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SYNERGY

BANGLADESHI ENGINEERS & ARCHITECTS WORLDWIDE

Welcome to Synergy Magazine:

A New Chapter for BEAWorld!

"Sustainable construction is vital for developing countries amid rapid infrastructure growth. Traditional cement concrete contributes nearly 8% of global CO_2 emissions. To align with developing countries Like the UAE's Net Zero 2050 Strategy, the construction sector must adopt greener alternatives."

- Engr. Rahana Akter

Addressing Environmental Pollution and It's Mitigation

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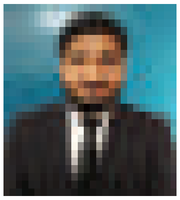


Engr. Md. Sani Miah
BEAWorld Coordinator, UAE
QA/QC Engineer, Combined Group Contracting

Editorial Message

We are pleased to announce the publication of Synergy Vol. 4, continuing our tradition of excellence and commitment. This issue naturally prioritizes Environmental Aspects and their Impacts on public health. Recent AQI records in Dhaka City reaching alarming levels during this dry season, raising serious public health concerns. As a conscientious member of society, we cannot turn a blind eye; we must address these issues and take counter measures. Our aim is to identify all elements contributing to environmental degradation and propose sustainable solutions. We are encouraged by the growing interest of authors from diverse fields, including students.

Synergy, as the networking hub of BEAWorld, prominently features with platform news, including recent events such as the first-ever Yearly Get-Together, the BEAWorld Champion Award, and the Student Leadership Award. We hope these news items add a new dimension to Synergy and attract our readers.

This time, we aim to reach out to stakeholders, including governments, institutions, and non-governmental agencies, by circulating our publication to raise awareness of environmental impacts and enable timely action demonstrating our efforts culminate in meaningful results.

We extend our heartfelt gratitude to the authors of Synergy for their steadfast partnership and dedication to our journey. We also thank the founder and key organizers of BEAWorld for their unwavering support and inspiration. Lastly, we express our profound appreciation to our readers and viewers of the BEAWORLD website for your continued online engagement.

We express our sincere gratitude to our sponsors who have supported Synergy since its inception.

Green Geopolymer Concrete : Transforming Sustainable Construction in the UAE

Engr. Rahana Akter
UAE Innovation 2025 Award Winner

❖ Introduction: A New Era in Construction

The United Arab Emirates (UAE) is experiencing rapid infrastructure growth, requiring sustainable solutions to minimize environmental impact. Traditional cement-based concrete is a major contributor to global carbon emissions, responsible for nearly eight percent of total CO_2 emissions. As part of the UAE's Net Zero 2050 Strategy, the construction industry must adopt greener alternatives to reduce its carbon footprint.

Green Geopolymer Concrete (GGC) is a revolutionary material that offers a sustainable, durable, and cost-effective alternative to traditional Portland cement concrete. Made from industrial byproducts such as fly ash, ground granulated blast furnace slag (GGBS), and silica-rich volcanic ash, GGC eliminates the need for conventional cement. This not only lowers CO_2 emissions but also enhances material strength and durability, making it ideal for UAE's infrastructure.

By utilizing industrial waste, GGC supports the UAE's vision for a circular economy while reducing landfill waste. This article explores the key benefits, applications, and implementation strategies of geopolymer concrete, highlighting its potential to revolutionize the construction sector.

