SEE INSTITUTE • SUSTAINABILITY THROUGH RESEARCH AND EDUCATION

SEE INSTITUTE
OUR PATH TO NET ZERO

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SEE INSTITUTE BUILDING

SEE Institute is a hub for sustainability education, research, business incubation, and advisory seeking to empower the growth of sustainable practices and the transition to a net zero world, and the term SEE stands for Social, Economic, and Environmental, the 3 pillars of sustainability.

SEE Institute was developed with the mission to enhance and share knowledge related to sustainability in the built environment, promote sustainable living globally, and help achieve the ambitions of the Paris Agreement and the UAE 2050 Net Zero Strategy, and with the development of the divisions at SEE Institute, the vision is for it to spearhead change in the region and be a leading global platform and a hub for sustainability knowledge, creation, and exchange.

SEE Institute has set a strategy to become net-zero by 2030, aiming to set an example to the world by demonstrating that a transition to a more sustainable, green future is well within reach and can be achieved in the region.

A range of strategies was implemented to mitigate the greenhouse gas (GHG) emissions of the SEE Institute Building. These measures encompass various aspects of structural design, low-carbon materials, and alternative building products.

SEE Institute came along as a vision for a future of the built environment that mitigates the impacts of climate change, addressing both embodied and operational GHG emissions. The golden rule of such an approach is reducing GHG emissions associated with the construction of a building, prioritizing energy efficiency to minimize operational GHG emissions, and producing onsite renewable energy to compensate for the unavoidable GHG emissions from those two life cycle stages of a built asset.

CONTRUCTION PHASE

Currently, the international best practice for the embodied GHG emissions of buildings is capped at 500 kgCO2e/m2, measured for a built-up area. This figure served as a benchmark for the project team which was evaluating the impact of different materials and design choices to make informed decisions. The achieved embodied GHG emissions were at 500 kgCO2e/m2 indeed, however, that also comprises transportation of the building materials as well as onsite machinery use. SEE Institute has been designed with embodied emissions reduction in mind, however, there have been trade-off moments where the project team was guided by the so-called “whole life cycle approach”. Such an approach suggests that key decisions should be viewed through the lens of the whole life cycle of a building.

Until recently, the procurement strategy for building materials typically involved choosing suppliers based on factors like delivery timeliness, cost, quality, project requirements, and financing. However, sustainability has gained increasing importance in recent years when it comes to purchasing goods and services. This shift entails considering lifecycle impacts, environmental effects, and social impacts, alongside the traditional procurement criteria of price, quality, and time, thus broadening the scope of decision-making in material selection.

LOW CARBON CONCRETE

Concrete that was used for the building, both precast and in-situ, was selected based on its embodied GHG emissions. Specifically, it contained 60% GGBS (Ground Granulated Blast-furnace Slag), a byproduct of the iron and steel industry which works as are replacement for Portland cement.

Apart from the structural benefits, such as increased durability and strength of the concrete, as well as its resistance to chemical attack and erosion, the use of GGBS in concrete reduces reliance on virgin materials, diverts waste from going to the landfill, and, most importantly, helps to slash GHG emissions as a less energy-intensive material, unlike Portland cement, and supports circularity.

OPTIMIZED STRUCTURAL SYSTEMS

A normal practice in the construction industry is utilizing software to model and analyze the performance of the selected structural components under various conditions, and then evaluating different design options and optimizing the size of each structural member to

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	minimize material usage while meeting safety requirements. The same was actioned by the project team behind the SEE Institute building with a goal to reduce the amount of concrete and rebar in certain elements such as beams, with an overall goal of reduction of GHG emissions and costs.
RECYCLED STEEL	One of the greatest properties of steel is the ability to be recycled infinitely without losing its structural properties. The rebar was sourced locally and has a great recycled content – 97%, which drives great reduction in GHG emissions, and, along with alternative materials for concrete, redirects waste from the landfills and contributes to a more circular economy.
LOCALLY SOURCED MATERIALS	Global GHG emissions resulting from various modes of transportation are on the rise. A major part of the building materials for the Institute building was sourced locally in order to minimize the impact by reducing the distances materials needed to travel, apart from those procured from the outside which appeared to have lower embodied GHG emissions even with the freight emissions factored in.

