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SINGAPORE GREEN BUILDING COUNCIL

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Pushing the Envelope

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SG GREEN

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MESSAGE FROM THE EDITORIAL TEAM

Even with the multitude of geopolitical events happening around the globe, the issue of climate change still remains clear and present. Extreme weather phenomena have already exacted heavy tolls on several countries even in the opening month of 2020, which thankfully have some respite for the time being.

Very clearly, we need to double down on efforts to curb the ramifications of climate change, to preserve the planet for future generations. Otherwise, we will end up with a planet with an irreparable climate.

The built environment industry is in a prime position to mitigate climate change through the design and construction of more sustainable and efficient buildings as well as infrastructure assets. The shift to use building materials with low embodied carbon emissions must also be accelerated. Essentially, the industry must continue to push the envelope of built environment sustainability, creating greener and healthier buildings for everyone to live, work and play in.

In the 10th issue of SG Green, we shine the spotlight on key built environment topics as well as trailblazing building projects, including the new SGBC Office. Designed and renovated with an emphasis on sustainability and wellbeing, the SGBC Office is inspired by nature and powered by collaboration to create a park-like ambience and a base from which SGBC's programmes and initiatives will be driven. With the new office, SGBC is poised to lead industry transformation by example.

Our institutes of higher learning have also been leading the way in designing and constructing green buildings as educational implements. The National University of Singapore School of Design & Environment 4 (NUS SDE4) is a net-zero pedagogical instrument while Republic Polytechnic's Sustainable Built Environment Laboratory (SBEL) is set to help advance sustainability research. There is no better way to learn about green building than from within one.

We hope you enjoy this issue of the magazine, perhaps the articles contained within will give you some keen insight on how to *push the envelope*.

Yours Sincerely,
SG Green Editorial Team


SINGAPORE
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INSPIRED BY NATURE, POWERED BY COLLABORATION

Leading industry transformation by example, the new base of the Singapore Green Building Council exemplifies a green and healthy workplace

The Singapore Green Building Council (SGBC) began life in 2009 with only a handful of full-time Secretariat staff seconded from the Building and Construction Authority (BCA). As industry support for the Council grew, the Secretariat expanded along with larger office premises correspondingly required for the Council to effectively perform its duties. From a mandate to certify green building products during its inception to now covering the entire green building ecosystem including managing Singapore's pool of Green Mark Accredited Professionals (GMAP) and the co-assessment of Green Mark building projects with BCA, SGBC has come full circle a decade on.

With the increased emphasis placed on climate change and global warming as extreme weather phenomena continue to make their presence felt across the globe, the built environment has been increasingly thrust into the limelight. Buildings are in a prime position to mitigate climate change and the Construction Industry Transformation Map released in 2017 specifically spells out green building as a key pillar of industry transformation. SGBC, now armed with a decade of actionable green building knowledge and expertise gleaned from both Singapore and the globe as well as the steadfast support of the construction industry, is primed to lead the way in sustainability for the next decade and beyond.

WALKING THE TALK

As the voice for green building in Singapore, SGBC's new office premises must encapsulate green building design principles in both its design and fitout. It must also be designed for the health and wellbeing of the Secretariat, creating a cohesive and productive base to run the Council's growing stable of activities, initiatives and programmes.

Intended to be SGBC's permanent base of operations for the foreseeable future, a user experience exercise was conducted with the SGBC Secretariat. Facilitated by students from the Nanyang Polytechnic (a SGBC Founding Member) School of Design as part of an industry experience programme, the exercise gleaned interesting insights and achieved consensus that the office design should draw inspiration from nature.

SGBC Member CIAP Architects Pte Ltd, having worked on successful green healthcare and commercial developments, was entrusted to design and manage the fitout of this green, healthy and nature-inspired workplace for SGBC. Tapping on in-house technical expertise, SGBC Secretariat staff also provided input and support for the office's environmentally sustainable design as well as mechanical and electrical engineering requirements.

While guided by the Building and Construction Authority (BCA) Green Mark for Healthier Workplaces certification, the SGBC Office also referenced the World Green Building Council's (WorldGBC) Better Places For People project. Through in-depth research and technical studies, a green and healthy office is co-related with these seven features:

1. **Biophilia & Views**
2. **Good Lighting**
3. **Noise & Acoustics**
4. **Thermal Comfort**
5. **Interior Layout & Active Design**
6. **Indoor Air Quality**
7. **Location & Access to Amenities**

Through its design and fitout, the SGBC Office encapsulates all seven features of a green and healthy office that pushes the envelope of environmental sustainability.

A NATURE-INSPIRED GREEN & HEALTHY WORKPLACE

The SGBC office draws heavily from Mother Nature for design inspiration, to reflect SGBC's key role as a champion of green building and sustainability in the built environment. The design strives to create the ambience of a park within the office space, to encourage occupant connectivity to the natural environment through direct and indirect association with nature.

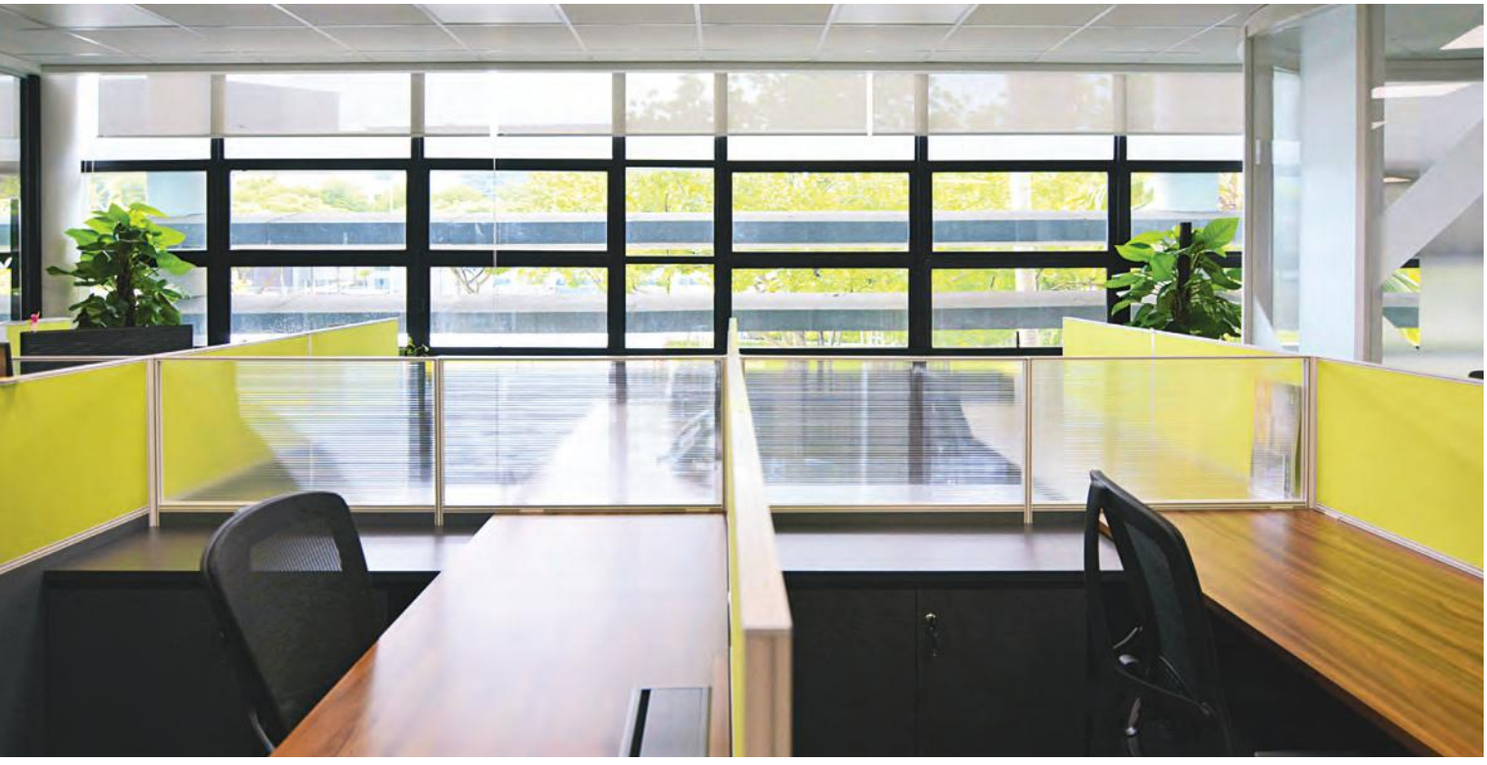
1 Biophilia & Views

Incorporating nature into the built environment has proven to reduce stress and enhance cognitive function, which can lead to increased productivity, reduced turnover and lowered absenteeism rates. Sited on the 2nd floor of the BCA Braddell Campus, the expansive window glazing along the perimeter of the office affords ample views out to tree canopies and exterior greenery. Nature also finds its way indoors in the form of tall potted plants and a green wall composed of preserved moss.

Biomimetic carpet tiles from Interface's Human Nature and Human Connections collections with GlasBac backing system (SGBP ✓✓✓✓) extensively cover the floors of the office space, mimicking the look of cobblestones, pebbles, stepping stones and grass, while Interface's Level Set Luxury Vinyl Tiles (SGBP ✓✓✓✓) simulate weathered outdoor decking. Furthering the office-in-a-park concept, timber-look high pressure laminates provided by Lam Chuan Import-Export (SGBP ✓✓✓✓) form 'tree trunk' wall panelling motifs throughout the office, to create the perception of being surrounded by trees in the workplace.

Interior furnishings that are suggestive of natural elements are used throughout the office. These include the white Axiom Cloud and Soundscapes Circle mineral fibreboard ceiling panels from Armstrong Singapore, the Pebble stools and replicas of iconic furniture classics such as the Tulip coffee tables and Swan lounge chairs.

The office's meeting rooms are named after local trees, with their carpet tiles reflecting the floral colours of the Angsana, Flame and Tembusu trees respectively. The gazebo-like discussion pods further add to the office's park-like ambience, with the pods named after tropical flowers (Jasmine and Orchid) and fitted with flower-inspired feature pendant lights.



2 Good Lighting

The SGBC Office embraces daylighting to enhance the health and wellbeing of its occupants, which has been proven to support the circadian rhythm (body clock) of office occupants and help improve concentration. The extensive high window glazing at the double volume main workspace was a challenge, turned into an opportunity. While it allowed for generous daylighting and views out to nature, glare from the intense evening sun rays could be overly harsh and adversely impact the occupants' visual comfort, if left untreated.

A glare control design strategy was devised, comprising a combination of light shelves, translucent/patterned glass film and vertical fins to carefully filter and manage the sunlight penetrating the glazing envelope, while still permitting views to the exterior. This in turn results in a softer, more diffused, and overall more pleasant lighting quality in the workspace, while the sunshade elements themselves add further visual interest to the space. The use of light colours and matte finishes, especially above the desk plane, further ensures a visually soothing environment. Operable window roller shades (mostly reused from the previous office tenant) help facilitate individual user control over their immediate work environment.

The workstations with partitions lower than 1.2 metres in height also help create an open office layout to facilitate daylight propagation. Translucent workstation partitions further encourage daylight penetration, while affording some sense of privacy to each workstation occupant. These workstations are from Innoplan's i3 Workstation (SGBP ✓✓) range. Additionally, AGC Lacobel (SGBP ✓✓) back-painted glazing, and AGC MNGE Mirox (SGBP ✓✓) grey tinted mirrors by AGC Asia Pacific Pte Ltd help reflect daylight deeper into the work spaces.

High performance Prestige PR60 solar film by 3M (SGBP ✓✓) with good visual light transmission properties, replaces the existing dark tinted glass film on the windows to help mitigate unwanted heat gain through the glazing, while producing a brighter and more cheerful workplace. Backend and ancillary facilities such as stores, server and printing rooms (enclosed in SGBP ✓✓✓✓ USG Boral Sheetrock® StandardCORE plasterboard) are located away from the office windows to keep the work spaces open to daylighting.

Artificial lighting supplement the generous daylighting to achieve comfortable illumination levels in compliance with Singapore standards. A minimum colour rendering index of 80 for all lamps ensures good colour perception throughout. A section of the office reuses circadian lighting from the previous office, with lighting temperature programmed to emulate the time of day. Artificial lighting along the office perimeter is linked to daylight sensors by Lutron to allow electrical energy savings when daylighting alone is sufficient. Further energy savings are achieved with Lutron occupancy/vacancy sensors that turn on or off lights as needed.

Workspace with ample daylighting with effective glare control strategy, comprising light shelves, vertical fins and patterned glass film, reducing the need for artificial lighting and improving occupants' sense of wellbeing.

3 Noise & Acoustics

A noisy office environment is undoubtedly detrimental to productivity, with sounds from both internal and external sources leading to staff distraction and dissatisfaction. Research has shown that staff performance can fall as much as 66 percent as a result from an aurally distracting workplace environment.

The SGBC Office is zoned into several areas for different activities, with the server room and printing facilities located a distance away from the main workspace. Within the main workspace, Discussion Pods and Phone Pods help contain vocal noise, while sound absorbing dividers at workstations, acoustic wall panels at the Phone Pods, and Armstrong Optra/ Ultima mineral fibre ceiling boards (SGBP ✓✓✓) help attenuate sound reverberation, to create an overall quieter and more conducive work environment. The glazed enclosures of these pods still allow access to daylight and maintain a visual connection to the rest of the office space as well as to the exterior greenery.

4 Thermal Comfort

It is not uncommon for staff members to feel differently about their thermal comfort: one occupant's cold climate might be too warm for another. Research has shown a 6 percent dip in staff performance when the office is too warm and 4 percent if it is too cold. Care must therefore be taken to achieve the thermal sweet spot.

The SGBC Office's air-conditioning (set at 24°C) is zoned according to usage and occupancy requirements. It is scheduled to turn on and off at specific times, with provisions for localised override controls to extend air conditioning beyond the set periods. Alternative cooling modes are also available for use after office hours (e.g. auxiliary air-conditioning for selected areas only, and localised cooling through TP-04 bladeless air purifying fans by Dyson). The meeting rooms, pantry and areas with specialty occupancies have controls capable of sensing space use and responding to space demand. Human comfort is ensured with energy savings in mind.

5 Interior Layout & Active Design

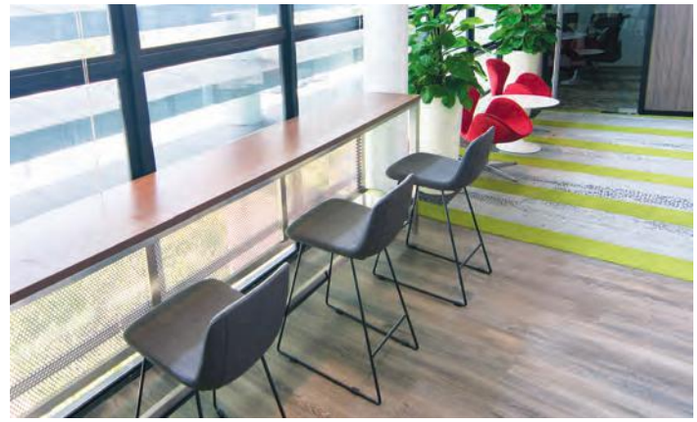
To enhance staff health and productivity, the SGBC Office is designed to provide staff members with a variety of working environments to work from, encouraging physical activity and movement. Staff members may work at their assigned workstations or in the pockets of break-out lounging and activity spaces around the office. Workstations can also be kitted out with standing desk converters, providing adjustable worktop surfaces to offer the option of working standing up. Bar-counter height tables within the Discussion Pods, Phone Pods and pantry also allow the users to convene standing meetings and casual discussions.

To provide for good office ergonomics, SGBC staff reviewed several office chair models and tried each one out before voting on their preferred choices. The eventual chair model selected features a high degree of personal control, being able to adjust almost every aspect of the seat (such as height, elevation and sway) to suit individual preference.

