EmiratesGBC
مجلس الامارات للابنية الخضراء
Emirates Green Building Council

EMIRATES COALITION for GREEN SCHOOLS

The State of Our Schools

White Paper

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Emirates Green Building Council

Emirates Green Building Council is a business forum based in the United Arab Emirates formed in 2006 with the goal of advancing green building principles. The Council gathers member companies and partners representing a diverse range of stakeholders from within the building industry, government, and academia. EmiratesGBC functions as a common platform for all stakeholders whereby they can meet, discuss, interact, and exchange groundbreaking ideas which help to promote a sustainable built environment in the UAE and the surrounding region.

Since its formation, EmiratesGBC has initiated several programs and events related to improving the operational efficiency of existing buildings. Membership is open to all stakeholders willing to influence a positive change in the country's built environment. The Council facilitates open engagement with its members and conducts quarterly review with its Board Members to devise work plans and programs which promote the Council's mission.

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Forewords

Saeed Al Abbar, Chairperson, Emirates Green Building Council

Under the leadership of HH Sheikh Mohammed Bin Rashid Al Maktoum, the UAE has always taken a leadership role in placing emphasis on educating the youth of the nation. Given that schools play a defining role in promoting the sustainability agenda of the UAE, the participation of our educational institutions and its leaders has a ripple effect on the building industry's concerted initiatives to promote a more sustainable built environment.

The most important stakeholder in the green schools' discourse is undoubtedly the students; they are today's change agents and tomorrow's leaders. Children spend over 1300 hours every year in classroom environments. Therefore, the design, construction and operations of our schools can not only achieve resource consumption targets, but can drastically impact the performance, happiness and wellbeing of the building occupants. Schools do not operate as just buildings but as education ecosystems, and when conducive to focus, creativity, critical thinking and social interaction can transform the leaders of tomorrow into thriving responsible members of our community.

The roundtable on the 'State of Our Schools' held on November 19th, 2017 presented a first of its kind platform to engage diverse stakeholder groups including members of the academic, government and private sector. The intention of the roundtable was to plan, design, implement, innovate and sustain green initiatives in our schools. The following white paper presents the findings of the roundtable, and also puts forth a national vision for green schools.

On behalf of EmiratesGBC, thank you to all the organisations and individuals who supported in this white paper. We look forward to continuing our work with schools with the support of UAE's stakeholders.

Aref Abou Zahr, Managing Director, TAQATI

As the dedicated program management office for the Dubai Demand Side Management Strategy, Taqati recognizes the important role that schools play in reducing the energy needs of Dubai and the United Arab Emirates.

With overall trends indicating the need to make our schools greener, it is of utmost importance to focus on energy efficiency alongside environmental aspects. To build and sustain the momentum of green transformation, schools should invest in energy efficient solutions and technologies such as retrofitting and transitioning towards renewable energy sources, particularly distributed solar. Green schools would greatly support the UAE's sustainability vision and energy efficiency goals set forth by our leadership. Taqati is proud to support the Emirates Coalition for Green Schools and we look forward to working together towards the proliferation of green schools in the UAE.

Anisa Heming, Director, Center for Green Schools at USGBC

The worldwide green schools' movement has gained considerable momentum and continues to gather together passionate advocates for school health, environmental sustainability, and 21st century education. No matter where in the world we live, the education of our children is of paramount importance. And the schools that are most important to each of us are those in our neighborhoods, in our towns—the ones our children go to and the ones our neighbors' children go to. Thus, leadership in the green schools' movement is local and rooted in common experience.

As it catalyzes the conversation among leaders in the UAE, the newly-formed Emirates Coalition for Green Schools has taken an important first step with this paper examining the state of schools in the nation. We are proud to have played a small part in the progress that Emirates Green Building Council has made since they joined with us to launch the Global Coalition for Green Schools in 2013. With two *State of the Schools* reports in the United States—one in 2013 and one in 2016—we were able to lay a foundation for conversations with government, NGO, and business leaders about how to address our country's lack of investment in school infrastructure and sustainability education. These papers have been important steps in clarifying the issues our country faces and inspiring solutions toward which we can work together.

The Center for Green Schools stands ready to help the UAE move toward greener schools as you build on the information gathered in this report. Your success is good for our planet, our children, and our children's planet, and so it is our success as well.

Introduction

On November 19th 2017, Emirates Green Building Council (EmiratesGBC) launched the Emirates Coalition for Green Schools, a national initiative aligned with the Global Coalition for Green Schools. The collaborative nature of the Coalition endeavors to foster open, multi-stakeholder discussion. In this spirit, the UAE's strongest advocates of green schools were invited to participate in a roundtable discussion to deliberate about the 'State of Our Schools'. Accordingly, roundtable participants included government, tertiary level academics, elementary school teachers, education and sustainability related associations, media and the private sector.

This white paper is the compilation of a literature review of existing global and local green schools research and the moderated discussion that ensued during the November 2017 roundtable. As the first installment in an intended series of roundtables and accompanying publications, *The State of Our Schools* was chosen as the inaugural topic to achieve the following objectives:

- Establish consensus for the definition of green schools in the UAE.
- Assess the current state of the UAE's schools in the context of this definition.
- Identify which stakeholders should be engaged to effectively determine a course of action for the Emirates Coalition for Green Schools in subsequent sessions.

The Global Coalition for Green Schools

The Global Coalition for Green Schools was founded in 2013 by the Center for Green Schools at the U.S. Green Building Council in partnership with the World Green Building Council and is comprised of green building councils and other like-minded organizations from around the world. With a vision that every child has the opportunity to learn in a green school within this generation, the network aims to equip communities with the resources and support they need to transform their schools. EmiratesGBC is one of 29 founding members of the Global Coalition for Green Schools.