❖ The Science Behind Green Geopolymer Concrete

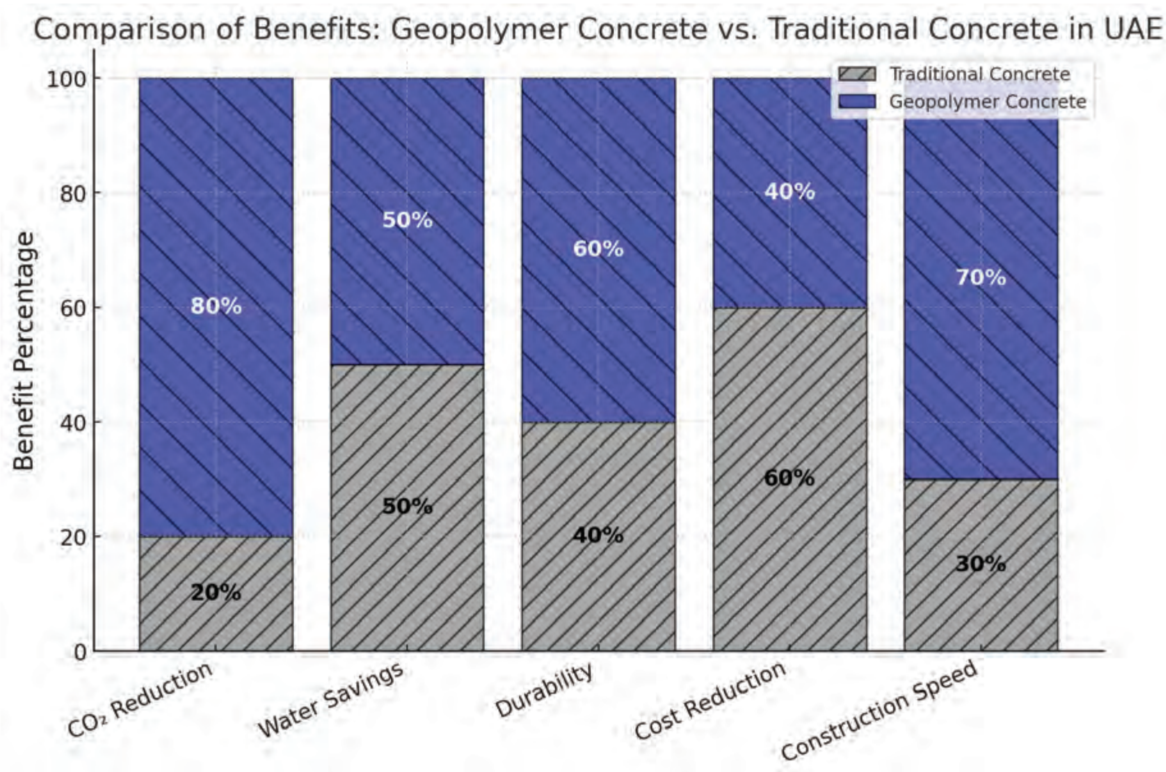
Unlike conventional concrete, which relies on Portland cement as a binding agent, GGC uses an alkaline activation process to create a durable and environmentally friendly material. This process enhances the structural properties of concrete while reducing its environmental impact.

❖ Composition and Key Materials

- Fly ash: A byproduct from coal combustion, rich in silica and alumina, which enhances concrete strength.
- Ground Granulated Blast Furnace Slag (GGBS): A byproduct of steel production that improves durability and sulfate resistance.
- Silica-rich volcanic ash: Abundant in Fujairah's mountains, providing natural strength to the concrete.
- Recycled aggregates: Crushed concrete from demolished structures, reducing waste and conserving resources.

❖ Benefits Over Traditional Concrete

- Eliminates the need for cement, reducing CO_2 emissions by up to 80 percent.
- Offers higher strength and durability, making it resistant to extreme heat and harsh environments.
- Requires 50 percent less water than traditional concrete, supporting UAE's water conservation efforts.
- Cures faster, allowing for quicker construction timelines and reduced labor costs.
- Uses locally available industrial byproducts, lowering raw material expenses.



❖ Why Geopolymer Concrete is Ideal for the UAE

The UAE is well-positioned to adopt and scale geopolymer concrete due to its ambitious sustainability goals and availability of industrial byproducts. Several factors make it an ideal material for the region's construction sector.

Climate Adaptability and Durability

- Withstands extreme heat and high salinity, which are common in the UAE's desert climate.
- Reduces maintenance costs as it lasts longer than conventional concrete.
- Offers enhanced resistance to sulfate attacks and temperature variations.

Sustainable Utilization of Industrial Waste

- Provides an effective solution for recycling industrial waste generated by power plants, quarries, and steel factories.
- Reduces landfill disposal, contributing to a cleaner environment.
- Aligns with the UAE's circular economy initiatives, promoting responsible resource management.

Strategic Fit for the UAE's Sustainability Vision

- Supports the UAE's commitment to reducing carbon emissions in line with the Net Zero 2050 Strategy.
- Complies with green building regulations and sustainable construction policies.
- Enhances the country's reputation as a leader in environmental sustainability.

❖ Implementation Strategy for the UAE

The widespread adoption of geopolymer concrete requires strategic initiatives involving government support, industry collaboration, and public awareness.

Pilot Project

- A dedicated Geopolymer Concrete Testing Facility will be established in Fujairah to assess the material's durability and performance.
- The pilot project will compare GGC with traditional concrete, evaluating its strength, cost-effectiveness, and environmental benefits.
- UAE will serve as a hub for advanced research in sustainable construction materials.

Industry Collaboration and Government Incentives

- Partnerships will be formed with municipalities, developers, and construction firms to integrate GGC into major projects.
- Updates to UAE building codes will incorporate GGC as an approved construction material.
- Tax incentives and financial subsidies will encourage businesses to adopt geopolymer concrete.

