HERIOT WATT UNIVERSITY

CENTRE OF EXCELLENCE IN SMART CONSTRUCTION

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Performance and Productivity

Research *Bulletin*

No.6-September 2022

EDINBURGH | **DUBAI** | MALAYSIA

Wellbeing

Sustainability

SHAPING TOMORROW TOGETHER

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About *Us*

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Heriot-Watt University's Centre of Excellence in Smart Construction (CESC) is committed to advancing industry-led innovations in construction that will revolutionise the way we develop, manage and operate smarter cities.CESC partners with like-minded organisations and government entities to lead the transformation of the Built Environment and development of next generation professionals for the benefit of the economy. CESC is a global hub for disruptive thinking, a platform for collaborative research and a model for solutions development and stakeholder engagement. More details about CESC can be found in the following link: https://www.hw.ac.uk/dubai/research/centre-excellence-smart-construction.htm

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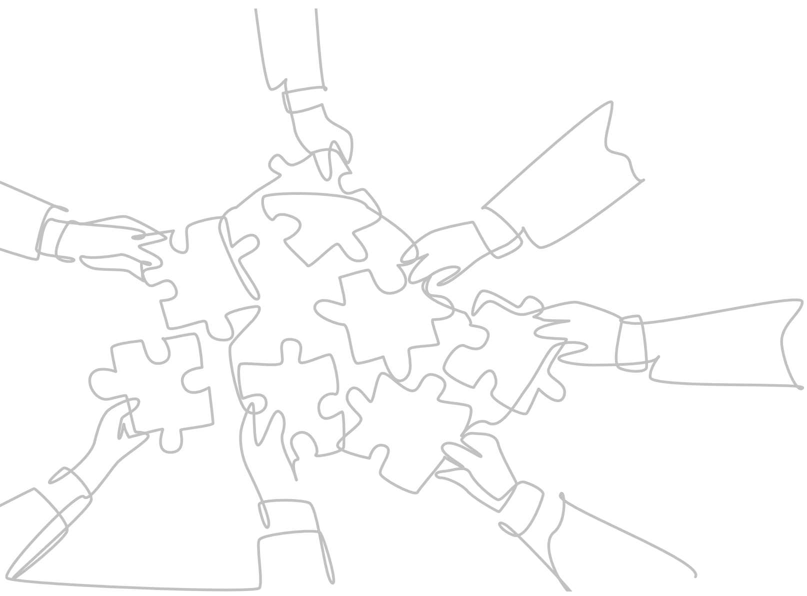

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For more information about partnership benefits and working collaboratively with the Centre of Excellence in Smart Construction please contact S.Bushnell@hw.ac.uk

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The sixth issue of the CESC research bulletin raises the commitment to reach net-zero carbon buildings through the "Topic of Focus" article by Anas Bataw, the Director of CESC. Bataw, in his article, brings up the fact that less than 1% of the globe's buildings are zero emissions. Therefore, he highlights trends which help make the newly constructed buildings net-zero carbon to reach the goal of saving our planet. Moreover, Bataw suggests updating the existing buildings with modern energy savers.

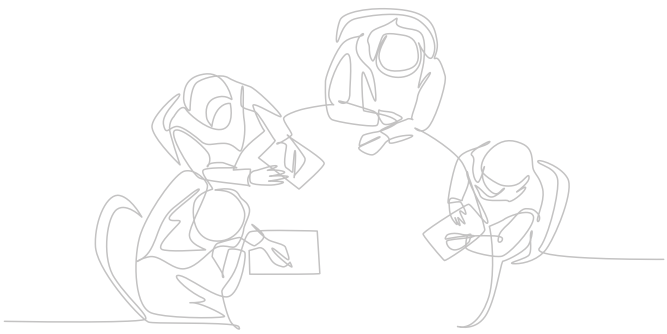
Also, in this sixth issue, more authors bring their valuable experience and research knowledge which focus on the CESC core themes: Performance &Productivity, Sustainability and Wellbeing.

The editorial explores and addresses in brief nine new topics as follows:

Performance and Productivity

Under this theme, Fadi Ghaith and Abdul Waris explore the current practice in water desalination plants, which consume a high quantity of fuel, causing increased costs and CO2 emissions. The authors suggest using a unique solar-powered greywater treatment unit. The article applies the new technique to a residential project in the UAE, where water consumption is almost 82% higher than the world average. The paper shows in detailed methodology and design how this method can be highly economical.

The second article by Sabih Khisaf starts with the disadvantages of the current public transportation system as it is outdated and not cost effective, besides its impact on the environment and society. Khisaf proposes the Hyperloop Transportation Technologies (Hyperloop TT) system as a solution to the issues and challenges caused by the old current system. The paper highlights the development and the past work undertaken by HyperloopTT company through active engagement with the governments such as the UAE, USA, and Europe.



Sustainability

In the first paper under this theme, Mutasim Nour and Maruthi Jupudi evaluate many energy-storage options to support Dubai's 2050 clean energy target. The authors present that although many types of energy storage technologies are available worldwide, selecting the right ones which suit each country or geography is essential, as this selection influences the economy. In detail, the article discusses two scenarios for Dubai to estimate the best clean energy technology and its benefits. Also, the influence of implementing a carbon tax and green hydrogen was evaluated.

The second paper is by Reem Alyagoub, who points out that the non-well-managed and unsustainable development of urban areas led to problems such as increased temperature and floods in the GCC countries. Alyagoub proposes to work with nature, not against it, through Natural-based Solutions (NbS), which can build a Socio-ecological system as a relationship between the ecosystem and surrounding societies. At the end of the article, the author brings interesting examples of the NbS and explores a collaboration project between Polypipe ME, a regional leader in green infrastructure solutions and water technology, and Heriot-Watt University through the Center of Excellence in Smart Construction (CESC).

In the third paper, Warren McKenzie brings the benefits of utilising geopolymer concrete as a low carbon footprint and durable type in wastewater systems. The article addresses how geopolymer concrete reduces steel corrosion rate by up to 5 times compared to conventional concrete. Consequently, it increases the service life of steel-reinforced concrete. This type of concrete, for sure, supports the goal of a zero-carbon future since it is cement free.

Wellbeing

Under this theme, Heba ElShimy, Hind Zantout, and Neamat ElGayar propose smart homes with digital healthcare to face the shortage of nursing care within the home environment. The authors add interesting information on applying sensors at home to detect physiological parameters such as blood pressure and heart rate. Moreover, these sensors can detect signs of silent killers such as heart attacks. The readers will agree that smart homes will definitely enhance the health lives of the elderly and make them independent in many cases. This article shows that smart homes are no longer a luxury option but essential.

The second paper by Mariam Azmy and Maged Elhawary explores the business vision of ASGC, the well recognised construction company in the UAE, through its People & Culture Strategy in investing time and resources in developing employees and considering the people a great asset to keep the business at the forefront. The article highlights how ASGC programs are targeting female development to break down the traditional thinking that the construction industry is a male-dominated environment. Moreover, their strategy addresses the generation motivation gap to remain the team happy and productive.

The article also shows that employee retention is not only about competitive salaries. It is an entire work lifestyle through flexible schedules, reasonable workloads, emotional support, etc. Therefore, ASGC has a high employee retention rate because the work-life balance is implemented in their strategy. On the other hand, the article shows how ASGC has developed a system to select their new joiners carefully to ensure they keep the business values high.

Feras Alkam and Tom Lahmer, in the third article, explore the Structural Health Monitoring (SHM) systems and the disadvantages of each system, especially when the monitoring system is involved in civil engineering structures where each structure is unique and affected by its environment. The article proposes a new model for damage detection of the structures, and they apply it to secure the safety of an electric transportation system which is one of the promising solutions to reducing climate change.

The last article under this theme is by Mustafa Batikha who proposes some tips to avoid the influence of high temperatures in the workplace because the wellbeing of workers plays a significant impact on productivity and society's health and happiness.

Acknowledgements

The Editor would like to sincerely appreciate Charlotte Turner and Monika Toth for their continuous and invaluable help in producing and designing the CESC research bulletin.

Topic of Focus

The Rise of Sustainable Construction Trends in 2022 and Beyond

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Sustainable ways of living improve the quality of our lives, safeguard our ecosystem, and preserve our natural resources for future generations. In addition, sustainability is key in developing a holistic built environment. As construction continues to be a significant component of growth for global economies, developers, contractors, governments, and other stakeholders need to develop and incorporate solutions that make it green.

A report by the World Green Building Council (WorldGBC) stated that there are currently only 500 net-zero commercial buildings and 2,000 net-zero homes around the globe (which is under 1 per cent of all buildings worldwide). The UAE has launched the 2050 Net-Zero strategic initiative, a national drive to achieve net-zero emissions by 2050, making the country the first in the region. While there is a long way to go, there is a lot more the industry can do collectively to be on the path to achieving it.

Furthermore, according to reports, over $10 trillion is spent globally per year on construction-related activities -- and that's projected to keep growing yearly by 4.2 per cent until 2023.

Advanced Technology

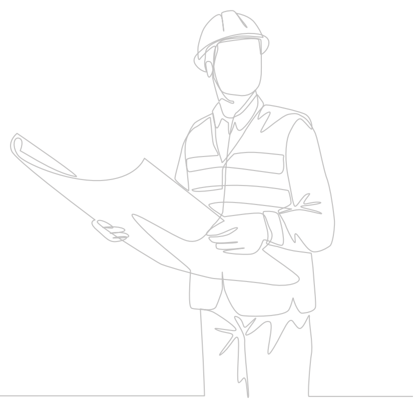
Technology has clearly embedded itself into many construction processes. The potential impact of advanced technologies such as Artificial Intelligence, Internet of Things, computer visioning, and modelling can phenomenally drive the industry towards sustainable construction. For example, IoT can collect specific information about materials, equipment, or building part and provide live data related to sustainability that can be harnessed with AI and Modelling to evaluate, visualise, compare, make decisions, and/or predict scenarios. Building Information Modelling (BIM) is another aspect of technology that the sector is consistently using. Using BIM data and simulation tools over the whole project lifecycle enables less wasteful construction and more cost-effective, sustainable operation, maintenance, and eventual decommissioning. Furthermore, the Digital Twin concept is gaining more and more prominence. It refers to the consolidation of data representing a physical object, in this case, a building site or the building itself (either in construction or already built). This pairing of the virtual and physical worlds allows data analysis and monitoring systems to understand and target problems before they occur, prevent downtime, develop new opportunities, and even plan for the future by using simulations. Digital Twin technology can also help improve the sustainability of buildings by enhancing the productivity and efficiency of the assets or ensuring buildings meet sustainability, efficiency, or regulatory requirements.

Modular Construction

A report by McKinsey stated that modular construction offers the industry an opportunity to shift many aspects of building activity away from traditional construction sites and into factories with off-site, manufacturing-style production. However, not a new technology, modular or prefabricated construction, has seen major technological improvements and upgrades coupled with growing demands and changing mindsets making it an attractive investment for corporates and governments. Modular construction has evolved significantly due to using various planning and application technologies and incorporating sustainable building materials, contributing to faster turnaround times and economic advantages. Modular construction plays a major role in making the construction sector more sustainable as it reduces waste thanks to the controlled environment it introduces. Additionally, prefabricating buildings off-site will reduce carbon emissions often generated on large construction sites due to lorry traffic and reliance on unsustainable power generators. The method also delivers efficient, versatile, and high-performing buildings, which can be reused multiple times.

Innovative Materials

Can Construction materials be greener? This question can potentially be answered by the wonder of some existing innovative materials, one of which is called graphene. Although not too highly used in commercial construction, Graphene possesses strong qualities to support green construction materials. Technically, it is a one atom thick carbon layer but 200 times stronger than steel, transparent, flexible, highly conductive both thermally and electrically. According to research, graphene has the potential to transform the built environment. For example, Graphene has been incorporated into traditional concrete production by scientists, developing a composite material. The method of incorporating graphene produces a high yield of concrete without defects and could be used directly on building sites, enabling the construction of sustainable and strong buildings using less concrete and reducing greenhouse gas emissions. While the material is already used in sportswear and equipment, making tennis rackets and footwear lighter and more durable, its usage in commercial construction has been minimal. However, it was reported in 2020 that the UAE has been closely following its progress, with an investment from Abu Dhabi's renewable conglomerate – Masdar making a substantial investment into an international innovation centre dedicated to graphene.



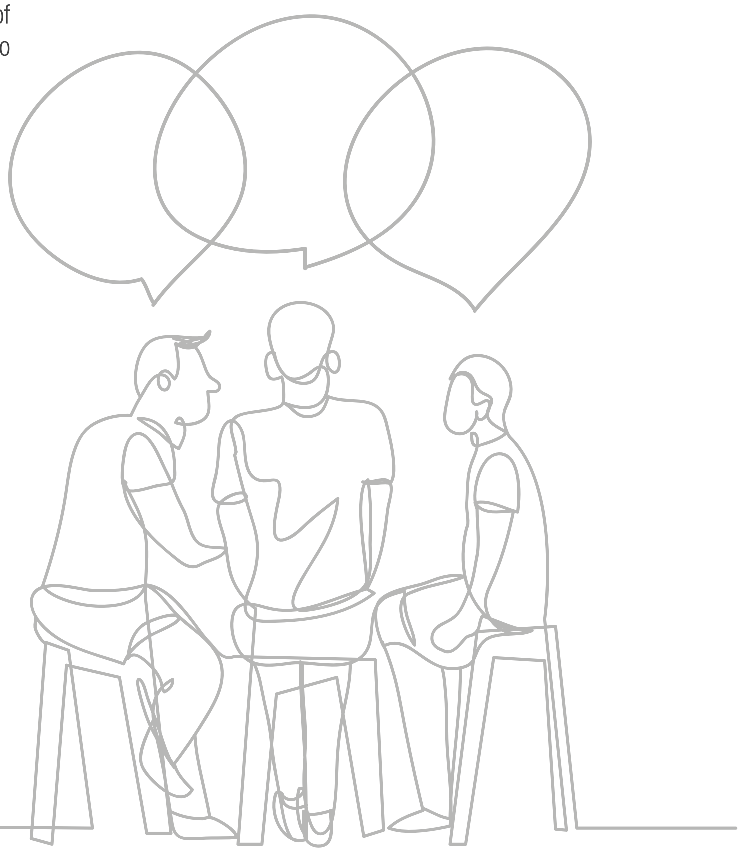
Topic of Focus

The Rise of Sustainable Construction Trends in 2022 and Beyond

Smart Retrofitting

One of the biggest sustainability concerns in the construction industry is the rise of new developments. Smart retrofitting existing building is one of the most important contributors in the built environment to combat this. As part of its commitment to the betterment of the environment, the UAE is taking significant steps in making it more sustainable. The country has set high targets for building retrofit, which are reflected in the UAE Energy Strategy 2050. Furthermore, the Dubai Supreme Council of Energy has set the goal of reducing Dubai's energy demand by 30 per cent by 2030, and retrofitting existing buildings is an integral part of the strategy. For sustainable development, the private sector must work with the government and semi-government companies to ensure these practices are followed. Initiatives that encourage a sustainable built environment need the combined effort from all parties. Studies have shown that deep renovation can be the preferred solution rather than superficial renovations from an economic and ecological perspective. Superficial renovations enhance the risk of missing the climate targets and huge absolute savings to remain untapped. Studies have also shown refurbishment's potential to upgrade the building stock's energy efficiency and the consequent savings in CO2 emissions. Retrofitting is a game-changer in modernising buildings to save the environment.

Modern-day construction is and should be about impacting the environment positively. Sustainability should not be a choice but a necessity across the globe. From making greener material choices to supporting sustainable use of available inventory – the Built Environment can be a game-changing sector to support efficiency and net-zero goals.



Performance and *Productivity*

Design of Solar Powered Greywater Treatment Unit for Residential Applications

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Many countries around the world depend primarily on seawater desalination process which is an energy-intensive process and incorporates high electricity consumption. In United Arab Emirates (UAE), desalinated seawater accounts for almost 89.9% of the country's water needs. The average residential water consumption is 550 liters per capita per day which is almost 82% higher than the world average. This paper aims to design a greywater treatment plant which is fully powered by solar photovoltaic (PV) panels. The proposed water treatment plant consists of a three-step filtration process to treat greywater. Initially, the collected greywater from households is pumped to a multimedia filter to reduce the level of turbidity followed by pumping the water at high pressure through Reverse Osmosis unit and finally passing the water in the chlorination chamber to remove odor and prevent microbial growth. The proposed system was implemented to the case study of a villa community located in Dubai which comprises 38 villas and accommodates a total of about 152 residents. The proposed water treatment plant has a capacity of producing about 83 m3 of clean water per day at a high recovery rate of 67%. The solar system proved to be efficient by providing energy of 57397 kWh which was enough to power entirely the greywater treatment plant. Cost analysis was carried out to assess the economic feasibility of the proposed plant. The system resulted in a tangible reduction in carbon dioxide emissions of 204 ton/year [1].

Keywords: Greywater, water treatment, Solar PV system, Reverse osmosis.

1. Introduction

The UAE has over 70 desalination plants present within the country, accounting for 14% of the total desalinated water produced globally [2]. They are operated by burning fossil fuels to produce around 2.19 billion m3 of water. Currently, the desalination of 1000 m3 of water per day, requires burning an average of 10,000 tons of oil that leads to an expected generation of 6.7 tons of carbon emissions. Conventional means of generating electricity pose a significant challenge for desalination plants as high costs of electricity are incurred which accounts for an amount of AED 12 billion a year to meet the increasing water demands [3]. The above issue was brought to light and considered as a foundation for this project to devise the design of a fully solar powered greywater treatment unit.

