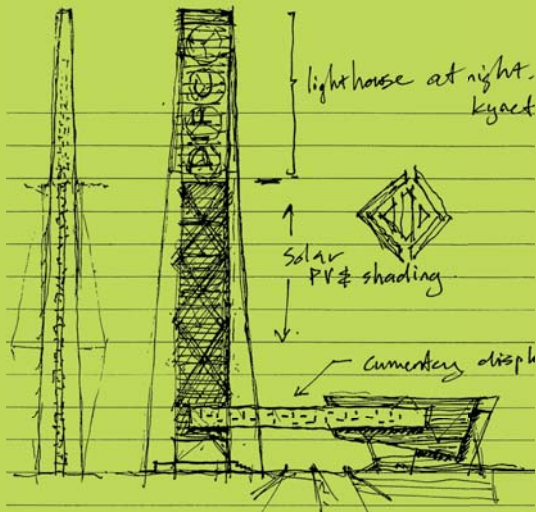
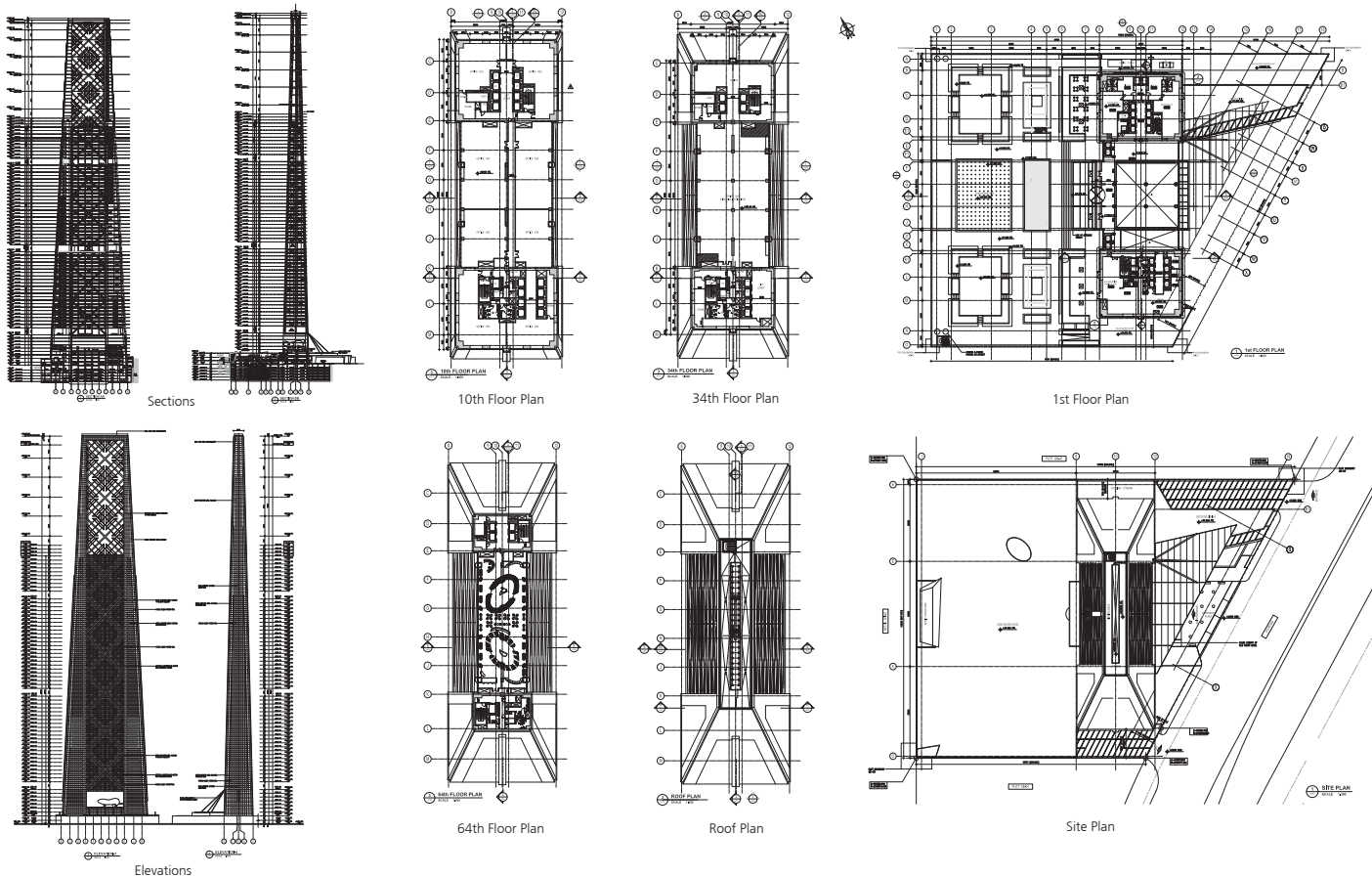
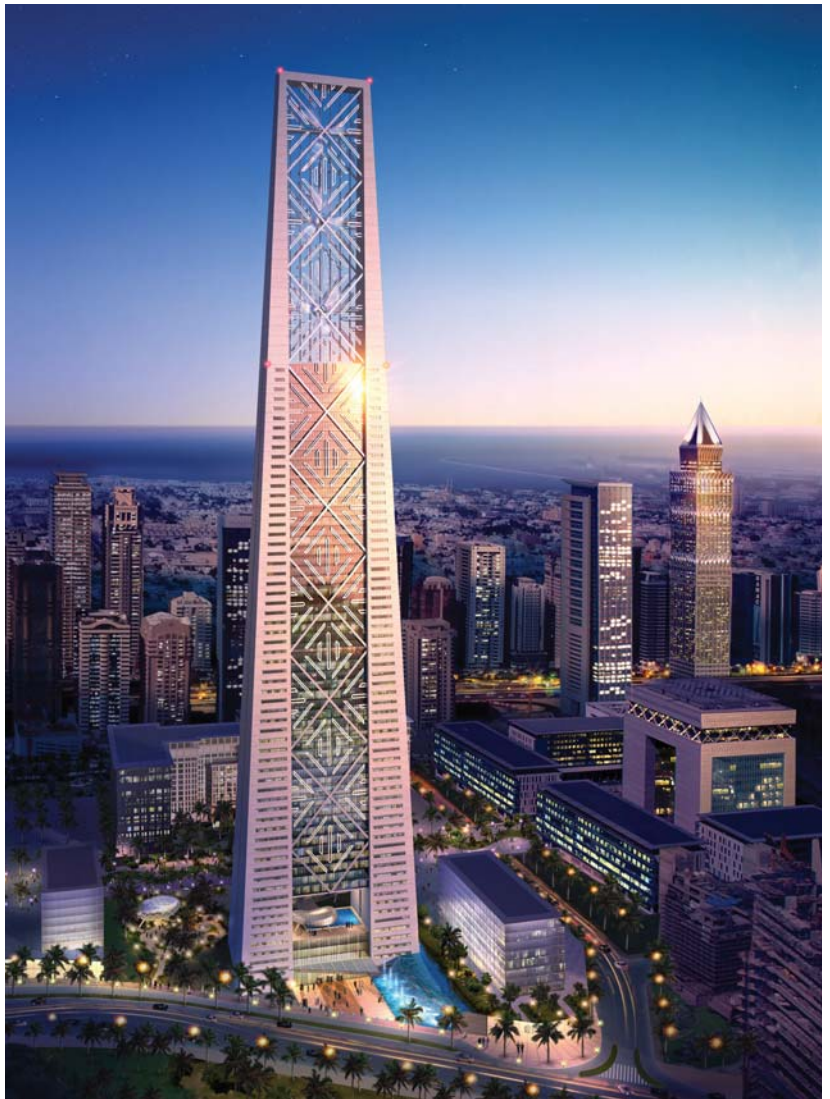