Public Awareness and Training Programs

- Educational workshops and certification programs will train engineers, contractors, and policymakers on the benefits of geopolymer concrete.
- Awareness campaigns will showcase successful case studies to promote confidence in the material's adoption.

❖ Applications of Geopolymer Concrete in UAE Infrastructure

Geopolymer concrete can be used across multiple sectors, offering long-term sustainability and economic benefits.

Eco-Friendly Buildings

- Used in residential and commercial structures to improve insulation and energy efficiency.
- Contributes to achieving sustainability certifications, such as Estidama and Dubai's Green Building Regulations.

Road Pavements and Bridges

- Offers higher durability than conventional concrete, reducing maintenance costs.
- Enhances resistance to heavy traffic loads and extreme weather conditions.

Precast Construction

- Ideal for manufacturing boundary walls, blocks, and panels in a controlled environment.
- Ensures high-quality production and efficient on-site assembly.

Marine Structures

- Provides excellent resistance to saltwater corrosion, making it suitable for piers, seawalls, and coastal developments.
- Reduces maintenance costs associated with marine infrastructure.

3D Printed Construction

- Supports automated building technologies, enabling the creation of complex structures with minimal material waste.

❖ Scalability and UAE's Global Export Potential

The UAE has the opportunity to become a global leader in geopolymer concrete production, benefiting both the domestic and international markets.

Steps for Large-Scale Production

- Establishment of manufacturing facilities in key locations such as Jebel Ali and Fujairah.
- Certification and standardization of UAE-produced geopolymer concrete for global exports.
- Implementation of government policies requiring a minimum percentage of public projects to use geopolymer concrete.

Export Opportunities

- Expansion into GCC, Africa, and Europe, where demand for sustainable construction materials is increasing.
- Competitive pricing and superior quality will position UAE as a preferred supplier of geopolymer concrete.

❖ Visual Enhancements (Charts, Graphs, Infographics)