6 Indoor Air Quality

The Indoor Air Quality (IAQ) of a place or space directly impacts occupant health and wellbeing, with factors such as carbon dioxide levels, presence of volatile organic compounds (VOCs), mould and bacteria affecting the air we breathe in. Studies have shown that staff members tend to focus better in green, well-ventilated workplaces with low VOC and carbon dioxide levels.

Almost all of the materials selected for use in the SGBC office are highly-rated products certified by the Singapore Green Building Product (SGBP) certificate scheme, meaning that the materials have been verified to be green and eco-friendly through the necessary documentation, test reports and proven benchmarks. The SGBP criteria also necessitates a low carbon footprint (backed up by the relevant reports) for products seeking the highest possible rating, ensuring that the products that eventually found use in the office have the lowest possible carbon footprint, especially for high impact materials. Even the pantry chairs, although not SGBP-certified, have a green narrative in terms of being fabricated from recycled materials.



The architectural finishes used in the office are all certified for their low-VOC content, and the paints used in the office are not only low VOC, but VOC abatement types in the form of Akzo Nobel's Dulux PureAir (SGBP ✓✓✓✓) interior paints. SGBC Member Big Red Pte Ltd also provided indoor air quality consultancy throughout the renovation process to ensure an atmospherically clean office premises.

7 Location & Access to Amenities

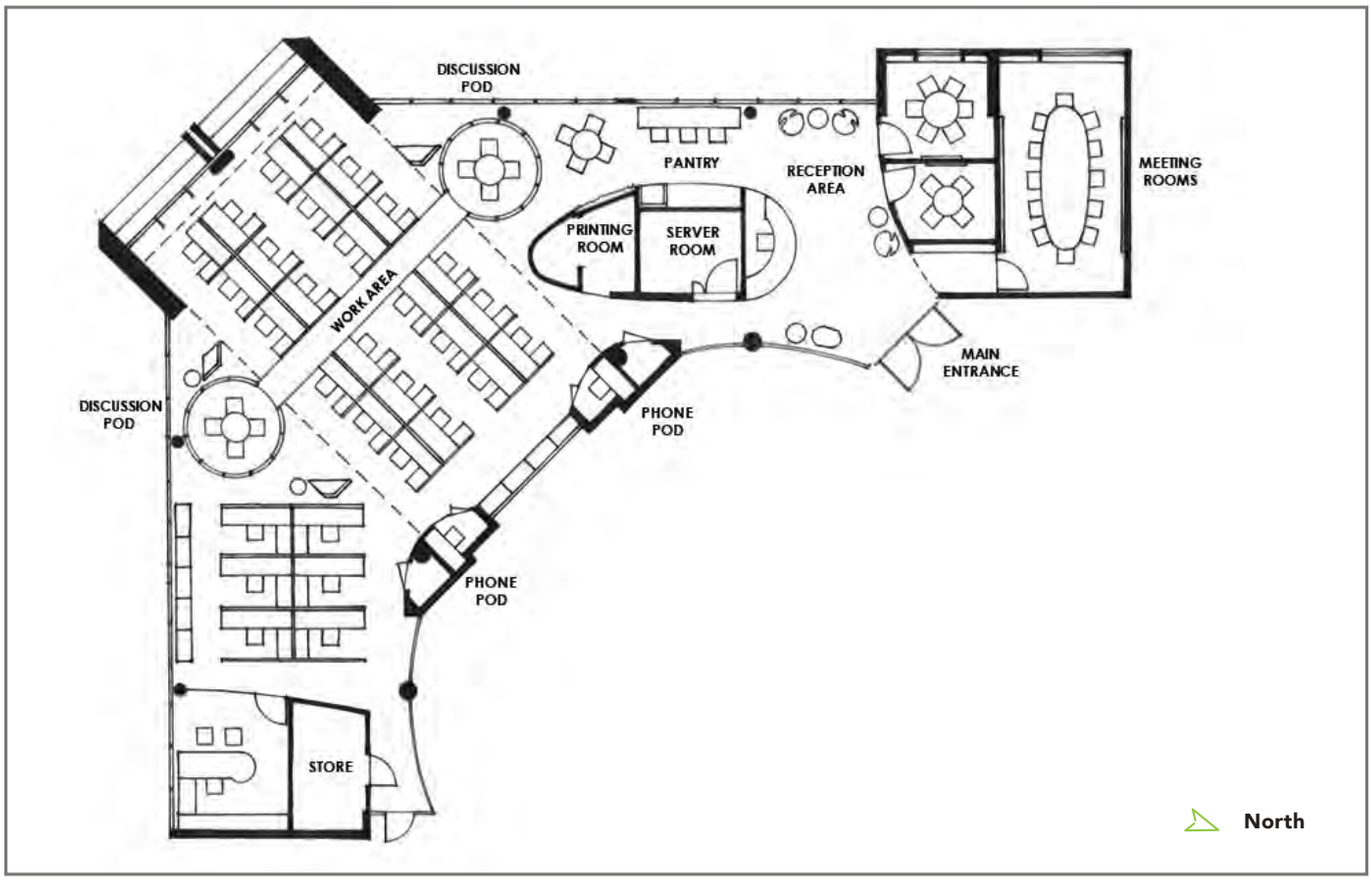
Green and healthy offices have good access to the public transport network, safe bike routes, ample parking and shower facilities, as well as a range of healthy food options. Ancillary services like childcare centres are also crucial considerations for employees.

Sited on the BCA Braddell Campus, the SGBC Office is well served by the public transportation network along Braddell Road leading to the Central Expressway (CTE) located 10 minutes away from Bishan MRT Station (NS17/CC15) and served by multiple public bus services. The Kallang Park Connector is also adjacent to the building, allowing for commutes by bicycle and even jogging as shower facilities are available on campus.

BEYOND GREEN MARK

For its new premises, SGBC is aiming for no less than the highest Green Mark Platinum rating under the BCA Green Mark for Healthier Workplaces certification, and beyond. The maximum lighting power density (LPD) for Platinum certification is 9W/m^2, while the SGBC Office is achieving about 6W/m^2. Air-conditioning indoor dry bulb temperature for Green Mark certification is not to be lower than 23°C, while the SGBC Office is set at 24°C. Additionally, just about everything that one sees, touches or steps on in the SGBC Office is a green product with a robust sustainability narrative. Coupled with green office policies such as a paper recycling programme and mandatory usage of environmentally-preferred stationery, SGBC is truly walking the talk and exemplifying sustainability in the built environment.

"SGBC's role in the industry and built environment ecosystem has greatly expanded in the past 10 years, but we would never have come this far without the support of our Members, partners and the industry," said Dr. Ho Nyok Yong, President of SGBC. ***"The new SGBC Office is a testament to SGBC's collaborative nature, working with like-minded organisations to create a healthy and sustainable space that showcases exemplary green building design. I hope that this new office will inspire the industry to create their own green and healthy places and spaces."***



Project Details

Gross Floor Area: 330 sqm
Design Architect: CIAP Architects Pte Ltd
Contractor: SkillPlan Designer & Builder Pte Ltd

SGBC Office Contributors

- **3M**
- **AGC Asia Pacific Pte Ltd**
- **Akzo Nobel Paints Singapore Pte Ltd**
- **Armstrong Ceiling Solutions**
- **Big Red Pte Ltd**
- **Consis Engineering**
- **Dyson Singapore**
- **Innoplan Technology Pte Ltd**
- **Interface**
- **Lam Chuan Import-Export (Pte) Ltd**
- **Lutron**
- **Nanyang Polytechnic**
- **USG Boral Pte Ltd**

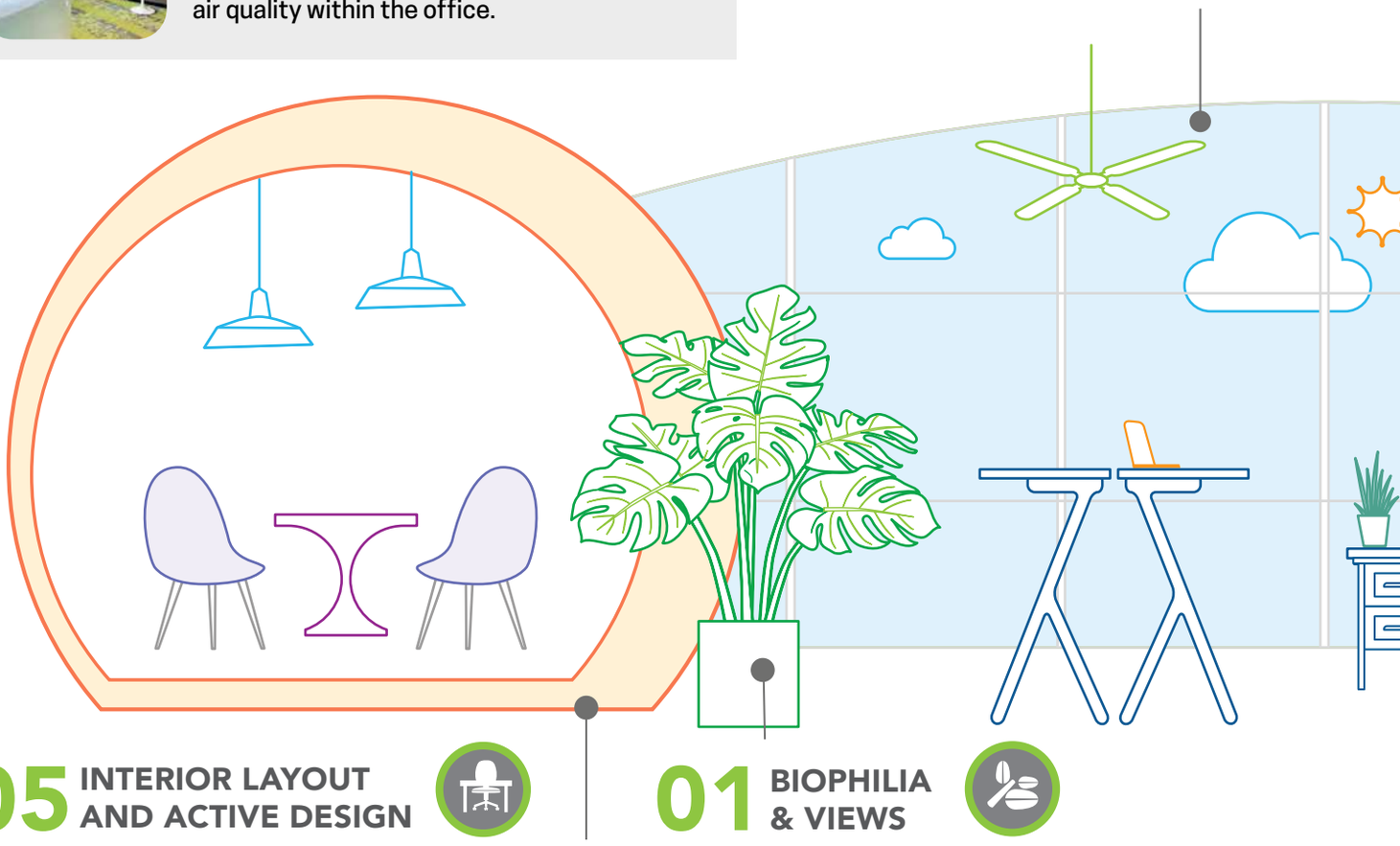
A GREEN & HEALTHY WORKPLACE

The SGBC Office is designed and fitted out with health, wellbeing as well as sustainability in mind. Addressing all 7 features of a green and healthy workplace according to the World Green Building Council's Better Places for People project, SGBC is walking the talk for better workplaces.

06 INDOOR AIR QUALITY (IAQ)

The architectural finishes used in the office are all certified for their low-VOC content, with the paints used being of the VOC abatement variety. Indoor air quality checks throughout the renovation process also help ensure good air quality within the office.

101% **WHY?**
increase in cognitive scores for workers in a green, well-ventilated office.



05 INTERIOR LAYOUT AND ACTIVE DESIGN

Pockets of break-out lounging and activity spaces encourage physical activity and movement within the office, while bar-counter height tables at Pantry, Discussion and Phone Pods allow for standing discussions.

WHY?
Flexible workspaces help staff feel more in control of their workload and engenders loyalty.

01 BIOPHILIA & VIEWS

Biomimetic furnishings and materials in the office, resembling grass, moss, cobblestone, stepping stones, clouds, flowers and tree trunks, are used throughout the office. Expansive glazed windows allow for ample views to the outdoor tree canopies and greenery.

7-12% **WHY?**
improvement in processing time at one office when staff had a view of nature.

02 GOOD LIGHTING

High window glazing with light shelves, coupled with glare control devices, allow for generous daylight penetration without unwanted glare. Artificial lighting linked to sensors supplement daylighting to achieve comfortable illumination levels throughout the office, while still achieving energy savings when not needed.

46 minutes

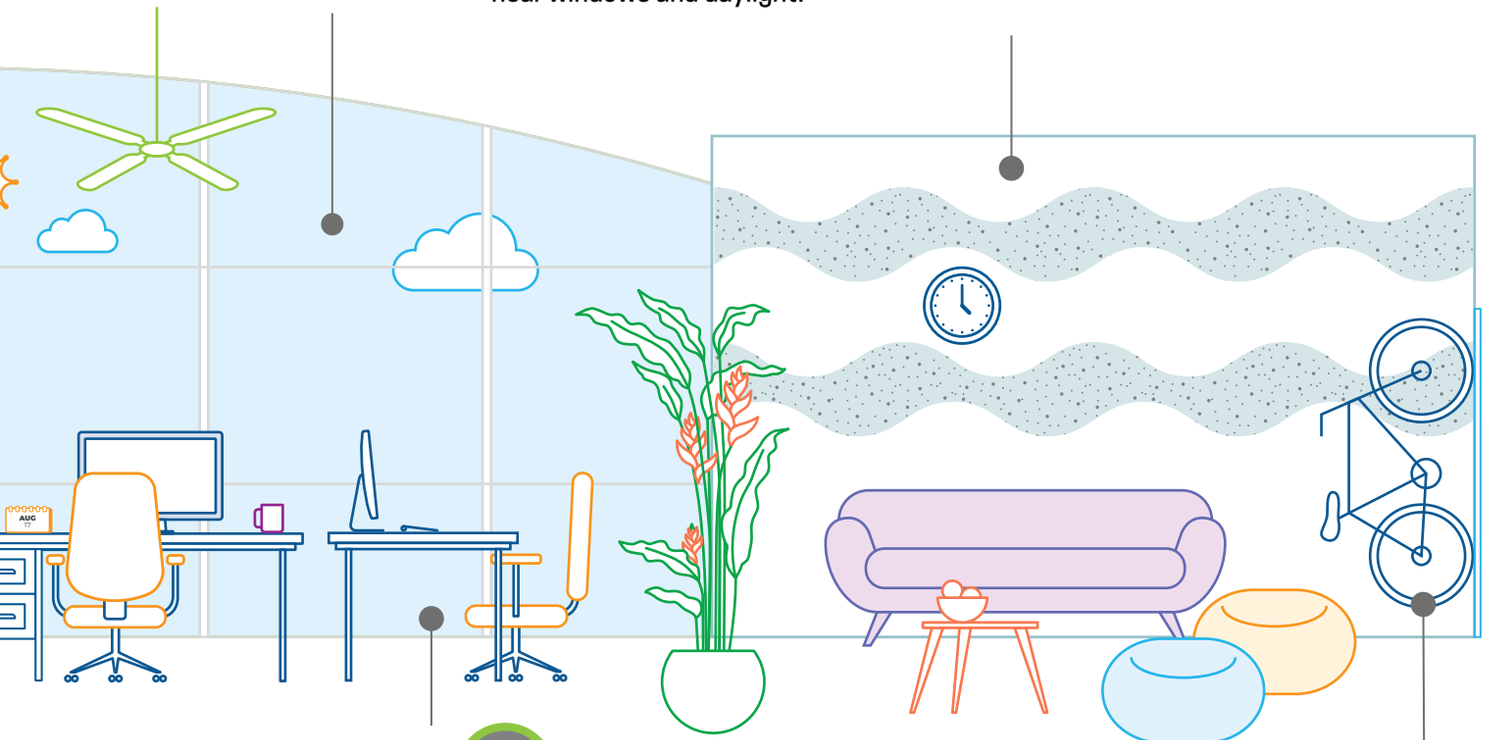
WHY?
more quality sleep at night for occupants with workspaces near windows and daylight.