About 65% of the wastewater generated within a household is identified to be greywater, which accounts for the water drained from tubs, showers, washroom sinks, and washing machines [4].

The quantity of grey water produced in a certain region depends on the lifestyle, population, age, gender and living standards of the people in that community. Literature studies showed that this value typically ranges from 90 to 120 liters per capita per day [5]. Greywater treatment technologies include physical, chemical and biological processes. In general, these systems are preceded by pre-treatment systems and followed by disinfection processes. The main objective of the proposed design of solar powered greywater treatment unit is to collect and treat greywater generated within the residential community. Filtered water is transported back to the villas having water quality that complies with the quality standards for potable water issued by World Health Organization (WHO) and Dubai Electricity and Water Authority (DEWA).

2. System Design and Methodology

The current work incorporated the methodology shown in Fig 1 to meet the research objectives.

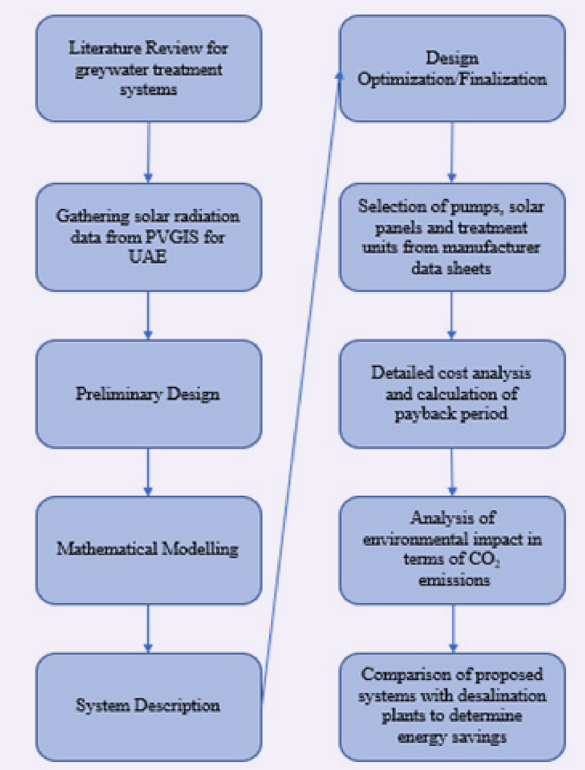

Fig. 1 Flowchart for methodology

Greywater from each villa is directed towards the nearest drainage manhole. According to the collected data, it was observed that every three villas in the community had a common manhole [6]. Submersible pumps located at each manhole will pump the greywater vertically upwards to the ground level and then to the collection tank placed at the treatment facility [6]. The schematic of the proposed design is shown in Fig.2.

Greywater pumped from the villas was collected in a large raw water storage tank. Collected influent water was then transported, to reach a multimedia filter which is used to reduce the level of turbidity in water and the amount of organic and inorganic contaminants. This pressurized filter vessel having multiple layers containing gravel, sand and activated carbon helps to remove suspended particles from the incoming water. The activated carbon layer removes taste, odor, and color from water. The next stage involves pumping the process water under high pressure to pass through RO unit which separates substances under pressure using microporous polymer membranes. Water is then passed onto a chlorination chamber where either chlorine, sodium hypochlorite or calcium hypochlorite is added depending on the pH level of water entering the unit to remove odor and prevent microbial growth which may have formed during the filtration process. The process of chlorination also prevents further microbiological growth inside the permeate water storage tank from which clean effluent water can be pumped to households for reuse. The treatment plant design implemented in the main case study is completely powered by 63 solar PV panels, installed around the treatment facility covering approximately 173 m2 of area, with each panel producing roughly 504 W of power.

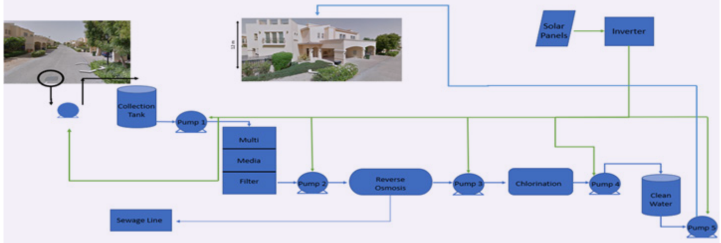

Fig. 2 Overall schematic of proposed treatment unit

3. Results

3.1. Design parameters of the selected case study

Considering an average of four people residing in each villa gives an approximate amount of 152 people living in the villa community. Also, assuming an individual uses 550 liters of water per day (i.e., average water consumption per capita in UAE), the total amount of water used per day within the community is approximately 572 m3. With reference to the literature, it was found that, in a typical household, 65% of the wastewater generated is greywater. Therefore, 123.9 m3 of greywater is generated within the community per day.

3.2. Design of Solar system

The Global Irradiance at optimum angle for a day was estimated using PVGIS Software [8] to be 6.686 kWh/m2. Hence the yearly irradiance would be 2440.704 kWh/m2.

There are several losses such as invertor losses, temperature losses, DC/AC cable losses and losses due to dust, pollution etc., that reduce the panel efficiency.

A panel rating of 560 watts having solar cell efficiency of 24.505% was chosen [9]. Hence the power output capability of a single solar panel is 421 W. The relationship between average monthly kWh requirement, peak hours of sunlight and panel wattage was used to determine the total number of solar panels required which was found to be 49. The central inverter used in this design was sized using the number of panels and the panel wattage. This value was calculated to be roughly 30 kW. The 30 kW sized solar invertor chosen for this design, has an overall output efficiency of 98%. Thus, the required production of electricity from solar panels is 58,568.33 kWh/year. The amount of electricity obtained by solar panels is sufficient to meet the required electricity requirements described in section 4.2. Each 560 W panel has an area of 2.734 m2. This requires a total area of 134 m2 of solar panels to be installed [9].

The cost for one watt of the solar panel was found to be AED 0.8441 [10]. This implies the total cost of panels to be USD 6312. Other miscellaneous costs involved with solar panels (invertor, racking, cable lines) are considered to be around 20% of the above-mentioned cost.

An additional 10% is included as installation charges. Hence the total cost for the solar components including installation costs is USD 8205.

3.3. Description and cost of the water treatment unit

The main costs of the water treatment unit are associated with the pumps and filtration process. Table 1 summarizes the different types of pumps used and their costs in the market [7], [11].

Table 1 List of pumps and their and costs [24], [11]

Type of Pump	Purpose/Position	Number of Pumps	Cost (USD)
Open Impeller (Filter Feed Pump)	From inlet tank to multimedia filter (MF)	1	1471
Vertical Multistage (High Pressure Pump)	From MF to RO unit	1	2772
Dosing Pump	Chlorination chamber	1	136
End Suction Pump	From RO to chlorination chamber	1	1414
End Suction Pump	From outlet tank to villas	1	2767
Sump Pump	At manhole	87	408.5

Accordingly, the initial cost developed to purchase the required pumps at the greywater treatment facility is USD 44,126. Additional 25% for operational and maintenance costs for pumps is included. Therefore, the total costs for pumps are USD 55,157.

Table 2 shows the filtration units used in the process and their costs. Additional 25% for operational and maintenance costs for filtration systems is included. Hence the total costs for the filtration units are USD 168,750. Hence the combined cost for setting up the entire treatment unit, excluding solar components, is USD 223,907.

Table 2 Different filtration units used and their costs [10]

Equipment	Cost (USD)
Multimedia Filter	30,000
Reverse Osmosis unit	65,000
Chlorination	25,000
SS316 Piping	10,000
Auxiliaries (Valves, Gauges)	5,000
Total	135,000

4. Conclusion

A completely off-grid solar powered greywater treatment unit design for residential applications was devised. The three-step filtration process comprised a multimedia filter, reverse osmosis unit and a chlorination chamber. The produced clean drinking water satisfied the water needs of approximately 152 residents in a community of 38 Villas. The treatment unit that operates at a recovery rate of 67% has the capability of producing 83.223 m3 of potable water per day. The amount of potable water returned to each villa for reuse every month is 2112 Imperial Gallons (IG). The standard tariffs for water consumption provided by DEWA were used to determine the expected monthly savings to be roughly USD 7960. After thorough calculations, the total cost of the treatment facility including operational and maintenance costs was found to be USD 241121. For future work, the design will be optimized by the application of multi-stage reverse osmosis processes between the multimedia filter and chlorination chamber to increase the overall productivity and recovery rate of the system. Water leaving the first membrane will be fed to the second reverse osmosis stage. The permeate water leaving the second stage is combined with the water leaving the first stage and then directed towards chlorination. Detailed cost and performance analysis need to be conducted to determine the feasibility of the proposed design.

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HyperloopTT: The New Way of Future Travel

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Current transportation systems and their accompanying inefficiencies are expensive. Gridlocked highways and cities cost countries billions of dollars of economic activity annually while requiring recurring long-term investment for minimal gains. Hyperloop System can change all that. The system can move people and goods at airplane speeds safely, efficiently, and sustainably. The system operates with very little aerodynamic drag and significantly reduced friction.

Keywords: Transportation; Hyperloop System; HyperloopTT; Advanced Transportation Systems.

Introduction

Transportation is a multibillion-dollar industry that has yet to meaningfully innovate against issues of gridlock, pollution, and passenger discomfort. Current systems rely heavily on government subsidies, an expensive and unreliable paradigm. Existing systems have been optimized in the last decades, but systemic problems are left unaddressed. The rise in metropolitan populations brings the need for satellite urban settlements with fast connection to city centres. In a world of constant, disruptive innovation, why did transportation have been overlooked, and why the advancements of new technologies have not touched transportation systems, some of our public transport systems are still reliant on Victorian technologies?

Impacts of current transportation

2.1. Economic

Current transportation systems and their accompanying inefficiencies are expensive. Gridlocked highways and cities cost countries billions of dollars of economic activity annually while requiring recurring long-term investment for minimal gains. Air travel and its associated emissions cost the European Union 66.7 billion Euros in 2016 and will continue costing future generations as travel demand increases. The billions being lost in economic activity or being spent to counteract the effects of climate altering emissions, do not include the consistent subsidization of public transportation. Rail systems maintain high operational and maintenance costs that require ongoing government subsidies. Subsidized infrastructure around the world costs governments and taxpayers for every passenger that uses the system.

2.2. Environmental

Current transportation systems account for 8.8 billion tons of CO_2 emissions annually, representing 23% of global CO_2 emissions. Fossil fuel reliant transportation options aim to reduce their environmental impact but will continue to increase pollution. Even current electric rail options are negatively impacting the environment using fossil-fuel derived electricity and the segmentation of habitats by continuous ground level rail lines. Minor transportation innovations reducing the volume of harmful emissions are not enough to halt the long-term climate challenges. The world needs a fully sustainable, renewable powered transportation system.

2.3. Social

Global citizens are losing hundreds of hours every year to gridlock, causing society wide increases in stress and anxiety. As passengers struggle to make progress on overcrowded roadways, underdeveloped airports are failing to meet the needs of travelers. New airport capacity developments drastically underserved passenger projections for the next 10 years and will lead to increased security waiting times, flight delays, and other travel inconveniences. Current rail systems are liable to accidents and delays caused by human error, decreasing their safety and reliability. Modern societies cannot run on the infrastructure of the past, and small incremental improvements fail to meet the travel needs of future generations.

Hidden costs of infrastructure

Throughout the world, our transportation infrastructure is failing to meet the expanding capacity of urban centres and to effectively distribute and manage population density. Congestion negatively impacts affected cities with wasted time, lost productivity, increased air pollution including carbon dioxide levels, reduced predictability, increased risk of collision, additional wear on vehicles and roads, as well as the psychological and social impacts like increased stress, anxiety, and decreased life-expectancy.

Hidden costs are often neglected in assessments of what the optimal mobility solutions are for local or intercity transportation, but their very real societal impact must be considered when analysing current systems. Hyperloop Transportation Technologies (HyperloopTT) is building a mobility platform that positively impacts the economic, societal, environmental, and social health of connected regions.

HyperloopTT, faster than airplane, cheaper than rail

Hyperloop can move people and goods at airplane speeds safely, efficiently, and sustainably. Passenger and cargo capsules levitate just above a track and travel through a network of low-pressure tubes between cities. Proprietary passive magnetic levitation and a linear electric motor, combined with a tube environment in which air has been drastically reduced, allowing the capsules to move at very high speeds with minimal friction.

The system operates with very little aerodynamic drag and significantly reduced friction. HyperloopTT uses passive magnetic levitation, requiring significantly less electricity than conventional maglev systems, to create ecologically sustainable and low impact travel. Renewable energy provides power to the system, which is designed to be net-energy positive over a full year of operation. The system operates autonomously, which increases safety, reduces operating costs, and creates a more profitable mobility solution.

HyperloopTT was founded in 2013. Today, it's a global team comprised of more than 800 engineers, creatives, and technologists in 52 multidisciplinary teams, with 40 corporate and university partners.

Headquartered in Los Angeles, CA, HyperloopTT has offices in Abu Dhabi and Dubai, UAE; Bratislava, Slovakia; Toulouse, France; and Barcelona, Spain. HyperloopTT has signed agreements in Ohio, Slovakia, Abu Dhabi, the Czech Republic, France, Indonesia, South Korea, and Brazil.

4.1. Hyperloop Components

HyperloopTT Capsule

The capsule size is like a small commercial aircraft without wings, hyperloop's pressurized capsules float on a frictionless magnetic cushion within the tubes (Figure 1).

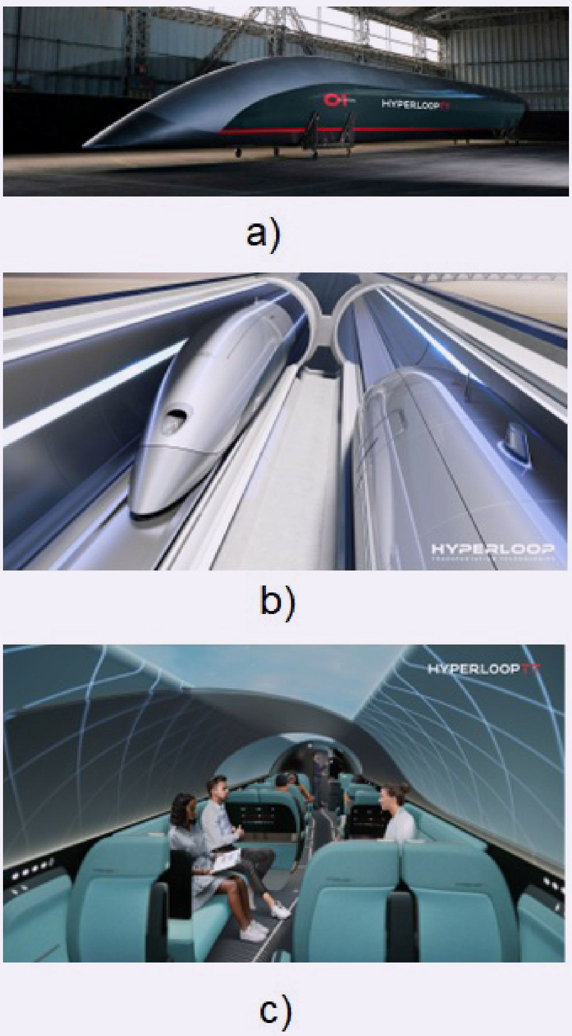

Fig. 1 Hyperloop System: a) HyperloopTT Fullscale Capsule, b) Typical cross section of a Hyperloop System, c) HyperloopTT Capsule Concept Design.

HyperloopTT capsules are engineered and designed for ultra-high speeds using cutting-edge composite materials and safety features. HyperloopTT developed a smart material with sensors embedded between carbon-fiber, and fuselage skin to monitor and transmit critical information regarding temperature, stability, and integrity, all wirelessly and instantly.

HyperloopTT Tube Structure

The primary function of the tube is to provide a straight and level guideway and a reduced-air-friction weatherproof corridor for capsules to travel through. The tube shell maintains a partial vacuum pressure to allow smooth high-speed operation of the passenger capsules, houses the high-speed and low-speed guideway, provides attachment points for communications and safety systems, and forms the structural foundation for the solar panels. Typical civil engineering principles are employed in the design of the structural capacity of the tube, while typical vacuum design principles are employed to maintain the pressure boundary. Tube materials could include steel, reinforced high-performance concrete, and composite materials.

HyperloopTT Support Structure

The capsule size HyperloopTT system infrastructure has a low Capital Cost compared to other high-speed transportation systems. As a civil infrastructure project covering long distances, the system can be implemented according to land availability and the complexity of the Right of Way will. This could be above ground, at grade, or below ground, optimising to meet unique local conditions.

The HyperloopTT system reduces the environmental cost of a large-scale infrastructure project by integrating solar panels and other renewable energy sources to create a net energy positive system that aims to generate more energy than it utilizes. The harnessing of renewable energy also lowers operational costs. The system operates in a low-pressure, fully enclosed environment, eliminating traditional hazards from weather and traffic crossings and significantly improving efficiency and reliability.