Client:	DIFC
Project location:	Dubai International Financial Centre (DIFC)
Building type:	Commercial
Construction commencement:	Scheduled for October 2008
Construction completion:	Scheduled for June 2011
Architect:	Shaun Killa, Atkins
Total area:	172,600 m ² (gross construction area)
Total height:	402 metres
Total number of floors:	64 storeys
Materials:	P.T. concrete and steel floors
Façade:	double facade, high performance glazing

DIFC Lighthouse Tower aims to reduce total energy consumption by up to 55% and water consumption by up to 50% in what will be the world's tallest and largest LEED Platinum building. In the context of Dubai's aggressive development, we changed our client's agenda by proposing a highly progressive, low-energy building that would lead future sustainable high-rise development within the Middle East and beyond.



Original sketch



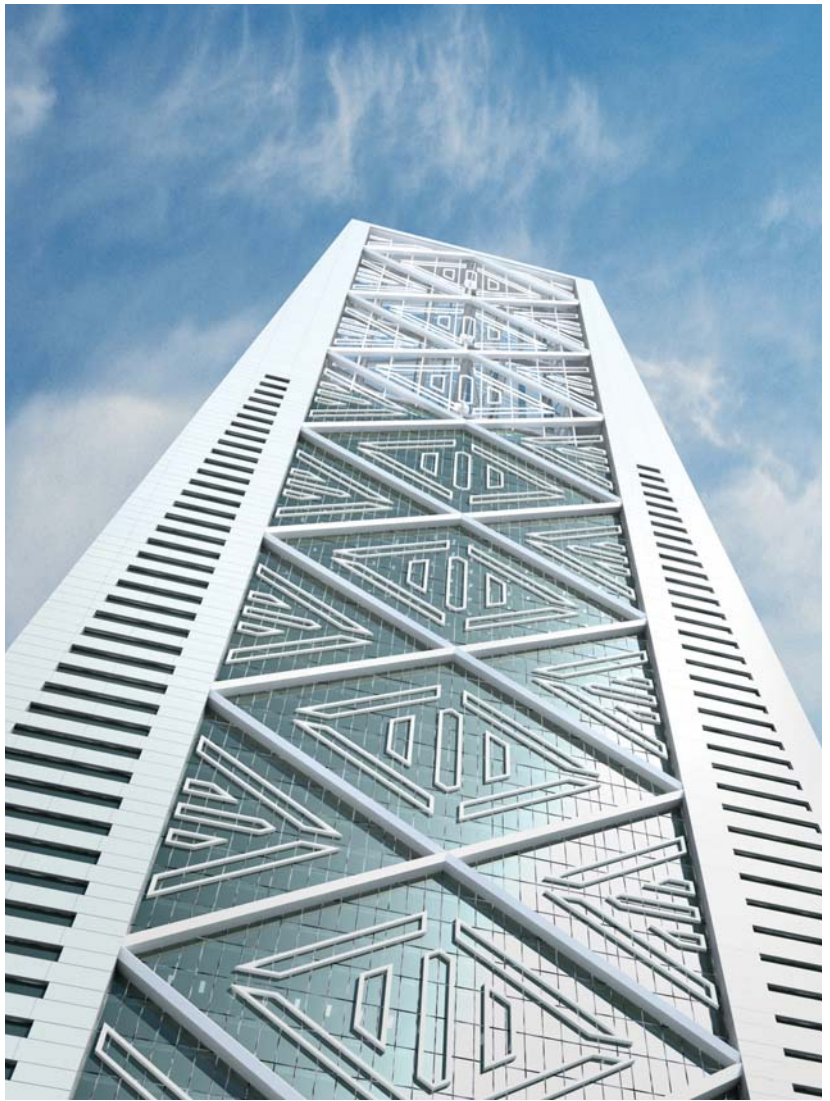
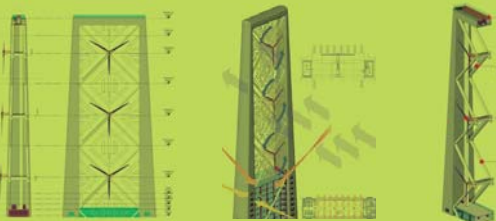
Quantum change & transferability