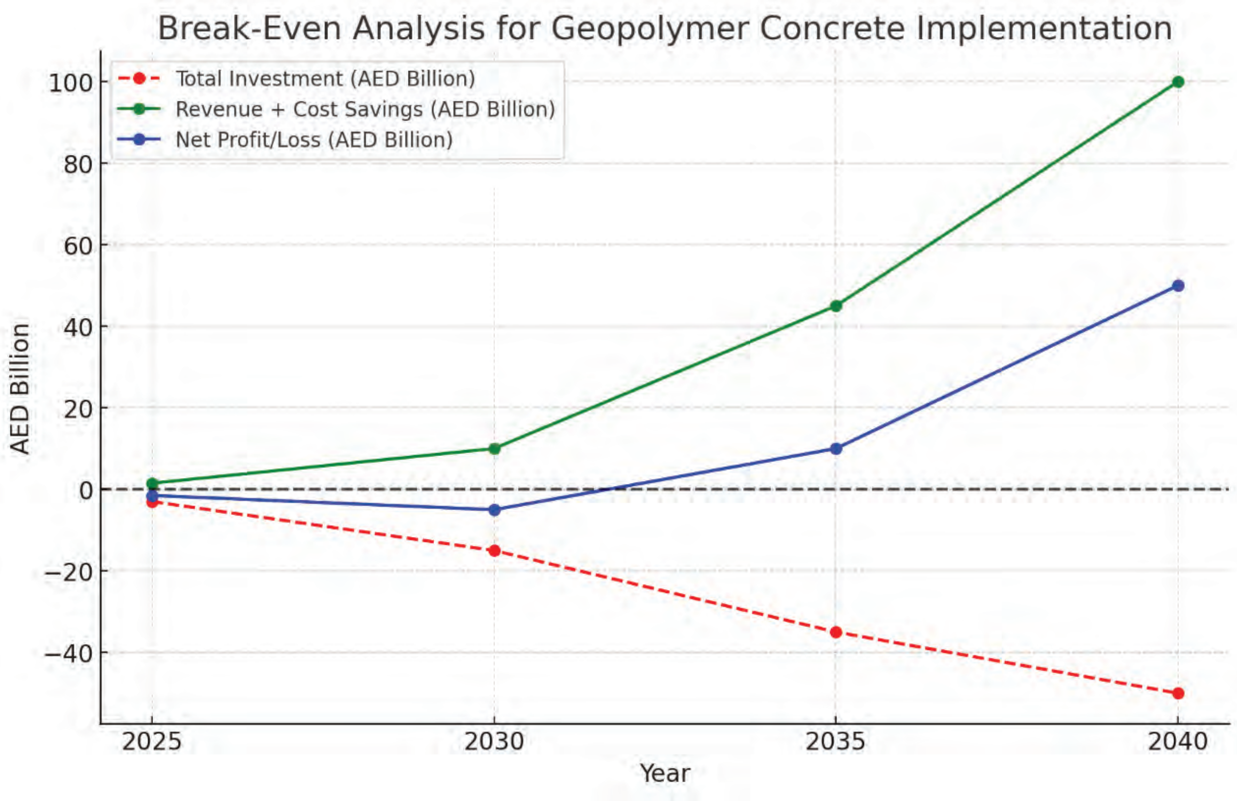


Fig: Investment Breakdown Chart – A bar chart displaying the phased investment required over 15 years.

❖ Financial and Environmental Impact

The adoption of geopolymer concrete is expected to bring substantial economic and environmental benefits.

Economic Advantages

- Reduction in construction costs due to the availability of raw materials and lower maintenance expenses.
- Faster construction timelines leading to reduced labor costs.
- Significant return on investment,

Environmental Benefits

- Reduction of CO_2 emissions by 80 percent compared to Portland cement.
- Conservation of water resources through reduced water consumption in concrete production.
- Decreased reliance on natural raw materials, promoting sustainability.

Projected Market Growth

- By 2025: Pilot projects and regulatory framework development.
- By 2030: Geopolymer concrete incorporated into 20 percent of public infrastructure.
- By 2040: UAE achieves 80 percent market penetration, establishing itself as a global leader.

❖ Challenges and Solutions

Despite its numerous advantages, the adoption of geopolymer concrete faces certain challenges.

Technical Challenges

- Lack of standardized mix designs and limited expertise in handling geopolymer materials.
- Solution: Establish a National Geopolymer Research Center and provide specialized training programs.

Financial Barriers

- High initial investment in production facilities.
- Solution: Government incentives, subsidies, and low-interest green loans.

Regulatory Gaps

- Absence of clear building code requirements for geopolymer concrete.
- Solution: Updating regulations to mandate the use of geopolymer concrete in public projects.

❖ Conclusion: The Future of Sustainable Construction in the UAE

Geopolymer concrete offers an innovative solution to the challenges of traditional cement-based materials. Its durability, cost-effectiveness, and environmental benefits make it an essential component of the UAE's sustainable development goals. With government support, industry partnerships, and increased public awareness, the UAE can lead the global transition towards greener construction.

As the UAE moves toward its Net Zero 2050 vision, the adoption of geopolymer concrete is not just a possibility—it is a necessity. The time to embrace sustainable building practices is now, ensuring a cleaner and more resilient future for generations to come.

Decarbonizing Domestic Shipping: Insights from Bangladesh

Dr. Sajid Hussain *HonDSc MSc CEng CMarEng FIMarEST*
IMO (UN) Maritime Ambassador

1. Introduction

As the world moves toward a more sustainable future, the maritime industry is facing increasing pressure to reduce its environmental impact. Shipping—both international and domestic—contributes significantly to greenhouse gas (GHG) emissions, and Bangladesh, with its vast network of rivers and coastal trade routes, is no exception. While inland and coastal shipping are the lifelines of the country's economy, they also generate large amounts of carbon dioxide (CO_2), sulfur oxides (SOx), nitrogen oxides (NOx), and particulate matter (PM). The need to transition to a low-carbon domestic shipping system has never been more urgent.

Bangladesh's maritime sector is vital for transporting passengers and goods, supporting key industries such as agriculture, textiles, and construction. With approximately 6,000 kilometers of navigable waterways available year-round—and an additional 5,000 kilometers open during the monsoon season—water transport offers a cost-effective and energy-efficient alternative to road and rail travel. However, outdated vessels, inefficient fuel use, and the absence of strict emission controls continue to pose environmental challenges.

As international regulations, particularly from the International Maritime Organization (IMO), push for lower carbon emissions, Bangladesh must take proactive steps to align its policies and infrastructure with these evolving global standards. Decarbonizing the domestic shipping industry is not just about meeting environmental targets—it is essential for maintaining economic competitiveness, complying with international regulations, and improving public health. This paper explores the current state of Bangladesh's domestic shipping industry, highlights key challenges, and outlines pathways toward a cleaner, more sustainable future.

2. Overview of the Domestic Shipping Sector

Bangladesh's domestic shipping sector is a lifeline for transportation, seamlessly connecting people and goods across the country's vast river network. For many regions with limited road and rail access, inland waterways are not just an option—they are a necessity. Cities like Dhaka, Barisal, and Chandpur rely heavily on river transport, with thousands of passengers commuting daily by ferry, making it an essential part of everyday life.