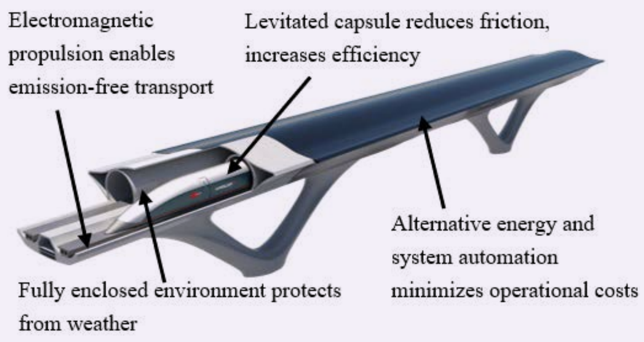

Fig. 2 HyperloopTT Support Structure

HyperloopTT Station Design

HyprloopTT stations are designed with the passenger's needs in mind. Every moment along the HyperloopTT journey is engineered to deliver a frictionless experience with digital ticketing, biometric check-in, wayfinding, and an on-demand boarding system.

HyperloopTT stations are specifically designed for local environments. A transit-oriented development, the station integrates existing first and lastmile solutions while creating a dynamic space where passengers can access goods, on-demand services, and experiences. Stations are designed as community hubs that reflect the local culture and provide significant value to surrounding neighborhoods and passengers.

Fig. 3 HyperloopTT Station Concept Design.

HyperloopTT Vacuum System

The low-pressure environment inside the tube is achieved through a specially designed HyperloopTT vacuum unit. Co-developed with Leybold, the inventor of the vacuum pump, the unit fits within a standard shipping container to offer a plug-and-play solution. The system is optimized to achieve and maintain low pressure in the tubes while minimizing energy consumption and maximizing operational uptime. The containers will be located along the route every 6.2 miles.

With the air inside the tube drastically reduced, the capsule can achieve high speeds with less energy consumption.

a)

b)

Fig. 4 a) HyperloopTT Vacuum System, b) Vacuum Pumps

HyperloopTT Passive Magnetic Levitation

HyperloopTT proprietary passive magnetic levitation technology called Inductrack™ is a game-changer for high-speed transportation. The magnets are arranged in a Halbach array configuration, enabling capsule levitation over an unpowered but conductive track. As capsules move through the low-pressure environment, they use very little energy on route thanks to the reduced drag forces.

Should there ever be a power failure, the capsule will automatically slow down and settle on its auxiliary wheels at low speed. The Inductrack™ system was tested and validated on a full-scale passive levitation track. HyperloopTT then improved the technology and optimized it for a low-pressure environment through testing in our prototype.

HyperloopTT Current Development

The HyperloopTT system is inherently sustainable and operates with zero emissions, the technology is faster, safer, and far cleaner than existing modes of transport by design. Hyperloop System uses less energy than alternatives. HyperloopTT provides a smarter economic solution for many regions worldwide.

HyperloopTT is actively engaged with governments around the world, providing a critical technical understanding of hyperloop systems to both the European Commission and USDOT. HyperloopTT is advancing towards the first commercial route, with both passenger and freight systems under development around the world.

In 2016, HyperloopTT signed an agreement with Abu Dhabi Department of Transport to carry out a Feasibility Study for a Hyperloop System to link Abu Dhabi city and Al Ain city. The study was the first detailed hyperloop feasibility study in the world.

In 2018, HyperloopTT signed a public private partnership agreement with the Northeast Ohio Areawide Coordinating Agency (NOACA) to study a Great Lakes Hyperloop corridor.

In 2018, HyperloopTT signed a public private partnership agreement with the Northeast Ohio Areawide Coordinating Agency (NOACA) to study a Great Lakes Hyperloop corridor.

In April 2018 HyperloopTT and Aldar Properties sign an historic agreement for the world's first commercial Hyperloop system of 10km in critical development area between Abu Dhabi and Dubai. The site is in Aldar's Seih Al Sdeirah landbank in Abu Dhabi and near the residential development AL Ghadeer.

HyperloopTT opened the first European Research and Development Centre in Toulouse, France, the aerospace capital of Europe, and is home to the world's first and only full-scale test system and full-scale capsule where the system components the capsule will be tested.

a)

b)

Fig. 5 Projects by HyperloopTT: a) Concept Design of first Hyperloop commercial system in Abu Dhabi, b) HyperloopTT first European Research and Development Centre in Toulouse, France..

Conclusion

HyperloopTT system is inherently sustainable and can operate with almost zero carbon emissions. HyperloopTT is working on a pioneering transportation technology that is faster, safer, and far cleaner than existing modes of transportation by design. This is due to Hyperloop System is designed to use less energy than current alternative transportation systems. HyperloopTT is developing a smarter economic solution for many regions worldwide. Hyperloop Transportation Technologies has demonstrated a commitment to the Ten Principles of the United Nations Global. This innovative breakthrough in transportation will be critical for humanity to meet the ambition of the United Nations Sustainable Development Goals.

Acknowledgements

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For further reading

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Sustainability

Techno-economic Analysis of Energy Storage System for Clean Energy Strategies: Dubai Perspective

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The United Arab Emirates (UAE) has stepped up to layout its Clean Energy Strategy well in advance within the region. Dubai, one of the Emirates in the UAE, has been aggressive in implementing its own Clean Energy Strategy 2050, from 7% clean energy in 2020 to 25% by 2030 and 75% by 2050 in its energy mix- with Solar PV being the most preferred clean energy choice in the Emirate of Dubai. This work evaluates the existing energy mix and the targeted energy mix for 2030 and 2050. Also, the current trends of selected energy storage technologies are presented. The study also presents the economic and sensitivity analysis of different clean energy penetrations scenarios, including carbon taxation using HOMER-Pro tool. For the 2030 scenario, Net Present Cost (NPC) is $Bn 170 with a Lifecycle Cost of Electricity (LCOE) of $0.098. 2050 Scenario proved to have an NPC of $Bn 240 with LCOE of $0.085. The presented findings shall benefit those interested in evaluating the techno-economic aspects of solar PV integration with energy storage in the middle east and elsewhere where higher renewable penetration is projected.

Keywords: Clean Energy; Renewable Energy; Techno Economic; Energy Storage.

1. Introduction

Many governments increasingly adopt clean energy strategies aimed toward the decarbonization of the planet across the world. These strategies will play a key role in accelerating renewable power generation technologies and energy storage technologies in the coming decades. Although there are many energy storage technologies available in the industry, specific focus and geographic conditions, and economies of scale play a massive role in choosing the right ones for each country or geography.

The Middle East aims to be at the centre of this energy transition as it unfolds itself from oil-based to clean and sustainability-oriented. The increased penetration of solar PV generation is helping many countries in the Middle East embrace aggressive clean energy targets for the coming decades. As one of the early adopters of many initiatives, UAE has taken the world stage by announcing its leadership for a cleaner, greener future. In 2017, UAE laid out its "Energy strategy 2050" with a target share of 50% coming from clean energy in the total energy mix by 2050 [1]. Dubai has also launched its "Dubai Clean Energy Strategy" [2] to have 25% of the energy mix by 2030 and 75% of the energy mix from clean sources by 2050. Dubai has invested AED50 billion in the Mohammed bin Rashid Al Maktoum Solar Park: the world's largest single-site solar project with Independent Power Producer (IPP) model and a capacity of 5 GW [3].

The rising penetration of renewables such as solar PV results in a few challenges due to the intermittency in the power generation and power utility grid balancing to match the power supply and load demand. Hence, the success of clean energy strategies also depends on the success of Energy Storage technologies and their economics. Massive investment streams and technology evolution shall also happen in energy storage technologies to make the increasing renewable penetration a reality in future grids.

Investments and research on Energy Storage Systems (ESS) have been aggressive. The ESS serves both the electricity and the transportation industry in terms of Electric Vehicles (EV) and hydrogen mobility of different energy storage technologies available today for various geographies dominate in various technologies with respect to adoption. For the Middle East, the potential could lie in thermal storage (if economic and risk-free in technology challenges) or battery storage (driven by solar PV) along with flow batteries due to land availability. Green hydrogen is being looked at as the new oil for the region [4] in the longer-term horizon. Air Products and ACWA Power have announced a 5 GW green hydrogen project at NEOM, Saudi Arabia, making it the most significant investment in hydrogen in the middle east. Electrical energy storage was thoroughly researched by Bruce et al [5]. Campos-Gaona et al. [6] presented their techno-economic assessment for wind power applications in the UK [6]. Although past and present research helped to assess multiple energy storage technologies for different scenarios, a focused assessment on a futuristic clean energy strategy with 25%-75% renewable penetrations presents an opportunity in itself.

1.1 Energy Storage Technologies

Electricity storage technologies will play a crucial role in enabling the energy transition towards cleaner and renewable power generation. Different energy storage technologies (EST) exist, such as electrical, mechanical, chemical, and electrochemical, as shown in Figure.1. These EST serve various purposes ranging from demand-side management such as peak-shifting, peak- shaving to ancillary services such as frequency regulation, load-balancing, and spinning reserves to support electricity grid for increased penetration of renewable energy generation. These applications influence the techno-economic selection of energy storage technologies. Figure 2 shows an example of the discharge times and the power capacities for various applications and related energy storage technologies.

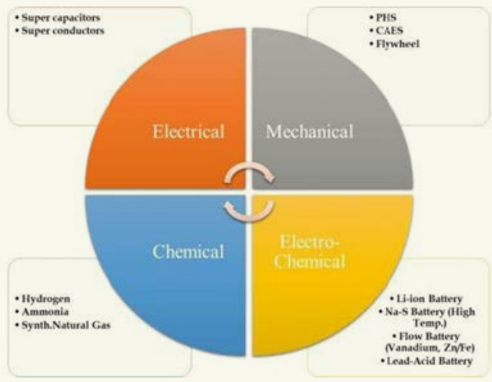

Fig. 1 Energy Storage Technologies Types.

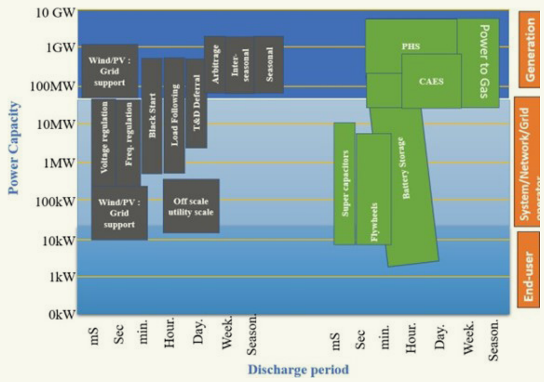

Fig. 2 Energy storage Applications and the relevant technologies.

The usage of EST is dependent on the time needed to serve the application and the power requirement. Services such as voltage and frequency regulation needed milli seconds (ms) response times and grid balancing. Supercapacitors, Flywheels serve these purposes given their super-fast response times and high-power densities. Black start, a methodology to restart the generators following a blackout/loss of line power, would need 15-30 minutes. Battery storage technologies, given their more comprehensive range of performance criteria, can serve this purpose. Load following, T&D deferral would typically last hours-days, and thus PHS, CAES, and BSS would be the suitable ones given their high energy/power ratings and discharge periods.

This article aims to give the technical and economic evaluation of having different energy storage options to support the grid with the forecasted many renewable capacity additions laid out in the Dubai clean energy strategy for 2030 and 2050 while also presenting the as on date energy mix assessment. The sensitivity analysis of these scenarios will also be discussed, including the carbon tax on emissions.

2. System Modelling and Analysis

HOMER-Pro software tool is selected in this work to model and simulate the different energy mix scenarios due to its robust and accurate modelling of hybrid energy storage systems and power generation schemes. The modelling and simulation are divided into three main scenarios, (a). 2020-22 Dubai clean energy strategy scenario (b). 2030 Dubai clean energy strategy scenario (c). 2050 Dubai clean energy strategy scenario. Each scenario is built to resemble the targeted Dubai Clean Energy strategic energy mix (and higher) and assesses the different energy storage technologies.

Most of Dubai's power generation comes from natural gas-based power plants. Dubai currently has 11.3 GW of NG-based power generation capacity [2]. As to the Dubai clean energy strategy, by 2020, it was expected to have a 7% clean energy mix. MESIA report (MESIA, 2021) [7] highlights that International Energy Agency (IEA) is projecting that the global solar installations are expected to grow 12-13% annually for the next decade. Considering the investments announced in Dubai at both grid level as well as Shams Dubai, a growth rate of 8.6% until 2030 and 11.3% between 2030-2050 are considered for Solar PV. NG-based power generation is expected to grow 3% until 2030 and 1% between 2030-2050. The overall projected electricity mix for 2020-22, 2030 and 2050 is shown in Figure 3.

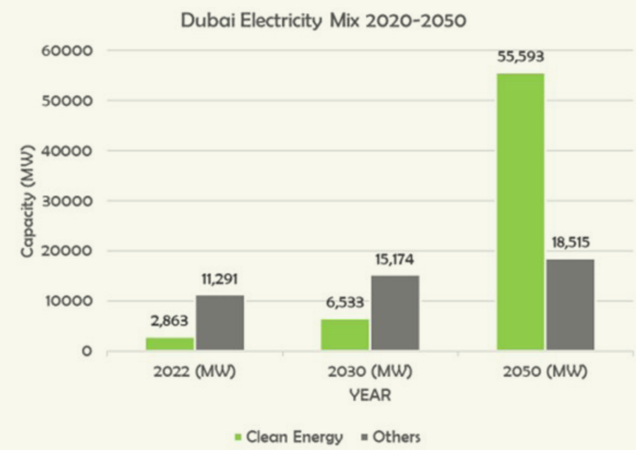

Fig. 3 Estimated electricity mix for Dubai 2020- 2050

3. Results and Analysis

HOMER-Pro defines the total Net Present Cost (NPC) of the system as the present value of all the costs the designed system incurs over its lifetime, minus present value of all its revenue streams it earns over its lifetime. System costs typically include capital costs, replacement costs, O&M costs, fuel costs, emissions penalties, and the costs of buying power from the grid. System costs typically include capital costs, the present value of all the revenue streams it earns over its lifetime. The other economic term the HOMER-Pro benchmarks the results with is the levelized Cost of Energy (COE) which is also called Lifecycle Cost of Electricity (LCOE) in industry. It is defined as the average cost per kWh of useful electrical energy produced by the system in its overall lifetime.

3.1 2030 Scenario

Figure 4 shows the HOMER-Pro model of Dubai 2030 energy mix scenario. In this scenario, renewable energy (RE) is simulated for 30%, 35% and 40% penetrations to assess the feasibility of higher RE penetration.

For 25% RE fraction, 15 GW of Solar PV with 12874 MWhr Li- ion battery system proved to be the optimal case with NPC of US Bn$166 with the COE of US$0.0938. For 30% RE fraction, a combination of 20 GW solar PV, 18 GW of CCGT with 15461 MWh Li-ion, flywheel combination has the same NPC and COE. For 35% RE fraction, the scenarios of Li-ion storage and the redox flow battery scenario with flywheel and the PbA and flywheel all prove to be very close in the COE of US$ 0.095. For 40% RE fraction, the combination of flywheel, Li-ion along with 25 GW of solar PV and 15 GW of CCGT proved to be optimal with a COE of US$0.0927 and an NPC of US Bn$164 as shown in Figure 5.

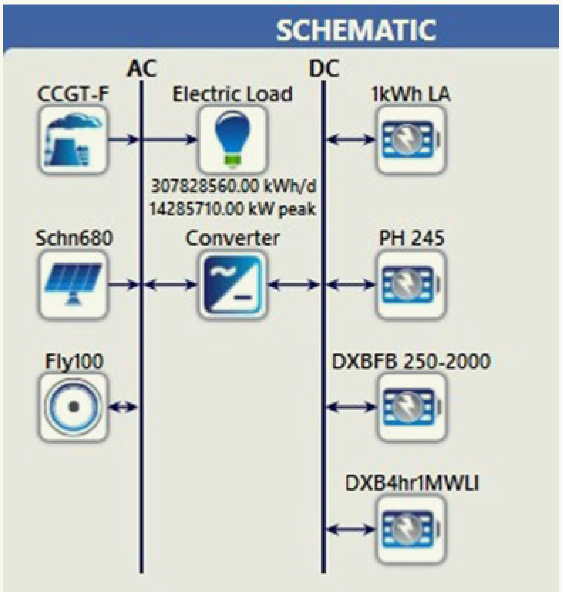

Fig. 4 Dubai's 2030 energy mix scenario

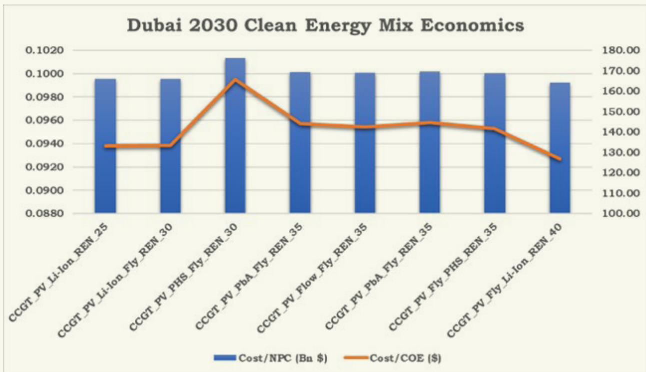

Fig. 5 Economic indicators for 2030 scenario.

The sensitivity analysis is carried out with a CO2 tax of $0/tnCO2, $40/tnCO2, and $80/tnCO2, along with the Internal Rate of Return (IRR) of 6%, 8%, and the inflation rates 2%, 4%. The optimal sensitivity cases are possible for 37% RE fraction. As the CO2 tax increased, the NPC, COE followed it with high valuations. For an increased IRR rate for the same inflation and CO2 tax, the NPC decreased while COE increased small fractions. The CO2 taxation from 0- $80/tnCO2 resulted in $30Bn increase in the NPC and $0.015-$0.02 rise in COE.