03 NOISE AND ACOUSTICS

Discussion Pods and Phone Pods help contain vocal noise, while noisy server and printing areas are located away from the main workspace, to ensure an overall quieter and more conducive work environment.

66%

WHY?
fall in staff performance as a result of distracting noise.



04 THERMAL COMFORT

Air-conditioning dry bulb temperature is set at 24°C and is zoned according to usage and occupancy requirements. Meeting rooms, pantry and areas with specialty occupancies have controls capable of sensing space use and responding to space demand.

6%

WHY?
fall in staff performance when offices are too hot and 4% if too cold.

07 LOCATION & ACCESS TO AMENITIES

Well served by the public transportation network and major thoroughfares. An adjacent park connector also allows for commutes by bicycle and even jogging, with shower facilities available.

WHY?
Office occupants often place significant emphasis on how accessible and well-connected their workplaces will be, usually ranking in the top four of their key consideration priorities.


Sustainable
Singapore
GALLERY

SUSTAINABLE SINGAPORE GALLERY: THE GO-TO LEARNING HUB FOR SUSTAINABILITY IN SINGAPORE

With Singapore's shift towards combating climate change, the Sustainable Singapore Gallery at Marina Barrage stands out as the place to learn more about sustainability in Singapore.

Global warming has caused the polar ice caps in Antarctica and Greenland to melt, introducing more water into the ocean. The United Nations (UN) has projected that sea levels will rise by up to one metre globally by the end of the century – just 80 years from now – but scientists' estimates seem to be more dire. Sea levels may rise higher and faster than we expected.

SINGAPORE'S NEWEST WATER SOURCE & CITY FLOOD CONTROL MECHANISM

As a low-lying city state, Singapore is vulnerable to the impacts of climate change such as more intense and frequent heavy rainfall.

One of the key measures that Singapore has implemented to prevent flooding in the city area is the construction of the Marina Barrage. The structure serves many purposes, though most Singaporeans would recognise it as the ideal destination for weekend kite-flying.

The Barrage functions as a flood control mechanism for the entire Central Business District (CBD), especially for low-lying areas such as Boat Quay, Chinatown, Little India, Jalan Besar and Geylang. During heavy rain, a series of nine crest gates at the dam are activated to release excess stormwater into the sea when the tide is low. When the tide is high, seven giant pumps from the pump house can drain excess stormwater into the sea. Individually, each pump can empty an Olympic-sized swimming pool in one minute.

However, as we put measures in place to improve flood resilience, we are also battling other issues that come with a changing climate: an increase in daily mean temperatures, rising sea levels, as well as food and water security.

THE SUSTAINABLE SINGAPORE BLUEPRINT

Since 2009, the nation has always had a plan for sustainable development, known as the Sustainable Singapore Blueprint (SSB). The SSB maps out strategies for Singapore's sustainable development, ensuring that the country remains a highly liveable home for all. These goals encompass multiple areas of sustainable development, such as reducing energy consumption, reducing carbon emission, and increasing green spaces.

In 2015, the Ministry of the Environment and Water Resources (MEWR) and the Ministry of National Development (MND) led a review of the SSB to

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highlight new targets that they would like to achieve by 2030. It was also announced that the government would commit S$1.5 billion to support the rolling out of programmes and initiatives contained in the SSB 2015 by various government agencies.

Singapore later launched the Sustainable Singapore Movement in 2016, a community movement that the government hopes will galvanise ordinary Singaporeans and encourage them to adopt more "greener" practices, such as using public transport, switching to energy-saving devices, adopting a zero-waste lifestyle and opting to purchase sustainable product alternatives. The movement hopes that Singaporeans can cherish the natural and man-made resources we have, consume less but enjoy more, and practise sustainable habits.

THE SUSTAINABLE SINGAPORE GALLERY

In June 2018, the 1,618 square-metre Sustainable Singapore Gallery (SSG) was re-opened to the public after an upgrade to its format and content. Housed at the second level of Marina Barrage, the SSG presents an overview of Singapore's commitment to sustainable development. With its informative and interactive displays, the Gallery is the go-to place for anyone to learn about sustainability in Singapore and how they can play a part in the Sustainable Singapore movement. The SSG hosts an average of 500 visitors every day.

The Gallery is divided into six zones, each providing information about a different aspect of sustainability in Singapore.

In *Red Dot (Zone A)*, visitors can learn more about climate change and its impacts on a small but densely populated Singapore. It also provides information about Singapore's Climate Action Plan, detailing the measures that will be implemented to combat climate change. The interactive games inside this zone will also help visitors learn more about the carbon footprint they are generating and the steps they can take to reduce it.

The second zone, *From The First Drop (Zone B)* tells the Singapore water story and the actions that we have taken to ensure that our water supply is diverse and resilient. Besides learning more about the sources of our water, visitors also have the opportunity to inspect a replica of the night soil bucket and step inside a life-sized replica of a cross section of the Deep Tunnel Sewerage System to better understand how our sewage management has evolved over the years.

A First World Oasis (Zone C) introduces Singapore as a City in a Garden. The zone showcases the city's various green and blue spaces and encourages everyone to play their part to make Singapore a liveable and endearing home. An interactive multi-touch map shows Singapore's extensive green and blue waterways while two rotoscope features provide fun facts on 5 native species of trees and flowers. Finally, a showcase of our Eco Champions highlights the environmental, water, and nature stewards who help make Singapore a clean, green and sustainable city.

As Singapore moves towards using smart technologies, the *City of the Future (Zone D)* shows how the nation is powering our way to remain a vibrant, smart and sustainable city. Besides informative panels about the technologies we are using to conserve energy and generate energy from renewable energy sources, visitors can also take a journey on the stationary bicycles in the zone to experience the features of a car-lite Singapore.

In *The Journey to Zero (Zone E)*, visitors can learn more about the efforts Singapore is taking to become a Zero Waste Nation. Other than insightful information about our waste management strategies, visitors can also see a floor display of Singapore's only landfill, Pulau Semakau, and how much it has already been filled up. The zone showcases a sculpture made from waste materials contributed by pupils of River Valley Primary School, with fun facts about recyclables and good recycling habits.

Finally, *Future Tense (Zone F)* concludes the gallery visit by inviting visitors to think about how they can make a difference by being a part of the Sustainable Singapore Movement. Visitors can stand in a trick-eye style mural for an Instagrammable photo opportunity or type their pledge for a sustainable Singapore and have it projected on a wall. Visitors can also expect to see a wall mural that summarises the goals that the Sustainable Singapore Blueprint aims to achieve by 2030.

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Besides these informative exhibits, the Gallery organises a wide variety of special events and exhibitions over the course of the year, offering many other reasons to visit the Sustainable Singapore Gallery.

In December 2019, the Gallery was transformed into an escape room, inviting players to experience the Gallery in a different way by exploring the Gallery in the dark and finding their way out. In January 2020, the Gallery hosted an Eco-Poetry Night where anyone could get up onstage and share original poems they had written about sustainability or the environment.

A special school programme is also available for students of all ages, ranging from children in kindergartens to students in tertiary institutions. During the school programme, students will be given a guided tour and an interactive game card which they can fill in by exploring the Gallery independently.

TOWARDS A SUSTAINABLE SINGAPORE

The Sustainable Singapore Gallery is but one small part of the whole Sustainable Singapore Movement. With sustainability now at the forefront of the country's agenda, the Gallery hopes that it can inspire individuals to take that first step on their sustainability journey.

For more information about future events, follow the Sustainable Singapore Gallery's Instagram at @ssgallery.sg and Facebook at **https://www.facebook.com/ssgallery.sg**.

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ADVANCING SUSTAINABILITY RESEARCH

Republic Polytechnic is set to equip students with green building knowledge from within an innovative, sustainable facility

Advancing Sustainability Research

Republic Polytechnic (RP), a Founding Member of SGBC, has always been a strong driver of green building and sustainability. Its iconic campus at Woodlands is a standing testament to RP's strong onus on sustainability, with the "Campus in the Park" awarded the BCA Green Mark Platinum award in 2006.

Over the years, RP has worked with other like-minded organisations to advance the sustainability knowledge and expertise of both students and industry alike. One of the learning journey partners for SGBC's Green Schools Initiative (GSI) student outreach programme, RP's School of Engineering (SEG) regularly hosts Green Campus tours for GSI student groups, taking them on a walk through the sprawling green campus and showcasing some of the educational implements used to impart a working knowledge of green building and energy management.

RP SEG has identified green building research as a potential niche area of growth. To equip students with a better understanding of modern green building developments, the Sustainable Built Environment Laboratory (SBEL) was completed in November 2019. Sited on the rooftop of an academic building within the RP campus, the 80 sqm facility provides a conducive space for staff and students from the Diploma in Green Building Energy Management (DGEM) to carry out learning and research activities in green building technologies in an outdoor setting. The lab helps to support industry project collaborations and create research opportunities in the area of Energy Efficient Building Envelope & Façade System, one of the key areas of focus under the Singapore Building Energy Efficiency R&D Roadmap.

The SBEL has a number of innovative features. The main feature is a plug-and-play wall and window system integrated into the east and west facades of the facility. This modular system is able to support performance analysis of a variety of wall and window materials at maximum solar radiation unobstructed. Testing materials can be easily mounted onto one or more of the modular panels to assess their performance based on one or more parameters, with unused panels available on the same side to serve as control groups.

The second feature is the use of mass engineered timber (MET), a construction material for the built environment sector that is seeing growth in adoption, for the north and south facades. Showcasing the utility of MET, it also serves to expose students to the merits of using MET, such as increased construction productivity, design flexibility as well as lower environmental impact.

Lastly, the facility's skylight roof structure is constructed with building integrated photovoltaic (BIPV) panels that generate enough electricity to independently power the equipment within the SBEL. Excess electricity generated is stored in a battery system housed within which can then be used to run testing equipment or research apparatus. The translucent panels also provide overhead shelter but still allow for generous natural daylight penetration, reducing the need for artificial lighting throughout most of the day.

Going forward, RP students will work closely with industry partners on research projects, giving them a hands-on working experience with contemporary green building materials and products. The SBEL will also allow both staff and students to hone their expertise and technical knowledge, advancing sustainability in the built environment.

SHINING A LIGHT ON LIGHT POLLUTION

Singapore is one of the world's most light-polluted areas but good lighting practices are able to help reduce excessive lighting but still keep things sufficiently lit

MISSING THE DARK

"The sun, the moon, and the stars would have disappeared long ago... had they happened to be within reach of predatory human hands" (Havelock Ellis).

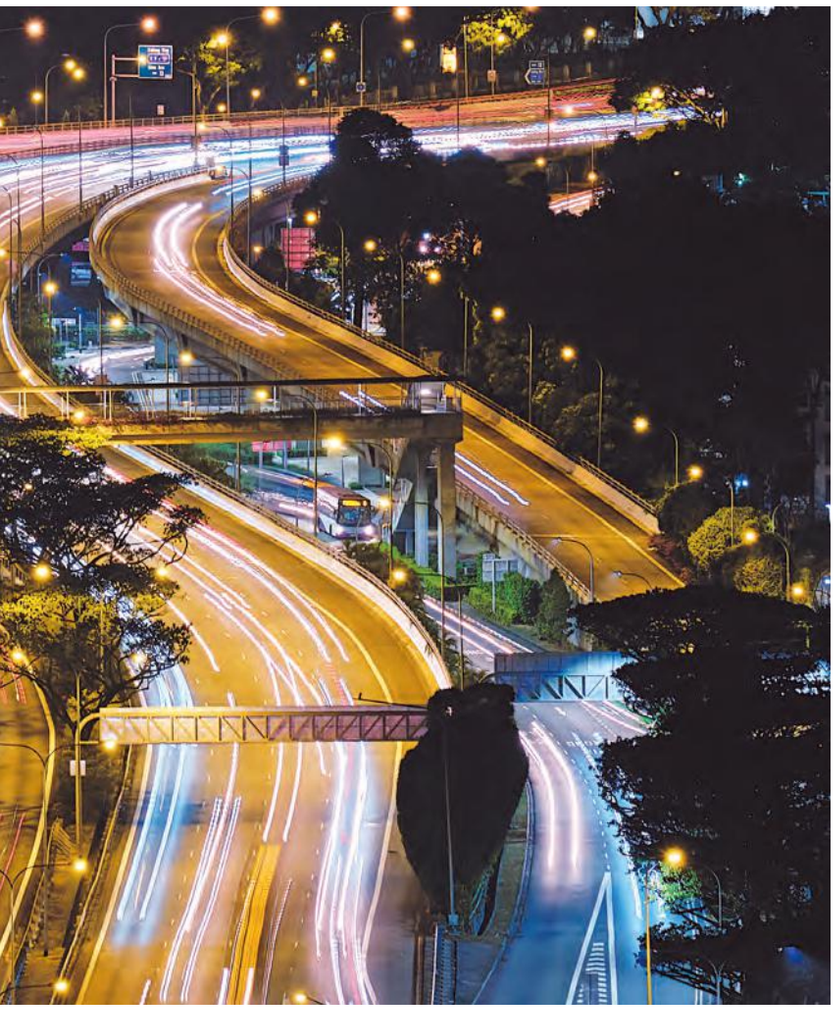
The hour is approaching midnight. Digital billboards are flashing from every corner. Most of the lights are trying to sell something. Illuminated by millions of lightbulbs, one building is brighter than the other. Nights are getting brighter. Where are the stars?

DARK SIDE OF LIGHT

The light bulb is one of the most transformative and greatest inventions of all time. It has changed the way we live. Cutting out the darkness by flicking a switch, the light bulb allows us to extend the day and travel safely in the night. But the lightbulbs come with a dark side. They have stolen the night and cause harm to the natural world. Incredible night transformation serves an important biological function. However, the excess light that we throw into the environment is endangering ecosystems and organisms whose life cycles depend on the darkness. And in a primal sense, by turning night into day, we are losing connection with a night sky. Light is essential, but in many places, light is used beyond necessity. Millions of people across the globe are losing a chance to be touched by cultural heritage and experience a shimmering river of stars. The loss is caused by light pollution.

WHAT IS LIGHT POLLUTION?