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OPERATIONAL PHASE

The built environment is responsible for almost half of the global energy-related CO2 emissions annually, with building operations accounting for 27% of those emissions.

Addressing operational emissions goes beyond design alone and necessitates a comprehensive three-pronged approach that considers design, facilities management, and occupant behavior. Gaining a thorough understanding of the building's operational performance is crucial, and energy modeling is a process used to estimate annual energy consumption based on factors like climate, building orientation, geometry, materials, and mechanical and electrical systems, allowing to evaluate the decisions made by the project team.

Passive and active design strategies to maximize energy efficiency

INSULATED EXTERNAL GLAZING

External glazing plays a crucial role in a building's thermal performance, like external walls. Effective glazing insulation reduces the energy needed to maintain a consistent temperature difference between the interior and exterior. Additionally, glazing's light transmittance affects both solar heat gain and visible light passage. In hot climates, the ideal scenario involves minimizing solar heat gain while maximizing daylight transmission, which can be achieved through specialized coatings. Considering these factors, the project team for the SEE Institute building opted for a new generation of window glazing with highly selective coated glass, providing solar protection, strong thermal insulation, and reducing reliance on air-conditioning systems.

A cutting-edge approach to advance decarbonization efforts is the implementation of "smart cladding," also known as Building-Integrated Photovoltaics (BIPV). Although this technology has been around since the 1970s, its use has been restricted due to unappealing designs and limited options. However, PV panels of 8.5 kWp capacity integrated into the south-facing wall of the SEE Institute exemplify a breakthrough. These panels seamlessly blend with the overall facade, appearing as normal cladding by matching the color and pattern of the building, all while generating renewable energy, about 7,900 kWh per year.

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INTELLIGENT LED LIGHTING SYSTEM

An intelligent LED lighting system incorporates sensors within the fixtures to detect the presence of natural daylight and occupancy/motion in specific areas of the facility, thus optimizing the amount of required lighting and resulting in energy conservation.

THE BUILDING MANAGEMENT SYSTEM (BMS)

The Building Management System (BMS) plays a crucial role in managing large facilities such as data centers, hotels, educational and commercial establishments, offices, and hospitals. By effectively overseeing and monitoring various equipment and systems including air-conditioning, ventilation, lighting, power, security devices, IoT sensors, and utility meters, the BMS enables buildings to achieve energy efficiency and reduce operational and maintenance costs. It serves as an integral part of facilities management, providing insights into building performance, allowing for system control and adjustment, compiling performance data, generating reports, issuing alerts for potential issues, and identifying the source of failures, thereby saving time and resources.

At the Institute, the BMS was deployed to efficiently control and operate a range of systems, including chillers, air handling units, power consumption units, water leakage detection, lighting, air quality, solar PV and EV charging points, and lifts, as well as fire alarm and voice evacuation systems.

Utilizing renewable energy to compensate for the hard-to-abate embodied and operational GHG emissions

BIOGAS PLANT & HYBRID COOLING SYSTEM

The Sustainable City, the mixed-use and residential community where the SEE Institute is situated, generates a significant amount of organic waste comprising food residues, animal manure, and green waste. Previously, most of this waste was collected and transferred to a local waste management company, with some food waste disposed of through kitchen sink garbage disposal units. However, an alternative solution involves diverting the waste through a small-scale biogas plant that utilizes anaerobic digestion. By converting organic waste into biogas, a renewable energy source, greenhouse gas emissions can be reduced while displacing the need for fossil fuels.

The designed biogas plant has the capacity to process up to 3,000 kg of organic waste per day, producing biogas and digestate. The biogas, consisting of approximately 60% methane and 40% carbon dioxide, is utilized in a direct-fired absorption chiller to replace the conventional chiller's compressor, thereby contributing around 31% of the cooling load required by the SEE Institute. This setup leads to lower electrical use intensity.