3.2 2050 Scenario

In the 2050 scenario, green hydrogen is introduced in line with the industry forecasts for green hydrogen becoming widely economical driven by the economies of scale of solar PV and electrolyser deployment [8]. The system shown in Figure 6 reflects the design of Dubai clean energy strategy 2050 scenario. The Pb-A battery system and Flywheel are discarded by introducing hydrogen and Li-ion battery storage and Redox Flow batteries. As the green hydrogen is configured to be generated from the curtailed/excess solar PV output, the hydrogen fuel cost for H2-CCGT shall reflect as zero in this study. The incremental costs of water for electrolysis are included in the overall electrolyser costs.

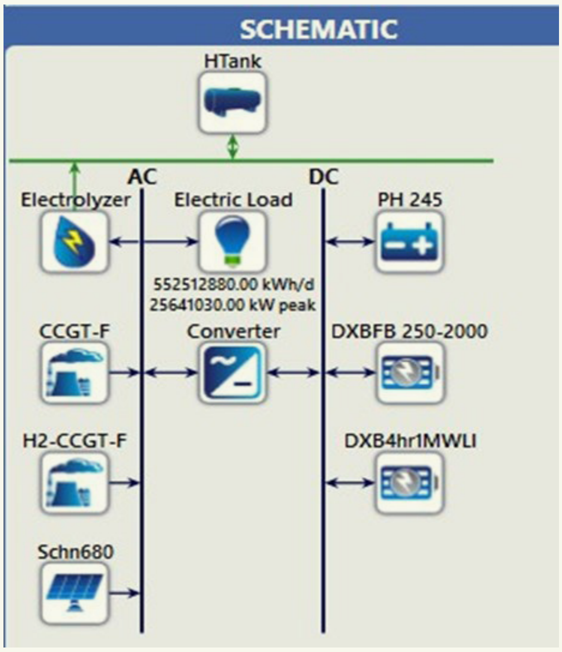

Fig. 6 Dubai's 2050 energy mix scenario.

Table 1 shows both 75% and 97% RE fraction scenarios are assessed to validate the feasibility of such self-sufficiency of RE generation coupled with energy storage technologies. To achieve 75% RE energy in the mix, a total installed capacity of 90 GW for solar PV is estimated along with 20 GW of CCGT and 3-5 GW of CCGT converted into hydrogen combustion capability. This is feasible with an electrolyser capacity of 6 GW overall and a hydrogen storage capacity of 3122 tonnes. The Li-ion battery storage is expected to be 39 GWhr. For the 100% RE grid, the solar PV installed capacity shall be 120 GW with a reduced CCGT installed base of 15 GW and hydrogen fired CCGT of 7.5 GW is required. The cost reductions in projected hydrogen and solar PV, and Li-ion are reflected in the cost effectiveness of the NPC and COE.

Table 1 2050 Model configuration and capacity.

Case Description	System/Ren Frac (%)	Schn680 (GW)	CCGT-F (GW)	H2-CCGT-F (GW)	DXB_4hr1M WLI	Electrolyzer (GW)	HTank (Tonne
CCGT_PV_Li-Ion_H2_REN_75_1	77	90	20.00	3	393120.00	6	3122.69
CCGT_PV_Li-Ion_H2_REN_75_2	77	90	20.00	4	393120.00	6	3122.69
CCGT_PV_Li-Ion_H2_REN_75_3	77	90	20.00	4	393120.00	5	3122.69
CCGT_PV_Li-Ion_H2_REN_75_4	77	90	20.00	5	393120.00	6	3122.69
CCGT_PV_Li-Ion_H2_REN_75_5	76	90	20.00	5	393120.00	5	3122.69
CCGT_PV_Li-Ion_H2_REN_100_1	97	120	15.00	7.5	393120.00	8	3122.688
CCGT_PV_Li-Ion_H2_REN_100_2	97	120	15.00	7.5	393120.00	8	21858.82

For 75% RE penetration scenario, the excess solar PV generation is used for hydrogen production to power the H2 fired CCGT. As shown in Figure 7, the average NPC for the 75% RE scenario is about US$240-260Bn with the COE of US $0.085. For 100% RE scenario, the NPC ranged about US$ 240Bn with further lower COE of US$0.0810.

Sensitivity analysis with respect to CO2 penalty of $0/tonCO2, $40/tonCO2, $80/tonCO2 for the 75%, 100% RE mix is carried out. The NG-powered generation's impact from CO2 tax is reflected with an NPC increase of $12Bn for $40/tonCO2 and $25Bn for $80/tonCO2 taxations. However, for 100% RE scenario, the impact of CO2 tax is hardly $2-3 Bn even for 80$/tonCO2 taxation with hardly an impact on COE.

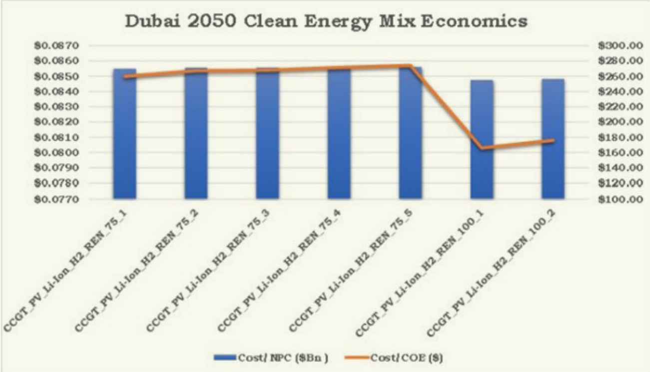

Fig. 7 Economic indicators for 2050 scenario.

Sensitivity analysis with respect to CO2 penalty of $0/tonCO2, $40/tonCO2, $80/tonCO2 for the 75%, 100% RE mix is carried out. The NG-powered generation's impact from CO2 tax is reflected with an NPC increase of $12Bn for $40/tonCO2 and $25Bn for $80/tonCO2 taxations. However, for 100% RE scenario, the impact of CO2 tax is hardly $2-3 Bn even for 80$/tonCO2 taxation with hardly an impact on COE.

Conclusion

This article presented an exemplary clean energy strategy of Dubai, UAE, and discussed the technological and economic merits and demerits of different energy storage technologies along with solar PV generation, which is the enabler for those technologies. Also, the future cost projections and the technologies that could prove feasible in the given regional focus were addressed and discussed.

The renewable penetration scenarios in line with the clean energy strategies, i.e., 2030, and 2050 scenarios, with the respective load/generation profiles and short-listed energy storage technologies are presented. In the given scope boundaries of this work, the overall technical and economic assessment with respect to 25%, 30%, 40%, 75%, and 100% renewable fraction scenarios were discussed to understand the feasibility and investments and COE of the said configurations. Green hydrogen is also addressed in the 2050 scenario, where it plays a role in utilizing the curtailed solar PV generation and helps the overall decarbonization theme. Monumental solar PV installations and energy storage and electrolyser technologies are required to enable green hydrogen economies of scale by 2050.

While the overall clean energy strategy targets look economical and technically feasible, the technological advancements and investments in energy storage must follow industry projections and policymaking.

Further research can address the grid stability, and reliability aspects with respect to short-term intermittency factors of high renewable penetration and energy storage device charge-discharge performances. It is safe to conclude that the ongoing and upcoming research will further bolster this research and design aspects to support such high renewable penetration at the grid level for the practical and successful implementation of clean energy strategies.

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Unsustainable Urbanisation and the Role of Nature Based Solutions: Case of Middle East

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Middle East region presents highest opportunities for youth growth and globalization, reflecting by that the highest rates of urbanisation. Urbanisation significantly affects the local weather and climate system due to the ultimate changes in natural lands, winds pattern and water cycles. Once urbanisation becomes unsustainable, it disturbs the natural environmental balance. Nature-based solutions (NbS) focus on adopting and managing nature to address in-society challenges while providing beneficial results for both welfare and biodiversity as part of well-balanced socio-ecological systems. However, a shortage of the definition and application of NbS is found in the region. In this article, we will address the impact of rapid urbanisation and how Nature-based solutions can tackle the challenges of climate change in the Middle East through their sustainable management. We will discuss as well green roofs as NbS and its role in the urban environment.

Keywords: Urbanisation; Unsustainable Urbanisation; Nature-based solutions; Green Roofs; socio ecological systems; sustainable management.

1. Introduction

Urbanisation has been considered over the years with its pivotal role in providing critical development to nations. However, the impact of progressive urbanisation, minimal nature consideration, and how organizations and local authorities should respond to its concerns have been on the discussion table for decades. This paper will discuss some conceptual topics related to urbanisation and its impact on the Middle East region's three main pillars of sustainability (economically, environmentally, and socially). Furthermore, this documentation emphasizes nature-based solutions and how they can be adapted to improve the socio-economical balance in urban areas. It concludes that although urbanisation brings severe challenges, a well-balanced socio-economic system supported by nature-based solutions such as green roofs can resolve these challenges and presents some benefits as well.

2. Urbanisation & Nature based Solutions

2.1. Urbanisation in the Middle East

Perhaps we can define urbanisation simply as the inconsistency in size, density, and diversity of cities [1]; because of natural population increase due to high rapid rates of birth and decrease in death rates, in addition to forced and non-forced migration from surrounding or distant areas [2].

Most of the blooming happened in urbanisation in the oil exporting countries within the oil boom era. Take, for example, the period between 1960 and 1980, when the population doubled in Saudi Arabia, the United Arab Emirates, Oman, and Libya [3]. It has been found that energy consumption rises as urbanisation increases in the long run [4] due to the increase in traffic facilities. In addition to the increased percentage of built-up areas compromising the natural lands, associated with significant amounts of GHGs emissions [5].

For the MENA region, the benefit from urbanisation did not end as expected. The Egyptian sociologist Saad Eddin Ibrahim describes it as 'Urbanisation without Urbanism,' explaining how the quality of a city does not grow at the same rate as its size [8].

Urbanisation is supposed to procure specific sustainable development goals inclusive of economic, social, and environmental benefits. Economically, the city's density creates proximity to businesses and goods, which leads to its development. Socially, density entices the result of a wide variety of attractions and socially desirable activities. For the environment, urbanisation presents an opportunity for higher energy efficiency buildings and powering transportation compared to non-urban areas [10].

2.2. Natural based Solutions (NbS)

The International Union for Conservation of Nature (IUCN) defines Nature-based solutions as *''actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature.''* [6]

Nature-based solutions (NbS) organization provides a detailed definition of NbS as the solutions that *''involve working with nature to address societal challenges, providing benefits for both human well-being and biodiversity. Specifically, they are actions that involve the protection, restoration, or management of natural and semi-natural ecosystems; the sustainable management of aquatic systems and working lands such as croplands or timberlands; or the creation of novel ecosystems in and around cities. [7]''* Moreover, they describe the related series of actions that biodiversity affects and how local communities and residents govern it.

The ecosystem is a structural and functional unit of ecology where the living organism interacts with each other and the surrounding environment. The relationship between the ecosystem and surrounding societies is called Socio-ecological systems, where the nature-based solutions in a specific ecosystem are utilized to serve the community and enhance the built environment.

3.Impact of unsustainable urbanisation

Urbanisation trends transform cities into unique hubs for services and housing, fulfilling the promise of social inclusion and better social and economic opportunities for all citizens. However, when it is unsustainably managed, these same trends can severely strain urban water, waste, housing, energy, and utility systems, unleashing long-term stresses on their efficiency and exposing their weaknesses, particularly when impacted by internal or external forces [9].

Expediting the development of urban areas in unsustainable ways has caused environmental problems linked with transport, housing, waste, energy, and land use management [13]. Moreover, excessive exposure to urban pollution (in air, water, and soil) has been associated with increased health issues such as cardiovascular and respiratory problems. For example, the recent urbanisation in the Gulf Cooperation Council Countries (GCCC), including Bahrain, increased ambient and surface temperatures in newly developed built-up areas, and this phenomenon is known as the urban heat island (UHI) effect [10].

In July 2022, a flooding event in UAE resulted in at least seven dead. In addition to field units that carried out evacuations in the emirates of Ras Al Khaimah, Sharjah, and Fujairah, the worst were affected by floods that followed torrential rainfall [19].

Climate change and urbanisation have resulted in a broad range of societal challenges for urban areas [14], such as the loss or degradation of natural areas, soil sealing, drought, and flooding, which pose further challenges to biodiversity, ecosystem functioning, delivery of ecosystem services (e.g., clean air, water, and soil), and consequently human health and well-being [15].

4. The role of NbS in developing sustainable urbanisation

Nature is essential to targeting all Sustainable Development Goals (SDG) as it provides vital resources such as food, air, water, and energy. In addition, nature is used to create positive solutions for social, economic, governance, and environmental outcomes to the challenges set out in the SDGs [17].

Nature-based solutions are key to advancing climate adaptation, especially when results from unsustainable urbanisation. The approach is to work with nature, not against it — from restoring wetlands, which can protect against storms, to conserving forests that stabilize soil and runoff during floods.
For example, planting trees within the community-built-up area contributes to climate change resilience as this green cover naturally captures and stores GHG emissions from the surroundings. Trees also provide consistent quality for the soil and water in extreme weather patterns, moreover, it is a substantial element in creating biodiversity that is crucial for humans' health [18].

Nature-based solutions in a holistic concept would be beneficial in the context of climate action and sustainable solutions to enhance ecosystem resilience and adaptive capacity within cities. There is significant evidence for NbS benefits for restoration and rehabilitation of ecosystems, carbon neutrality, and improved environmental quality, eventually improving health and well-being [19].

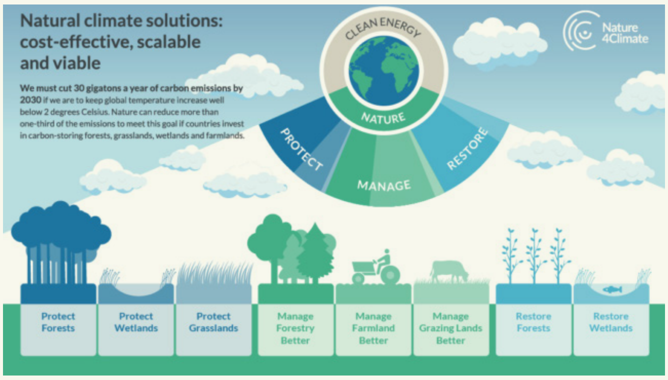

Fig. 1 Nature- based Solutions Benefits for the Built Environment.

However, the mechanism of NbS provision of the intended benefits, especially of combined multiple benefits of one and several NbS, still need to be better understood; especially, co-benefits, synergies, and trade-offs have not been systematically measured in diverse structures, configuration, and scale [16].

The NbS framework and principles provide a foundation for developing standards for successful implementation. The three NbS principles are synergy with other solutions; landscape scale considerations; and policy integration [18].

The approach is not working against nature from restoring wetlands, to protecting against storms, to protecting forests for stabilizing soil and runoff during floods [19].

Fig. 2 Nature- based Solutions Framework, Societal Challenges, and Associated Benefits.

5. Nature based solutions examples in the Middle East

One existing example is The Blue Carbon Project due to collaboration between The Environment Agency – Abu Dhabi (EAD) and the energy company - ENGIE. This project aims to restore mangrove forests along the coast of Abu Dhabi that were cleared in the late 1970s and 1980s. Using innovative drone planting technology, the Blue Carbon Project has planted over 35,000 mangrove seeds and saplings in the Mirfa lagoon [20].

In 2021, the UAE stepped up its ambition to expand its mangrove cover by raising the mangrove-planting target in its second Nationally Determined Contribution (NDC) under the Paris Agreement from 30 million to 100 million by 2030. The move consolidates the nation's position as a global leader in nature-based climate change solutions [21].

On the other hand, green roofs have multiple benefits such as managing rainwater, mitigating flood events, increasing biodiversity, improving air quality, and can help reduce the urban heat island effect.

However, the performance of green roofs in the Middle East region is yet to be investigated and controlled. This problem can be solved by constantly monitoring vegetation health, watering needs, and available water through advanced digital technology. Combining sensors, actuators, and the Internet of Things (IoT) with predictive models and 'live' weather data, it is possible to detect when plants have insufficient water. Innovative systems linked to the building wastewater recovery system(s) can automatically water the soft landscaped areas.

Polypipe ME, as a regional leader in green infrastructure solutions and water technology, has recently collaborated with Heriot-Watt University- Center of Excellence in Smart Construction (HWU-CESC) to elaborate an alternative method of irrigation from water stored at a shallow subterranean storage vessel while at the same time allowing for water management of rainfall, utilizing Polypropylene modular attenuation units, Permavoid, with 95% void ratios and having a high structural compressive strength. These units are joined together in a system to create a horizontal structural raft.

This test should allow for monitoring of the performance of green roofs/ podiums and evaluate the benefits in the arid gulf regions.

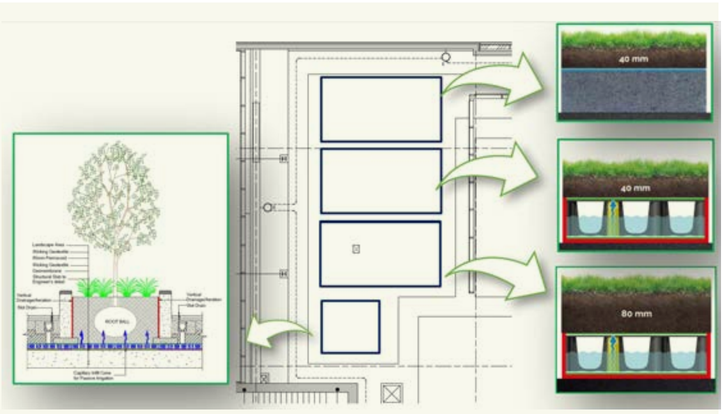

Fig. 3 HWU-CESC and Polypipe ME Collaboration Project Schematic Layout.