The Emirates Coalition for Green Schools

The Emirates Coalition for Green Schools brings together the UAE's strongest advocates to create a national platform for the proliferation of green schools in the UAE. Sharing the vision of the Global Coalition, the Emirates Coalition for Green Schools aims to ensure that every child in the UAE learns in a green school within this generation. The Emirates Coalition focus ranges from K-12 up to tertiary level institutes.

As highlighted in *Figure 1*, over the past 11 years EmiratesGBC has continued to engage with schools in the UAE to promote the concept of green buildings. As well as holding the annual Green Apple Day of Service and supporting student research papers, EmiratesGBC now holds an Annual Student Excellence Award as well as an Annual Green Building Industry Student Forum with Herriot Watt University, where

tertiary level students across the UAE are invited to join and are encouraged to explore sustainability as a potential career path.

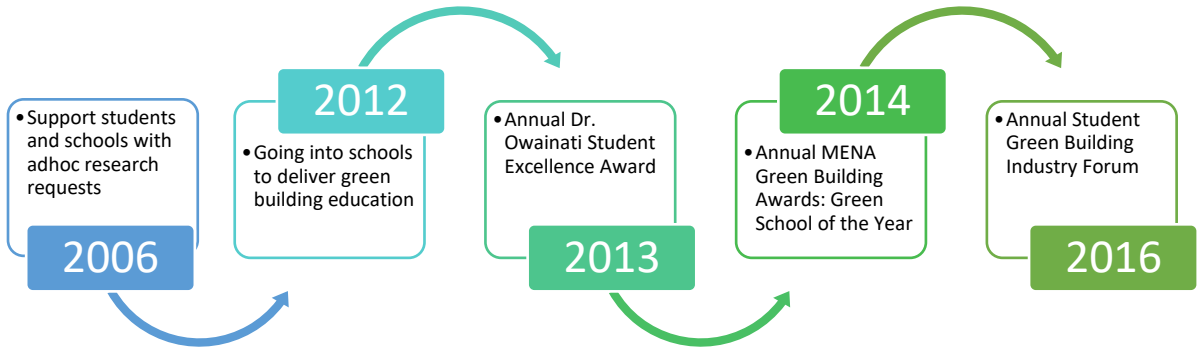


Figure 1 Emirates Green Building Council's Work with Schools Prior to the Coalition Formation

Establishing Consensus: What is a Green School?

Based on the literature review, a working definition for the term "Green School" was presented to the roundtable attendees for revision. After deliberations, the below definition was agreed by the group.

Green School Definition:

> A green school provides a healthy environment for occupants, conducive to learning while optimizing environmental performance and encouraging environmental literacy.

Considerations that must be factored in while working with schools:

- Every school has the potential to be a green school, regardless of the age of the building.
- Students who attend green schools are de-facto change agents for the future.
- Environmental and social impact must go beyond the school envelope boundary to address community impact.

Building the Case for Green Schools

Children differ from adults both anatomically, physiologically, cognitively and psychologically [1]. Children have higher metabolic rates than adults, which results in increased body heat and breathing, and therefore have increased cooling and ventilation needs [2].

In the context of schools, there is comprehensive research to support that indoor environmental quality (IEQ), which includes lighting, acoustics, thermal comfort and indoor air quality, has an effect on students' health, productivity, performance, physical and mental development [3], [4], [5], [6], [7], [8], [9], [10]. In

terms of school building occupants, impacts are not limited to students. Inadequate IEQ in schools have also shown to negatively impact staff health, absenteeism and teaching quality [4], [5], [7].

As will be reviewed in the following section, green schools are designed to the same, if not higher, standard as other green buildings typologies. They offer superior performance over conventional schools and can help improve student academic achievement, reduce truancy and suspensions, improve staff satisfaction and retention, as well as raise property values [6].

A report by Capital E reviewed 30 green schools in the U.S. and demonstrated that the operation of green schools initially cost approximately 2% more than conventional schools - or about $\$3/ft^2$ more. However, green schools save approximately $\$12/ft^2$/year as a result of lower energy, water and emission costs [11]. These savings stem primarily from resource efficiency, using 33% less energy and an average of 32% less water than conventionally designed schools [11].

Differences Between Green Buildings and Green Schools

The differences between a green building and a green school were assessed by review of four relevant green building ratings systems.

Leadership in Energy and Environmental Design (LEED), US Green Building Council

In addition to the prerequisite Green Building credit requirements, LEED gives school-specific criteria that projects can choose to pursue in both Building Design and Construction [12] and/or Building Operations and Maintenance [13] rating systems as follows:

- **Indoor Environmental Quality - Minimum Acoustic Performance (required)** - highlights the need for effective acoustic design as the primary method of teaching across various educational institutes is through verbal communication.
- **Indoor Environmental Quality - Low-Emitting Materials** - especially stringent for schools, which must comply with all 7 product categories, noting that batt insulation products should contain no formaldehyde.
- **Sustainable Sites - Environmental Site Assessment -** ensures protection of vulnerable populations (children) by assessing the site for environmental contamination and remediating if necessary.
- **Sustainable Sites - Site Master Plan -** promotes the use of a master plan to achieve long-term sustainability regardless of future changes to the school buildings or campuses.
- **Sustainable Sites - Joint Use of Facilities -** encourages use of the school amenities for community purposes.
- **Location and Transport** - **Green Vehicles -** encourages alternative vehicle usage as opposed to conventionally fueled vehicles.
- **Location and Transport - Transport -** schools should be easily accessible (transit-served location or within safe walking distance).
- **Materials and Resources - Purchasing** - encourages purchase of food from sustainable agriculture or local sources.
- **Materials and Resources - Waste Policy and Management** – encourages reduction of food waste and/or composting when possible.