Beyond passenger transport, domestic shipping is the backbone of bulk cargo movement, supporting key industries such as ready-made garments (RMG), construction, and agriculture. Oil tankers, cargo ships, and barges play a crucial role in transporting fuel, coal, cement, and agricultural products between major ports like Chattogram, Mongla, and Payra, ensuring the steady flow of goods that drive the nation's economy.

However, despite its importance, the sector faces significant challenges. Many vessels are aging and operate with outdated technology, leading to inefficiencies and higher emissions. The widespread use of low-quality marine fuels with high sulfur content contributes to air pollution, while the lack of energy-efficient vessel designs and limited investment in cleaner fuel technologies make progress toward sustainability slow.

The environmental and public health risks posed by emissions and water pollution underscore the urgent need for modernization. To build a more sustainable and efficient maritime sector, Bangladesh must focus on policy reforms, technological upgrades, and financial incentives that encourage greener practices. Investing in cleaner, more efficient shipping is not just about reducing pollution—it's about securing a healthier future for the people and the industries that depend on these vital waterways.

3. Emissions from the Domestic Shipping Sector

Bangladesh's domestic shipping sector has a significant environmental footprint, largely due to its heavy reliance on fossil fuels. Most vessels run on heavy fuel oil (HFO) and marine diesel oil (MDO), both of which contribute to high levels of CO_2, SOx, and NOx emissions. Outdated engine technologies only make matters worse, increasing fuel consumption, raising operational costs, and further polluting the air.
Many of the country's vessels are aging and lack modern efficiency standards, leading to excessive fuel use and unnecessary emissions. Poor maintenance, overloading, and prolonged idling at ports add to the problem, wasting fuel and accelerating environmental degradation.

Beyond air pollution, water contamination is another pressing concern. Oil spills, fuel residues, and improper waste disposal have taken a serious toll on aquatic ecosystems, endangering fisheries and marine biodiversity. These pollutants don't just harm the environment—they also pose health risks to coastal communities, contributing to respiratory and cardiovascular illnesses.

Addressing these challenges requires a shift toward cleaner fuels, more efficient vessel designs, and stricter emissions regulations. Without decisive action, the domestic shipping sector will remain a major source of pollution, standing in the way of Bangladesh's sustainability goals. Investing in greener practices now is not just an environmental necessity—it's a commitment to a healthier future for both people and the planet.

4. Regulatory and Policy Framework

Organization (IMO) has set ambitious targets, aiming to cut shipping-related CO_2 emissions by 40% by 2030 (compared to 2008 levels) and reach net-zero emissions by 2050. As a signatory to MARPOL Annex VI, Bangladesh is also committed to adopting low-sulfur fuel alternatives to curb SOx and NOx emissions.

At the national level, the Bangladesh Inland Water Transport Authority (BIWTA) oversees regulations related to vessel design, emissions control, and environmental compliance. The country's commitments under the Paris Agreement, outlined in its Nationally Determined Contributions (NDCs), prioritize reducing emissions from the transport sector, including inland and coastal shipping. Additionally, Bangladesh's long-term development plans, such as Vision 2041 and the Delta Plan 2100, emphasize sustainability in the maritime sector.

However, enforcing these regulations remains a major challenge. Limited technical expertise, insufficient funding, and weak coordination between agencies make effective implementation difficult. Many shipowners, already struggling with financial constraints, hesitate to invest in cleaner technologies. Strengthening enforcement mechanisms and providing financial incentives for green initiatives will be key to ensuring compliance and promoting sustainable practices. Without these efforts, the transition to a cleaner maritime industry will remain slow and uncertain.

5. Challenges in Decarbonizing Domestic Shipping

Bangladesh's journey toward a low-carbon shipping sector is not without its challenges. A major hurdle is the continued reliance on fossil fuels, as cleaner alternatives like biofuels, liquefied natural gas (LNG), hydrogen, and ammonia are not yet widely available. The high sulfur content of locally sourced marine fuels makes the transition even more difficult, adding to environmental concerns. Financial constraints also slow progress. Retrofitting older vessels or building new, energy-efficient ships requires significant investment—something many shipowners struggle to afford. The absence of green financing options, such as low-interest loans or government subsidies, makes it even harder for industry players to adopt cleaner technologies.