Through this test, a complete investigation of the requirements and parameters of green roofs is provided to determine the right nature of local soils, the water requirement needed to develop and maintain growing media growth, and vegetation root zone requirements. These main factors can assess in covering the knowledge gap of green roof requirements in arid regions.

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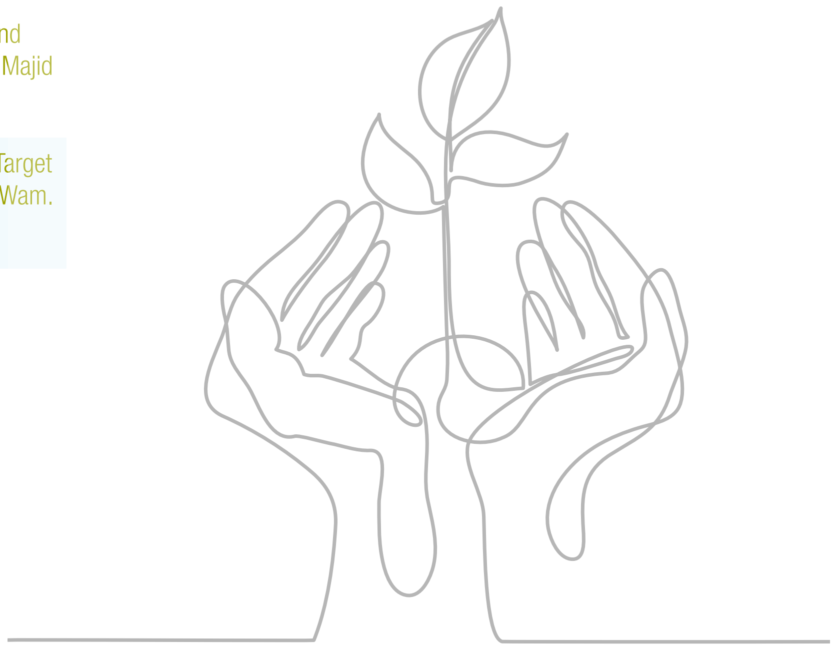

Low Carbon Geopolymer Concrete for Wastewater Systems

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Tunnels are designed globally to address a multitude of applications such as wastewater and are a key infrastructural requirement in all developing countries. As sustainability becomes a focal point across the various sectors, the construction sector is challenged with pushing the engineering envelop to develop low carbon, geopolymer concrete for the harsh and acidic environment of wastewater tunnels. The improved durability properties of geopolymer concrete, may be the answer.

Keywords: Geopolymer Concrete; Microbially Induced Corrosion (MIC); Corrosion; Durability.

1. Introduction

It has been widely reported that carbon dioxide (CO_2) in the rage of 0.6 to 0.8 kg is emitted per 1.0 kg of Portland cement produced (Gunasekara et al. 2016) and is the third largest contributor to global CO_2 emissions representing 5 to 6% of approximately 65% (Rangan 2014). According to (Wimpenny and Chappell 2013) it is possible to produce high performance low carbon durable concrete for underground applications.

This paper highlights key durability aspects such as chloride and carbon induced corrosion and microbial action effecting the implementation and use of geopolymer concrete for future infrastructure developments, increasing service life with a lower carbon footprint.

2. Chloride Induced Corrosion

The long-term durability properties of concrete are a fundamental concern associated with civil infrastructures globally, with the probability of steel reinforcement being subjected to chloride attack being the most comprehensively witnessed and measured aspect. Chloride progress through the concrete via capillary absorption, diffusion and hydrostatic pressure and promotes corrosion of the embedded steel through the depassivation process leading to a reduction in loading capacity of the concrete (Ismail et al. 2013). Several different test methods are available to evaluate concrete's ability to resist chloride ingress with the most common method in the Middle East being ASTM C 1202 by measuring the electrical conductivity. However, ASTM C1202 is not suitable for testing geopolymer concrete as it contains high Na^+ levels that register during testing and produce a false result. Testing according to NordTest NT 492 subjects the test specimens to a chloride concentration for 96 hours and using a silver nitrate spray, the depth of chloride penetration is recorded.

As a result of the 3D structures such as Sodium Alumino-Silicate Hydrate (NASH) and Calcium Aluminium Silicate Hydrate (CASH) gels, formed in geopolymer concrete the rate of chloride diffusion is decreased (Gunasekera et al. 2019) and decreases further the higher percentage of Ground Granulated Blast-furnace Slag (GGBS) in the mix (Tennakoon et al. 2017). Geopolymer has also been reported by (Fan et al. 2021) to have a more stable passivation layer.

3. Carbon Induced Corrosion

Carbon induced corrosion is the phenomenon by which CO_2 is absorbed by cement and reacts with calcium hydroxide in the pores producing calcium carbonate, which reduces the pH and affects the passivation of the embedded reinforcement (Bosch Giner 2021). In conventional concrete, portlandite decomposes and forms the expansive calcium carbonate.

To determine the depth of carbonation, a colorimetric analysis is conducted according to BS EN 12390-12 by applying phenolphthalein to the specimen. A non-coloured specimen indicates the pH is below 8.5 and carbonation has occurred. However, since geopolymer is free of Portland cement and thus Portlandite, the use of phenolphthalein is not a reliable method and as such methods such as Fourier-transform infrared spectroscopy (FTIR) is recommended. Comparison between the two methods is shown in table 1. Geopolymer produced with low calcium binder and high percentages of GGBS present with improved resistance to carbon induced corrosion despite a decrease in the overall pH of the concrete (Sufian Badar et al. 2014, Pasupathy et al. 2016, Pasupathy et al. 2021, Li and Li 2018).

4. Macrocell Corrosion

Chloride-induce macrocell corrosion leads to premature aging and failure of concrete structures by breaking doing the layer of passivation and forming a looped cycle whereby anodic (active) and cathodic (passive) areas are spatially separated. The anode is the part of the reinforcing that corrodes, forming a pit through the deterioration process, releasing iron into the water forming Fe^{2+} and allows electrons to flow through the steel to the cathodic area where they are taken by oxygen and form hydroxyl ions (OH). The mixture of Fe^{2+} and OH forms hydrous iron oxide (FeOH) as illustrated in Figure 1.

Table 1 Methods to assess the carbonation of concrete.

Technique	Principal	Advantage	Disadvantage
Phenolphthalein	Colorimetric analysis to identify the carbonation front	✓ Simple ✓ Rapid calculation ✓ Economical	✓ Destructive test ✓ Carbonation depth is often underestimated ✓ Accuracy based on test personnel experience
FTIR	Passing infrared light through the sample to cause the resonance of functional groups with characteristic absorption frequencies	- Easy and small sampling - Fast measurement reading - Able to detect Portlandite	- Not practical in the field - Capillary water can affect the result

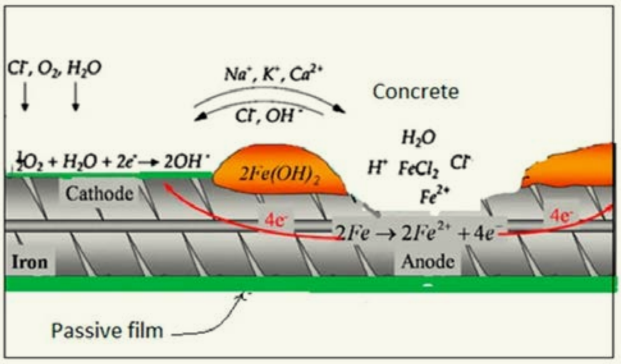

Fig. 1 Macrocell corrosion illustrating the corrosion pit adjacent to the anode.

The service life steel reinforced concrete was conceptualized by (Tuutti 1982) and is characterized by three phases, the initiation phase, the onset of corrosion and the propagation phase. Several studies have indicated that geopolymer concrete presents with an increased penetration of chloride ions and would appear prone to corrosion (Olivia and Nikraz 2012) (Mundra et al. 2017) however; the alkaline activators used to produce geopolymer present with a high electrical resistance and therefore enhances the cathodic reaction and reduces the rate of corrosion by up to 5 times compared to conventional concrete.

5. Microbiological Action

Concrete subjected to wastewater may be susceptible to multi-stage degradation under highly acid conditions, commonly referred to as Microbially Induced Corrosion (MIC) a result of anaerobic sulfate reducing bacteria producing hydrogen sulfide (H2S(aq)) consumed by sulfur oxidizing bacteria (SOB) producing sulfuric acid (H2SO4). The H2SO4 attacks the cement paste portion of the concrete matrix through the decalcification of calcium hydroxide (CH) and calcium silicate hydrate (CSH) forming expansive corrosion products such as gypsum and ettringite causing internal stress and failures leading to accelerated deterioration of the concrete (House 2013, Erbektas et al. 2019, Kumar et al. 2021).

MIC is dependent on the consumption of Calcium Hydroxide (CH) and Calcium-Silicate Hydrate (C-S-H) derived from Portland cement, literature suggests geopolymer concrete is highly resistant to acidic environments and provides sustainable opportunities going forward (Grengg et al. 2018).

Conclusion

The construction industry is moving towards a watershed moment with the focus on producing sustainable elements with a design life more than 100 years. The use of supplementary cementitious materials to produce high functioning low carbon concrete is the way of the future. From the literature presented in this paper, the implementation and use geopolymer concrete for wastewater applications will allow governments, engineers, and contractors to produce sustainable fit for purpose elements, moving the construction industry towards net zero. However, the challenge regarding standards, specifications and test methods remains an ongoing topic.

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Wellbeing

Smart Buildings for Better Healthcare

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The recent advances in information and communication technologies are promising a bright future for healthcare and for better wellbeing of humans. It is possible to integrate sensors that are connected to the internet within homes, workplaces, and healthcare facilities to create a network of smart buildings. Machine learning and big data techniques can then be utilized to understand and make use of the information shared within this network. The fusion of advanced sensors, high-speed internet and machine learning provides the core of smart healthcare; a system that allows delivering high-quality at-home healthcare, monitoring patients remotely via sensors, to alert caregivers of any abnormalities or potentially dangerous situations and helping with the early detection of illnesses that affect human behaviors and quality of life. This article briefly introduces the recent technologies that are making the transition into smart buildings and thus facilitating smart healthcare, review studies on the topic and finally discuss current challenges and future opportunities are discussed.

Keywords: Smart Buildings; Smart Healthcare; Artificial Intelligence; Machine Learning; Internet of Things.

1. Introduction

Smart cities are a futuristic endeavor aimed at improving the quality of life and productivity of humans through a large-scale network that facilitates information sharing and information retrieval between the various components of a smart city.

It is estimated that by 2050, about 66% of the population will be living in urban areas [1]. Additionally, there has been an increase in the average life span of humans by six years in the past two decades to reach 73.3 years. This number can be as high as 81 years in developed countries [2]. Meanwhile, there is a lack of trained caregivers and nursing care homes availability is not keeping up with demand, especially in less developed countries [3]. These figures necessitate implementing better and smarter healthcare solutions that could empower people to manage their wellbeing at home; meanwhile allowing care providers to monitor their patients' health remotely and detect early signs of diseases or infections that could potentially be dangerous to the individual or turn into an outbreak that endangers the wider society. The use of smart technologies can create an Ambient-Assisted Living (AAL) system to support patients with chronic diseases or disabilities and enable elderly people to live independently as safely as possible for the longest time possible [4]. This approach can be advantageous as it provides control and safety to the patient's own familiar stress-free environment with less risk of secondary hospital-induced infections while reducing the costs and strains on the healthcare facilities.

Smart healthcare and AAL are advanced concepts that incorporate smart homes with telehealth; and are an integral part of smart cities, promoting good health and wellbeing of a city's residents. Quality healthcare is a step towards social sustainability [5] and one of the United Nations Sustainable Development Goals (SDGs) to transform our world by 2030 [2]. Smart buildings can facilitate the provision of quality healthcare services. The term "smart" refers to the incorporation of sensors within an object to collect data about its functioning and surroundings. Data collected by the sensors need to be processed and analyzed to make use of it. Buildings with the purpose of providing AAL need to consider smart technologies starting from the planning phases and into the design and construction phases. In recent years, there have been great advancements in the fields of Artificial Intelligence (AI), Internet of Things (IoT) and Cloud Computing; complemented by high-speed internet and wireless networks (5G); which made it possible to incorporate smart healthcare into smart buildings.

2. Industry 4.0 technologies: AI and IoT

Artificial Intelligence (AI) in general deals with developing technologies and solutions that mimic human thinking and perception. Machine learning is considered a subfield of AI and is concerned with the development of techniques that allow computers to "learn" and forecast future trends. Learning mainly involves exploiting a huge amount of data to be able to gain insights and discover patterns.

Data can come in various forms, sizes and speed. A recent report by Statista [6] predicts that by 2025 the overall amount of data that will be created, stored and consumed will grow to 180 zettabytes. It is also estimated that at least 40% of this data will come from sensors. It is also perceived that by the next decade connected devices to the internet will grow to nearly 1 trillion. Connected devices such as sensors and Radio-Frequency Identification (RFID) tags produce real-time data that would require machine learning and big data analytics tools to analyze, store and make sense of.

IIOT (Industrial Internet of Things) refers to the connection between people, objects (like sensors-environmental, wearable, and implanted) and the internet. IIOT is a pillar for industry 4.0; a new industrial revolution that relies on interconnectivity, automation, machine learning, and real-time data. IIOT has driven new dimensions in healthcare applications that can make use of smart spaces for real-time patient monitoring and remote care. In the following section, we review some of these case studies.

3. Case Studies

There have been several studies carried out for the design and implementation of AAL systems. Such systems have been used successfully in aiding patients with chronic diseases or mental health problems; and also enabling elderly individuals to continue to safely live independently and safely. An example of a typical plan for a smart home is shown in Figure 1.

3.1. AAL for Patients

The careful design and implementation of ambient sensors in homes can help gather important information for monitoring patients remotely in their homes. Sensors to measure temperature, humidity, light, sound, and detect infrared, ultrasonic, and pressure signals, are connected to a central machine (backend) wirelessly via Wi-Fi or Bluetooth and send their data to this machine for further analyses and decision making. The ambient sensors are usually complimented by a wearable device such as a smart watch or a fitness tracker that can track physiological parameters such as blood pressure, heart rate and oxygen saturation in the blood. In the backend, usually, there is a data processing pipeline to clean the data and unify its format before feeding it into one or more Machine Learning (ML) models that are responsible for "making sense" of the data and detecting or predicting an event happening in the near future. If an ML model detects a potentially dangerous situation, the system will alert the caregivers to take action. Signs of serious but initially silent diseases such as arrhythmia (irregular heartbeat), diabetes, and high blood pressure, which is considered a silent killer, can also be detected. A modeled person's behavioral patterns, such as not opening the curtains or refrigerator (detected via ambient sensors), can also raise alarm.

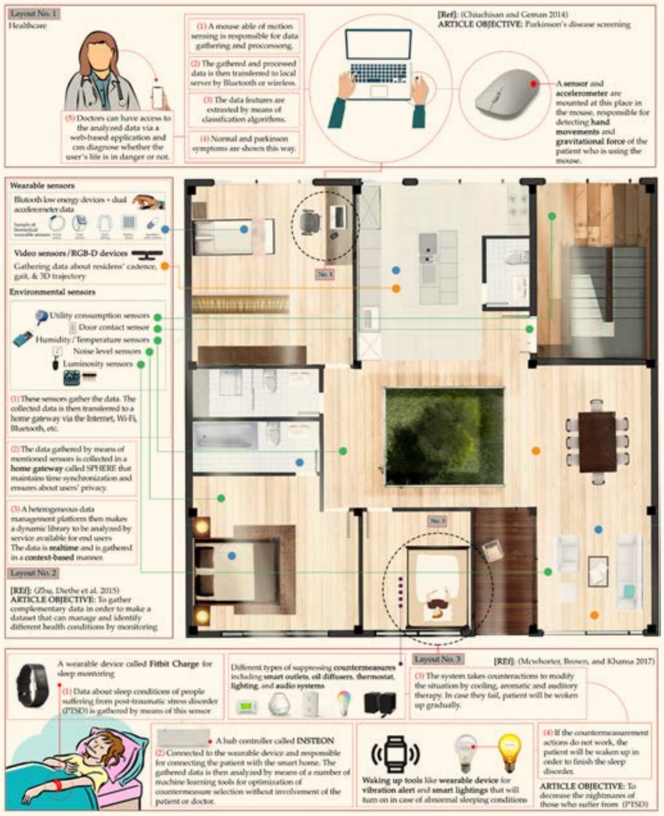

Fig. 1 A typical plan of a smart home for monitoring patients using AAL systems as cited in [7].

Several studies have been carried out on systems to monitor the health of patients either generally as in [8], or for specific diseases as in [4] for monitoring hypertensive patients. McWhorter et al. proposed a system for monitoring patients suffering from Post-Traumatic Stress Disorder (PTSD) during their sleep and relieve them of nightmares by detecting abnormalities in their heart rate and gently waking them up via controlling the ambient temperature, light and sound systems [9]. Mukherjee suggests using ambient sensors to normalize the body clock and induce desirable physiological changes that can potentially have curative effects on patients [3].