The WELL Building Standard

To encourage certification of schools, the WELL Educational Facilities Pilot Addendum [14] offers school-specific guidance across the 7 concepts highlighted below:

- **Air** - Playground equipment safety must be addressed, including lead paint assessment, remediation of pressure treated wood, and risk mitigation of contaminated artificial turf; humidity and mud control and direct source ventilation for locker, transition and shower room areas; antimicrobial and cleaning provisions for lockers.
- **Light** - Ambient lighting providing minimum lux levels for visual acuity for learning and minimum melanopic light intensity (to support circadian rhythms) in learning areas based on student age groups.
- **Mind -** Health/wellness awareness strategy including: sleep policy, building health policy through community immunization program, and behavior support available to students if necessary.
- **Water** - At least one dispenser with free, potable water is provided per 30 students in outdoor activity areas, based on average outdoor occupancy.
- **Fitness** - Activity incentive programs aimed at reducing sedentary time; structured fitness opportunities activities via physical activity breaks; physical fitness activity spaces including age-appropriate fitness equipment and bicycle storage spaces.
- **Nourishment** - Beverage restrictions and food ingredient requirements based on school typology; signage indicating handwashing and promotion of healthy food choices; adequate time for lunch breaks.
- **Comfort** - Ergonomic work stations to support standing; external acoustic assessment and sound pressure minimization strategy; noise criteria for internally generated sound, reverberation time requirements, school ceiling height specifications; wall construction specifications to create sound barriers meeting minimum Sound Transmission Classes.

Al Sa'fat - Dubai Green Building Evaluation System

In addition to the existing Dubai regulations for all new buildings, the criteria specific for educational facilities, which includes nursery schools, primary schools, secondary schools, colleges and universities under Al Sa'fat [15] are:

- **Credit 401.07 (required) - Indoor Air Quality Compliance -** indoor air contaminants such as formaldehyde, respirable dust and total volatile organic compounds (TVOC) must be below maximum acceptable thresholds before operation of the building. Furthermore, after building operation, another compliance test is required within 5 years of the initial test.
- **Credit 403.01 - Acoustic Control -** should meet the control requirements according to Building Bulletin 93: Acoustic Design of schools – A design Guide (UK).
- **Credit 404.03 (required)** - **Carpet systems** - Carpets are not allowed to be used. Synthetic carpets emit volatile organic compounds and can also act as sponges, which trap pollutants brought in from the outside environment.
- **Credit 502.04 - Lighting Power Density** - **Interior -** should not exceed a maximum of 12 W/m^2 across total building area.
- **Credit 502.06 - Lighting Control** - All lighting zones in education facilities must be fitted with occupant sensor controls capable of switching the electrical lights on and off, according to occupancy unless lighting is required for safety purposes.

Estidama Pearl Building Rating System (PBRS): Design and Construction

In addition to the existing regulations for all new buildings, schools in Abu Dhabi, which includes primary schools, secondary schools, sixth form colleges and further and higher education/vocational colleges and institutions, have the following additional requirements under the Pearl Building Rating System: Design and Construction [16]:

- **Precious Water - 2.1 - Exterior Water Use Reduction: Landscaping** - minimize landscaping water demands through the use of turf substitutes requiring no irrigation water for playing fields alternatives.
- **Living Buildings: Indoors - 2.1 & 2.2 - Material Emissions -** extreme significance is placed on this as 100% of adhesives and sealants used in the building interior must not exceed the prescribed VOC limits in South Coast Air Quality Management District Rule 1168. Additionally, 100% of all surface areas covered by paints and coatings must have VOC limits no more than the limits prescribed per Annex II, Phase II, Table A of European Directive 2004/42/CE: 2004.
- **Living Buildings: Indoors - 5.2 - Thermal Comfort & Controls: Occupant Control -** ensures individual comfort controls as a minimum of one control per two occupants in the occupied area is required for the wellbeing, productivity and thermal comfort of occupants. Additionally, school classrooms, lecture theatres, conference halls etc. must have at least one thermostatic controller.
- **Living Buildings: Indoors - 7 - Daylight & Glare -** Must have occupancy sensors in all rooms intended for occupancy. Glare control devices must achieve a minimum daylight illuminance threshold of 300 Lux on the working plan (desk level).
- **Living Buildings: Indoors - 10 - Safe & Secure Environment: School Transit Safety & Security Plan -** to ensure safety of children during school transit.

The review of two international rating systems and two local building regulations highlight that schools as a building typology have additional requirements that differentiate and/or are additional to the standard green buildings; namely, emphasis is given to IEQ ensuring increased safety and health for the requirements of school building occupants.