The initial brief was simple: 90,000 m² of rentable office, a tall building showcasing the DIFC and a building that respected its architectural context. We set ourselves the additional challenge of a LEED Platinum high-rise using 65% less electrical energy and 55% less water. We knew it would be a challenge to achieve Class A office space and LEED requirements for thermal comfort, visual comfort and renewables in a tall building for a hot climate. No Middle-East client or developer had ever asked for it and no architect had ever tried. Our client embraced our innovative proposal. The final design had 97,000m² of rentable office area and is the tallest and largest LEED Platinum building in the world. Much of the design effort focussed on how Lighthouse Tower operates. It saves energy in more than fifty ways. Some relate to quality control and some to the technical performance of building systems. Some are unorthodox and some are commonplace. All belong to the four-stage design impact hierarchy.

1. Passive design using fundamental techniques like orientation, shading windows, insulating, preventing infiltration, and use of daylight all have a high return in terms of performance and cost efficiency.
2. Improved engineering design using techniques such as turning off lights automatically to reduce energy consumption, heat load and CO₂ emissions, or using larger pipes to reduce pump power and energy consumption.
3. Recovery systems taking output from one process and feeding it into another, such as using air-conditioning condensate for irrigation.
4. Renewables are included but they are still relatively expensive for what they produce. Greater savings were to be gained from the three other stages.

The design phase involved analysing all fifty techniques in many combinations and selecting the one most efficient and sustainable. The façade system having vertically-mounted spandrel PV panels is just one technique. It was chosen from 27 different energy models on the basis of conclusions drawn from our own research programme for monitoring the actual energy output of seven different technologies over different seasons, angles, orientations, and cleaning regimes. The 56% energy saving accounts for 3% of all energy saved.

The energy saved by Lighthouse Tower is the sum of many such small savings, and the intelligent building energy management system continuously monitors building performance and synchronises all systems to reduce the total energy requirement by a further 5%. Lighthouse Tower contains many interdependent systems and its occupants are the passive recipients of their combined benefits. Transient local environments are adjusted continuously and with limited user intervention. The building envelope is sealed to prevent condensation on the chilled beams and to eliminate infiltration that could increase the cooling load by as much as 10%. Lighthouse Tower is a finely-balanced environmental system.

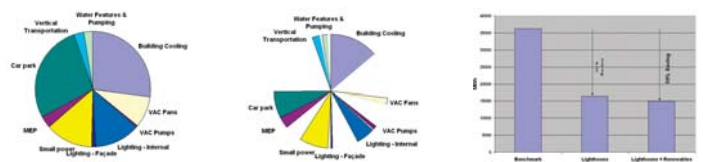


ELECTRICAL ENERGY (55% less electrical energy)

Energy consumption can be reduced by up to 55% in the Lighthouse through the following design initiatives (Parentheses show the reductions with respect to the benchmark total energy.)

- Use of smart carpark (-20%)
- Reduced cooling loads (-13%)
- CIBSE Lighting Guide (LG) 7 compliant lighting with automatic daylight control and task lighting (-7%)
- High efficiency motors, pumps and fans for building services systems, along with chilled ceilings (-7%)
- Low fit-out weight, double-decker lifts with regenerative motors (-1%)
- Advanced control systems to reduce small power energy (-5%)
- Use of LED lighting for façade lighting (-1%)
- Use of efficient pumps for water features (-1%)

ELECTRICAL ENERGY (-55%)

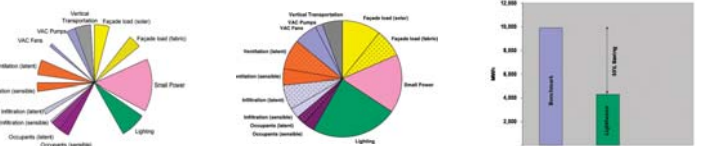


DISTRICT COOLING (55% less district cooling energy)

Cooling loads on the building can be reduced by 48% for the lowest energy option, (or 44% for the best financial option), through the following initiatives. (Parentheses show the reductions with respect to the benchmark total energy.)

