces are created by eliminating modules or by arranging them in a way that creates courtyards or voids.

While entry and exit to the school campus as well as the classroom blocks are controlled; the majority of spaces open up to outward views enables by the sustainably-designed glazing on all elevations.

“The module can be independently created, repeated, and connected **to the other modules offering ultimate** flexibility **to suit various plots and different construction phasing requirements.”**

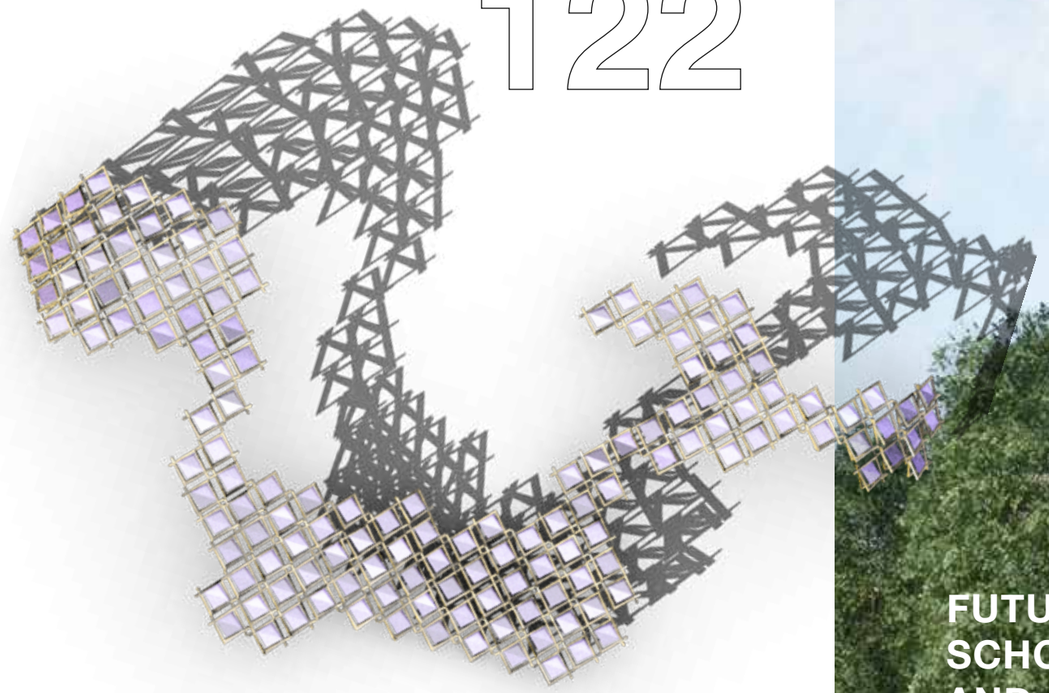


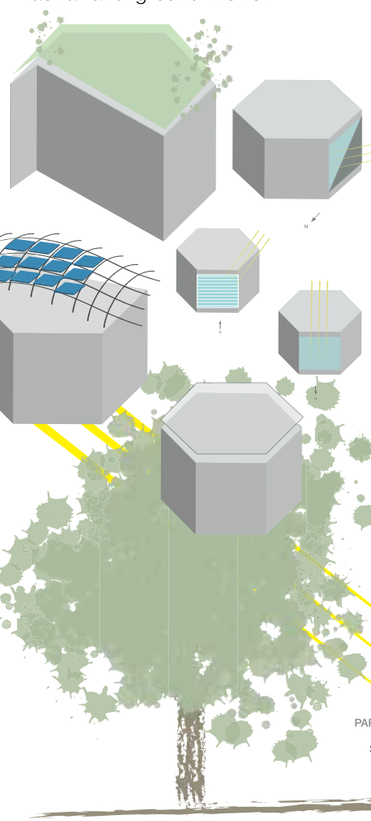
ZONING & PROGRAMS

Providing a sense of enclosure while keeping a connectivity to the outside is essential for optimal learning. The space assignments took that into consideration optimizing daylighting and views in all classrooms and the majority of other spaces; especially those used for learning. It was ensured that circulation was continuous and optimized with no dead ends. Corridors regularly open up to bigger spaces which are occasionally used for reading nooks and gathering spaces. While entry and exit to the school campuses and to the classroom blocks are controlled, the majority of spaces open up to outward views.

SUSTAINABILITY

The sustainability measures developed for the two concepts are integral to the basic design concepts making them seamless and functional in multiple directions: a facade element can generate shading while harvesting solar energy; a simple tilt in the roof creates aesthetic appeal while being faced towards the south for the best photovoltaic panels orientation; exterior shading is used as an architectural element that controls glare and reduces heat gain. A skin of solar panels that are rotatable on a frame was also introduced to generate energy while shading external spaces. It also creates a mesmerizing aesthetic skin from aerial and ground views.