Additionally, the digestate serves as a soil conditioner/fertilizer for the community's landscaping needs. The remaining cooling load, accounting for over 79%, is met by a highly efficient water-cooled chiller equipped with a two-step compressor and a variable frequency drive (VFD) motor to achieve optimal efficiency rates, especially under part load conditions. By consuming methane instead of releasing it into the atmosphere, this plant effectively prevents methane emissions. Moreover, the energy generated by the plant exceeds the energy required to operate it, making it self-sufficient.

The hybrid cooling system, comprising an absorption chiller with a refrigerant capacity of 75 tons (TR) and an electrical backup chiller with a capacity of 185 tons (TR), contributes to demand-side management by reducing electricity usage while simultaneously diverting organic waste from landfills and converting it into clean renewable energy. Additionally, the electrical chiller utilizes water for cooling and has demonstrated a 35% higher energy efficiency compared to air-cooled chillers. To ensure proper functioning, the chiller plant manager acts as an independent Building Management System (BMS) solely dedicated to managing the chillers.

SMART CLADDING

A cutting-edge approach to advance decarbonization efforts is the implementation of "smart cladding," also known as Building-Integrated Photovoltaics (BIPV). Although this technology has been around since the 1970s, its use has been restricted due to unappealing designs and limited options. However, PV panels of 8.5 kWp capacity integrated into the south-facing wall of SEE Institute exemplify a breakthrough. These panels seamlessly blend with the overall facade, appearing as normal cladding by matching the color and pattern of the building, all while generating renewable energy, about 7,900 kWh per year.

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SOLAR POWER

Nearly 1 MWp of solar PV panels have been installed on the car parks and rooftops to meet energy demand, which is threefold the coverage of what the building might need in a year – about 1.6 million kWh. The reason for such an uptake has been to offset operational emissions beyond just energy use – these imply food, water, purchased goods, commuting employees, and waste generation.

The employed solar panels are bi-facial which, unlike mono-facial solar panels, absorb direct as well as reflected light. The front side of the panels uses direct sunlight while the reflected light is absorbed from the rear side. Hence, there are multiple benefits of using bi-facial solar PV panels, such as higher efficiency, production being less impacted by the bad weather, and angle of installation flexibility to name a few.

Breakdown of the Solar PV Installations feeding into the SEE Institute

SEE INSTITUTE PARKING	SEE INSTITUTE ROOF AREA	THE SUSTAINABLE HOMES
905 Modules – Bifacial 479.65KWp	530 Modules 280.9 KWp	459 + 6 Dummy Panels – Bifacial 211.14KWp

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BEYOND NET ZERO

This phase entails the implementation of various sustainable measures, and by accomplishing this, the building will become a sustainable living model that prioritizes self-sufficiency and serves as a beacon of sustainability to the surrounding areas, the following are examples that serve this strategy:

ELECTRIC VEHICLES	The Institute allocated more than 15 parking bays for EV charging and procured 6 electric vehicles to power the Institute's transportation fleet, to raise awareness about the effectiveness of mobility strategies in offsetting carbon emissions and promoting sustainable transportation.
WATER HARVESTER	The Institute installed a water harvester just outside the building, which collects air from the atmosphere and initiates a process of capturing the humidity in it and converting it to water, this water then goes through multiple stages of filtration, mineralization, and UV radiation, and the end product is 100% pure drinkable water ready to be dispensed for consumption.
VERTICAL FARMING	Part of the building's landscape has been reserved for the installation of vertical farms that will allow the production of crops in a significantly smaller footprint compared to traditional agriculture, and the technology behind it lies in using artificial lighting and controlling the environment by mimicking optimal conditions for plants growth, this would enable year-round crop production and reduce water usage.