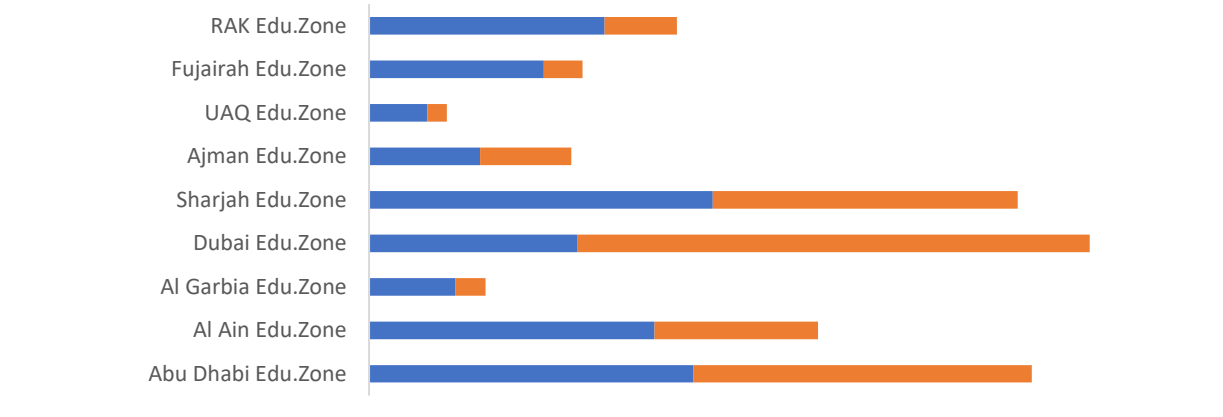
Schools in the UAE

According to Article 17 of the UAE's Constitution and Article 1 of Federal Law No. 11 of 1972, education is compulsory and free of charge at all stages for citizens (nationals) in the UAE. Further, under Article 31 of Federal Law No. 3 of 2016 Concerning Child Rights, every child shall have the right to education and the State (UAE) shall work on achieving equal opportunities for every child according to the Laws in force [17]. Thus, while education is free of charge only for nationals in the UAE, every parent is expected to provide an education for their child, as it is their right.

Number of Schools

There are currently 1,316 schools in the UAE (*Figure 2*). It should be noted that the number of schools does not reflect the number of physical buildings, which is likely to be much higher. Closer inspection of *Figure 2* shows that the emirate of Abu Dhabi has the highest number of schools, with a combined total of number of 443 schools, as Abu Dhabi is split into three different education zones, followed by Dubai

with 260 schools. The graph also shows that there are almost equal number of public schools and private schools in the UAE, which highlights that there is considerable opportunity for greening both



	Abu Dhabi Edu.Zone	Al Ain Edu.Zone	Al Garbia Edu.Zone	Dubai Edu.Zone	Sharjah Edu.Zone	Ajman Edu.Zone	UAQ Edu.Zone	Fujairah Edu.Zone	RAK Edu.Zone
Number of Schools (Public Education)	117	103	31	75	124	40	21	63	85
Number of Schools (Private Education)	122	59	11	185	110	33	7	14	26

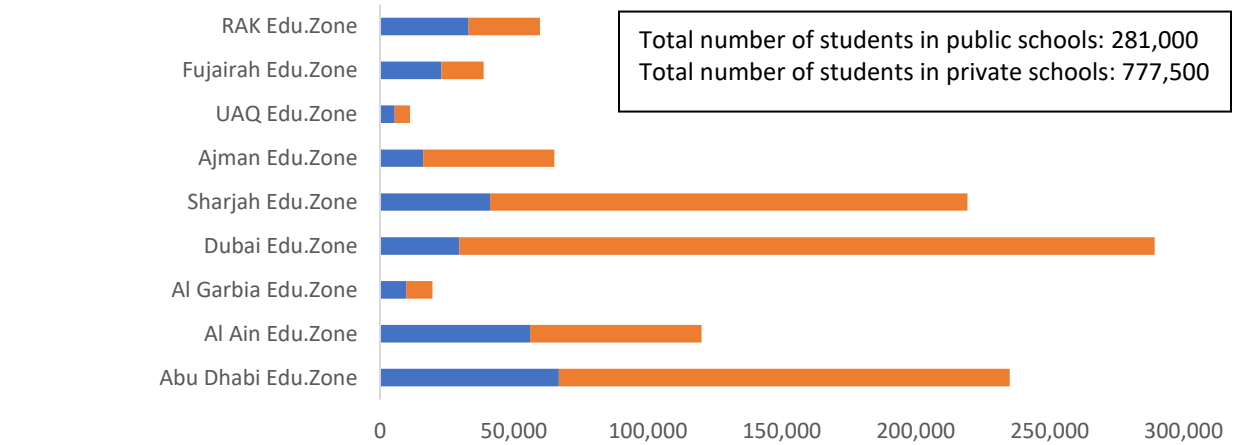
categories of schools.

Figure 2 Distribution of schools (public and private) in each of the respective education zones in the UAE 2016-2017 [18].

Total number of public schools: 659
Total number of private schools: 657

Number of Students

There are over 1 million students currently enrolled across the UAE which indicates the potential impact that green schools in the UAE can achieve in terms of educating and influencing future advocators of sustainability (*Figure 3*). Compared to public schools, there are almost three times as many students enrolled in private schools, with an average student to private school ratio of 1371.



Total number of students in public schools: 281,000
Total number of students in private schools: 777,500

	Abu Dhabi Edu.Zone	Al Ain Edu.Zone	Al Garbia Edu.Zone	Dubai Edu.Zone	Sharjah Edu.Zone	Ajman Edu.Zone	UAQ Edu.Zone	Fujairah Edu.Zone	RAK Edu.Zone
Number of Students (Public Education)	66,738	56,015	9,795	29,597	41,063	16,120	5,461	22,967	33,085
Number of Students (Private Education)	168,379	64,056	9,806	259,681	178,267	49,006	5,808	15,785	26,671

Figure 3 Distribution of students enrolled in public and private schools in the UAE 2016-2017 [18].