- Reduction in lighting loads through lighting system described above (-16%)
- High performance double façade with aspirated cavity, plus integrated blinds and chilled ceilings (-10%)
- The best financial option of a high performance double glazed façade reduces cooling load by 6%.
- Reduced infiltration loads through improved construction management, pressure testing and use of revolving doors and airlocks through the building (-8%)
- Reduced fresh air load through use of total energy heat recovery wheels, wrap around heat pipes, demand controlled ventilation and reduced air conditioning running time (-6%)
- High efficiency motors, pumps and fans that, due to their efficiency, release less heat (-5%)
- Advanced control systems to reduce small power loads (-2%)
- Efficient lifts that, due to efficiency, release less heat (-1%)

DISTRICT COOLING (-55%)

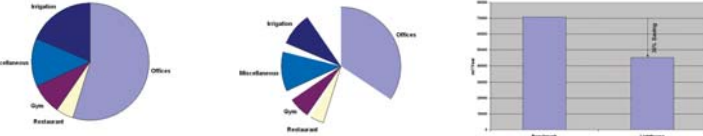


WATER (36% less water)

Water consumption can be reduced by 36% through the following initiatives. (Parentheses show the reductions with respect to the benchmark total energy.)

- Low volume / low flow rate washroom fixtures (-22%)
- Soil amendment additives to reduce irrigation water (-9%)
- Low water consuming dishwashers in pantries (-3%)
- Reduced cooling demand leading to reduced water consumption at district cooling plant (-2%)

WATER (-36%)



Ethical standards & social equity

Lighthouse Tower provides its users with an agreeable internal environment but this is merely part of the normal role of buildings and the responsibilities of architects. So too are positioning and orienting it to have minimum impact on traffic outside the site, optimal traffic flow within the site, and enhancing the functioning of the ground-level pedestrian and retail complex that will link all the precinct's buildings.

Skilful manipulation of site levels creates new spaces for pedestrians and enables the surrounding landscaped concourse to be used as a public park even before this retail link is completed. Adaptive plants filter grey water. Spaces are shaded, breezes are channeled, and evapo-transpiration captured to temper the microclimate. Surfaces with low-heat retention temper it further into the summer months. Any well-designed building should do all of this for its occupants as well as for casual passers by and visitors.

As part of its mission to rehabilitate the image of Dubai as a place of waste and excess, Lighthouse Tower is prepared for its responsibility to educate and inform all who visit. Some of those visitors will come to Lighthouse Tower to see the view of Dubai it offers from its 94th-floor Viewing Gallery. When they change elevators on the 64th floor they will pass through the Visitor Centre for Sustainable Design in the Middle East. This is a dedicated educational centre with an exhibition explaining the building's many techniques from the simple and passive to the complex and technological. It also has a library of environmental literature, a media centre and realtime information display of the building's energy consumption and generation. The knowledge contained in this Visitor Centre will interest all around the world who design buildings now as well as those who someday will. A panoramic elevator then takes visitors past 30 floors of turbine space to the Viewing Gallery from which they might one day look over a more sustainable city.

Lighthouse Tower takes an equally broad view of its stakeholders for, in the big system, they are future generations. Engaging with them comes not from the building but from the people who designed it. ATKINS involves itself in a range of educational initiatives that include sponsoring university programmes and mentoring and teaching primary school children about energy efficiency. Their University Liaison Directors programme has ongoing relationships with 31 universities around the world.

One of these is with the British University in Dubai of which His Highness Sheikh Ahmed Bin Saeed Al Maktoum is Chancellor. ATKINS provides financial and academic support to their Sustainable Design and Built Environment (SDBE) programme, and each year makes six scholarships available to Emiratis so they can be equipped with the knowledge and expertise to sustain their country with less reliance on expatriate knowledge skills. Working together allows BUID and Atkins to continue their pioneering research and development and ensure engineers and architects can respond to the challenges of a carbon critical world.