3.2. AAL for the Elderly

AAL technologies provide great benefits for the elderly and allow them to live independently by giving them the means to control their own environment and surroundings without moving into a care home. They can live safely, with their health status monitored around the clock via ambient sensors and wearables and notifications sent in cases of emergencies. They can receive instructions and reminders of upcoming or missed medication doses in a user-friendly manner, usually via audio messages. AAL technologies can also prove useful in alleviating the loneliness that the elderly may feel by connecting them to their friends and loved ones.

With old age, there usually exists a deterioration in the ability to carry out daily activities normally and with the same efficiency. Dementia and Alzheimer are neurological diseases affecting cognitive functioning such as remembering, thinking, and reasoning and are more common in aging people. Parkinson's is another disease that might affect the elderly and is characterized by tremors and difficulty in movement or maintaining a posture.

It is a neurodegenerative disease that might result in the form of disability. AAL systems in a smart building are capable of monitoring and learning the behavioral patterns of the residents and detecting any deviations that could lead to the diseases above. Javed et al. carried out a study that focused on how ML algorithms trained on data labeled by a neuropsychologist can learn patterns from data acquired by ambient sensors to give scores to the execution of daily activities based on how well they performed [1]. In another study by Enshaeifar et al., a system which monitors and delivers healthcare for dementia patients was trialed in cooperation with the United Kingdom's National Health Service (NHS). The system used data from ambient sensors placed at the patients' homes and ML algorithms on the backend to learn the patients' daily behavioral patterns and find deviations, learn patients' moods, and detect if patients are agitated; they could also detect possible Urinary Tract Infections (UTIs). The system can alert the patient of a missed medication via audio instructions and can contact caregivers in cases of emergencies [10].

Another useful use case for smart homes with elderly residents is fall detection which is a common situation that can cause severe injuries or life-threatening situations and is considered an emergency. Fall detection systems can identify these incidents and alert a caregiver. They use a combination of infrared sensors, Wi-Fi signals and ultrasonic sensors for motion detection and pressure sensors on floors to detect vibration and changes in the pressure due to a fall. It is important to mention that sensors implemented by these systems will usually require a home renovation due to being embedded either in walls or underneath the floors; hence in the future, it is best to plan and design homes with these sensors in mind to incorporate during the construction phases [11]. An interactive floor system has been developed by Chang et al. which consists of LCD panels that operate like the haptic interfaces on smartphones that can identify points of interaction [12]. Interactive floors open an array of possible use cases from fall detection to being used on staircases and house flooring to analyze the gait of individuals and detect any musculoskeletal or neurophysiological problems.

4. Challenges and Opportunities

The transition to smart buildings and its potential to improve healthcare and the health and safety of the population doesn't come without challenges. The most prominent is the possible breach by cybercriminals of such systems and the privacy implications. As most of the systems embedded in a smart home will at some point communicate over a network or even over the internet, securing such systems will be essential. Additionally, the type of data being communicated and transferred is very sensitive as it contains personally identifying information. These communications require strict security measures to be implemented from day one of the developments of AAL systems.

Other challenges of AAL systems are related to the data. The data quality and dimensionality will be heterogenous, ubiquitous, and dynamic due to the different sensors collecting this data with different sampling frequencies, operating systems, and data formats. After data acquisition, there needs to be a pipeline developed that could efficiently validate and clean the data to remove any abnormal or missing readings that could affect the ML algorithms' predictions. The pipeline needs to implement a unified format for the data so that sensor data are converted into this final format before feeding into a model.

4. Conclusion

Smart buildings are no longer a nice-to-have luxury but an essential step towards social sustainability and better healthcare for a city's population. Great advancements in the fields of IoT and ML have made the realization of smart buildings and smart healthcare possible via AAL systems. To implement these systems and the devices and sensors they require for functionality in a building, it is recommended to start from the planning phase and into the design and construction phases. It is essential to ensure the security of these systems from malicious attacks using the latest cybersecurity techniques which will give the users more trust in the systems and allow their increased adoption.

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Human Resources as a Valuable Asset

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ASGC considers its responsibility to fulfilling the commitment of #expectmore, which is applied to the human capital as the primary asset to the group. Being a construction business, ASGC examines who we are and respects the employee consideration of being the significant driver of business excellence. Talent acquisition and retention plans are part of the core strategies of the group to maintain the successful journey of more than thirty years in the built environment business.

Keywords: People, Talent, #expectmore.

1. Introduction

ASGC Construction LLC was founded in 1989 in the United Arab Emirates by the Azmy family, Bin Shafar family and Al Sayyah family. It has become a vertically integrated construction group best known for delivering special turnkey projects in the UAE. Over the past decade, the ASGC Group expanded into the broader geographic region extending beyond the Middle East to North Africa, including Egypt.

ASGC Group's landmark construction projects cover diverse sectors, including residential, commercial, leisure, hospitality, healthcare, oil and gas, education, industrial and aviation. The global ASGC Group employs more than 18,000 personnel worldwide and has more than USD 1 billion in annual revenues.

A progressive growth with a clear vision for the future to deliver all projects with an uncompromising commitment to our customer's needs through exceeding their expectations by applying cutting-edge technologies, processes, and professional practices.

As a Group, we recognise that people are our greatest asset. For our business to continue to innovate and remain at the construction industry's forefront, we must invest considerable time and resources in developing people's assets to be the best they can be. To achieve such a vision, we have developed a People & Culture Strategy that is aligned with the business vision of #ExpectMore and to ensure a work culture embodies guiding principles that guide every ASGC employee in delivering group vision through:

- ✔ Foster a professional and ethical work environment.
- ✔ Set safety and quality as our top priorities.
- ✔ Encourage creativity and innovation in every aspect of our work.
- ✔ Recognise the value of a continuous improvement.
- ✔ Be open, listen to our customers, and adapt to change.

In this article, we will explore some of the initiatives we have undertaken that are integral to the future development of our People & Culture Strategy.

2. People and Culture Strategy

2.1. Diversity and Inclusion (D&I)

The origins of diversity stem from the models applied to the workplace since the 1960s; most notable in the USA, the implementation of the Civil Rights Act of 1964 centred around affirmative action from equal opportunity employment objectives. Fast forward nearly 60 years, and the topic today of Diversity and Inclusion remains relevant now.

ASGC's approach is based on Transformation Change, covering a plan focusing on immediate needs and a longer-term view. The strategy has always been fully committed to an inclusive workforce representing many different cultures, backgrounds, and viewpoints in the countries in which it operates. The group's employees come from over 46 other countries across the globe (Fig.1).

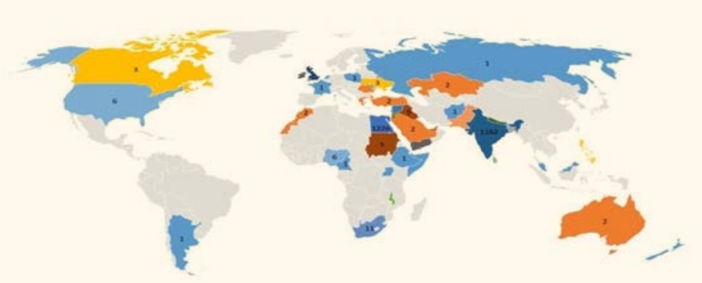

Fig. 1 Staff-ethnicity Demographics in ASGC

We understand that construction is traditionally a male-dominated environment; therefore adopted practices that address this imbalance with our People Programs in the context that can be applied in a practical scenario and will add value to our business goals.

Adoption of an inclusive work culture approach and our talent acquisition strategy is integral; throughout the years, we have provided internship programs across various disciplines in the organisation for individuals to be nurtured and guided in their areas of expertise, as well as get a genuine glimpse of how different departments operate, and what it is like to work in each.

With our base in the UAE, evolution has been the planning of an internship initiative that, while one aspect supports the UAE government's immediate initiative of Nationalisation, will help form a key component of our longer-term D&I Strategy.

ASGC programs are targetting female interns, locally within the UAE, specifically Emirati, who want to experience more than a traditional role within the construction sector, e.g., Health Safety Environment (HSE) and design but intend to be able to turn their knowledge and learned skills into a more modern approach to Sustainability and Environmental, Social, and Governance.

While they learn the trade from our team, we also leverage their knowledge to advance further our business initiatives linked to our Corporate Social Responsibility (CSR) goals that go beyond the role of a corporation to maximise profits on behalf of the corporation's shareholders.

Our People Plan continues to evolve, linked to the long-term Transformation Change initiatives to formalise a Graduate Program, working with female and male candidates in the UAE, and nurturing the best and brightest talent. While we recognise our strategy to focus on 'females in construction, we also want to ensure we give opportunities to the most brilliant minds to help shape our future and drive our cutting-edge approach.

Over the past few years, ASGC has diversified our senior management team. We are pleased to note that an ever-widening group of female leaders has contributed to women's representation in the organisation and firm-wide growth.

2.2. Generational Gap and Motivations

Happiness and the generational gap in the workplace is always a concept only that the dimensions of it are now changing drastically, with up to 5 generations being employed in the workplace.

The generation gap can be significantly referenced at the end of world war1, where the war's outcome can impact those workforce demographics. More relevant than ever now, where the impact of changing workplace and technological advancement has affected how we work and how happy people are perceived to be.

The younger generations are bringing a new perspective to it. They prioritise happiness and personal well-being and work-life balance and are less compromising. The older generations were more attached to their organisations and colleagues and the benefits they would reap from staying there longer.

For the younger generation, however, happiness at work is summed up by flexible working locations and hours, incentives, professional development opportunities, seeing that their contributions make a difference, and feeling trusted by the leadership and appreciated for their effort. Anything out of their 'normal' is viewed differently.

Generations have diversified expectations in the workplace. The older workers have spent decades developing relationships, work habits, schedules, and a sense of identity hinges on their workspace.

The younger generations have an affinity for the digital world. They have grown up with broadband, smartphones, laptops, and social media being the norm, expect instant access to information on the internet, and thrive in their space.

Businesses need to recognise this generation motivation gap and implement programs that ensure the generational gap is bridged and that all individuals remain happy and productive team members, contributing efficiently to the broader business goals.

ASGC Management has always coached their team members using their experience, a traditional top-down approach. They still recognised the changing workplace where everyone can learn from each other.

We have evolved a new strategy. A mentoring and coaching program that brings together different generational perspectives enabling our experienced professionals to learn from our millennial joiners and our millennials to share their views with our more experienced leaders, a shared learning experience. This platform enables our team to cultivate ideas that help continue to ensure we have a relevant and engaged workforce.

Our people's communication methods consistently look to address the needs of the younger generation through digital channels while also remaining relevant and accessible to older generations, where the information continues to be cascaded through toolbox talk and managers' briefings. The transformational change of information exchange is a program continually evolving and encouraging the older generation into technological adoption through education and learning.

For us to thrive, we need our people to access their full potential and develop and execute new, dynamic strategies that keep our people engaged and our business relevant in the market

2.3. Culture founded on happiness

During the early 19th Century, it was perceived that the first stage of modern Western happiness emerged through the industrial revolution and beyond into daily life practices. With the emergence of the new middle class, the work ethic involved should and can be a source of happiness.

More recently, it is widely recognised that a culture founded on satisfaction and happiness promotes creativity and innovation, which then, in turn, fosters productivity and business growth, which is aligned with our guiding principles that guide every ASGC employee in delivering our vision.

To ensure we drive a culture of Happiness and Engagement, our business leaders need to be consistent, ensuring their actions match their words – building a repour of trust is known as a supportive leader and connecting our People with their purpose. To enable this, our People Team is developing a Group-wide approach to People management with a local flair recognising the individualities of each operating country within which we work.

Our foundations and building blocks will be supportive and straightforward policies, encouraging clear channels of communication and open forums, offering opportunities for upskilling to support their people's long-term development and ensuring our managers show their commitment to having an inclusive organisational culture.

2.4. Gender diversification strategy

We set our goals with a realistic approach to the market, business, and people. Our policy on gender diversification outlines practices for understanding gender inequality and setting objectives for progress. As a business, we must recognise the industry in different operating countries and understand how social norms influence workforces.

ASGC's approach to gender diversifications includes:

- Rather than waiting around for talent, we proactively source a gender-diverse pipeline for the roles we recognise we can.
- Unconscious first impression biases exist, and recognising them is the first step toward overcoming them in recruiting and hiring. Our training focused on how to overcome these hiring biases and how to evaluate candidates on a predetermined set of criteria fairly.
- Set a diverse group of interviewers - include people from different backgrounds, including an office tour to introduce the candidate to more people at the company and special onboarding programs for new employees.

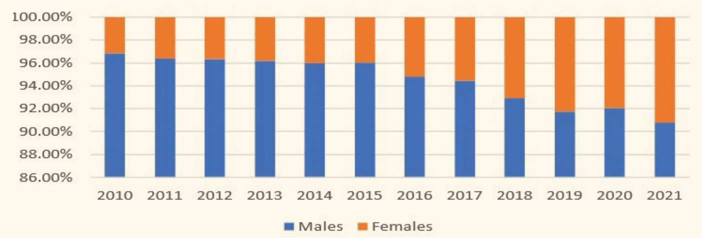

Fig. 2 Gender diversity trend in ASGC

2.5. Talent Retention Strategies

Our business has a track record of long-term employee retention within our team, but we recognise the global talent war and our drive to ensure we stay ahead of the curve.

While compensation and benefits are significant, today's person is looking for more than just a competitive salary. Joining decision-making is influenced by career growth opportunities, access to learning and development programs and prioritising their time, mental health, wellness, and work-life balance more than ever before. So, we are looking to enhance our employee lifecycle experience and support long-term engagement and retention for our global teams while we continue proactively implementing changes and adjusting our People and Programs to stay relevant.

Lack of flexibility is one of the main reasons for employee resignation. Individuals want options apart from the traditional 9-to-5 office jobs. Hybrid models are attractive options that also give flexible schedules. Keeping our work model relevant with flexible work policies is a consideration that our organising can adopt.

ASGC guiding principles of open communications enable us to build team trust and engagement. Collaboration is also key to a more transparent, productive, and happier workplace and, therefore, higher retention rates.

Focus on work-life balance – people who do not feel this will likely leave, so wellness initiatives are critical. Our culture must enable people to prioritise well-being, giving them more control over their work, flexible schedules, reasonable workloads, and emotional support.

Cultivate inclusion positively impacts well-being, performance, and productivity, leading to innovation and creativity. Diverse teams give employees a sense of belonging and connectedness to the business while improving innovation simultaneously. Employees with a strong sense of belonging are likelier to be engaged.

2.6. Focus on Talent Acquisition

Talent acquisition strategies have roots dating back to 2000 BCE. During the empire of Greece, the government actively sourced soldiers to be recruited as part of their army. Julius Caesar can be noted as an implementor of an employee referral program, with a reward of a component of pay and more solid marked with a tattoo which is considered an employer brand, often worn with pride and purpose by the most engaged team members. What remains true then and is considered today is that the right person, with the proper skill set, mindset, and motivation, is the best person for the role.

One of the most significant people challenges we face is how to attract the best talent, how we hire and retain and how to create teams to meet business goals. ASGC has a long successful history in the UAE, and our reputation precedes us. We leverage this success to ensure we have a strong employer brand in the market well positioned to attract top talent, which ASGC's esteemed clients consistently recognise.

To remain relevant, we evolve practices aligned with business needs. At the same time, our approach will ensure that employer brand and reputation remain a crucial building block as people initiatives are a key differentiator. We focus on the candidate experience building a positive relationship, and maintaining relationships for candidates who are not currently selected against a particular skill set but have other promising skills.

We hire people whose personal purpose aligns with ASGC's business values and company purpose; it ensures they are successful when integrating into our business because they are aligned with who we are and how we operate. We are developing a robust onboarding experience to ensure every member of our team experiences the same when joining the business; having an engaged employee from the beginning ensures they are more productive and satisfied.

ASGC is crafting career paths for all our team members even before we hire them. Career planning and development align team members' goals with our own, increasing motivation and productivity. A longer-term focus is global mobility which we can enable through business growth.

People are focusing on motivation and benefits more than salary. Flexible hours, health insurance, day-care, wellness programs, and time off enhance the employee experience and improve satisfaction and belonging. We consistently review global benefits approaches to align with employees' needs, best practices, and business viability. ASGC #expectmore.

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Structural Health Monitoring: an Application to High-Speed Electrified Train Tracks

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The future Structural Health Monitoring (SHM) Systems should form the basis for integration into civil infrastructure, taking into account modern concepts such as smart cities, the Internet of Things, digital twins, and building information modeling. Electric trains are considered one of the most eco-friendly and safest means of transportation. Catenary poles are used worldwide to support overhead power lines for electric trains. The performance of the catenary poles has an extensive influence on the integrity of the train systems and, consequently, the connected human services. It is a must nowadays to develop SHM systems that provide the instantaneous status of catenary poles in-service, making the decision-making processes to keep or repair the damaged poles more feasible. This study develops a data-driven, model-free approach for status monitoring of cantilever structures, focusing on pre-stressed, spun-cast ultrahigh-strength concrete catenary poles installed along high-speed train tracks. Besides, the study proposes an efficient Bayesian, frequency-based damage identification approach to identify damages in cantilever structures with an acceptable error rate; even at high noise levels, to higher levels of damage detection, namely identifying both the damage location and severity using a low-cost Structural Health Monitoring (SHM) system with a limited number of sensors.

Keywords: Catenary poles, Structural Monitoring Systems (SHM), Damage identification, Bayesian inference.