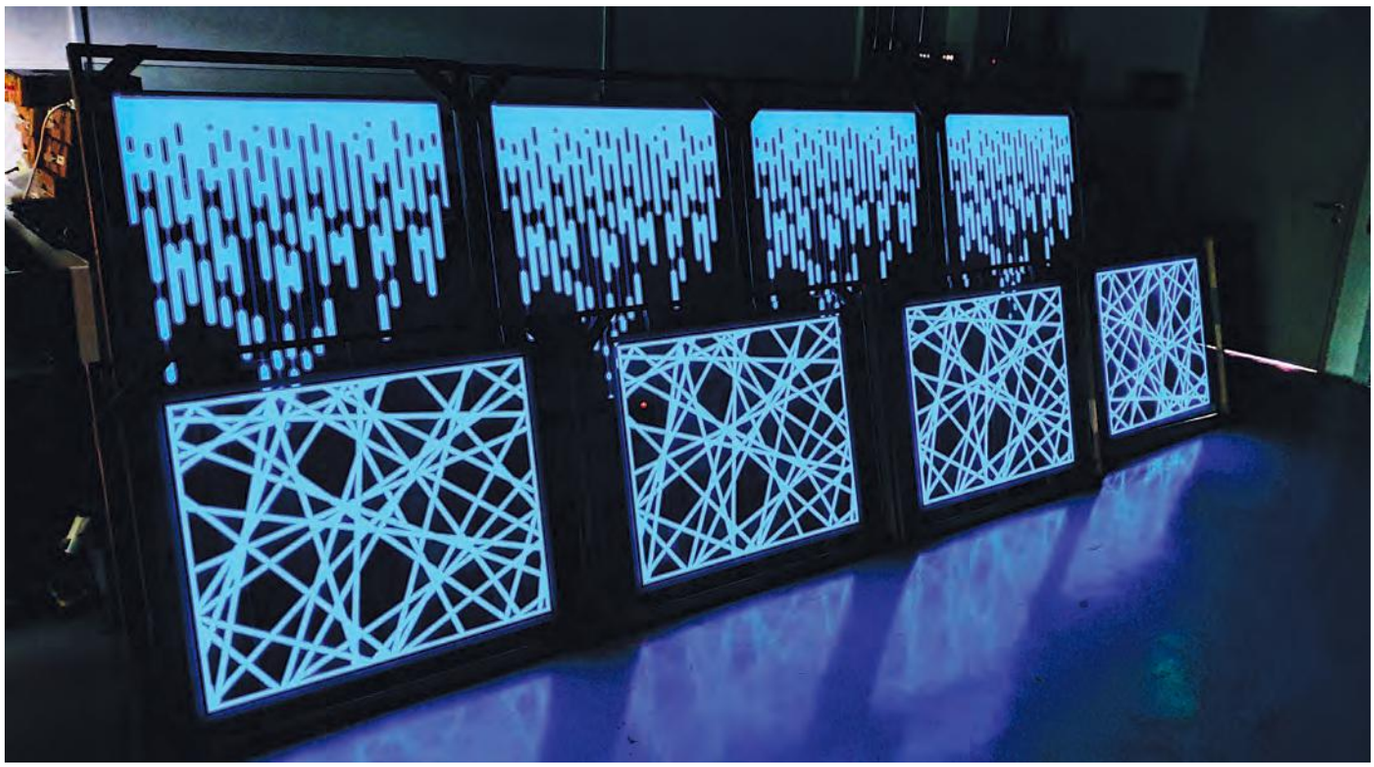
Light pollution, also known as photo pollution, is the excessive use of light produced by humans in the night environment. Its artificial sources



include street lamps, billboards, factories, residential properties and offices. According to the International Dark-Sky Association (IDA), light pollution comes in a variety of forms, including glare, glow, light clutter and light trespass. Glare is defined as an extremely bright light that reduces visual performance. Skyglow is that diffused glow and brightening of the sky; it is those poorly designed lighting systems that cause dome-like orange skyglow. Light clutter is a cluster of excessively bright streetlights that cause confusion and disorientation. Lastly, light trespass is unwanted street lighting that unintentionally illuminates homes and other properties. A light trespass problem occurs when an unshielded streetlight is directed skyward. The fact is that lighting wastefully spills into the night sky instead of illuminating the intended area.

SINGAPORE – THE CITY THAT NEVER SLEEPS

Despite the growth rate of 6 percent each year, the problem of light pollution is getting very little attention. Today, more than one-third of humanity live under the skyglow and can no longer see the Milky Way. According to research findings, Singapore has the highest level of light pollution in the world. Over the past decades of rapid economic growth, the use of artificial lighting has dramatically increased and the glare of lights drowns out the brightest stars. The younger generation might never get a chance to be bathed in the beautiful mystery of the night sky. However, the problem of light pollution is beyond stargazing. The excessive light at night is unnecessary and generates heat that pose severe climate challenges. As Singapore is striving to become an environmentally-friendly hub at the forefront of climate action, it is time to ask: "Does Singapore need so many lights?"



EFFECTS ON HUMAN HEALTH

From starry night to electric light, the invention of the light bulb has changed the human lifestyle by turning night into day. Over the past half century, a series of studies have shown how exposure to artificial lighting at night causes harm to human health. But before understanding the potential consequences, it is important to understand the mechanism of the circadian rhythm, driven by a 24-hour light-dark cycle. Overexposure to lighting at night results in the suppression of melatonin production, metabolic, and other psychological processes. Chronic disruption eventually causes serious health issues. The most common disorder is a circadian rhythm sleep disorder. Millions of shift workers experience forgetfulness, heart disease, diabetes, obesity, and other ailments. In 2007, the World Health Organization (WHO) found that shift work serves as a potential risk for cancer. Lastly, it is important to understand that the "missing sky factor" in urban areas creates a potential risk of psychological disorder, including depression, anxiety, and other illness. It is time to undertake the measures against light pollution and bring back the night sky.

LED PARADOX

People across the globe are moving away from fluorescent and incandescent lamps to cost-saving Light-Emitting Diodes (LED). LEDs are brighter, more durable, and consume lesser energy as compared to traditional light sources. However, the problem of light pollution continues to grow. According to a study by National Geographic, people tend to misuse the energy-saving alternative and over illuminate the environment that have never been lit up before. However, the problem is not with LED technology. In many cases, street lighting is used beyond necessity. Misdirected amount of light that bounces in the atmosphere creates a light cluster and skyglow. The outcome is growing light pollution, an unnecessarily lighted environment and an increase in electricity bills. By cutting down on unnecessary lighting, the world may once again start to see the Milky Way opening up above. Well-designed lighting is essential for living and can help to reduce light pollution, as long as lower energy usage is not used to create additional lighting.

SOLUTION TO LIGHT POLLUTION

Although light pollution is becoming one of the most chronic pollutant situations that the world is facing today, it is one of the most accessible problems to resolve. With a good lighting policy in place that does not require a big budget, undertaking measures to curb light pollution can help to reduce energy wastage and contribute to environmental sustainability.

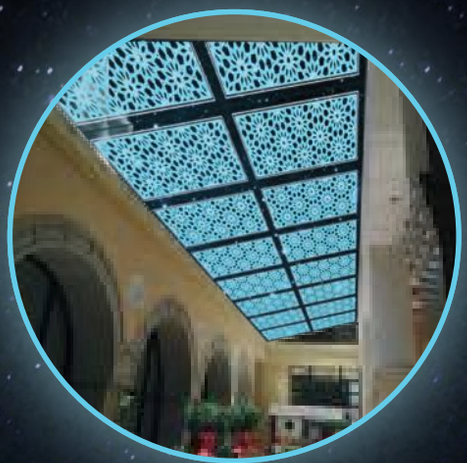
Cutting down on excessive lighting can help to reduce carbon emissions that light bulbs emit into the atmosphere. Here are some practical methods to fight light pollution:

- **Save energy:** Place motion sensors on outdoor lighting systems to reduce illumination level and use light only when needed.
- **Reduce heat:** Use a high-quality light source that produces less heat.
- **Minimise glare:** Use low-glare lighting systems with uniform illumination that allows dimming of the light source.
- **Shield the light to prevent escape:** Proper shielding using the installation of necessary fixtures into the lighting system can help to direct light downward onto its intended target.
- **Save the environment:** Minimise the spill of indoor lighting into the environment, as every little step counts and each step is a victory over light pollution.

According to the IDA, success in reducing light pollution can be achieved not only through understanding the technical elements of lighting but through environmental education programs. It is necessary to raise the awareness on the danger of unnatural light that can help to reduce light pollution and implement good lighting practices across the globe.

By Alina Yanguchina
SG-Glass Pte Ltd


SINGAPORE
GREEN
BUILDING
PRODUCT
SGBC
VERY GOOD
LES
LES IS MORE
SINGAPORE INNOVATED
INTERNATIONALLY PATENTED
GLASS TECHNOLOGY
A LES BRIGHT FUTURE
Uniform Light
Moon Shine Effect
No Heat
Print Light on Glass
No Glare



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Unlike Any Partition.
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Lighted Mirror.
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See the beauty of light printed on mirror.

LIGHT EMITTING SURFACES

An all-in-one glass lighting system that brings light to life with the print technology. LES is the product of SG Glass Pte Ltd, supported by A*Star and developed in joint collaboration with the technology of SG-Tech Pte Ltd. Certified by SGBC (Singapore Green Building Council), LES is high in energy saving and low in carbon emission, therefore can be viewed as a beacon for Green Technology.

LES IS MORE

Light Emitting Surfaces (LES) is the innovative lighting on the glass, the only cold light source in the industry with a uniform diffusion of light that mimics the moonshine effect. Without the limitation of traditional light bulb, LES print technology is capable of even dispersion of light across large surface. With no heat and glare produced, LES allows you to conveniently light up more area with less energy required. Cool ambient luminescence allows to create a harmonious and peaceful environment lighting that does not invade its surrounding.

PAINT LIGHT ON GLASS

LES is the first print lighting technology that captures the light on glass like never before. Cool ambient luminescence allows architects and designers to create a harmonious and peaceful environment that does not invade its surrounding in creative lighting applications such as facade lighting, glass features, designer lamps, signages, billboards and others. A key differentiator for LES is that technology allows to feel no discomfort when staring directly into LES light source that can be viewed evenly at a wider angle and for a longer distance. Throughout the day, LES printed technology allows to reject a heat transfer by providing insulation. In the night time, a display of soft, cool light mimics the glow of the moonshine with minimal energy consumption.

SG-GLASS SG-TECH

www.lightemittingsurface.com les@sgcorp.biz

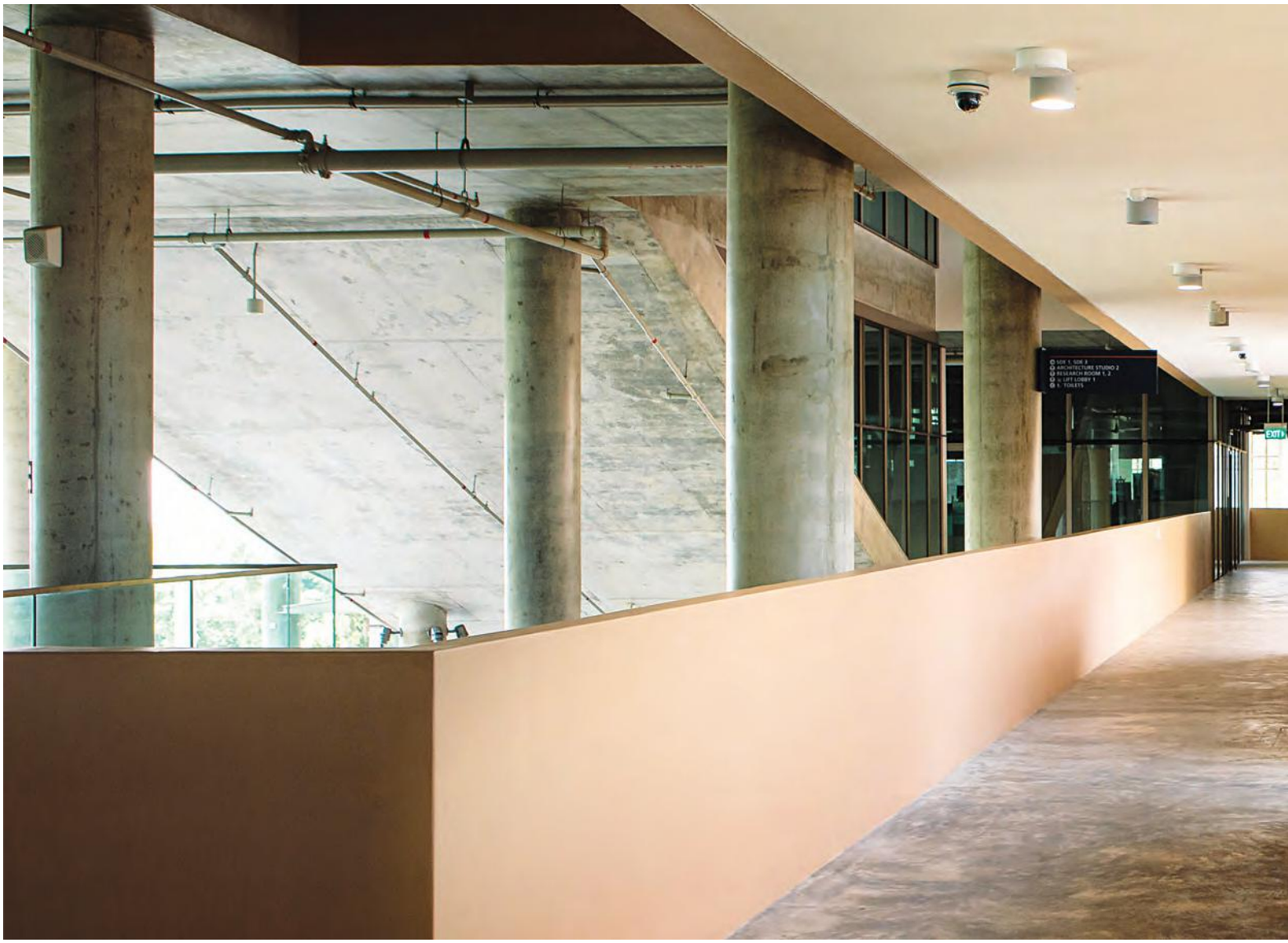
SG Glass is committed to environmental sustainability and actively initiates Go-Green efforts with LES lighting solution. Energy efficiency and environment cohesiveness will continue to be a priority for SG Glass with the introduction of LES surface lighting technology

NUS SDE4 seamlessly ensconces itself within its setting which comprises of mature trees and existing SDE blocks.

© Office of Estate and Development, NUS

NUS SDE4: PUSHING THE ENVELOPE

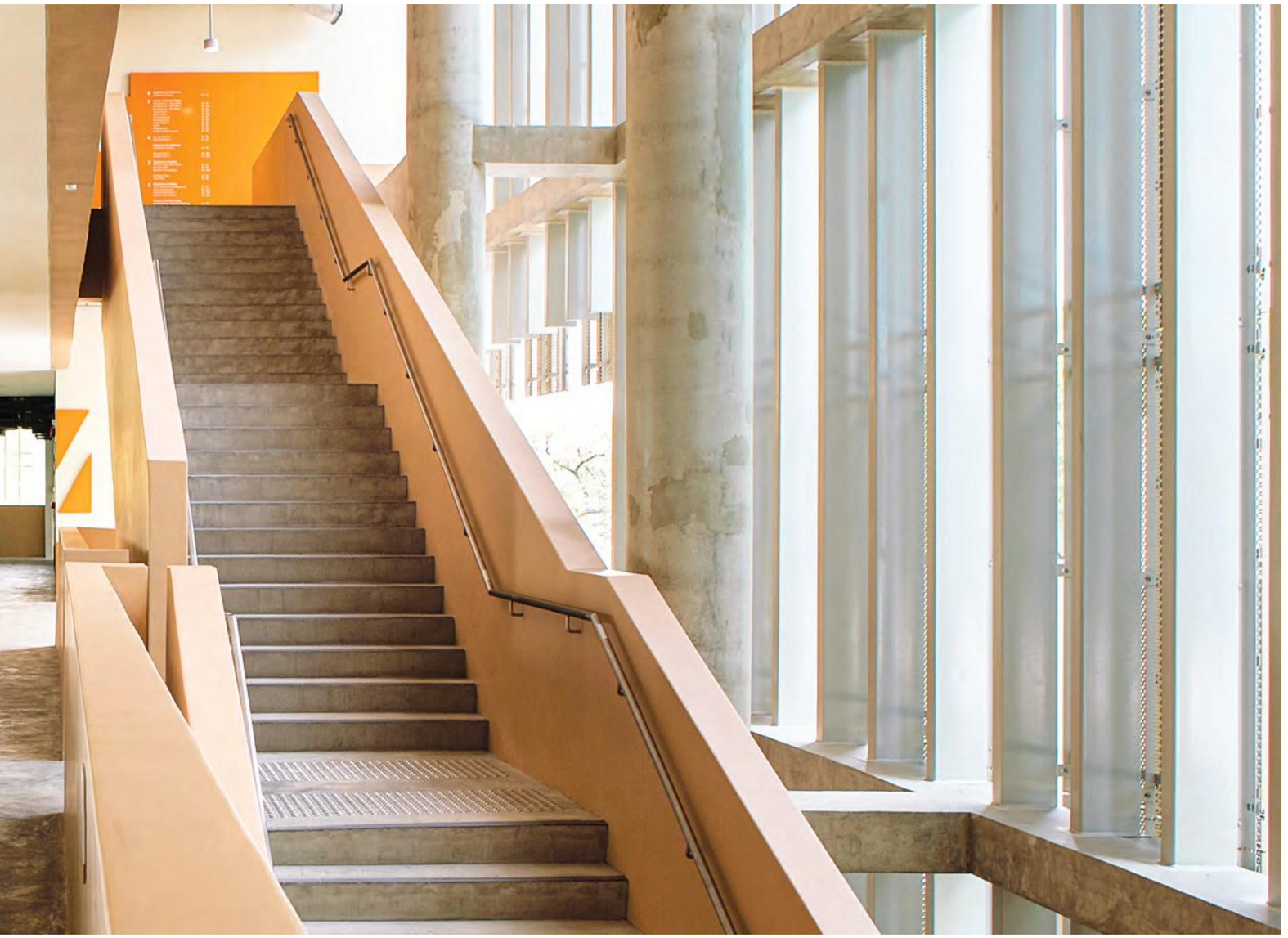
The National University of Singapore's School of Design and Environment 4 (SDE4) is Singapore's First New-Build Net-Zero Energy Building



INTRODUCTION

NUS SDE4 started its journey in 2013, with a clear design brief that was more than a mere list of rooms and space allocations. It was an aspirational and strategic statement of how the School of Design and Environment wished to be perceived. Four key strategies were articulated in the brief: design, energy, process and well-being.