Spaces were arranged in a way that creates green areas with large trees for shaded outdoors and an improved microclimate. The design has the flexibility needed to adjust as per the prevailing winds and sun orientation in the actual plots. The use of native plants preserves and protects the ecosystem by reducing the need for watering; hence reducing water consumption. Native plants grow year-round with minimal care for a healthy landscape. The Ghaf tree is an ideal candidate for the courtyards of a school in the UAE.

While optimizing the orientation of the building will depend on the site selection, the use of small modular elements, as proposed in both schools, provides the flexibility of elongating the building in the east-west direction permitting more windows on the north and south facing facades. The designs proposed maximize the use of windows on north-facing facades. Windows on south facing facades are used with the aid of shading techniques by horizontal overhangs and/or louvers and perforated sub control techniques. Windows on the east- and west- facing facades were minimized.

Cool roofs were also introduced. This entails a light colored smooth roof surface that will not absorb much of the sub energy and a high thermal emissivity to radiate away any solar energy that is absorbed so that the roof can cool down rapidly.

FUTURE SCHOOLS AND INNOVATION

Future schools will move from the traditional teaching methods to a more collaborative environment that is not centered around [teaching] but rather around [learning]. They will rely on collaborative work as opposed to isolated efforts; on real life experiences as opposed to artificial content; on information exchange as opposed to information delivery. With the ever-evolving methods of teaching, one of the constants and most valuable experiences remains to be learning from the environment and the outdoors. Taking this philosophy to heart we have maximized the outdoor spaces throughout the design, and provided views to the inward courtyards for learning and recreation. The views are unobstructed and leave an impression of continuity between indoors and outdoors.

“Taking this philosophy to heart we have maximized the outdoor spaces **throughout the design, and provided views to the inward courtyards** for learning and recreation.”

Successful architecture springs and evolves around human needs by designing buildings for people. In this exercise we reimagine the classroom: adjustable wall boundaries, farming and sustainable planting areas, innovation labs, connectivity to nature, technology and robotics, and challenging playgrounds.

List of Projects

NEW CONSTRUCTION

Al Ferdous 1, 2, 3, 4
AED400M B+G+1 Mixed Use Buildings (Retail + Residential + Offices). Total built-up area is 120,000 m2.
Full MEP design and construction supervision.

ARYANA Five Star Hotel Tower
AED250M Full MEP design of the five star landmark in Sobha Hartland consisting of B+G+4P+30.

Sabreen
AED195M 2B+G+8 residential building with retail spaces on the ground floor. Total built-up area is 18,000 m2.
MEP redesign (18% cost savings) and construction supervision.

Warehouses Complex
AED105M warehouses complex located in Jebel Ali Industrial Area is composed of 39 buildings housing 52 warehouses, cold stores, and administrative buildings.
Full MEP design and construction supervision.

Industrial Complex
AED65M complex comprising a yacht factory, labor accommodation, and administrative offices.
Full MEP design.

UAE Pavilion for Expo2020
LEED Independent Commissioning Agent to achieve LEED Platinum and Sa'fat Building Rating.

Tabreed- Al Raha Beach 250 ETS's
Consultancy services.

Jumeirah Heights District Cooling Expansion
Design and supervision of the expansion of the existing plants to accommodate new developments.

Masdar Sustainability Framework
Framework agreement for multiple sustainability-related projects.

GEMS Al Reem Primary School
Estidama Consultancy and Independent Commissioning Agency.

GEMS Al Reem Secondary School
Estidama Consultancy and Independent Commissioning Agency.

ADHA Near-Zero Sustainable Villa
MEP design and Estidama consultancy (5 Pearl) for a near-zero villa prototype.

Bugatti Villas
MEP design.

Private Villa – Pearl Jumeirah
MEP design.

Private Villa – Dubai Hills
MEP design.

Private Villa – Sharjah
MEP design.

Private Villa- Abu Dhabi
Interior design.

GEMS National Schools for Boys and Girls
Energy Simulation and sustainability compliance.

District Cooling Connection to School at Jumeirah Islands
District Cooling interface design and supervision.

Adventure ParX
Complete fit-out management including interior and MEP design and construction supervision.

Royal House in London
Interior design and fit-out management.

Valentino Store at TDM
MEP design.

EXPO 2020 Site Office
MEP design and commissioning management.

Zayed University Students Club
Project management of MEP and interiors.

Advect Offices
MEP design.

Yinyang Spa
MEP design.

Ministry of Energy and Industry
Cooling load identification for the new HQ.

Mamzar Hotel
Cooling load identification.

Residential Development on Plot C-008-009, TECOM
MEP peer review.

Residential Tower in Business Bay
MEP peer review.

Al Khail Avenue
Peer review services and VAC design optimization.

Nad Al Sheba Mall
Peer review services and VAC design optimization.

POLICIES AND STUDIES

Dubai Cooling Market
Robust assessments of the size of the cooling market in Dubai, the extent of penetration by district cooling and other cooling methods, the actual efficiency of district cooling and the efficiencies of other cooling systems.

Technical Consultancy for the Dubai Demand Side Management Strategy
State-of-the-art technical consultancy to support the review and upgrade of the Dubai Demand Side Management with a focus on detailed energy modeling and advanced engineering techniques.