The State of Our Schools: How Green Are Our Schools?

In order to identify the most impactful course of action for the Emirates Coalition for Green Schools, the current state of the schools in the UAE must first be assessed. The following section highlights where schools in the UAE currently stand relative to the definition of green schools established earlier.

Environmental Performance: Regulatory Requirements

The emirates of Dubai and Abu Dhabi have stringent building regulations for new buildings that ensure environmental standards and adequate IEQ in new schools.

Abu Dhabi's Estidama – Pearl Rating System (PRS) requiring that all new applicable buildings must meet the 1 Pearl requirements, whilst all government funded buildings, and thus public schools in Abu Dhabi, must achieve minimum of 2 Pearls as per the Executive Council Order of May 2010. There are 156 Abu Dhabi school buildings that have been rated by the Estidama Pearl Rating System representing a total floor area greater than 1.95 million m^2.

Since 2014, all newly constructed buildings in Dubai must comply with Dubai Green Building Regulations and Specifications (DGBRS); with Al Sa'fat to be made mandatory from 2018 onwards. Government buildings (which would include government schools), were mandated to follow DGBR from 2011. It is currently unknown how many existing schools in Dubai have been built in accordance to these standards to date.

Given the aforementioned points, all newly constructed schools in Dubai and Abu Dhabi can be assumed to have adequate environmental performance to partly qualify as green schools for their design and construction features. However, standardized environmental performance measurement would be required to verify that the buildings are operating to building regulations. Furthermore, the other emirates in the UAE do not have mandatory green building regulations and therefore any new schools built in emirates other than Abu Dhabi or Dubai do not automatically qualify as green schools.

In the absence of a system for assessing environmental performance of existing schools, which were not built following these building regulations in Dubai and Abu Dhabi, their performance is unanimously believed by roundtable attendees to be poor.

It should also be noted that while the aforementioned building regulations address the physical aspects i.e. the built environment of the school itself, they do not necessarily address the operation and maintenance as well as the eco-literacy aspect of green schools and hence only partly qualify as green schools as per the established definition. This will be assessed in the following section.

Environmental Performance: Optional Certifications

The UAE currently ranks in the Top 10 countries to hold LEED certification outside the United States [19] but examination of *Figure 4* shows that out of the total of 830 Registered LEED projects in the UAE, only four schools, two nurseries and one university are LEED certified.

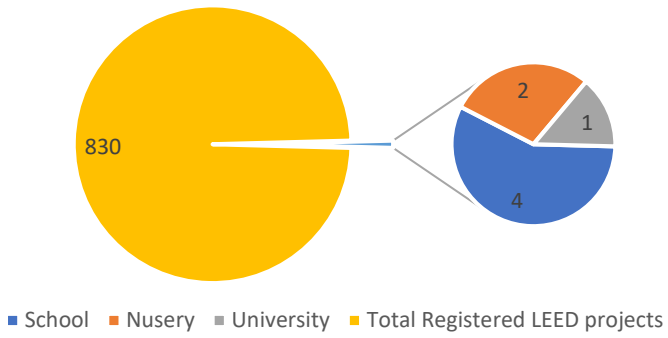


Figure 4 Number of LEED educational institutes in the UAE

As of December 2017, there are no WELL registered school projects in the UAE.

Healthy Environment

As noted, IEQ is adequately addressed in new schools in Abu Dhabi and Dubai as the building codes and regulations ensure that they are built to requisite environmental standards. However, for existing schools, tests in five public schools and three private schools over a period of eight hours found excessive levels of carbon dioxide and volatile organic compounds excessive under the local building codes and regulations. The maximum recoded levels in the schools were 2,326 ppm and 3,131 mg for carbon dioxide and VOC, respectively. [20]. To put these figures in context, maximum acceptable levels under Al Saf'at is 800 ppm and 300 mg/m^3 for carbon dioxide and TVOC, respectively. While further studies with larger sample sizes are necessary, the existing research indicates Indoor Air Quality (IAQ) of existing schools' in the UAE is in critical condition, which can lead to long term respiratory related illness such as bronchitis and asthma. Roundtable participants unanimously believed IEQ performance for existing schools across the UAE to be poor.

A study 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 [32].

Environmental Literacy

The Foundation for Environmental Education's (FEE) international Eco-Schools program and Environment Agency Abu Dhabi's (EAD) Sustainable Schools Initiative focus on environmental education of elementary school students and provide platforms to help students become eco-literate. The scope of both these programs involves the entire school building and involves participation from the students, teachers, parents, administrators and all members of the school community. Currently, there are 75 awarded Eco-Schools and 148 schools involved in the Sustainable Schools Initiative in the UAE.

Another local effort is the '*Water: The Global Passport'* module in elementary schools facilitated by Surge and in partnership with DEWA and Suqia. The program teaches students about their water footprint, virtual water and global water inequities. To date, Surge has reached 2964 students across 19 schools across the UAE.

Most recently, a new grading system for schools was launched by the Ras Al Khaimah Waste Management Agency (RAKWMA), a subsidiary of the Public Works Department, and the Ras Al Khaimah Education Zone across in October 2017 to encourage students to become advocates for the environment. Under this grading system, Ras Al Khaimah schools will be assessed and graded to measure their commitment to environmentally sustainable practices in the 2017/18 academic year [21].

A key outcome from the State of Our Schools roundtable was the collective agreement that a very limited number of schools, if any, fulfill all three aspects of the definition of a green school in the UAE.