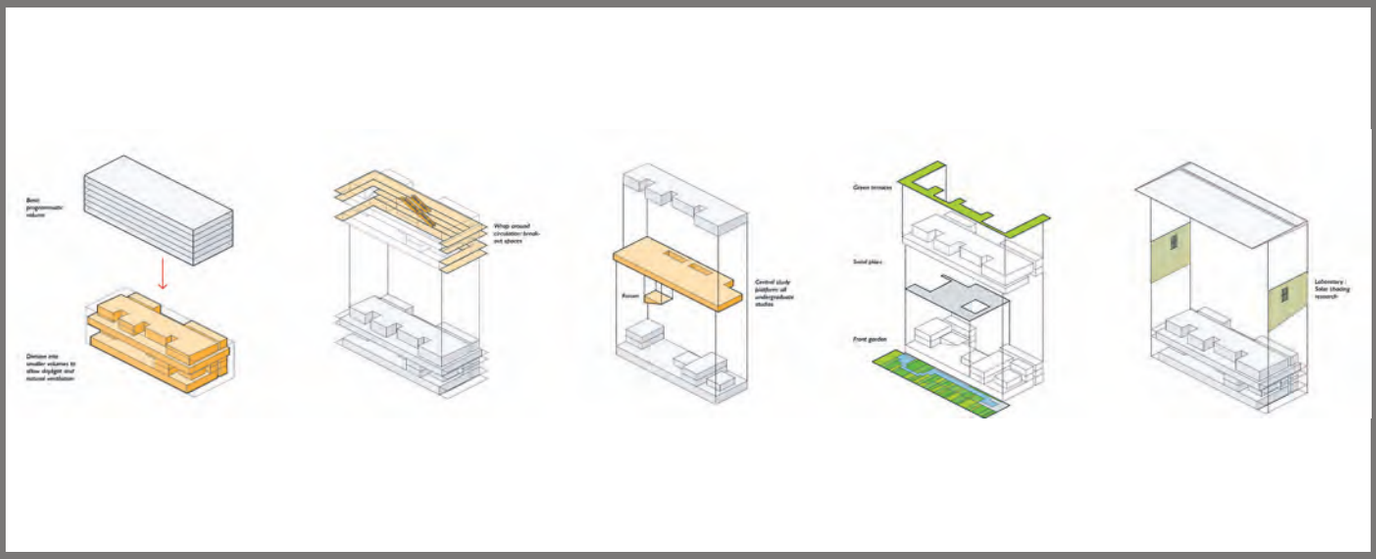
The performance target was perhaps the most demanding of all requirements. The building had to be a Net-Zero Energy Building (NZEB), meaning that the energy demand of the building would have to match its on-site energy production. In addition, SDE4 had to become a pedagogical instrument, facilitating the School's teachings both inside and outside of the classroom. The design brief also looked at formulating strategies to foster embodied wellness with special attention to occupant well-being. Access to daylight, ventilation, views and fresh-air were pre-eminent requirements for the new building. And finally, SDE4 had to create an identity of itself whilst also being a complimentary part of the already established Design & Environment precinct.



CHALLENGES & OPPORTUNITIES

Like any project, SDE4 too had its share of challenges or rather site constraints which became an important driver in developing the design, as well as in managing the construction process.

The main constraint was the site's topography. The site was an existing hillock adjacent to the existing SDE1 block. This presented a challenging terrain to set the building in and manage its proximity to the existing buildings. The other challenge associated with its site was the abundance of existing matured trees on site. The planning of the building's footprint, driveway, and other site features had to negotiate with the requirements ascribed to mature such trees while assimilating the built spaces into this verdant landscape. The conscious effort to conserve these existing trees on site was paramount to both the design and the construction process. In the former stage, the footprint of the building was mindfully located to avoid the trees. This also resulted in a limited building footprint which in-turn presented another challenge of creating ample roof area to support the necessary amount of photo-voltaic (PV) panels to achieve the net-zero energy status. The team did explore the possibility of façade PVs (including BIPV), but these were limiting in their performance yield owing to the inherent sun-path of Singapore.

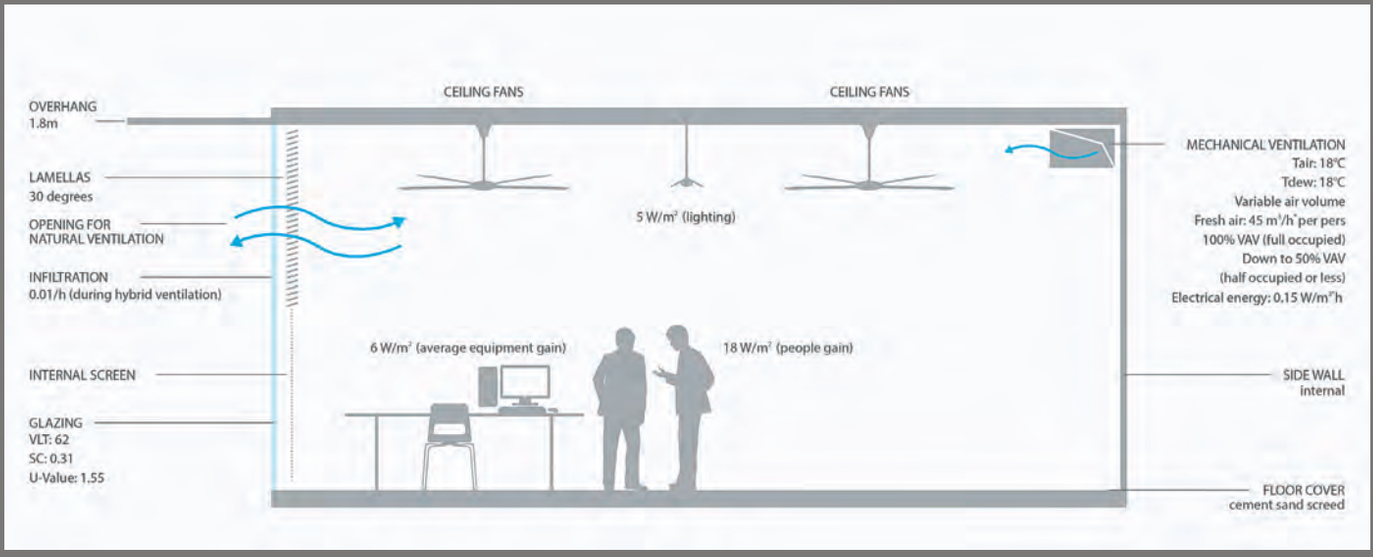


Concept Diagram
© Serie+Multiply Architect Pte Ltd

DESIGN IDEATION: ARCHITECTURE

The new SDE4 design is a model example of construction of a high-performance zero-energy building in a tropical climate. Rather than sealed air-conditioned interiors, the building embraces the potential of plants and landscape as part of the working environment. Solar shading is provided by an over-sailing roof on the south and perforated screens on the east and west facades. On the glazed facade there are large overhangs and high-level louvres. To encourage natural ventilation most glazing is openable. Interiors feature high ceilings with fans.

The building is envisioned as a porous architecture, structured in a juxtaposition of 'platforms and boxes' expressing its programmatic content. The design challenged the notion that an energy efficient building must be very opaque. The massing is broken down to give students and faculty better access to light and natural ventilation. The completed building is therefore seen as incredibly open where the boundary between the outside and the inside spaces is ambiguous. Most of the rooms are designed in a variety of sizes to allow a flexible rearrangement of layout for exhibitions, school-specific installations and future change of use. The design uses the potential of sectional connections across programmatic zones and a circulation strategy to set up unexpected meetings across the student body and faculty. A dramatic central staircase forms the social heart of the educational community: this is the place where students meet and share ideas. Level 3 features a plaza facing out over the landscaped hillside. These spaces are based on the idea that learning takes place both inside the studio but also in the informal social spaces of the building.



The design of the spaces and the facade act in concert with the innovative hybrid cooling system to create spaces that deliver comfort and wellness.
© Transsolar Energietechnik GmbH

DESIGN IDEATION: ENERGY, COMFORT AND WELLNESS

The built environment affects occupants at physiological, psychological, and emotional levels. The design of SDE4 speaks to spatial quality and embodied wellness. But there is a general impression that better quality means using more energy. In the case of SDE4, the net-zero energy target necessitated hybridizing its systems and design to take advantage of the tropical climate. The architectural design of the building creates a porous form which is connected to the outdoors; whilst the innovative hybrid cooling system redefines thermal comfort in the tropic. This symbiosis between the design and the engineering systems creates a synergy wherein the architectural language complements the cooling requirement thus optimising the energy use.

The hybrid cooling system is a single pass system (100 percent fresh air with no return air) that supplies rooms with pre-cooled air, at higher temperature and humidity levels than in a conventional system, and augments this with an elevated air speed by using ceiling fans. This cool circulating air creates a thermal comfort condition that is significantly better than that of overcooled spaces. This idea of using fans was mooted at the very beginning of the design and was part of the winning bid. Fans also invoke a very tropical feel to the architecture.

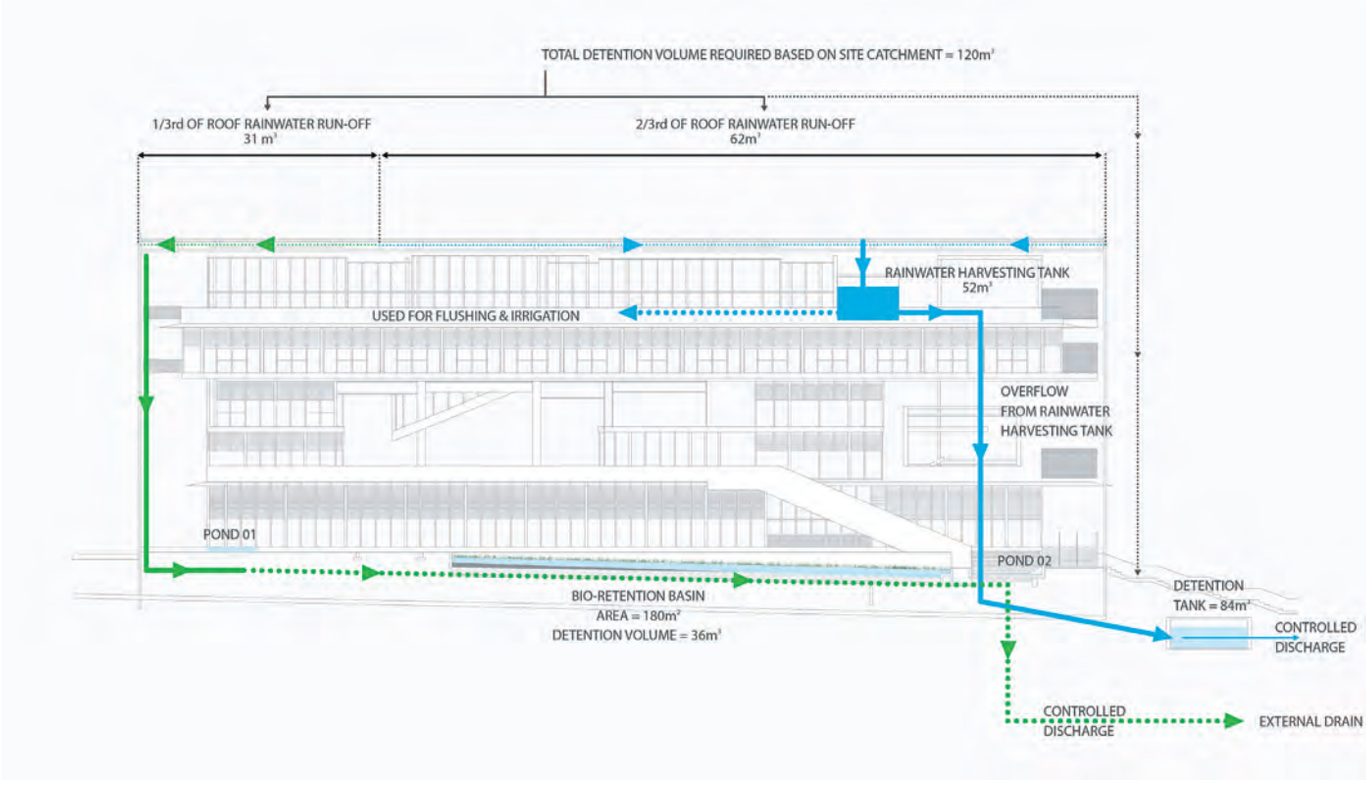
DESIGN IDEATION: BIOPHILIA

SDE4 offers a deeply biophilic experience for its occupants, connecting them with the natural systems and processes; from uninterrupted views to greenery, to the visibility of energy and water systems, and access to daylight and air.

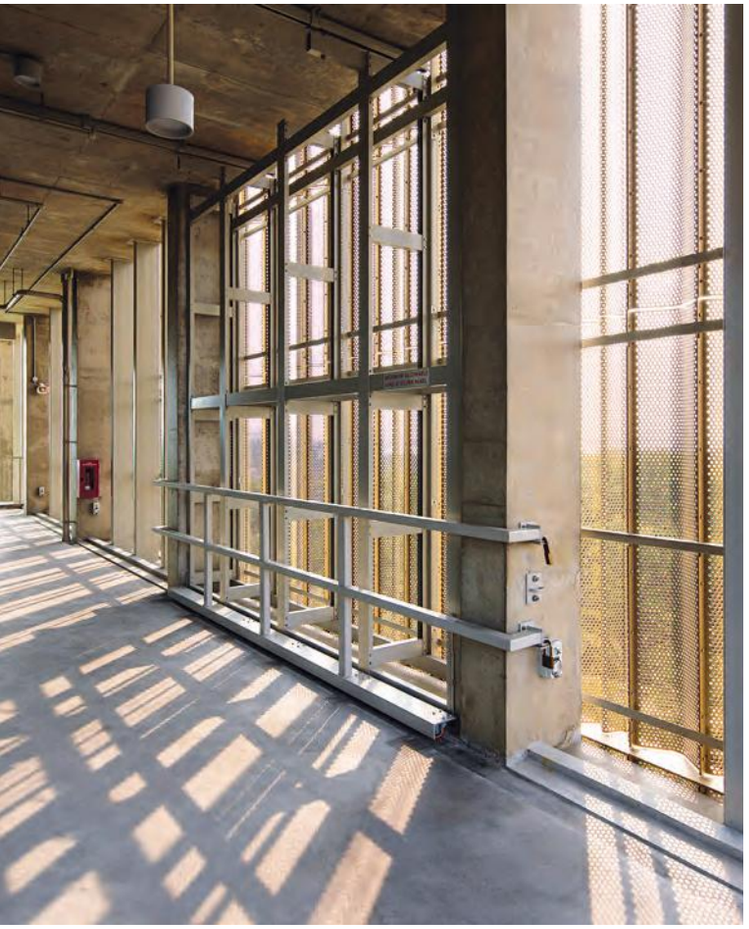
All the spaces look out onto the landscaped space at the south. This comprises of existing trees and a bio-retention basin.
© Office of Estate and Development, NUS

DESIGN IDEATION: WATER

The design of SDE4 has embraced water both as part of the building's story as an educational resource. One third of the roof rainwater run-off is conveyed into a bioretention basin on level two which slows down the stormwater run-off, embellishes the landscape and filters the water through a dense vegetation layer. Water manifests itself mostly after rain, and this is made visible through two ponds located in the upstream and downstream ends of the landscape profile. Two thirds of the roof rainwater run- off are collected in a rainwater harvesting tank placed in the upper level of the building. The harvested water is then used for flushing and irrigation, catering for up to four days of the building's non-potable water demand.