1. Introduction

Structural Health Monitoring (SHM) is a challenging field of science, especially in civil engineering, whereby important constructions are provided with monitoring systems that permanently update the status of these structures, as in the case of protected historical constructions. In addition, extending the operational lifetime of aging constructions means that such systems are necessary. The SHM system is based on a data acquisition system that periodically samples response measurements from an array of sensors attached to the structure being monitored. Then, the data interpretation process is achieved using diagnostic techniques [1]. The structural condition is assessed to evaluate the integrity of the structure, localize, quantify possible damages, and take subsequent prevention actions, as well as to predict the remaining service life of the structure [2,3].

Many methods have been developed for detecting and identifying damage to specific structures. However, the achievements are still inefficient for damage detection in all civil engineering structures. One reason is that each civil engineering structure is unique and has its individual identity, and is intensively affected by its environment, surrounding boundaries, constantly changing applied actions, material degradation, and more.

Techniques for Damage Detection (DD) have been widely developed and implemented to ensure the integrity of structural and mechanical systems. In structural systems, the damage is generally defined as changes to the properties of a given system that adversely affect its performance [4]. Damage inspection is hierarchically classified into four levels: damage detection (Level 1), damage localization (Level 2), damage quantification (Level 3), and prediction of the remaining life of the structure (Level 4) [5,6].

Based on data provided by the SHM system, two approaches are defined: supervised and unsupervised. In the supervised approach, both the healthy and damaged states of the structure of interest are known and are consequently used to classify the state of the structure based on newly recorded data. In civil engineering, the unsupervised approach is used, as the available data describes only one class; that is, the healthy state. Therefore, any deviation from the healthy state of the structure under monitoring is considered a change in its response and is consequently classified as a damaged state [7,8].

Based on the nature of diagnostic techniques, DD processes are classified into data-based and model-based techniques [9]. The model-based damage detection technique is an inverse process of estimating the dynamic characteristics of structure using an appropriate model (commonly a FEM). The damage features are identified through updating the numerical model based on measurements recorded by an SHM system [10,11]. However, the efficiency of the model-based techniques is strongly affected by the accuracy and performance of models used in the updating process.

The model updating process is solved in either a frequency or a time domain. Several algorithms have been developed over the past years. For example, in the frequency domain, the Frequency Domain Decomposition method is used [12,13]. In the time domain, subspace-based methods, such as Stochastic Subspace Identification, have attracted significant civil engineering attention [14,15].

The data-based approach identifies the state of the structure of interest using tools such as signal processing and modern statistical tools. These methods are mainly able to detect damage at Level 1 and, in some cases, at Level 2, which is insufficient for many practical applications [16].

Conversely, modern statistical tools (such as machine learning, artificial neural networks, and Gaussian processes) train the data to build statistical models or patterns that represent possible states of the concern structure [17,18]. Then, the state of the structure is identified using pattern recognition algorithms in supervised cases [19,20]. In addition, algorithms like novelty detection [21], outlier analysis [22], control chart methods [23], and principal component analysis [24] are used for unsupervised cases. The drawback of these algorithms is the excessive time needed in the data training process.

This research aims to bridge the gaps in the existing SHM systems. Furthermore, it offers real-time monitoring of structures and provides the necessary information to many disciplines, such as lifecycle assessment, decision-making, and asset management systems.

2. Methodology

A model-free Status Monitoring (SM) approach is built in this study to detect changes in cantilever structures using the data from an SHM system. The newly proposed approach solves the Level 1 of DD by utilizing logistic functions to detect the structure data's outliers, which avoids the expensive learning step in the existing approaches of DD, namely when using modern machine and deep learning methods.

The proposed SM approach improves the concept of control charts using a logistic function (a sigmoid function) to classify the status of the structure of interest within pre-specified regions based on its healthy data. New features of the given structure λ_d are calculated using newly data recorded by an SHM system, for example, the eigenfrequencies f, and the mode shapes. Fig. 1 describes the proposed approach for a considered feature. The new value of feature λ_d is classified as damage when it is located outside pre-defined alarm limitation (namely, a threshold $P= \beta \cdot \sigma_\lambda$), where σ_λ is the standard deviation of the considered feature λ. Test data is compared to a reference status using a sliding window with a length wlen, and a window shift wsh. The window length wlen decreases with the increase in speed by which data is changed. The window shift wsh controls the smoothness of the results. The Damage Index (DI) is defined as the change of sigmoid indices $\tilde{S}$, as follows:

$$DI_i = \frac{\tilde{S}_i^d - \tilde{S}_i^u}{\tilde{S}_i^u}, \quad (1)$$

where DI_i is the damage index of the ith mode. $\tilde{S}_i^d$ and $\tilde{S}_i^u$ represent sigmoid indices of the damaged and un-damaged statuses, respectively.
When damage is detected by the SM algorithm, a new Frequency-based Damage Identifcation (FDI) algorithm [29] detects the location ϑ and severity α of the damage to Level 3 using the Bayesian inference and realizations of multiple damage features, namely, changes of the eigenfrequencies Δf. One advantage of the Bayesian inference is that the uncertainty quantification of the parameters of interest is integrated in this process. Besides, the Bayesian inference is an effcient tool for data fusion, namely, using the joint occurrence of multiple phenomena. Based on Bayes' theorem, the posterior of the damage can be written, as follows:

$$\pi(\vartheta, \alpha|\Delta f) = \frac{\mathcal{L}(\vartheta, \alpha|\Delta f) \cdot \pi_0(\vartheta, \alpha)}{\pi(\Delta f)} \quad (2)$$

Then, the unknown parameters $\{\vartheta, \alpha\}^T$ can be inferred by sampling from the posterior $\varpi(\vartheta, \alpha \mid \Delta f)$ using, for example, an MCMC algorithm.

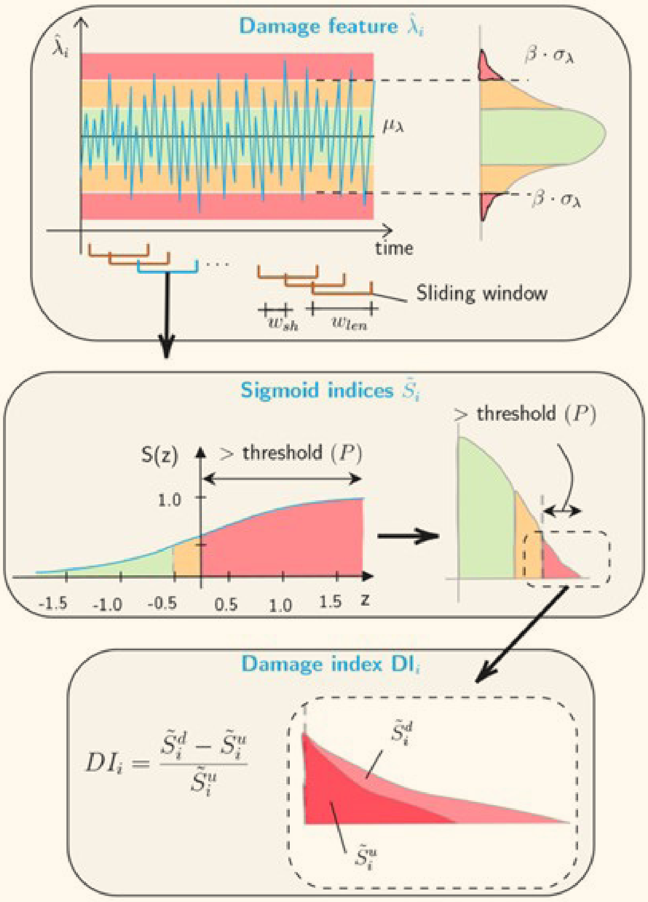

Fig. 1 Detailed steps of applying the Status Monitoring (SM) approach [28].

Fig. 2 The catenary pole system for high-speed rail routes.

3. Case Study

Today, electric transportation is one of the most promising solutions for mitigating the effects of greenhouse gas emissions that contribute to climate change and global warming [25,26].

In electrified transportation systems, the electrical power supply is secured by a catenary system installed along the transportation route. Structural members, known as catenary poles, suspend the catenary system supplying electric trains.

In this study, the catenary poles for high-speed rail routes, reaching a speed of 330 km/h, are chosen as a realistic case study, as shown in Figure 2. The poles are 10 m in height with tapered hollow circular sections and are produced by a spinning method. The outer diameter at the bottom end is 400 mm and reduces linearly to 250 mm at the top of the pole [27].

4. Results and Discussion

To implement the SM algorithm, Data from SHM system for the first five years were considered for defining the reference status, that is, the un-damaged properties of the catenary pole. Changes in eigenfrequencies were artificially generated using a numerical model. Measurements were generated for five years with a sampling frequency of one measurement per hour. To simulate the expected future status of the poles, three damage scenarios were proposed to cover the expected damage cases use of the pole, as follows:

- ✔ **Scenario 1** (sudden damage status): represents the case of local damage due to sudden damage propagation over a short period (for example, in one month).
- ✔ **Scenario 2** (slow damage status): describes the case of local damage due to slow damage propagation over a long period (for example, in fifteen years).
- ✔ **Scenario 3** (global change status): simulates the status of an un-damaged pole with global changes over a given period.

The results in Fig. 3 show the efficiency of the proposed SM algorithm in detecting the damage and distinguishing the scenarios of local damage (Scenarios 1 and 2) from the global changes scenario (Scenario 3).

The FDI algorithm was implemented using the artifcial measurements. Uninformative priors of damage severity a were used, such that π0(a) ~ U(0.0, 1.0). The posteriors were derived by implementing the MCMC algorithm for 1000 samples. Some selected results of the FDI algorithm are depicted in Figure 4 for noise levels of 1 and 5%, respectively. It is evident that the exact damage location ϑ and damage severity a coincide with the MAP values calculated using the FDI algorithm, even when using different noise levels up to 5%. However, the noise level signifcantly affects the variances of the identifed damage parameters. For example, for the identifed damage location, the variance changed from 0.03% for the noise level of 1% to 1.2% for the noise level of 5%, which is expected.

5. Conclusion

In conclusion, the damage indices are suitable for detecting the damage efficiently starting from a damage severity a = 30%, whereas the pole shows low sensitivity to damage severity below this value for all modes. In addition, the relatively small change in relative eigenfrequencies due to damage severity below the a = 30% is located within the variance of the identified eigenfrequencies. It should be noted that small cracks are not considered severe for the poles because of the role of prestressing forces in closing the cracks, as notified in the literature.

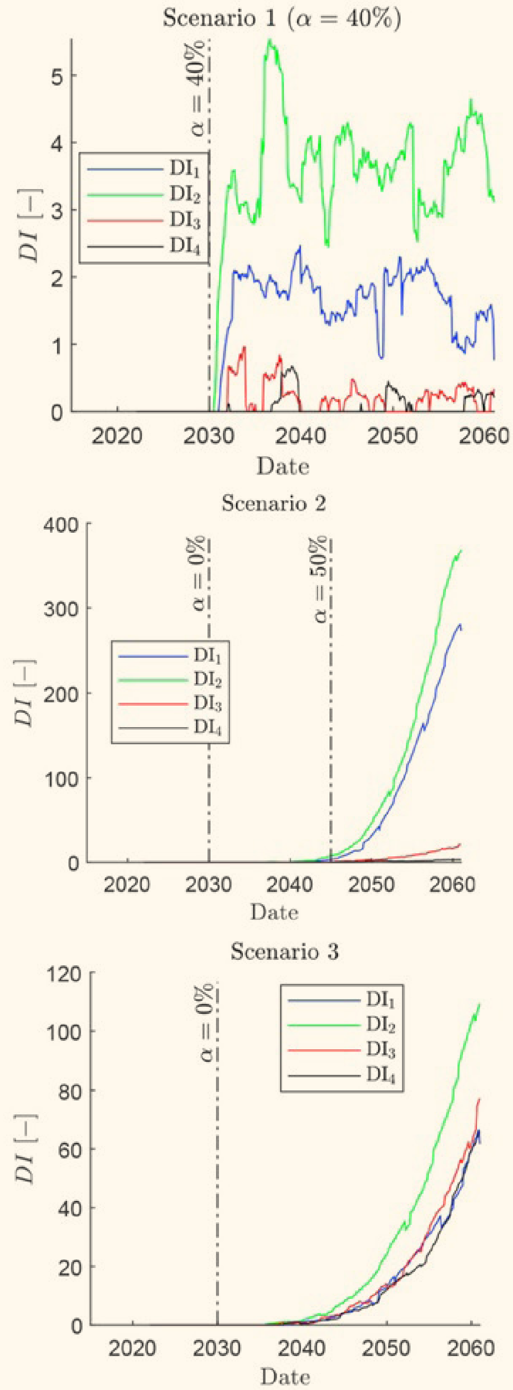

Fig. 3 Damage indices DI_i using eigenfrequencies [f1- f4]: Scenario 1 (top), Scenario 2 (middle), and Scenario 3 (bottom) [28].

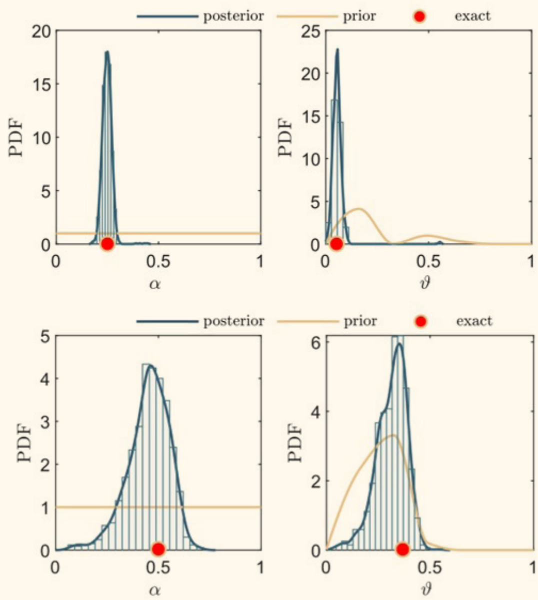

Fig. 4 Identifed damage severity α, and damage location ϑ, using the FDI algorithm for the noise of 1% (top), and 5% (bottom) [29].

Acknowledgements

This work was done under the Deutsche Forschungsgemeinschaft (DFG) supported through the Research Training Group 1462.

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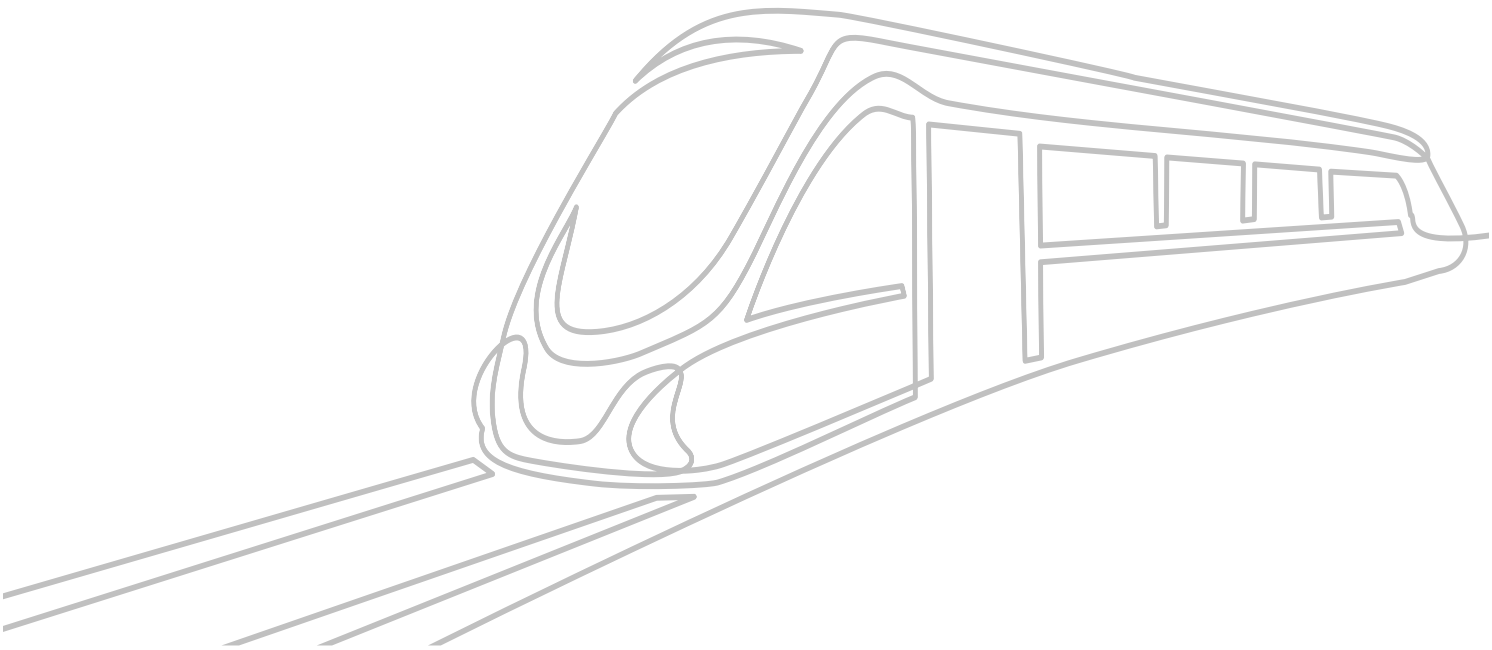

Safer Construction Workplace in High Temperatures

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This article was published online on Health and Safety Middle East (hsme) News on May 20, 2022: https://www.hsmemagazine.com/press-release/safer-construction-workplace-in-high-temperatures-2/

With the growth of the global population, the construction industry has expanded. It is expected to reach about USD 14.4 trillion by 2030, with approximately USD 0.9 trillion an average growth yearly. In contrast, the work environment in the construction industry is the least healthy and safe compared to other industrial sectors. This issue becomes more serious in severe-weather countries like the United Arab Emirates (UAE), which witnesses temperatures as high or even higher than 48 degrees Celsius in peak summer. Consequently, construction workers on-site have to deal with extreme temperatures during the day. Furthermore, warehouse workers also undergo the condition, as most warehouses are not air-conditioned.