Putting Green Schools in Context: The UAE Stakeholders

In order to realize the Emirates Coalition for Green Schools vision of ensuring that every child in the UAE learns in a green school within this generation, EmiratesGBC seeks to identify the relevant stakeholders in the UAE, their respective objectives and how they can work together to unify them under a common goal.

Government: Education

Figure 5 shows the government authorities responsible for the educational sector in the UAE. The Ministry of Education (MoE) is the federal authority that supervises both public and private schools and handles all stages of education in the UAE including schools, colleges, universities and post-graduation programs. While MoE does not direct the private schools and their curriculum (with the exception of Arabic, social studies and Islamic Studies), they set overall guidelines that the private schools must adhere to.

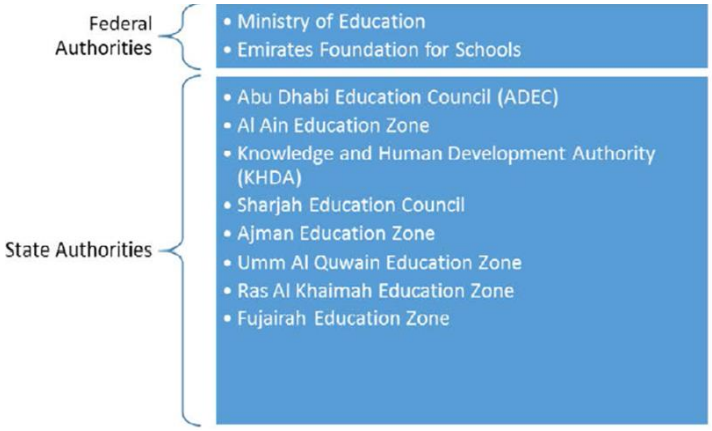


Figure 5 Entities Responsible for Education in the UAE [17].

The Abu Dhabi Education Council (ADEC) is responsible for supervising, regulating and spearheading the development initiatives within the education sector in the Abu Dhabi emirate, including public and private schools [22], while the Knowledge and Human Development Authority (KHDA) has the authority to inspect schools in the emirate and is responsible for the growth and quality of private education in Dubai [22]. Schools in Umm Al Quwain, Sharjah, Ras Al Khaimah, Ajman and Fujairah operate under MoE through local branches or educational zones [22].

For UAE Public Schools: The Emirates Foundation for Schools was established as the federal governing body to manage public schools and has the authority and independence to run all public schools. This includes curriculum approvals of the schools and not the school building itself. The Ministry of Infrastructure Development is the federal authority responsible for development of new construction and maintenance of existing public school buildings along with MoE. Furthermore, the energy data for public

schools is centrally recorded by the Ministry of Energy while the public school energy bills are paid by the Ministry of Finance.

School Inspections: To ensure quality education and support schools' improvement and students' outcomes, the Ministry of Education carries out regular school inspections which is complimented by Abu Dhabi Education Council's (ADEC) Irtiaq'a Program and Knowledge and Human Development Authority's (KHDA) Dubai Schools Inspections Bureau. School inspections are structured around six performance standards, 17 performance indicators and 70 elements and conclude with an overall performance judgement [23].

Among the 70 elements of assessments that refine specific aspects of the indicators, only one element assesses schools on whether they educate the students on environmental awareness and actions [23].

Educational Targets

Providing a world class education system is one of the pillars of the National Agenda in line with Vision 2021 [17]. In order to meet this objective, the Ministry of Education launched a strategic plan for 2017-2021, shown in *Table 1*. Among the targets shown in *Table 1* is the Program for International Student Assessment (PISA), which is a worldwide study by the Organization for Economic Co-operation and Development (OECD) conducted every three years, which tests the performance of fifteen-year-old students on science, reading and mathematics. The UAE has participated in the PISA assessments since 2009 and *Figure 6* shows the PISA results over the subsequent years. Despite the educational reforms to improve education quality in the UAE, there has not been any significant improvement in mathematics and reading scores since 2009 and science scores have actually dropped. In fact, the UAE ranks well below the OECD average results across all three domains [24].

Main 2021 Targets		
1	Average TIMSS Score	Among the top 15 countries
2	Upper Secondary Graduation Rate	98%
3	Enrollment Rate in Preschools (public and private)	95%
4	Average PISA Score	Among the top 20 countries
5	Percentage of Student with High Skills in Arabic, according to National Tests	90%
6	Percentage of Schools with High Quality Teachers	100%
7	Percentage of Schools with Highly Effective School Leadership	100%
8	Enrollment Rate in Foundation Year	0%
9	Expenditure on Research and Development as % of GDP	1.5%

Table 1 Ministry of Education Strategic Plan 2017-2021 [25]