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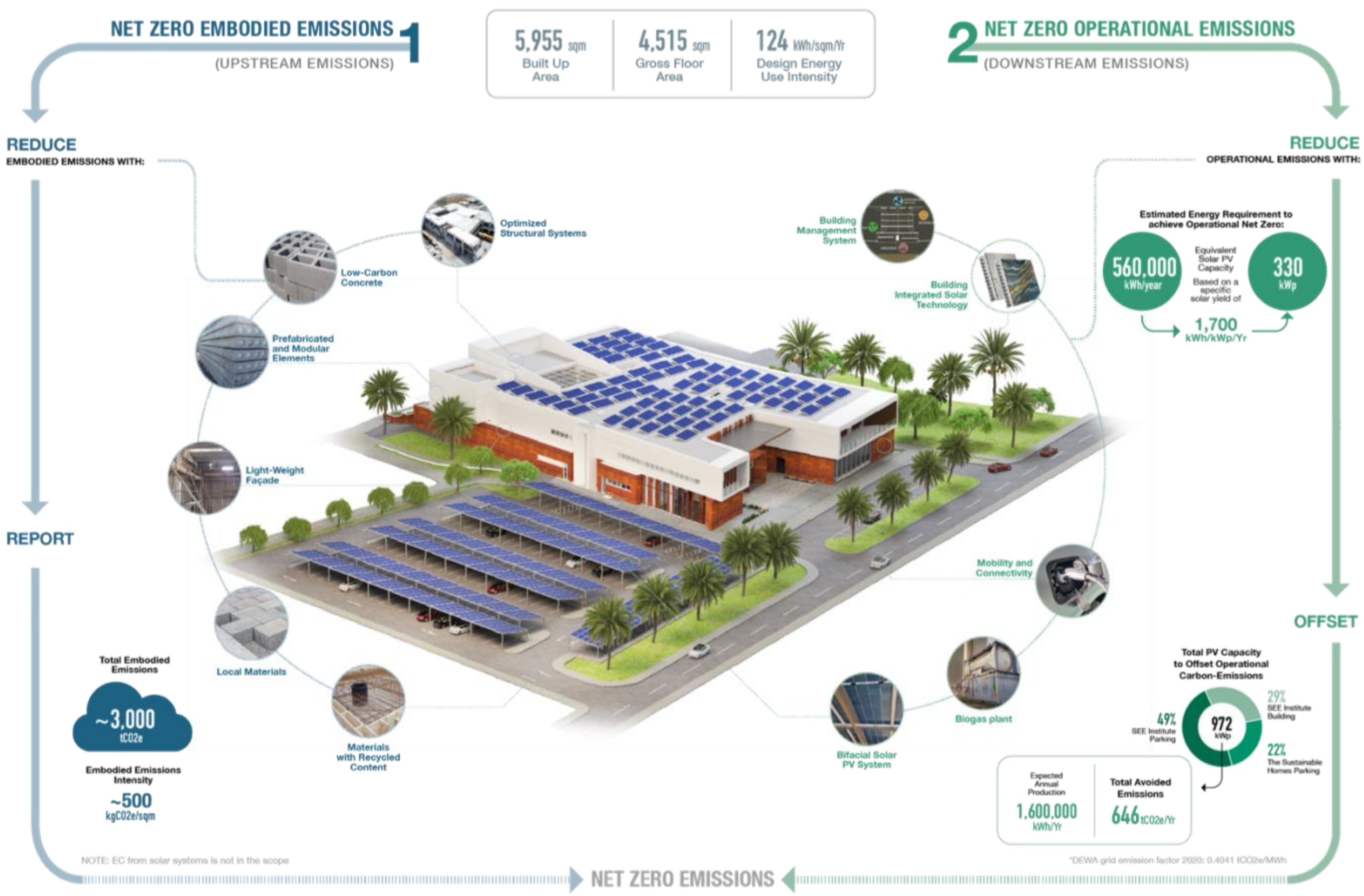
GOING FORWARD

The SEE Institute Building will continuously be monitored, to reach and set new standards across the region.



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SOCIAL
ENVIRONMENTAL
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