Working in extremely hot conditions can put a worker's body at significant risk of heat-related illnesses and injuries, causing poor physical and mental well-being. For example, dizziness, muscle fatigue, fainting, sweaty and slippery hands, heat strokes, impaired thinking, muscle cramping, and dehydration are all ill effects associated with working outdoors in high temperatures. Besides the injuries from these symptoms, they influence the workers' productivity.

Dr Mustafa Batikha, Associate Director of Research at the School of Energy, Geoscience, Infrastructure and Society at Heriot-Watt University Dubai, shares quick tips on working safely in high temperatures.

Cooler Working Hours

In the extremely hot weather, the work can be rescheduled for the cooler time of the day, for instance, at night. This practice is highly witnessed in the UAE summertime.

Take a Break

It is imperative for all workers to take periodic breaks while working, more so during the summer months. This will help regulate their body temperatures and allow them to step away from labour-heavy work.

Hydration and Wet towels

To avoid dehydration, precautions must be taken to keep oneself hydrated while working in extremely hot conditions. Water should be a priority for hydration rather than other beverages such as sodas. Additionally, wet towels can be regularly placed on the forehead, neck, and hands to cool down body temperature.

Fiber-enriched Foods

It is advisable to avoid heavy foods during work. Instead, it is recommended to eat a bigger breakfast with a light lunch full of fruits with high fiber and water content, such as cucumbers, apples, watermelon, and other needed nutrition.

Selecting Protective Clothing

Materials that weigh less that are light-coloured and made from cotton material help minimise the effects of high temperature. In addition, some clothes in outdoor-activity shops are made from engineered fabrics to provide a cooling feeling and absorb sweat.

Protecting Each Other

Workers need to be aware of the heat-illness symptoms and report if signs are witnessed on someone to take early steps for medical assistance and advice.

Since the well-being of workers plays a significant influence on productivity and society's health and happiness, the construction industry has already started to pay serious attention to the well-being of its employees. In hot weather, providing employees with longer break hours, regular medical checkups, cooling stations/rooms on-site, free water, and refreshments on the work-site can all significantly help employees. However, it is still to say that future digitalisation of the construction industry will lead to safer working environments in hot weather conditions. For example, introducing new monitoring technologies to the site, such as drones, will ensure reporting of the site status for an urgent emergency. Moreover, new construction techniques like 3D concrete printing and modular precast will push the industry toward more off-site construction and minimise the risk of harsh on-site conditions in hot weather.

News and Events

News and Events

News April 2022 – September 2022

• 7th April 2022

Collaboration with Colliers Project Leaders, Middle East

Summary: CESC were pleased to host Dick Bayer, VP for Lean and IPD as a guest lecturer to speak about IPD/Lean Construction

LinkedIn:

https://www.linkedin.com/feed/update/urn:li:activity:6917797631784030209

• 10th April 2022

JLL MENA Signing Ceremony and Workshop

Summary: Professor Ammar Kaka and Dr Anas Bataw welcomed key personnel from JLL MENA for the signing ceremony which was followed by a kickoff workshop which cemented our newly formed partnership

LinkedIn:

https://www.linkedin.com/feed/update/urn:li:activity:6930092577333338112

• 11th May 2022

CESC Welcomes China State Construction

Summary: Dr Anas Bataw welcomes Mansour Faired, Chief Engineer at industry affiliate China State Construction Middle East to continue conversations around ongoing collaborative projects, due to start later in 2022.

LinkedIn:

https://www.linkedin.com/feed/update/urn:li:activity:6930783808447201280

• 12th May 2022

Meeting, Higher Colleges of Technology

Summary: Dr Anas Bataw and Vice Principle, Tadgh O'Donavan met with key personnel from Higher Colleagues of Technology to continue conversation around synergies for collaboration on applied research and innovations.

LinkedIn:

https://www.linkedin.com/feed/update/urn:li:activity:6932243165345103872

• 19th May 2022

Aldar Properties Signing Ceremony and Workshop

Summary: Professor Ammar Kaka and Dr Anas Bataw visited Aldar HQ in Abu Dhabi for the official partnership signing ceremony which was followed by a second workshop to discuss ongoing projects and collaboration.

LinkedIn:

https://www.linkedin.com/feed/update/urn:li:activity:6933382745196748800

• 2nd June 2022

Non – Executive Board Meeting

Summary: CESC were delighted to welcome His Excellency Dr Abdullah Belhaif Al Nuaimi along with other esteemed board members to campus to discuss progress and next steps.

LinkedIn:

https://www.linkedin.com/feed/update/urn:li:activity:6941976950789791744

Published articles April 2022 – September 2022

• 28th April 2022

CESC Research Bulletin Five

Summary: CESC published issue five of its bi-annual Research Bulletin.

The bulletin included research articles focusing on the most recent trends in the Built Environment and was structured as per CESC's three innovation themes: Performance & Productivity, Sustainability, and Wellbeing.

Bulletin Link: https://www.hw.ac.uk/dubai/research/cesc/recent-publications.htm

• 20th May 2022

Health & Safety Middle East

Summary: Dr Mustafa Batikha shares his thoughts on safer construction workplaces in high temperatures.

Full Article: https://www.hsmemagazine.com/press-release/safer-construction-workplace-in-high-temperatures-2/

• 22nd May 2022

Al Bayan

Summary: Dr Anas Bataw shares his thoughts on digital transformation and the road to carbon neutrality.

Full Article: https://www.albayan.ae/economy/uae/2022-05-22-1.4439845

• 9th June 2022

ME Construction News

Summary: Dr Anas Bataw shares his thoughts on the rise of sustainable construction trends in 2022.

Full Article: https://meconstructionnews.com/52634/the-rise-of-sustainable-construction-trends-in-2022-and-beyond

• 14th July 2022

Construction Week

Summary: Matt Smith shares his thoughts on the future of the Construction Workforce.

Full Article: https://www.constructionweekonline.com/business/insights/construction-work

• 31st July 2022

Al Bayan

Summary: Dr Anas Bataw sheds light on the latest trends in construction focusing on the usage of drones in construction sites

Full Article: https://www.albayan.ae/economy/uae/2022-07-31-1.4486164

• 1st August 2022

MEED

Summary: This article published by MEED discusses research efforts by CESC to decarbonise the cement industry along with continued collaboration with MOCCAE to do so.

Full Article: https://www.meed.com/new-ways-of-working-for-uae-construction

• 7th August 2022

Al Bayan

Summary: Dr Anas Bataw shares his expert opinion on the necessities of plastic recycling in Al Bayan

Link: https://www.linkedin.com/feed/update/urn:li:activity:6968084320523579394

• 10th August 2022

MEP Middle East

Summary: Dr Hassan Chaudhry talks about the Built Environment and it's challenges in the print edition of Mechanical Engineering & Plumbing Middle East

• 10th August 2022

MEP Middle East

Summary: Dr Anas Bataw talks about how the industry is supporting the next generation of Built Environment leaders in the print issue of Mechanical Engineering & Plumbing Middle East

Events April 2022 – September 2022

• 5th April 2022

CESC Industry Webinar

Summary: We were delighted to welcome esteemed panel Ellyn Lester, Pennsylvania College of Technology, Mehreen Saleem Gul, Heriot-Watt University, Louise Collins, JLL MENA, and Ahmad Al Darwish, Falcon Robotics as our panel at the 'Future Proof Workforce in the Construction Industry' webinar.

To View Webinar: https://www.youtube.com/watch?v=volvMbSm1vo&t=16s

• 10th May 2022

CESC Industry Webinar

Summary: It was our pleasure to welcome Dave Knight, CARES, Ivano Iannelli, Emirates Global Aluminium (EGA) Hala Yousef, JLL MENA, Fernando De los Rios Hyperion Robotics and Ferenc Kis, Alpin Limited. as our panel at the 'Carbon Accounting in Construction' webinar

To View Webinar: https://www.youtube.com/watch?v=UiKOOVnCR0A&t=89s

• 11th May 2022

ASTM Extechnology Workshop

Summary: It was our pleasure to welcome James Olshefsky, Director, External Relations, William Billotte, Executive Director ASTM International and Ahmad Al Darwish, CEO, Falcon Robotics to our Heriot-Watt University, Dubai Campus when hosting their #uae Exotechnology workshop.

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6930380019600887808

• 12th May 2022

First Decarbonisation 'Cluster' workshop

Summary: In the first of our Cement Decarbonisation Delivery Group (CDDG) Dr Olisandwendu Ogwuda and Dr Mustafa Batihka welcomed the cluster group who are focusing on material and waste management.

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6932939696024997888

• 30th May 2022

CPD Session in conjunction with Institute of Civil Engineers

Summary: Dr Mustafa Batikha held a CPD session which addressed the challenges faced when producing sustainable concretes.

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6934381827553906688

• 2nd June 2022

Construction Megatrends Webinar

Summary: Dr Anas Bataw, was delighted to join the panel of industry experts to discuss the outlook for construction over the next decade at the Construction Megatrends webinar.

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6935114773902569472

• 7th June 2022

CESC Industry webinar

Summary: We were delighted to welcome Ayhan Tugrul, CARES, Graeme Bowles, Heriot-Watt University, Darren Denikiewicz, JLL MENA, Riyaz Kazi,, Mott MacDonald as our panel at our webinar 'A Whole Life Cycle Approach to Value Creation in Construction'.

To View Webinar:
https://www.youtube.com/watch?v=-QAmUVcPL6Y&t=70s

• 7th and 8th June 2022

Construction Technology Festival

Summary: Dr Anas Bataw, spoke at the Construction Technology Festival about how the construction industry needs to overhaul its procedures to support digital transformation

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6937988574441009152

• 9th June 2022

Jacobs and CESC Workshop

Summary: The workshop brought together industry and academia intel and focused on specific areas of expertise such as robotics, architecture, transport, modular construction, digital delivery, intelligent systems and sustainability

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6940925720206405632

• 14th June 2022

Second CDDG Cluster One Workshop

Summary: The Materials & Waste management cluster, led by Warren Mc Kenzie -MSc Eng. ACT, MICT, Master Builders Solutions, and Mustafa Batikha, Heriot-Watt University, Dubai Campus spent the afternoon setting benchmarks which will form the next steps to contributing to a Net Zero cement industry.

• 15th June 2022

Attendance at Emirates Green Building Council Annual Congress

Summary: Dr Hassam Chaudhry MCIBSE, FHEA, Assistant Professor, Heriot-Watt University, Dubai Campus and Director of Studies Representative, Centre of Excellence in Smart Construction was delighted to join the panel of esteemed industry and academic leaders at the Emirates Green Building Council Annual Congress where he joined a round table to discuss the Climate Crisis.

For More Information:

https://www.linkedin.com/posts/centre-of-excellence-in-smart-construction-cesc_netzero-climatecrisis-construction-activity-6944927790483800064-9gFs?utm_source=linkedin_share&utm_medium=member_desktop_web

• 22nd June 2022

CESC visit Fairgreen School

Summary: Linsey Thomson, Academic Lead for Student Engagement, CESC was joined by industry experts from Godwin Austen Johnson at Fairgreen School to advise students on best practice when designing entries for COYO ‘ Design the COP’ challenge.

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6949966549105418240

• 4th July 2022

CESC & Aldar host ConTech Day

Summary: Dr Anas Bataw co-hosted a dedicated ConTech day with esteemed industry partner, Aldar Properties which saw CESC affiliates present their products and services to key stakeholders from Aldar and a variety of its businesses.

For More Information:
https://www.linkedin.com/feed/update/urn:li:activity:6965562623710887936

• 5th July 2022

The potential of BIM for measuring and enhancing productivity in the Construction Industry

Summary: We welcomed Prof. Mohamad Kassem, Professor of Digital Construction Management, Department of Engineering, Newcastle University Tamer El Gohary, Digital Innovation Manager, ASGC Prakash Senghani, Director and Head of Digital Delivery, JLL MENA Mo Barghash, Asset Management Practice Lead - Middle East, Mott MacDonald Middle East who discussed the potential of BIM in the construction industry.

To View Webinar:
https://youtu.be/JJ4od4bvADY

• July 2022

CESC Collaborates with 2022 Class of Your Own Initiative

Summary: CESC is delighted to collaboration with Class of Your Own, Design the COP challenge for the second year and as part of our student outreach programme we saw a number of industry partners visit Dubai British School to assist student develope their ideas.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6947415625019314176

• 1th September 2022

CESC Women in Construction Initiative

Summary: CESC launched it's Women in Constuction intitative which is designed to intigate change and have firm commitment from industry to support women working in construction and encourage the next generation of female leaders to see the industry as a viable career choice.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6971018087680618496

• 6th September 2022

CESC attends Saudi Infrastructure Expo

Summary: Dr. Anas Bataw, was delighted to attend the first day of the Saudi Infrastructure Expo (SIE) yesterday which aims to showcase the systems and infrastructure needed for the creation of truly smart cities in the Kingdom of Saudi Arabia

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6973164182204506112

• 7th September 2022

Cluster Three Decarbonisation Workshop

Summary: Led by Dr Olisanwendu Ogwuda, CESC welcomed over 20 decarbonisation professionals to our Dubai campus to discuss the third most pressing challenge of cement decarbonisation, Standards, Procedures and Policies.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6973559311448850432

• 8th September 2022

Decarbonisation Steering Group Meeting

Summary: The Centre of Excellence in Smart Construction were delighted to welcome our decarbonisation steering group members to a meeting held both at our Heriot-Watt University, Dubai Campus and online.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6980053114611478528

• 12th to 15th September 2022

Resilient and Sustainable Cities Trade Mission

Summary: Dr Anas Bataw joined a number of other leading Built Environement professionals at the Resillient and Sustainable Cities Trade Mission, held in the Netherlands

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6980115372330872833

• 13th September 2022

World Green Building Week event

Summary: CESC celebrates World Green Building Week by holding a 'round table' event which was hosted at our Dubai campus in collaboration with Emirates Green Buiidling Council.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6978609239749464064

• 14th September 2022

Digital Construction Summit 2022

Summary: Dr Mustafa Batikha and Dr Harpreet Seth represented Heriot-Watt University at the Digital Construction Summit 2022 and took part in the 3D Concrete Printing: The Opportunities in Construction panel.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6979024226355720193

• 20th and 21st September 2022

Smart Construction Conference and Expo 2022

Summary: Dr Anas Bataw was pleased to chair the first day of the Smart Construction Conference and Expo 2022 which brough together leading experts in BIM, Digital Twin and other Build Environment sectors.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6980390635031658496

• 23rd September 2022

Smart Built Environment Awards

Summary: Dr Anas Bataw was delighted to be on the judging panel of the second Smart Built Environment Awards, the leading regional event honouring excellence in the management of buildings and communities.

To View Webinar:

https://www.linkedin.com/company/cmtodaymagazine/

• 29th September 2022

WETEX 2022

Summary: Dr Anas Bataw joined the panel at WETEX 2022 and discussed ' Education for Sustainable Developement' along with other leading members of Heriot-Watt University faculty.

For More Information:

https://www.linkedin.com/feed/update/urn:li:activity:6978219413749555200

CESC Partners' News

Aldar expands its portfolio with acquisition of luxury islands

Summary: Aldar Properties PJSC has added a complementary luxury asset to its hospitality portfolio with the acquisition of Nurai Island Resort, as well as two additional new islands within the Abu Dhabi archipelago that are intended for residential development.

For More Information: https://www.aldar.com/en/news-and-media/aldar-expands-its-portfolio-with-acquisition-of-luxury-islands

ASGC

Summary: ASGC is delighted to announce the new project award for Masdar City Square, the latest development by Masdar City, the pioneering sustainable community and technology and innovation hub in Abu Dhabi.

For More Information: https://www.asgcgroup.com/news/asgc-is-delighted-to-announce-the-new-project-award-for-masdar-city-square

Jacobs

Summary: Across multiple NASA Centers, contracts and programs, Jacobs is providing innovative solutions and technologies to support NASA in their quest to explore deep space

For More Information:

https://www.jacobs.com/newsroom/news/we-are-going-making-artemis-reality?utm_source=social&utm_medium=linkedin&utm_term=ffcf5181-a9e8-40cb-ad4e-5b04fb011cc9&utm_content=&utm_campaign=news-release

JLL

Summary: JLL have published their latest report which focuses on the key trends of the UAE Real Estate Market – Q2 2022.

For More Information: https://www.jll-mena.com/en/trends-and-insights/research/the-uae-real-estate-market-q2-2022

Mott Macdonald

Summary: Mott Macdonald explain how route-maps help set a visible strategic direction towards net-zero and other intermediate decarbonisation targets.

For More Information: https://www.mottmac.com/views/decarbonisation-route-maps-that-move-with-the-times

Polypipe

Summary: As Polypipe continues to thrive in the Middle East, the company have outgrown their previous regional Head Office in Jebel Ali Free Zone, and have moved to a new and improved space in Dubai mainland.

For More Information: https://www.middleeast.polypipe.com/news/polypipe-middle-east-head-office-moves-dubai-media-city

Keep updated via social media

To keep up to date with all the forthcoming events follow our social media channels

Thank you for reading.

The next Centre of Excellence in Smart Construction bulletin
will be published in April 2023.

To have a research paper considered for inclusion please contact
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