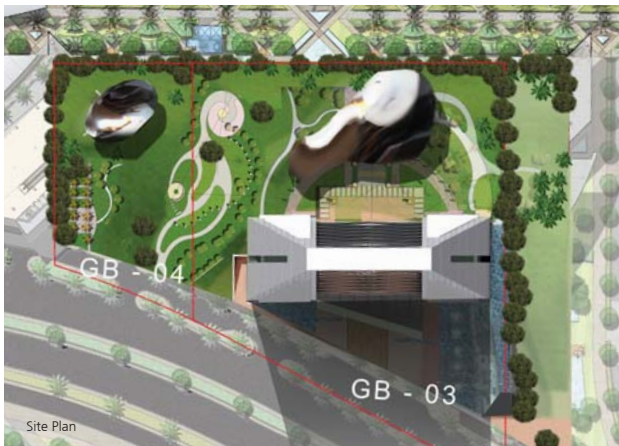
Integrated plaza & raised park



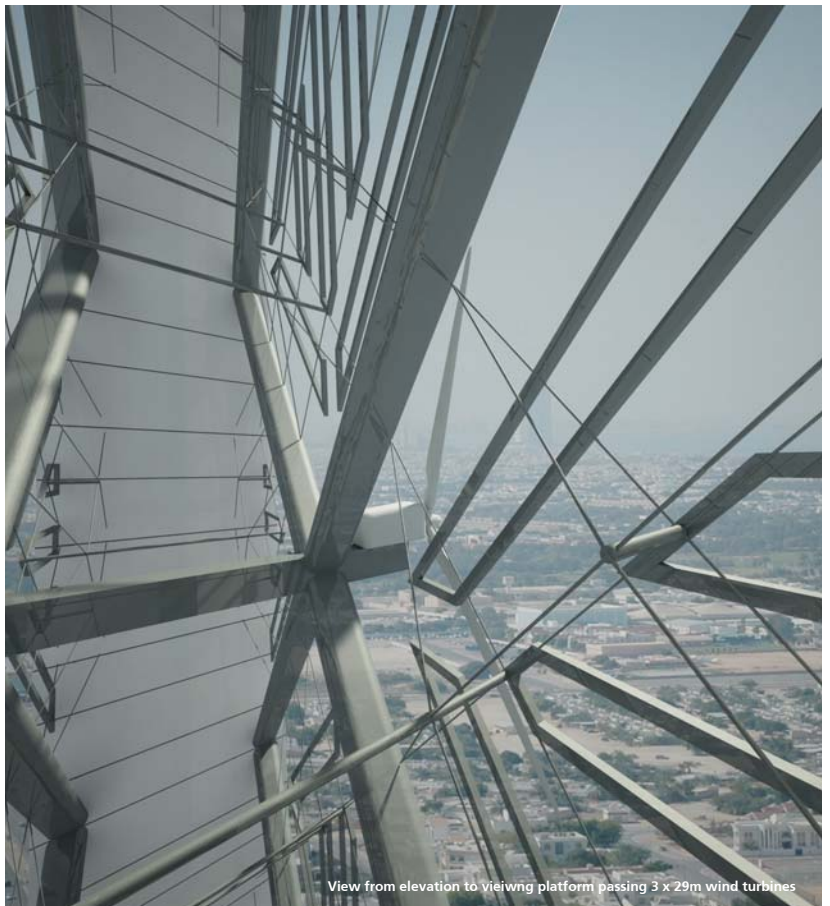
BUID workshop



Sustainable research centre, 64th floor



Site Plan



View from elevation to viewing platform passing 3 x 29m wind turbines

Ecological quality & energy conservation

The design phase involved fundamental decisions regarding shape and height. The composite structure minimises concrete and steel usage by isolating their structural roles. The use of recycled steel and interior finishes and the use of local concrete, ceramics, glass and other materials reduces needless haulage and also feeds back into the local economy. Timber that, for obvious reasons, could not be locally sourced was certified by The Forest Stewardship Council. All components that can be prefabricated offsite locally, are.

During construction, the quality of the air around Lighthouse Tower is being continuously monitored. No buildings had to be demolished to make way for Lighthouse Tower but a storage area separates construction waste into five categories and recycles it to divert it from landfills. Maintaining quality during the construction phase is especially important for future energy issues since improper façade sealing, for example, can cause infiltration which can easily account for 10% of the cooling load. Upon completion, each floor will be pressure tested. Even after completion, modular internal layouts enable them to be reconfigured for different tenants and uses with a minimum of waste and trauma.

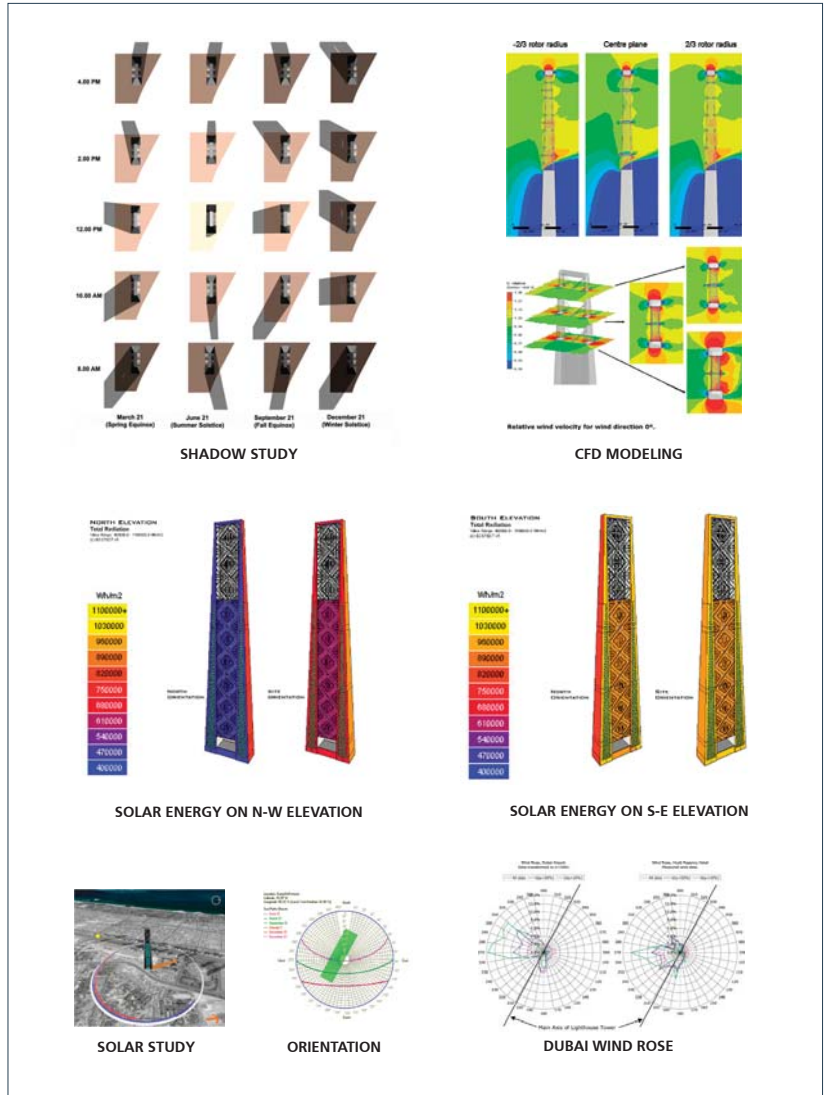
A feasibility study is ongoing for the possible incorporation of three 29-metre commercial wind turbines. If adopted, they will take the integration of large-scale wind turbines pioneered by the Bahrain World Trade Centre (also designed by ATKINS) to a new level where the design is far more holistic in terms of low-energy design. Lighthouse Tower's more subtle integration of turbines offers wider scope for transferring this technology to other buildings.