A graphical representation of the water story.
© Surbana Jurong Consultants Pte. Ltd.



CONCLUSION

SDE4 succeeds in making the building systems and elements visible to the users. It enhances the users' engagement and association with them by creating and utilising several living test beds. This is of particular interest as the building is designed to achieve a net-zero energy target and each of these architectural and engineering systems work in tandem to deliver the high-performance targets. The interstitial space between the inner and outer skins on the east and west facade is, for instance, designated for research. In these areas, elements of the façade can be dismantled and replaced with new systems depending on the School's research needs. The building, thus, serves as a canvas for test-bedding and developing relevant green building technology, becoming, in effect, a living laboratory. In doing so, not only does the building envision how students are taught today but also paves the way they might be taught in the future.

"Projects like the NUS SDE4 have to be designed at the design brief stage with the goals and targets firmly held in mind and followed through even after the building's completion and into the operational stage," said Ar. Owen Wee, Lead Consultant for the project. The building has completed the first year of its operation. Subjective surveys completed by occupants show high levels of user acceptance of the environmental conditions offered by the building. In doing this, SDE4 speaks to multiple audiences: occupants and users, policy makers and developers. The building has also received the BCA Green Mark Platinum Certification, the Green Mark Super Low Energy (SLE) Award which was conferred to SDE4 as a Net-Zero Energy Institutional Building and the WELL Gold Certification awarded by the International Well Building Institute.

Project Details

Gross Floor Area: 8,588 sqm
Number of Storeys: Six
Lead Consultant: Surbana Jurong Consultants Pte. Ltd.
Design Architect: Serie + Multiply Architects Pte. Ltd.
QP Architect: Surbana Jurong Consultants Pte. Ltd.
M&E Engineer: Surbana Jurong Consultants Pte. Ltd.
C&S Engineer: Surbana Jurong Consultants Pte. Ltd.
Landscape Architect: Surbana Jurong Consultants Pte. Ltd.
Quantity Surveyor: Surbana Jurong Consultants Pte. Ltd.
Energy and Climate Consultant: Transsolar Energietechnik Gmbh

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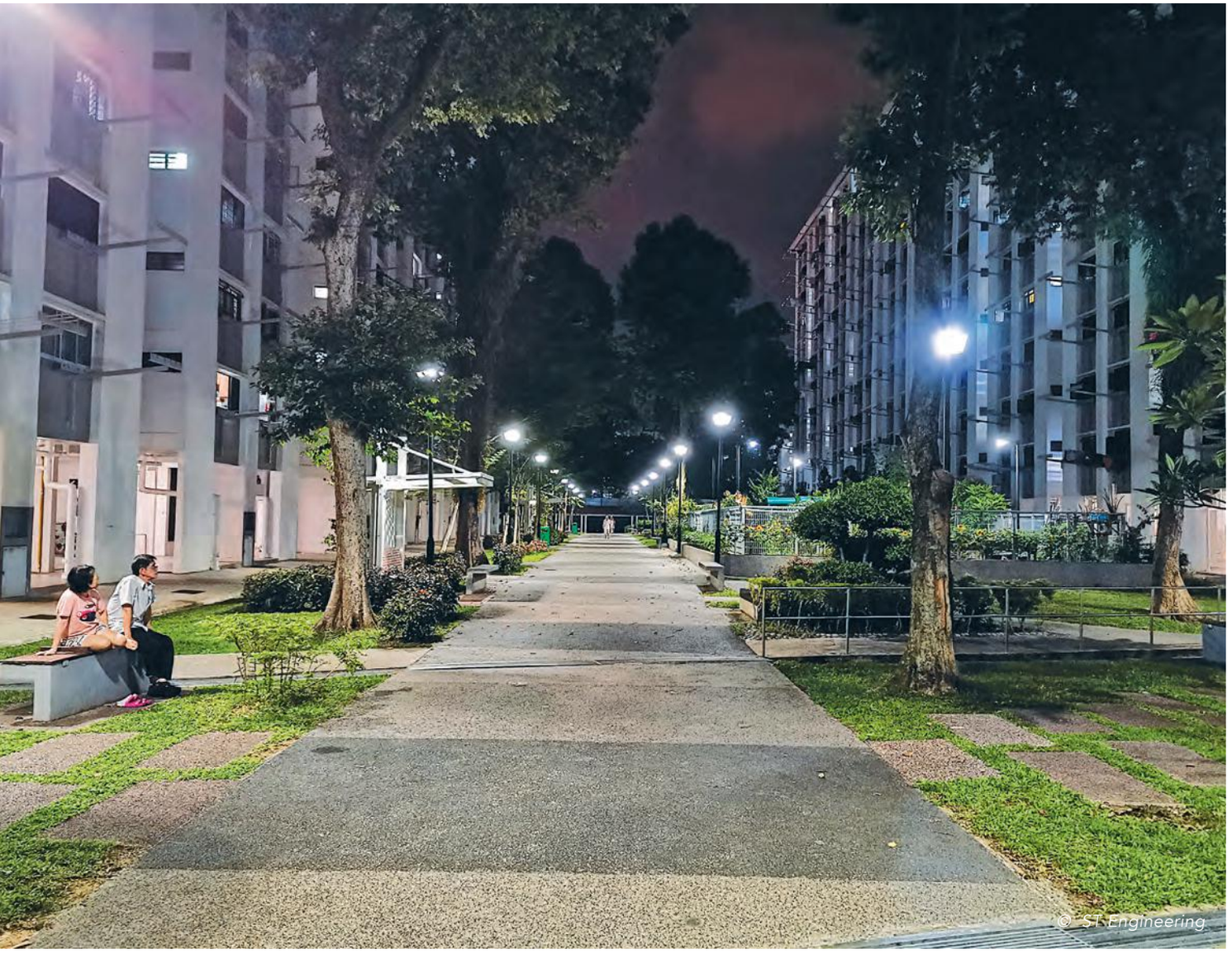
ILLUMINATING THE PULSE OF THE HEARTLANDS

Shedding light on smart lighting

Illuminating The Pulse Of The Heartlands



Public lighting is an essential part of urban living but comes at a cost. It accounts for almost 20 percent of global electricity consumption, according to the International Energy Agency (IEA). As the world grapples with climate change, there is a growing need to cut power consumption from public lighting.

Long a fundamental service that only offers illumination, safety and aesthetic appeal for human and vehicular traffic, public estate lighting now provides improved visual comfort and functionality. The humble light fixture looks set for a bright future, thanks to smart technology.

So when a reputable housing developer wanted to upgrade its lighting network, it looked for a system that was not just efficient and sustainable but could also be integrated with smart city technologies such as the Internet of Things (IoT).

ST Engineering's IoT-enabled on-demand lighting is a solution that ticked all the right boxes: adaptable, relatively easy to deploy and smart.

THE CHALLENGES

A key objective of the housing developer was to overhaul its ageing lighting infrastructure as the rest of city-state began adopting smart technologies.

The developer wanted a single reliable platform that could seamlessly and remotely control and monitor both indoor and outdoor lighting systems while boosting energy savings.

Sensor data on human and vehicle traffic, and the network's ability to collect such information, would also be a key requirements of the new infrastructure. This meant that indoor and outdoor sensors on light fixtures have to be weatherproof, yet able to minimise false alarms and connection downtimes triggered by external factors such as communication interferences.

Adding to the challenge was the sheer scale of the deployment – a large, mature housing estate with an existing lighting system, that was both expansive and varied, was chosen as the installation site.

Residents' needs were a priority, so the system's reliability and safety were paramount. The developer had another condition: there must be no disruption to the lighting service while it was being upgraded.

Before

After

BRIGHT IDEAS FOR SMART LIGHTING

The housing developer eventually selected the dynamic, on-demand lighting with smart monitoring system developed by ST Engineering.

© ST Engineering

© ST Engineering

DIGITALISING SINGAPORE

1 Centralised Control

The system consists of wireless, smart control and lighting management software that manages both indoor and outdoor lights. It allows for the remote configuration and customisation of dimming lighting profiles to suit different luminosity requirements, ensuring that the user has full control over the entire system from one platform.

The on-demand lighting and progressive dimming features can track the movement of both people and vehicles.

As a result, the system can slash costs by up to 50 percent, on top of the energy savings from LED lights. Lights can now be dimmed to any level to reduce energy consumption, especially during times of low footfall and during initial years when the LEDs are at their brightest.

2 Wireless Mesh Communication Network

The system runs on a wireless mesh communication network that is easily adaptable to different situations. The scalable and flexible implementation allows for easy expansion of existing infrastructure, while eliminating disruption to the residents.

The system screens the health of the light fixtures in real time and initiates fail-safe mechanisms and preventive maintenance notifications before a fault occurs. This minimises downtime for the entire network.

3 Data Analytics

At the heart of smart lighting system is a powerful data analytics capability that serves as the brain of its smart system.

The collected data from the sensors provide actionable insights to help building and estate managers better understand human traffic patterns and optimise the provision of lighting.

Together with artificial intelligence (AI), the collected data optimises the smart lights – lamps brighten up in advance to serve motorists and pedestrians, attributed to its intelligent predictive lighting algorithm. When light is not needed, the lamps will progressively dim in secluded areas, minimising energy consumption and carbon emission.

SMART SYSTEM PUT TO THE TEST

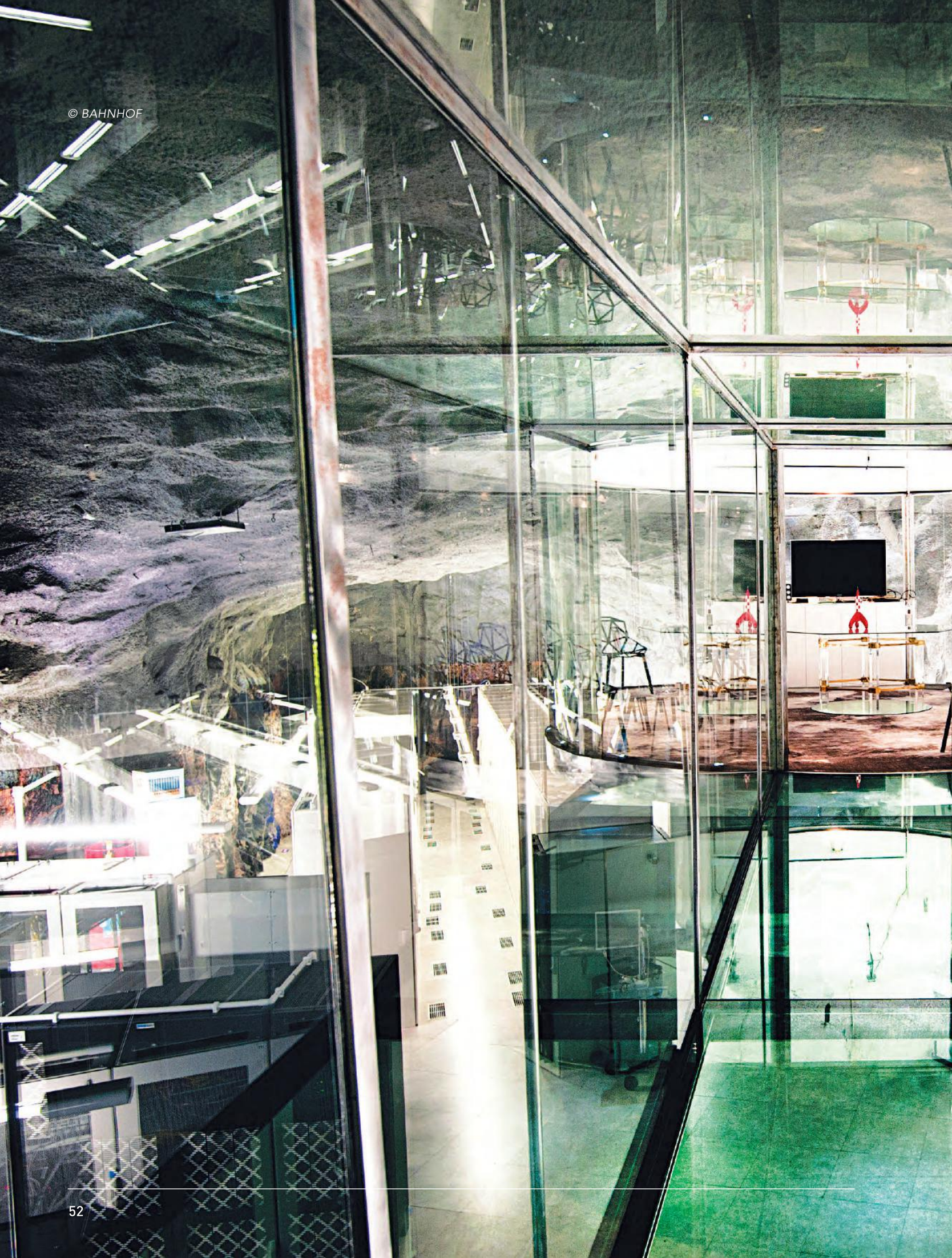
The wireless smart lighting system was deployed in an estate with more than 40 blocks, housing more than 5,800 residential homes over a year between July 2018 and August 2019. It marked the first time smart lighting was used on such a large scale in the country. Over 10,000 LED lights with motion-sensor technology were installed in common areas, walkways and gardens, multi-level carparks and outdoor open carparks.

The system has halved energy consumption of both indoor and outdoor lights, leading to lower costs, decrease carbon footprint and higher savings.

Lights fitted with sensors have also yielded valuable data that enables the town councils to better understand human traffic. This, in turn, aids estate management.

More importantly, the system incorporates Internet of Things (IoT) technology and can be easily integrated with other IoT-enabled sensors for applications such as water metering and temperature sensing and air quality monitoring.

Best of all, the solution is in line with the city-state's Smart Nation drive, to contribute to sustainability beyond cost saving and ultimately improving the lives of users. To find out more, visit **www.agillites.com**.