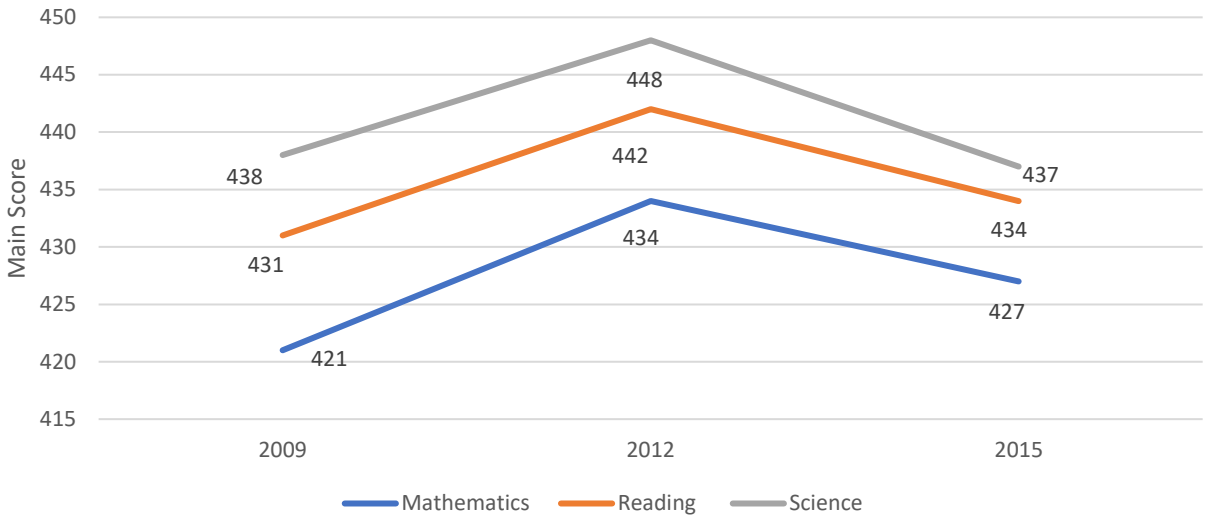


Figure 6 Trends in Students' Skills – PISA 2009, PISA 2012 and PISA 2015 IN THE UAE [26].

A number of large scale studies have shown that increased daylighting, thermal comfort, effective acoustic designs and appropriate classroom aesthetics increase test scores of students [5]. Green schools incorporate all these features with their inherent higher IEQ features and thus can enable students to achieve better results. Furthermore, green schools can also support the other targets as defined by the Ministry of Education's Strategic Plan 2017-2021 such as higher enrolment rates and higher quality teacher attraction and retention [6], [7], [11].

Government: Energy

It is clear from various strategies including UAE Vision 2021, UAE Clean Energy Strategy 2050, Dubai's Demand Side Strategy (DSM) and Abu Dhabi's DSM program Tarsheed, that the UAE has put concerted focus on energy, water and waste management as well as clean energy generation. Some of these targets are summarized in *Figure 7* and show UAE's commitment to becoming a leader in sustainability.

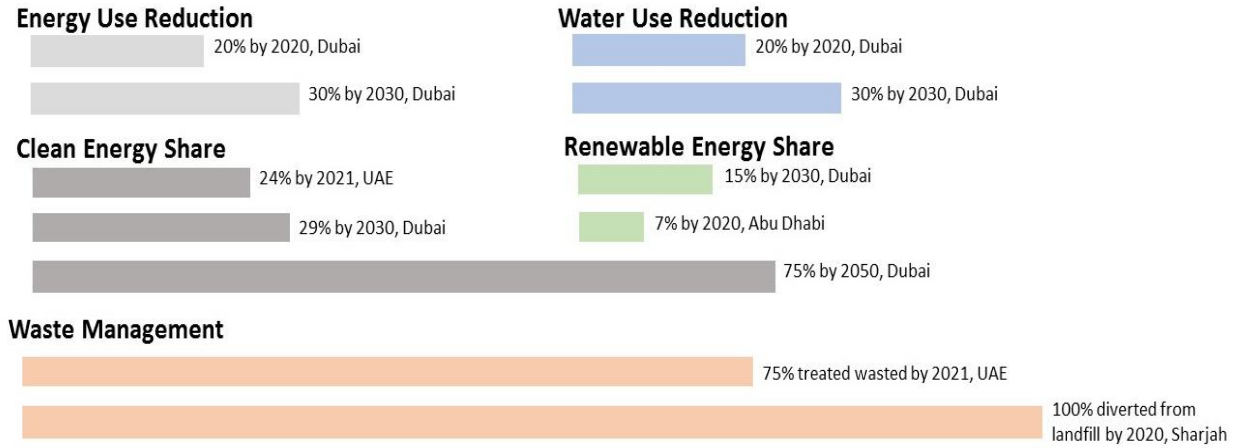


Figure 7 Energy, Water and Waste Targets in the UAE [28].

Green schools can support in achieving the targets shown in *Figure 7*. Given that there are over 1300 schools operating in the UAE and each school has at least one or more operational buildings, transitioning the large number of the school building stock to green schools would allow the UAE to make considerable progress in reaching local targets and the COP 21 commitment of limiting global warming to less than 2°C. Further, by implementing a nationwide green school program, there is a significant ancillary benefit of educating tomorrow's leaders in the principles of green buildings.

Etihad Energy Services Company had stated that out of the 1,898 government buildings retrofitted in 2016 [31] as part of Dubai's DSM Strategy, no schools had been retrofitted under the program thus far.

DSCE Energy Auditing Directive No.1 (issued in March 2015), mandates a walkthrough Energy Audit for Government Buildings with over 1,000 m^2 GFA and therefore, are advised to develop a Retrofit Plan addressing the buildings for which estimated potential savings exceed 20% of electricity and/or water consumption and payback time is shorter than 10 years.

As public schools in Dubai are funded and operated by governmental entities, they are governmental buildings and thus also required to comply to the Energy Auditing Directive. Considering that schools built prior to Estidama and DGBRS have been operational for at least 5 years, the benefit to cost ratio of retrofitting these schools can be high. Additionally, when compared to other building typologies, schools are relatively easier to retrofit as they operate according to school timings and any retrofit work could take place during school breaks.