The 48% saving in water use was achieved by the combined application of many known technologies such as low-consumption, dual-flush WCs, waterless urinals, low-consumption showers, electronic taps, flow restrictors, condensate recovery, and soil amendment additives. Five out of five LEED points for reduction in water usage were scored by landscaping with efficient irrigation and adaptive plants, grey water recycling and efficient fixtures and low-flow sensors to reduce water usage within the building. The 95% saving for domestic hot water was mainly achieved through commonsense approaches such as doing without hot water in the restrooms, using solar hot water heating for the health club and using high-efficiency dishwashers in the kitchens. There, the 30% reduction in kitchen vent energy was brought about by using sophisticated capture jet technology instead of conventional hoods.

The 36% reduction in energy required for vertical transportation is a good illustration of what simple measures can achieve when coupled with evolved technologies. Escalators are demand-controlled, and the 16 high-efficiency double-deck elevators have a lightweight cabin fit-out and LED lighting and fans that are switched off when not required. The elevators are slower in off-peak times and have the same regenerative braking that is now found in some automobiles.

The narrow plan means high levels of daylight anyway, but when sunlight strikes the glass, the blinds are automatically lowered and angled to create light shelves that then bounce the light off the ceiling to either reduce or eliminate energy to maintain nominal lighting. These nominal lighting levels are supplemented only by task lights and any thoughtlessly left on will be switched off. In corridors, restrooms and the car park, progressive motion sensors raise non-stationary local lighting levels from zero or minimal to the nominal 11W/m². The 67% saving in lighting energy represents 11% of the total saved.

Understandably, the energy required for conditioning air came under the most scrutiny and the 21% saving accounts for a 6% saving overall. This comes from established technologies such as heat pipes and total heat recovery wheels, by operational fine-tuning such as fresh air intake being CO₂ demand driven, and by commonsense actions like turning off the air conditioning at night. The infiltration-free façade system improves cooling efficiency and the cooling load on the building was further reduced by high-efficiency lighting, and pumps and motors that have advanced control systems to reduce the heat they generate.



Economic performance & compatibility

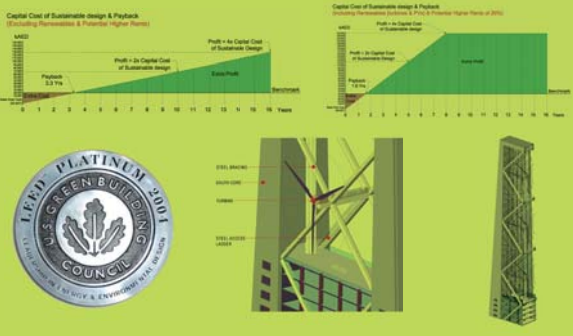
A building's use of financial resources over the course of its lifetime is now more important than ever. Decisions on this affect all aspects and all elements of the building's performance. For example, opting for a high-performance double façade with an aspirated cavity and integrated blinds in conjunction with chilled beams brought about an energy saving of 10% when compared to a conventional façade. Despite this, the best financial option of a high-performance double-glazed façade reduced the cooling load by only 6%.

An economic case was made for all sustainable initiatives. The three 29-metre wind turbines are still the subject of an ongoing economic feasibility study. Even without allowing for these additional renewables or for rent increases, all the sustainable initiatives pay for themselves in 3.6 years. This period becomes 1.6 years if the office space commands a rental premium of even only 20% and, after five years, they actually generate a 200% profit and a 400% profit after eight. The 20% figure is very conservative when compared to the 50% rental premium commanded by the Bahrain World Trade Centre. Other experiences have been taken on board. In Bahrain, the wind turbines are prevented from operating at full capacity because the regulatory mechanisms are not yet in place for them to feed surplus power back into the grid. These regulatory mechanisms are not the mechanical or electrical ones.