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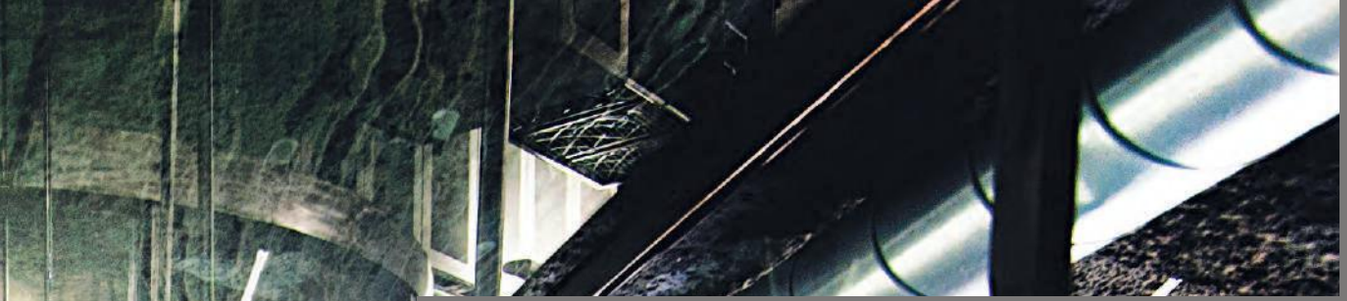

BEATING THE HEAT IN DATA CENTRES (THE GREEN WAY)

Data centres, like all buildings, can also be sustainable and energy efficient

Beating The Heat In Data Centres (The Green Way)

Data centres are buildings dedicated to housing computer systems and associated components, such as telecommunications and storage devices. In recent years, sustainability concerning energy use in data centres has become a growing concern. According to energy efficiency expert Mr Anders Andrae, Principal Architect of Huawei Technologies in Sweden, data centres consume about 2 percent of all electricity worldwide. This figure could rise to a global total of 8 percent in 2030.

In Singapore, studies done by the National Environment Agency in 2010 estimated that the total electrical energy usage of data centres is 3.6 percent of Singapore's total electrical energy consumption. The energy consumption demand of data centre buildings is estimated to grow to 2,260 GWh by 2015, which is a 51 percent increase over 5 years. In 2020, these figures could only be even higher.

Real estate consultancy firm Cushman & Wakefield also ranked Singapore as the third most robust data centre market in the world, jumping four spots from seventh place in 2017 to third, while retaining the top spot in the Asia Pacific region. This suggests that energy consumption by data centres in Singapore has been increasing and will continue to increase in the years to come.

There are many reasons as to why energy consumption in data centres is at an all-time high. Trends such as 5G, Industry 4.0, mobile internet and internet TV have led to an ever-increasing demand for data. This in turn has led to a constant need to upgrade equipment and expand data centres. In addition, instant retrieval and access of data have now become a default expectation. As a result, data centres have to be in constant operation. Therefore, it is of no surprise that data centres expend large amounts of energy and generate an immense amount of heat at the same time. In fact, ventilation systems can account for up to 35 percent of energy use in data centres and energy used by fans contributes to a large portion of this statistic.

There are many ways to ventilate a data centre. As there is no standard in the design of data centres, the design of ventilation systems within them vary as well.

Fig. 1

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Fig. 2

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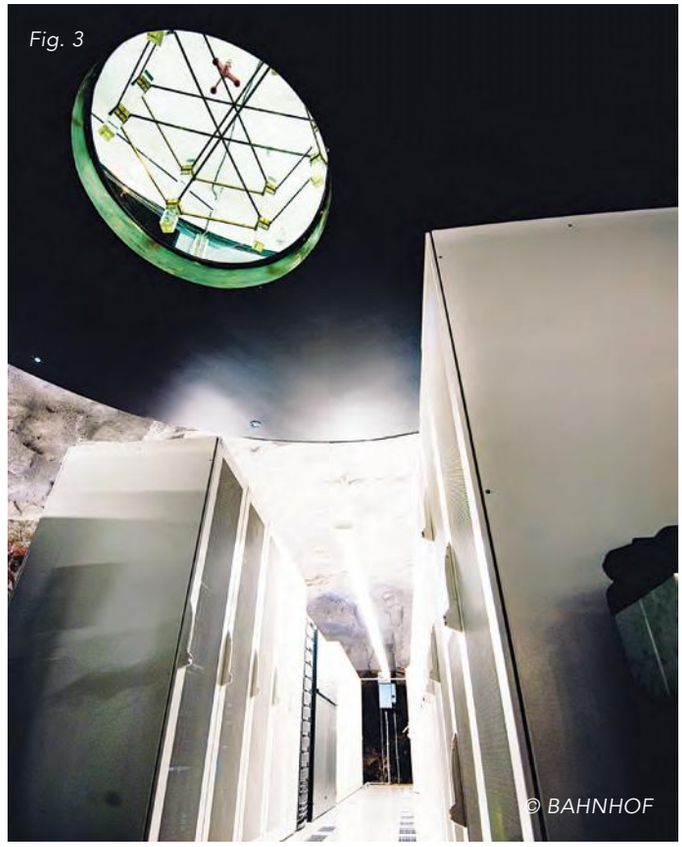
Fig. 3



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FACILITY COOLING

In the FanGrid configuration *(Fig. 1)*, multiple centrifugal fans operate in parallel ensure the necessary inflow with a high level of efficiency.

Powerful and efficient axial fans that operate in parallel are the perfect choice for the controlled exhaust *(Fig. 2)*. Diffusers can be mounted to provide an additional reduction in noise levels and higher efficiency.

SERVER RACK COOLING

Powerful compact fans, typically available in axial, centrifugal or diagonal configurations, are used to keep server racks *(Fig. 3)* cool.

AREA COOLING

For data centres in particular, fans on condensers have a high duty cycle. They are usually found in data centres of various sizes.

In area cooling, Computer-Room Air-Conditioning (CRAC) units *(Fig. 4)* are of particular importance. CRAC units should be capable of maintaining constant temperature and humidity levels. Ideally, they should also be energy efficient, so as to reduce costs in operations.

But wait – there's more. Keeping the (often sensitive) information secure is of utmost importance. The type of data stored encompasses all facets of modern life. This includes, but is not limited to, credit card information, banking transactions, cloud data and websites.

For data centre owners, losing any amount of data can be devastating. This can occur in a multitude of ways, such as security breaches or the overheating and subsequent spoiling of equipment. Therefore, reliable ventilation equipment is of paramount importance.

Fig. 4

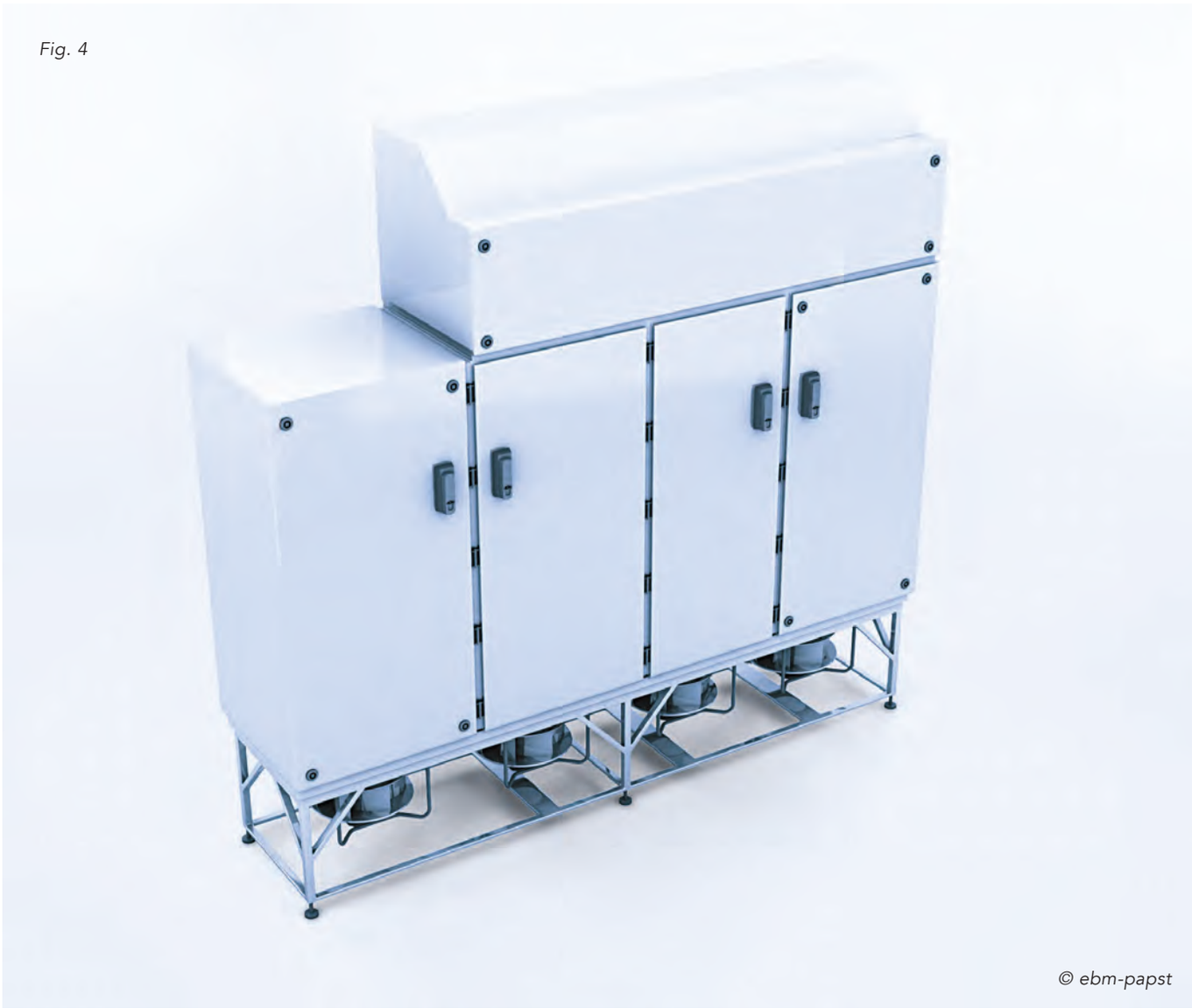

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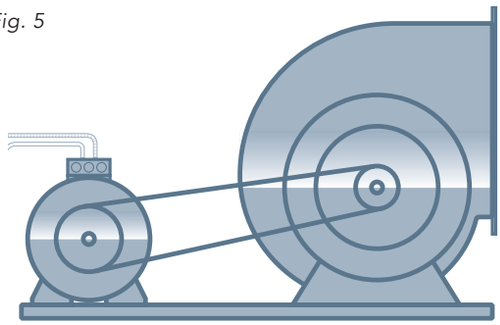
Fig. 5



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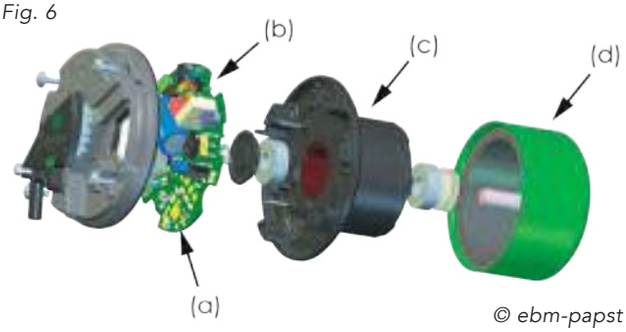
CONVENTIONAL FAN DESIGN & ALTERNATING CURRENT (AC) MOTORS

In older data centres, AC belt-driven fans *(Fig. 5)* are used. Belt-driven fans, however, are susceptible to the accumulation of dirt particles. While filters can lessen the impact, this then leads to the need for constant maintenance, where old belts and filters are replaced with new ones.

New technologies, such as the fans from ebm-papst, are able to resolve such issues and improve energy efficiency at the same time.

MODERN FANS & ELECTRONICALLY COMMUTATED (EC) MOTORS

Fig. 6



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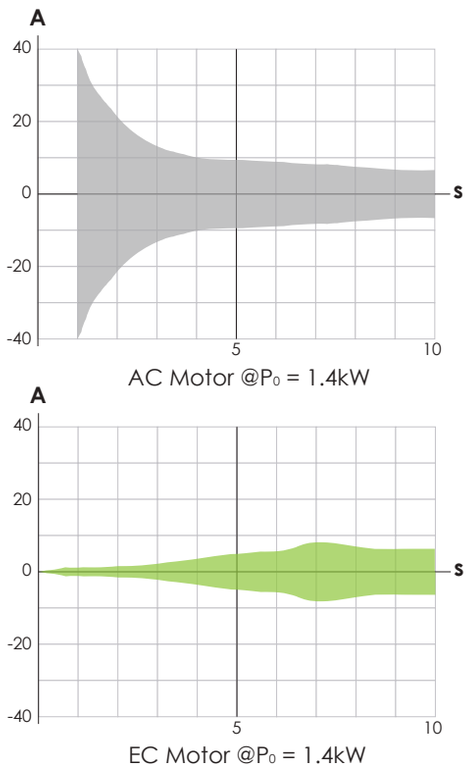
EC technology is the latest motor technology available that can meet the high efficiency standards of today. EC motors have a higher performance that spreads across a wider operating point. In contrast with traditional AC motors, they are extremely efficient, especially at reduced speeds.

The EC fan comprises of an integrated system *(Fig. 6)*. It contains (a) Conversion Electronics, (b) Speed Control Electronics, (c) Stator and (d) Rotor. There are a few reasons why EC technology saves more energy as compared to AC.

Fig. 7



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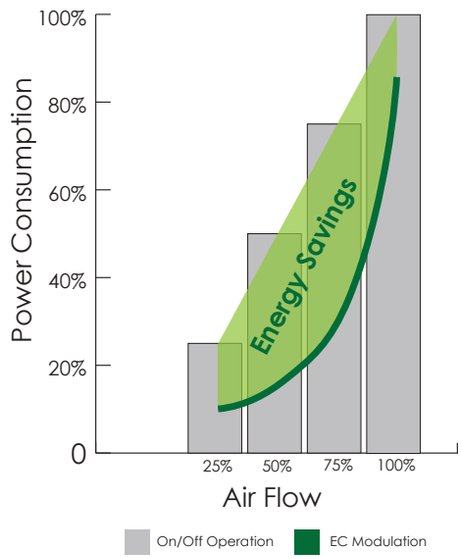
Soft-Start *(Fig. 7)*: When switching an AC motor on, it reaches its peak power rating before tapering off to the desired power level. In contrast, for EC motors, a soft-start occurs before it elevates to the desired power level.

Fig. 8



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Power is proportional to revolutions/min^3

Variable Speed Control *(Fig. 8)*: In AC motors, there are limited speed settings. This results in energy use that is not necessary. In contrast, EC motors can regulate energy use based on the conditions of the environment, resulting in improvement in energy efficiency.

An immense amount of research and development was necessary to develop these efficient technologies. Refinement in other aspects of the fan, such as the impeller, further improves the performance and thus efficiency of the equipment. The combination of all of these factors in EC fans *(Fig. 9)* thus results in much lower energy use compared to conventional/AC ventilation equipment.

Fig. 9

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BUNKER TURNED FORTIFIED DATA STORAGE

Thirty meters beneath Stockholm's tranquil Södermalm district is one of the most secure – and extraordinary – data centres in the world. In a retired fallout shelter called Pionen, data centre operator BAHNHOF stores its customers' data behind steel doors that are 50 centimetres thick.

Previously, this James-Bond-inspired data centre utilised inefficient belt-driven AC fans in their CRAC units. ebm-papst Sweden was tasked to modernise Pionen's ventilation system.

In the upgrade, the CRAC units were retrofitted with ebm-papst's EC centrifugal fans, also known as the RadiCal *(Fig. 9)*. These are low pressure fans with backward-curved blades.