Infrastructure gaps further complicate the shift to sustainable shipping. Bangladesh currently lacks LNG or hydrogen refueling stations for domestic vessels, and shore power facilities at major ports are still underdeveloped. Without these critical components, transitioning to low-emission technologies remains an uphill battle. Resistance to change and regulatory shortcomings add another layer of difficulty. Many stakeholders worry about the high costs and potential disruptions that come with decarbonization. To overcome these challenges, strong government support, financial incentives, and clear regulatory guidelines will be essential in driving meaningful, industry-wide transformation. With the right policies and investments, a cleaner, more sustainable future for Bangladesh's shipping sector is within reach.

6. Technological and Operational Strategies for Emission Reduction

Decarbonizing Bangladesh's domestic shipping sector will require a blend of innovation, efficiency, and strategic investment. A key step is transitioning to cleaner fuels such as LNG, biofuels, hydrogen, and ammonia. While LNG is currently the most accessible option, long-term sustainability will depend on shifting toward zero-emission fuels. Electrification also presents a promising opportunity, especially for smaller inland vessels. Battery-electric and hybrid propulsion systems, supported by charging infrastructure powered by renewable energy like solar and wind, can significantly cut emissions. Additionally, solar-assisted propulsion systems could enhance fuel efficiency in smaller vessels, making them more environmentally friendly.

Improving vessel design is another crucial factor. Energy-efficient hulls, lightweight construction materials, and advanced propulsion technologies can help reduce fuel consumption and emissions. Retrofitting ships with features like air lubrication systems, specialized hull coatings, and energy recovery devices can further optimize performance. Beyond technology, smarter operations can also make a big difference. Digital tools for voyage optimization, slow steaming techniques, and shore power (cold ironing) at ports can drastically lower fuel use and emissions. However, implementing these solutions requires close collaboration between government agencies, industry stakeholders, and financial institutions. By working together, Bangladesh can pave the way for a cleaner, more efficient, and sustainable shipping sector.

7. Finance and Investment in Green Shipping

Building a sustainable shipping sector requires significant financial investment, but the right incentives and partnerships can make the transition more achievable. Green financing programs—such as low-interest loans and grants—could help shipowners invest in cleaner technologies without overwhelming financial burdens. Public-private partnerships (PPPs) can also play a crucial role in developing essential infrastructure, including LNG bunkering stations, hydrogen refueling facilities, and shore power systems at ports.

To further encourage investment in energy-efficient vessels and emissions reduction technologies, tax incentives, subsidies, and carbon pricing mechanisms could be introduced. Additionally, international collaborations with financial institutions like the World Bank and the Asian Development Bank could open doors for large-scale green shipping projects, providing much-needed funding and expertise. By creating a supportive financial ecosystem, Bangladesh can accelerate its shift toward a cleaner, more sustainable maritime industry—one that benefits both the economy and the environment.

8. Conclusion

Transforming Bangladesh's domestic shipping sector into a cleaner, sustainable industry is challenging but essential. Despite obstacles like outdated vessels and fossil fuel dependence, decarbonization offers significant benefits. A successful transition requires collaboration among shipowners, policymakers, researchers, and investors to accelerate cleaner technologies and innovative practices.

Key steps include strengthening regulations, investing in sustainable infrastructure like LNG bunkering stations and shore power, and promoting green technologies and alternative fuels. Financial support through green financing, tax incentives, and international partnerships will help ease the financial burden. Decarbonizing will not only protect the environment but also improve public health, create jobs in green sectors, and enhance Bangladesh's global trade reputation. While the journey is demanding, acting now will secure a thriving, environmentally responsible maritime future for Bangladesh.

About the Author

Chartered Marine Engineer (UK) Sajid Hussain is enriched with 13 years' (1980-1993: Cadet to Chief Engineer) seafaring experience through 13 long voyages by 13 ocean-going ships visiting 70 countries and thereafter 30 years' (1993-2023: Chief Engineer and Commandant) maritime teaching experience in Bangladesh Marine Academy. Currently a Maritime Ambassador of IMO since 2016; besides a Trustee of IMarEST and a Trustee of IMarEST Guild of Benevolence, a Maritime Expert of IMO and GlobalMET Australia. Also, served World Maritime University (WMU), Sweden (2013–2024) as a Board of Governors' Member. Authored 26 books, 40 Research papers and over 250 features; forthcoming book is 'Technological Brilliance of Marine Engineering'.

Five Minutes of AI

Dr. Mohammad Mehedy Masud
Professor, College of Information Technology
United Arab Emirates University | Email: m.masud@uaeu.ac.ae

Artificial Intelligence (AI) is reshaping our technology and everyday life. AI is progressing very fast. We need to understand this disruptive technology, so that we can use it effectively, and responsibly. Therefore, I would like to take the humble opportunity to present the technology in simple terms in a series of articles. We all are busy, so I wish to keep each article reading time within five minutes. There comes the title: “five minutes of AI”. The topic for this volume is **a brief *history of Artificial Intelligence***.