Lighthouse Tower is therefore a real example of how an aggressively sustainable high-rise building can also be economically attractive and, because of that, more likely to be a precedent for further low-energy high-rise buildings and more environmentally sensitive cities.

Improved staff efficiency and productivity are two indirect cost advantages gained over the life cycle of the building. Lighthouse Tower can be expected to have a longer life as an environment that is good for the occupants is good for the building. Lighthouse Tower is a sophisticated building with many interdependent systems. Its users passively receive the benefits of those systems and a "Building Users Guide" educates them about what they can do to help the building do its job better. Part of this job is monitoring its own performance. All services are monitored floor by floor and energy consumption data compared with that from other developments of comparable size. Energy consumption can also be compared for different tenants and significant disparities used to identify areas of waste, and make recommendations for savings. The intelligent building energy management system can also compare measured readings with baseline data so that action can be taken to see if, for example, an unusual increase in chiller energy consumption indicates an obstruction or fault in the system.

The effect of this intelligent building energy management system is an educational one for it can teach its occupants how to use the building better. It is also a diagnostic one for it can identify problems so that its management and maintenance regimes can be improved.



DIFC Lighthouse - LEED Certification Assessment Chart

Sustainable Issue Credits	Yes	with Effect	Unlikely	No	Assigned by
SS1-1 Construction Activity Pollution Prevention	3				Contractor
SS1-2 Site Remediation	3				ATKINS & Client
SS1-3 Development Density & Community Connectivity	3				ATKINS
SS1-4 Renewable Redevelopment	3				ATKINS
SS1-5 Alternative Transportation: Public Transportation	3				ATKINS
SS1-6 Alternative Transportation: Bicycle Storage & Changing Rooms	3				ATKINS
SS1-7 Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	3				Client
SS1-8 Alternative Transportation: Parking Capacity	3				ATKINS & USGBC
SS1-9 Alternative Transportation: Parking Capacity	3				ATKINS & USGBC
SS1-10 Site Development: Protect & Restore Habitat	3				ATKINS & USGBC
SS2-1 Site Development: Maximize Open Space	3				Landscape Designer
SS2-2 Open Space: Quality, Quantity, Location	3				Landscape Designer
SS2-3 Stormwater Design: Quality Control	3				ATKINS & USGBC
SS2-4 Stormwater Design: Quantity Control	3				ATKINS & USGBC
SS2-5 Stormwater Design: Pollution Control	3				ATKINS & USGBC
SS2-6 Stormwater Design: Pollution Control	3				ATKINS & USGBC
SS2-7 Heat Island Effect: Roof	3				ATKINS & USGBC
SS2-8 Heat Island Effect: Roof	3				ATKINS & USGBC
SS2-9 Heat Island Effect: Roof	3				ATKINS & USGBC
SS2-10 Light Pollution Reduction	3				ATKINS & USGBC
SS Total	33				
Water Efficiency Credits	Yes	with Effect	Unlikely	No	Assigned by
WE1-1 Water Efficient Landscaping: Reduce by 50%	3				Landscape Designer
WE1-2 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-3 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-4 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-5 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-6 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-7 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-8 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-9 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE1-10 Water Efficient Landscaping: Use Potable Water Use in No No-Region	3				ATKINS
WE Total	30				
Energy & Atmosphere Credits	Yes	with Effect	Unlikely	No	Assigned by
EA1-1 Fundamental Commissioning of the Building Energy System	3				Client
EA1-2 Fundamental Commissioning of the Building Energy System	3				ATKINS
EA1-3 Fundamental Commissioning of the Building Energy System	3				ATKINS
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Contextual & aesthetic impact

Lighthouse Tower is oriented to receive offshore winds and this orientation also makes it part of Dubai's urban grain as set up by Sheikh Zayed Road. Architecturally, Lighthouse Tower slots into the rectilinear layout of the DIFC precinct and its diagonal structural bracing that enables the use of steel to be minimized, also identifies it as one of the family of buildings of which The Gate Building is centrepiece.

It is the size of Lighthouse Tower that sets it apart. Its height extracts maximum efficiency of land use just as the first tall buildings did and, like every tall building since, is also symbolic of progress. Lighthouse Tower towers over Dubai to catch the wind. The building tapers to keep its centre of gravity low and its structure minimal. It also sits better.

The use to which the additional height of Lighthouse Tower is put, sets it apart from its neighbours, all other buildings in Dubai, and all other buildings in the world. Bahrain World Trade Centre is an integrated mechanical system that has two buildings channel wind toward the turbines. What it is doing is more obvious because it had to present to the world a new way for buildings to be. By contrast, the Lighthouse Tower does not showcase renewable energy because it is more subtly integrated.