Benchmarking for A Building Energy and Water Rating Scheme for Dubai
Technical consultancy and benchmarking to develop an energy and water benchmarking system for residential buildings, office buildings and hotels in Dubai.

Kuwait Cities District Cooling Feasibility and Guide
Development of a comprehensive financial, legal, commercial, and technical guide to enable the adoption of District Cooling in Kuwait in addition to a concept level design of the network and plants in the new South Al Mutlaa City.

Abu Dhabi Department of Energy's Plan to Energy Retrofit Project 150 Governmental Buildings
Five year plan to retrofit 150 buildings selected from a pool of 2,500 eligible buildings that display the highest potential of energy savings and the highest likeliness of retrofit success.

INTERVENTION

Burj Khalifa MEP Retrofit
Design, supervision, and commissioning management for the modification of Chilled Water system above level 150 the burj, Domestic Water System pumps retrofit and Firefighting Pump Line upgrade.

Retrofit Management for the Abu Dhabi Department of Energy
Consultancy services to facilitate the energy retrofit of eight DoE buildings including solar installations and the establishment of a central smart monitoring station.

Nakheel Energy Conservation Studies
Detailed energy audit and simulation of all typical buildings in the five communities (Ibn Battuta Mall, The Gardens (129 bldgs), The Gardens Furnished Apartments (8 bldgs), Discovery Gardens (41 bldgs), International City (111 bldgs)) and PEA of the full buildings profile (~300 buildings with a total built-up area of over 2,000,000 m_2).

Meraas Discovery Gardens
Detailed energy audit and retrofit management for 59 buildings.

Emaar Energy Benchmarking 2016, 2019
Energy benchmarking of all of Emaar properties in Dubai and establishing a methodology and templates for continuous tracking and benchmarking activities.

Webcor Group
Preliminary energy analysis and benchmarking of over 20 facilities of Webcor Group.

Etihad ESCO- Energy Audits
Walkthrough energy audit for select governmental entities.

Etihad ESCO- Measurement & Verification
Sole M&V consultant for energy retrofit projects.

Saudi Tarshid NESCO
Energy Audits and Retrofit Bid Management.

Project Solis
Consultancy services for the 1,000MWh rooftop on-grid Solar Photovoltaic installation at Dutco Balfour Beatty labor camps.

Royal Winter House Renovation
Complete retrofit of the architectural façade, interior, and MEP of a winter palace located in a nature conservation in the UAE to improve occupants experience, comfort, and views.

Tabreed Seawater Plant
Technical audit.

Chilled Water Consultancy Services at City Walk
Identification of and supervising the implementation of optimization and corrective measures.

Emicool DCP 11
Client representative services for quality assurance for energy retrofit at the district cooling plant.

Dubai Festival City – District Cooling Plant Audit
Identification of optimization and corrective measures at a 50,000TR district cooling plant.

Dubai Festival City – Low Delta T
Identification of the causes to and mitigation measures of low delta.

Fairmont the Palm- Low Delta T
Identification of the causes to and mitigation of low delta T syndrome.

Index Tower
Energy Performance Contract management/ Low Delta T mitigation.

Hilton Corniche Abu Dhabi (now Radisson Sas)
MEP technical audit.

Humidity and Mold Mitigation in a Five Star Resort in Dubai
Engineering consultancy services to identify causes and advise mitigation measures.

Dutco Balfour Beatty Camps Energy Retrofit
Client representative services to facilitate and supervise energy retrofits from inception to completion of EPC.

Transformers Rooms Study
Engineering consultancy services to identify causes of transformers deterioration and advise mitigation measures across tens of district cooling plants.

Dubai Mall Aquarium
MEP design modification and on site supervision to upgrade the chilled water system feeding the Dubai Mall Aquarium.

Dubai Mall Waterfall Fountain
Engineering services for the upgrade of the chilled water system feeding the waterfall.

Court of HH Crown Price of Abu Dhabi
Redesign for VAC system for improved thermal comfort.

Dubai Mall F&B Exhaust System Retrofit
Rectification of F&B exhaust system in Dubai Mall's food courts for improved performance.

Masdar City Offices
Redesign for VAC system for improved thermal comfort.

Emirates Nuclear Energy Corporation Offices
Redesign for VAC system for improved thermal comfort.

Honeywell Offices
Identification of measures for improved thermal comfort.

Fairmont the Palm Energy Audit
Energy simulation and energy reduction measures selection.

Zee Tower Energy Audit
Detailed energy audit and simulation.

Raha Building Energy Audit
Detailed energy audit.

Hamza Tower Energy Audit
Energy audit.

Sidra Tower Energy Audit
Detailed energy audit and simulation.

Golden Mile 1&2
VAC bill allocation.

M&V at Park Place
Measurement & Verification services.

Al Sahel Contracting Sustainability Policies
Development of a comprehensive sustainability policy and management of successful adoption across the business units.

Dubai Economic Department
LEED Existing Buildings and WELL consultancy services.