Schools

It was noted previously that the operation of public schools involves a number of federal governmental stakeholders, with design-and-build, operational and curriculum decisions being made centrally. Private schools have an additional stakeholder group governing the decision making around key green school factors: the owners. The relevant decision-making pathways of the owners, administration and facility management/operators of private schools are dependent on the structure of the given private school organizational and governance structure.

Greenwashing is Awash: In schools across the UAE, teachers who carry the environmental coordinator role are overwhelmed by the vast number of incoming communications from the private sector – all claiming to have the best technology and savings for their school. Without the ability to ascertain credibility, the task to parse through the information is difficult.

Arguably the most captivating element on the topic of green schools is the reality that the most valued stakeholders in the discourse are the students whose lives are shaped by the schools. It is they, along with the guidance of their teachers, who are able to enact the behavioral change required for schools' operations to meet many of the green school criteria.

Every School is Unique: Having the right access to technology, financing and trustworthy consultants have been identified as the required resources for schools to navigate the options and select the best interventions for the needs of their own school.

Private Sector

Many companies in the private sector have Corporate Social Responsibility (CSR) policies that aim to positively contribute to the environment and/or the local or international community. Therefore, they are eager to help educate schools' students on environmental awareness at no cost, as was pointed out during the roundtable. There is potential for the private sector to play a much bigger role where their technical knowledge and capabilities can be crucial for developing greens schools in the UAE. Additionally, schools are receptive to trialing new technologies as and when there is an educational component for students.

Academic

Access to UAE-based green schools research to aid decision making is crucial. Tertiary level academic institutions, schools and the private sector play a key role in ensuring a pipeline of baseline assessments, unbiased technology reviews and best practices becomes more widely available.

Lessons Learned

The vision of the Emirates Coalition for Green Schools is to ensure that every child in the UAE learns in a green school within this generation. As the Coalition launches and looks towards creating an action plan for achieving this vision, the following lessons have been learned:

- Existing data and the roundtable attendees unanimously agree that the vast majority of existing schools in the UAE do not fulfill all aspects of the agreed definition for a green school.
- Given the number of existing schools and identified areas for retrofit improvements, greening schools in the UAE is an optimal conduit for achieving national agenda targets:
    - Green schools can help reach the UAE's educational targets for 2021 by providing a better learning environment for students.
    - Green schools can aid in achieving national and Emirates-level energy, water and waste reduction targets.
- A cross-sectoral and multidisciplinary platform is necessary to improve the level of sustainability in UAE's schools; private-public partnerships can pave the way for all schools in the UAE to become green schools. Key stakeholder insights include:
    - The private sector needs a platform through which they can approach schools to initiate the transformation into green schools.
    - The academic sector is needed to provide UAE-specific research on schools to identify better baseline readings on the state of environmental performance and effectiveness of technology and solutions.
    - Schools in the UAE want to become green schools. They understand and appreciate the potential impacts green schools can have on their staff and students but need trusted guidance on actions needed and access to financing to make that change happen.
    - In order for positive change to be possible, all stakeholders involved must join the discourse. Without the buy in of key governmental bodies, it is not possible to achieve the desired change.

Conclusions

New Schools

According to Oxford Business Group, Dubai will require 53 new schools by 2020 and Abu Dhabi will require 44 new schools [29]. While the emirates of Dubai and Abu Dhabi ensure that resource efficiency and the IEQ in these schools are adequately built to standard through mandatory regulations, concern lies with other emirates in the UAE which do not have green building standards.

Further, it is important to measure the performance of new schools to verify that they achieve the energy, water and IEQ performance requirements set out by the regulations. In this regard, operation and maintenance practices are crucial.

Existing Schools

Considerable work is required in transforming existing schools in the UAE into green schools due to their relatively large number. While retrofitting schools can drive UAE's local and international targets for energy, water and waste, the process should also place education of students at its core. Education is the primary role of schools and therefore students should be aware of the benefits that the green school is providing them. This can be done either by using the building itself as a passive tool (using signage and/or features of the building) or as an active tool (using practical work such measuring solar power generation and changes in efficiency as a result of dust) for education. It was noted during the roundtable that the best way to persuade school administration into becoming green is by highlighting the educational benefits that green schools offer to students and parents [30].

It is vital to involve stakeholders from public school sector as their involvement and subsequent actions can transform almost half the number of schools in the UAE into greens schools.

The private schools in the UAE are managed autonomously, which presents a challenge to individually engage with each administration team and encourage retrofitting of schools. However, the Ministry of Education uniformly oversees the quality of educational standards. To this extent, the KHDA and ADEC perform school inspections and are graded to ensure continual improvement in the schools' performance and quality. Therein exists an opportunity, where the scope of the inspections can be expanded to encourage schools' environmental performance. Given the average student to private school ratio of 1371:1, this inspection-based incentive towards greening schools can have significant impact on educating future generations and providing the benefits to the maximum number of students.

It is also important to address environmental literacy through implementation of existing programs such as the Sustainable Schools Initiative or Eco-Schools for all schools so that students are educated on environmental awareness and can serve as future advocates for sustainability.

The Emirates Coalition for Green Schools is an important step for not only promoting the sustainability of school buildings in the UAE but also for improving the learning environment for future generations to come. The Emirates Green Building Council recognizes the work that has already been initiated by various entities such as EAD, EWS-WWF, Surge, FEE among others that promote eco-literacy in UAE schools, all important and integral to the vision of the Emirates Coalition. It is hoped that following this white paper and the Coalition's first roundtable, further collaborative partnerships between schools, the private sector and government can help stimulate our schools in the UAE becoming green schools.

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