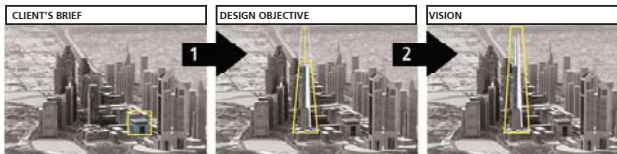
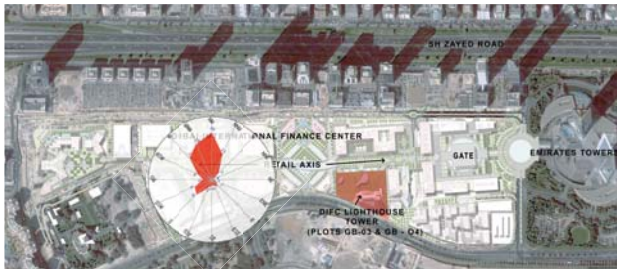
There is more to Lighthouse Tower than wind. The diagonal bracing stabilizing the two cores is subsumed into the pattern formed by the DIFC logo multiplied across its long façades. Some look for and find in this pattern, a reference to the traditional arabian *mashrabiya*. The pragmatism of structure and the directness of logos disappear at night when LED transform it into a singular lighting effect having the decorativeness and delicacy of lace. At night, most other buildings in Dubai exhibit the arbitrary and irregular patterns of people turning lights on as they move about the spaces within. DIFC Lighthouse Tower is part of a financial centre and, at the end of the trading day, its occupants go home. When they do, the building places all systems in maximum energy-saving mode and, behind a softly glowing filigree of light, sleeps.



Existing DIFC Gate building



DIFC precinct



PORTE-COCHERE & PLAZA



Further thoughts

The UAE is the world's 38th largest producer of CO₂ emissions and on a per capita basis second only to Qatar. Construction accounts for 35% to all CO₂ emissions globally but in the oil-producing countries the main contributor is the extraction and processing of oil and gas. Some of this oil and gas is used for electricity generation which is their second major contributor and some of this electricity is used for the desalination of sea water which is their third.

The fact that the Qatar and the UAE rank 60th and 38th in terms of gross CO₂ emissions but 1st and 2nd on a per-capita basis indicates just how much CO₂ is produced producing fuel for others to burn. The UAE is changing to zero-emission flaring of waste gas and oil and is shifting to the use of natural gas in power and desalination plants. This will vastly improve UAE CO₂ emission levels but, for as long as the people of the world need oil and gas and the people of the UAE need electricity and water, will do little to alter the consciousness of individuals.

The individuals who are the users of Lighthouse Tower will soon not notice the regenerative braking or the increased efficiency of the double-deck elevators, the solar-heated hot water, the lack of draughts or glare or any of the other benefits passive solar architecture brings. They may at first see the solar switched lighting and blinds, the waterless urinals and the provision of only cold water to the staff restrooms as energy-saving measures but will soon come to think of them as the way things ought to be.

The people of Dubai may feel some sense of pride when they learn Lighthouse Tower is the world's first hot-climate, low-carbon, high-rise to attain LEED Platinum rating. It is a unique achievement but the qualifier of 'hot climate' is important. People did once live in Dubai without air conditioning but, for most of the summer, all activity stopped. Survival downtime gave rise to traditions of thought, storytelling and poetry rather than the energetic folk dancing that is often the case with cold climates.

Ultimately, Lighthouse Tower is greater than its envelope, its systems, and information about them. As the local and global symbol of Dubai International Financial Centre, it must be a symbol of prosperity and, particularly now, responsibility. It must communicate optimism for the future by showing it is ready for it. And it must communicate that optimism to those who use it, those who see it, and to those on this planet who will only ever know it through images of it and by what is written about it.

DIFC Lighthouse Tower began as a tall building designating the DIFC precinct and, over the course of the project, the metaphorical "Lighthouse" that was only a visual marker to begin with, grew and transformed into a beacon for future low-energy buildings within the Middle East and possibly the world.



Some of the energy efficient measures implemented

Efficient Facades Energy Saving	3%	<ul style="list-style-type: none"> Aspirated double façade and high performance glazing Larger super insulated spandrels Automatic blind
Infiltration Energy Saving	2%	<ul style="list-style-type: none"> High cladding specification Enhanced quality control Building pressure testing Enhanced draught lobbies
Air Conditioning Energy Saving	6%	<ul style="list-style-type: none"> Chilled Beams Variable speed fan coil units
Ventilation systems Energy Saving	2%	<ul style="list-style-type: none"> Fresh air is CO₂ demand driven Total heat recovery wheels Heat pipes A/C off overnight
Mechanical Energy Saving	1%	<ul style="list-style-type: none"> High efficiency motors, fans and pumps Intelligent switching
Thermal Storage Energy Saving	3%	<ul style="list-style-type: none"> Chilled Water thermal storage tank (fire sprinkler tank) to reduce peak load by 25%
Car Park Energy Saving	26%	<ul style="list-style-type: none"> Robotic car storage Very low ventilation & lighting Induction fans in drop/collect bays Reduced petrol consumption
Lighting Energy Saving	11%	<ul style="list-style-type: none"> From 17 W/m² non-LG7 to 11 W/m² – combination of low glare background lighting and local task / up lights Occupancy and solar switched Fully automated Retro blinds IBMS interfaced for intelligent office environment
Intelligent Building Control Energy Saving	5%	<ul style="list-style-type: none"> High level system to enable all building control systems to operate in symphony
Vertical Transportation Energy Saving	3%	<ul style="list-style-type: none"> 16 x High efficiency double deck elevator Lightweight cabin fit out Regenerative braking LED cabin lighting Off peak speed reduction Demand controlled escalators Destination control