A Brief History of Artificial Intelligence
What is AI? In simple terms, AI is a technology built on computer systems that simulates human intelligence. For instance, AI simulates human learning. When a child interacts with the world, and see things and hear new words, he learns new things. In the same way when AI system is presented new data, it learns. But what does it learn, and how exactly? That is what we are going to delve into in this series. However, learning is just one aspect of AI. The modern AI technology’s capability is beyond just learning. It can do problem solving and decision making, create arts, and many more. All of which I would like to cover in this series.

Now, I would like the readers to walk through some of the major events in the history of AI.

Turing Test (1950): Alan Turing[1] a British Mathematician, who is also widely considered to be the father of theoretical computer science, proposed the “Turing test”[2]. So, the test goes like this (see figure 1).

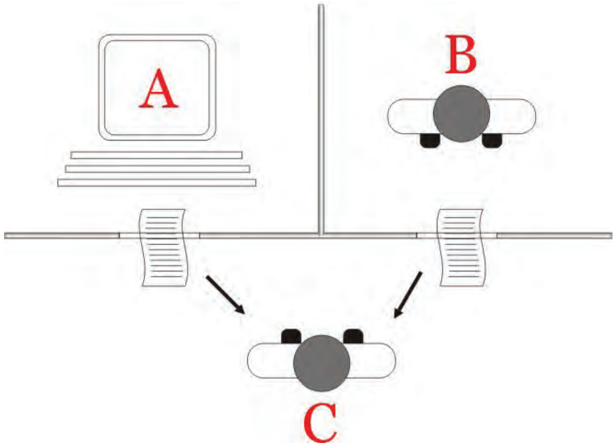


Figure 1: Turing test setting, also known as the imitation game[2].

In this test, a human interrogator (player C) is given the task of trying to determine which player, A, or B, is a computer and which is a human. The interrogator can only use responses to written questions to determine this.

The computer (player A) passes the test if the human interrogator can’t determine which player (A or B) is human and which is a computer.

Turing test has been the gold standard in measuring the success of AI algorithms, as if it is the ultimate goal of any AI tool. However, although the Turing test has been proposed in 1950, till now no AI tool has passed the test. In a recent study[3], GTP4 has shown 49.7% passing rate in a public online Turing Test. This falls short of the baseline set by human participants, which is 66%.

The birth of Artificial Intelligence (1955): John McCarthy, a Professor at Dartmouth College, coined the term “Artificial Intelligence” in a summer workshop at the Dartmouth Conference, to develop ideas about “thinking machines”[4]. This conference is considered as the birth of AI as the field of research, and quickly gained attention by researchers and the field grew rapidly. McCarthy developed a programming language LISP in 1958, which was largely used by the AI community. By the mid 1960s, AI research in the US was heavily funded by the Department of Defense and laboratories were established around the world.

The first chatbot ELIZA (1964): It is one of the earliest natural language processing software developed by Joseph Weizenbaum at MIT[5]. ELIZA was programmed by simulating conversation using pattern matching and substitution. It gave users an illusion that ELIZA understood what the user typed, although it didn’t understand. ELIZA is thus one of the first chatterbots (or modern day chatbot), and was capable of attempting the Turing test. However, compared to modern GTP4s 49.7% passing rate at a Turing test, ELIZA shows only 22% passing rate.

AI Winter (1966-1997): The initial enthusiasm in AI was brought down due to many project failures[6]. This includes the failure of machine translation. Machine translation (MT) research was about developing a computer program that can translate speech or text from one language to another language. As a result of this setback, the MT research funding was diminished. Similarly, several other research projects failed, including DARPA’s Speech Understanding Research program, leading to large decrease in government and academic AI research program. Thus, the initial progress and hype in AI research was down in frustration. However, there were sporadic successes, such as an autonomous drawing program known as AARON, shown at the 1985 AAAI conference, and the first driverless car created by Ernst Dickmann and his team in Munich, in 1986 [7].

Deep Blue (1997) and other successes: IBM’s Deep Blue apparently ended the AI Winter, bringing new hope to AI research[7]. Deep Blue beat the World Champion Gary Kasparov, becoming the first computer program to beat a human champion. This success was followed by a rapid shift in AI agents successes. This includes the Robot Roomba in 2002. In 2003, NASA landed two robot rovers in Mars – Spirit and Opportunity that navigated autonomously on Mars. In 2011 IBM’s Watson, capable of natural language processing (NLP), won the game Jeopardy against two former champions. In the same year Apple released Siri, the first popular AI assistant.