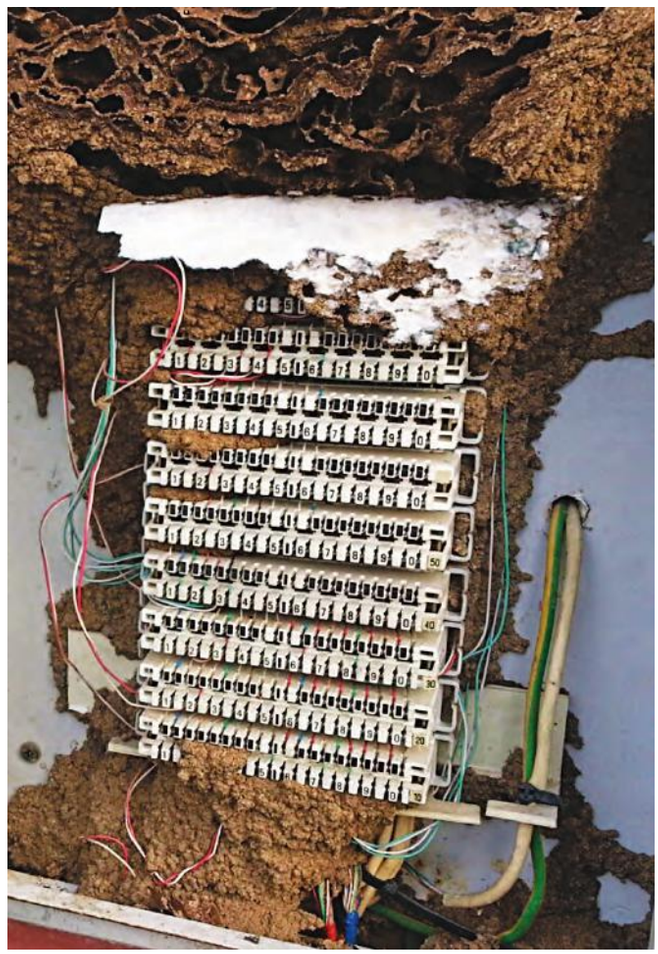
In total, the upgrade saved BAHNHOF 275 megawatt-hours of energy annually. It spends about 40,000 euros less on its annual electricity bill. In addition, there is no longer a need to conduct frequent maintenance as the EC fans do not use a belt-driven system. With this upgrade, not only did BAHNHOF save on operation costs, they also took a step forward in keeping their operations as eco-friendly as possible.

By Rickie Chua
Product Strategy Manager
ebm-papst SEA Pte. Ltd.

BREAKING THE MOULD FOR TERMITE CONTROL

If left unchecked, termites can cause irreparable damage to buildings but homegrown pest management firm PestBusters has an innovative and eco-friendly solution designed to protect buildings from the tiny terrors.

Termites are one of the most common pests found in buildings. Known as the silent destroyer, these pests are capable of chewing through the wooden structures in buildings without being noticed. However, termites do not stop at wood: they can even chew through plasterboard and electrical wiring. In serious cases of termite infestation, the insects can even cause structural issues to buildings and interiors. In most cases, engaging a Singapore-based termite extermination company is the best (and sometimes only) option to completely eliminate the threat.

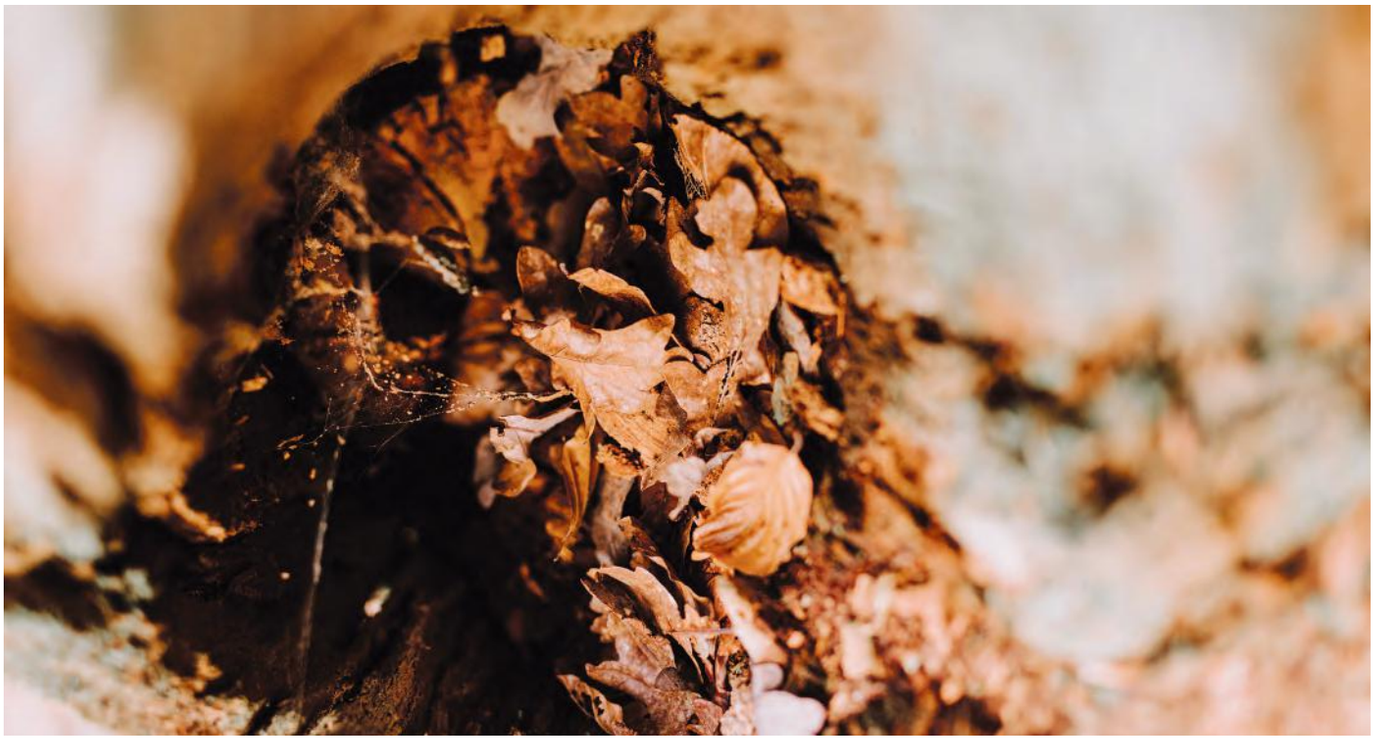


POSSIBLE CAUSES OF TERMITE INFESTATION

There are numerous causes for termite infestation but there are three main reasons: moisture, wooden foundations or furniture and cracks or crevices.

1 Moisture

Leaking pipes, drainage issues or a lack of proper airflow are all potential contributing factors to moisture build up in buildings and interiors. This moisture causes wooden furniture to become soggy and damp, attracting both damp wood and subterranean termites. The damp environment suits both of these termite species.



However, the subterranean termite in particular, feeds on softwood and is unable to live in areas without moisture, making these conditions their perfect breeding spot.

2 Wooden Foundations and Furniture

Termites mainly move around through wood or soil, making buildings with wooden foundations, or foundations that are in contact with wood, highly susceptible to termite infestation. Furthermore, these pests feed on wood. Having numerous wooden furniture acts as an attraction to termites, therefore increasing the likelihood of an infestation.

3 Cracks and Crevices

Despite a termite's main transportation route being through wood or soil, this does not mean that they cannot travel without them. Subterranean termites can build mud tubes, enabling them to travel to wherever they desire. Cracks and crevices then provide these termites with a route straight into buildings, allowing them to build mud tubes through these tiny spaces.

If a building or interior has any of these three "symptoms", it is time to be on high alert for any signs of termite activity.

HOW TO SPOT TERMITES EARLY ON

The best time to stop a termite infestation is during its early stages. To do so, keep an eye out for the following telltale signs of termite activity in places and spaces.

- **Sign 1: Mud Tubes**

  Mud tubes are a sure-fire sign of termite infestation. Often made of soil and dirt, they are transportation tunnels used by subterranean termites. If these are spotted, it would be best to take immediate action and contact a termite extermination specialist.

- **Sign 2: Fine Wood Dust**

  Termites consume wood as their primary choice of sustenance and this makes their excrement take a form that strongly resembles fine wood dust. If you happen to discover an abundance of "fine wood dust" at a particular spot in a building or interior, then there might be a termite problem.

- **Sign 3: Hollow Sounding Wooden Walls or Furniture**

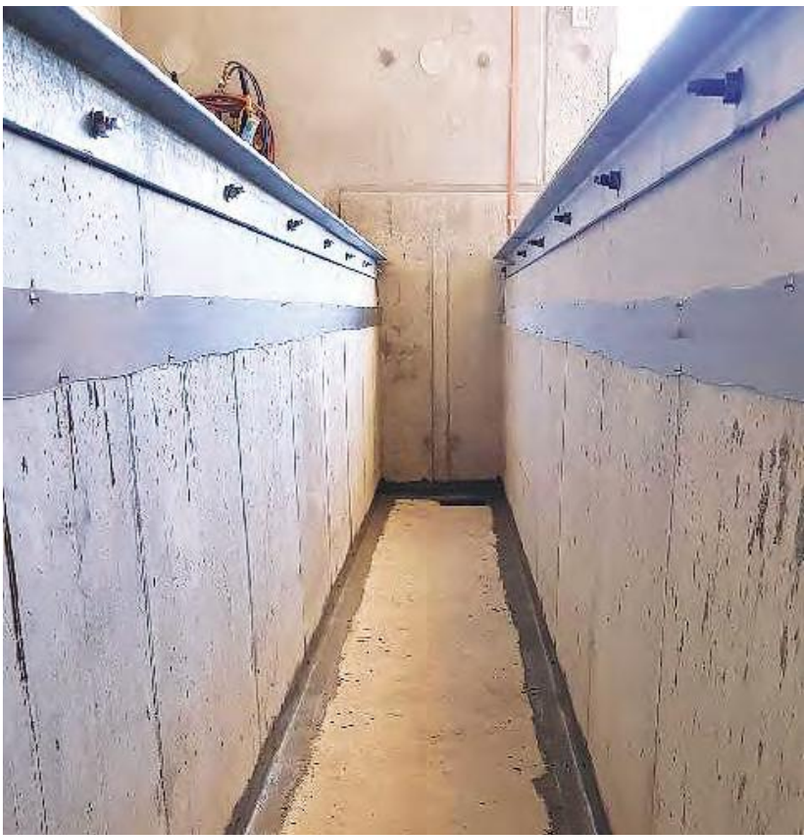
  If cracks and fissures appear on wooden walls or furniture, give it a knock or tap. If the once-solid wooden wall now sounds hollow, there is a high chance that it could be due to termite infestation.

  Quickly identifying and eliminating termite problems is crucial in limiting the damage an infestation can cause. Upon discovery of a termite colony, it is highly recommended to immediately seek professional help from termite extermination specialists for efficient removal of these pests.

AN INNOVATIVE & GREEN SOLUTION FOR BUILDINGS

Founded in 1991 and Singapore's largest locally owned pest management firm, SGBC Member PestBusters utilises only the most innovative and proven pest management systems. When it came to looking for clean, green and poison-free termite control solutions for new building and construction projects, they scoured the globe and found the answer in the form of TermSteel, a pesticide-free and poison-free stainless steel termite management system that is globally recognised to meet the stringent standards required of stainless steel mesh systems.

As a physical termite barrier for buildings, the system will prevent concealed termite entry into a structure for the life of the building without the use of dangerous pesticides or poisons. The system is also flexible enough to be installed in hundreds of ways to suit any construction method and building type. The product completely eliminates the use of repetitive and expensive poison treatments, which sometimes do not achieve the intended outcomes. With no usage of any invasive or harmful substances, the product is not bound by construction limitations or constraints in place after the building is handed over.



The TermSteel system comprises of many components, first and foremost the TS1000 stainless steel woven mesh which is manufactured with an ultra-high grade of custom marine stainless steel which meets all global standards. The other components include the no-pesticide, no-poison TermLok Parge which secures the TS1000 mesh to the other termite resistant materials. The TermBlok Collars are fabricated from the same steel with the mesh and are installed to all service penetrations passing through the concrete slabs (in contact with soil) and secured using the custom TermGrip clamps, providing life-of-structure protection.

The TermSteel system is able to be recycled at the end of its operational lifespan and is also a verified carbon-neutral building product. For its innovative take on sustainability, the product achieved the highest possible 4-ticks Leader rating under the Singapore Green Building Product (SGBP) certification scheme. Usage of highly-rated green building products will help Green Mark projects gain bonus points while improving its overall sustainability.

The system is even more ideal in areas where the water table is high due to prevailing authority regulations where chemicals cannot be used within areas where the water table is higher than half a meter from the topsoil (including basement areas).

As part of its corporate social responsibility efforts, PestBusters has gone a step further with its industry first "Green Singapore Initiative", where the company will plant two trees to reduce its carbon emissions for each and every project using the TermSteel system.

Text and Images courtesy of PestBusters Pte Ltd

TermSteel®

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Professional Architects And Builders Specify And Trust The TermSteel Stainless Steel Termite Management System.

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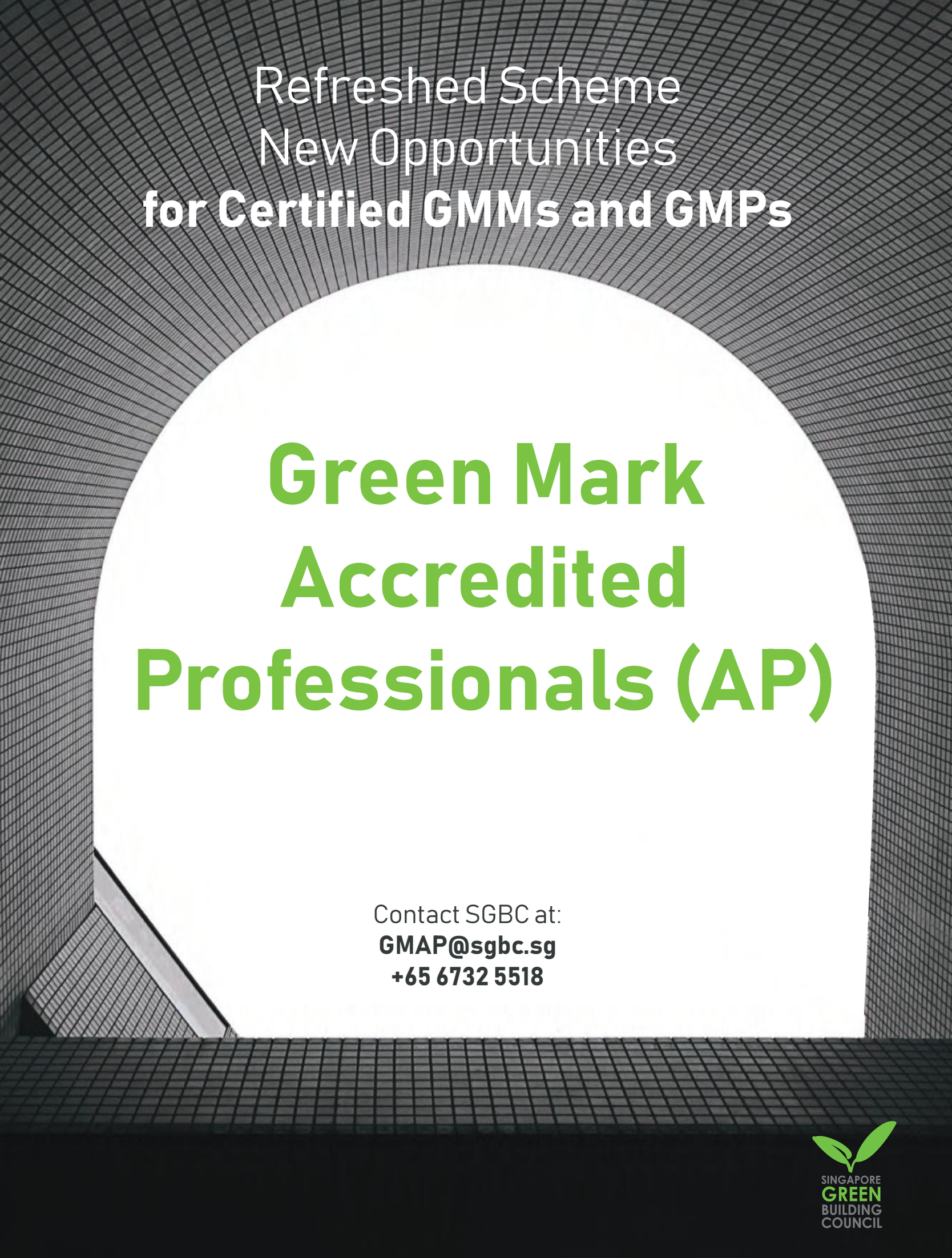

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