AI Boom (2012 and beyond): We have seen rapid growth of AI tools including virtual assistants, Deep Learning and Generative AI [7]. This leads to the OpenAI’s release of GPT-3 in 2020 that is capable of human-like conversation, and DALL-E that can process and understand images.

That is all for this edition. I hope to explore one of the fundamentals of AI in the next edition, namely, machine learning.

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Advancing Indoor Air Quality Standards: A Bangladeshi Perspective under LEED v5

Engr. Md. Al-Emran Hossain
(PE, M.Sc. Mech Eng, LEED AP, BCxP, CST, CDCS, IAAI-CFI, FIEB)
MEP & LEED Consultant
President "Bangladesh Green Building Academy"
President-Elect "ASHRAE Bangladesh Chapter"
Email: al.emran.hossain@greenbuildingacademy.com.bd

In a rapidly urbanizing country like Bangladesh, improving indoor air quality (IAQ) is essential for public health and sustainable development. As global standards evolve, the latest version of the Leadership in Energy and Environmental Design (LEED v5) emphasizes more stringent IAQ benchmarks, prioritizing advanced air-cleaning technologies and real-time monitoring systems. With air pollution reaching critical levels in many parts of Bangladesh, implementing these standards is more urgent than ever.

Understanding LEED v5's Enhanced IAQ Requirements

LEED Version 5 (v5) introduces significant enhancements to indoor air quality (IAQ) standards, emphasizing continuous monitoring and proactive management to improve occupant health and comfort. Key updates include:

1. Continuous IAQ Monitoring Incentives: LEED v5 rewards projects that implement real-time IAQ monitoring systems. Up to 12 points can be earned by continuously tracking parameters such as CO_2, PM2.5, total volatile organic compounds (VOCs), ozone, PM10, nitrogen dioxide (NO_2), and formaldehyde. This approach encourages ongoing assessment over periodic spot checks, promoting sustained air quality management.

2. Enhanced Ventilation and Filtration Standards: A new prerequisite requires projects to verify ventilation and filtration systems against benchmarks like ASHRAE Standard 62.1. While immediate corrective actions aren't mandated, identifying potential improvements is essential. The use of MERV 13 filters is recommended to enhance filtration efficiency.

3. Strategies for IAQ Improvement: LEED v5 offers additional points for implementing IAQ enhancement strategies, including:

- **Increased Ventilation:** Exceeding ASHRAE 62.1 requirements by increasing ventilation rates by at least 15% in occupied spaces.
- **Infection Risk Management:** Adhering to ASHRAE Standard 241's Infection Risk Management Mode to mitigate airborne health risks.
- **Advanced Filtration:** Installing filtration systems with a minimum MERV 13 rating to capture finer particulates.
- **Operable Windows:** Providing occupants with access to operable windows to enhance natural ventilation.
- **Outdoor Air Quality Monitoring:** Implementing systems to monitor outdoor air quality, informing indoor air management strategies.

These updates reflect LEED v5's commitment to advancing IAQ standards, promoting continuous monitoring, and encouraging proactive measures to ensure healthier indoor environments.

Optimal Indoor Air Quality Performance to Earn Points in LEED v5

PM2.5 Standards in LEED v5:

Measurement and Thresholds:

- Projects must measure PM2.5 levels continuously over a specified period (e.g., at least four consecutive months).
- To earn credits, PM2.5 levels must meet or improve upon the following thresholds: 1) Minimum Threshold: $\leq 12\ \mu g/m^3$ (aligned with the World Health Organization or national standards); 2) Enhanced Threshold (optional, for additional points): $\leq 7\ \mu g/m^3$.

Points Allocation:

- Meeting the minimum PM2.5 threshold earns 2 credits.
- Meeting the enhanced threshold can earn additional credits.

Filtration Requirements:

- The ventilation system must include air filters rated at least MERV 13 (or equivalent).
- Filtration must effectively capture fine particulate matter (PM2.5) from outdoor and recirculated air.

PM10 Standards in LEED v5:

Measurement and Thresholds:

- PM10 must also be measured during the same monitoring period as PM2.5.

- To earn credits, PM10 levels must meet these thresholds: 1) Minimum Threshold: ≤ 50 µg/m³ (24-hour average); 2) Enhanced Threshold: ≤ 25 µg/m³.

Points Allocation:

- Meeting the minimum PM10 threshold earns 1 credit.
- Meeting the enhanced threshold can earn additional points.

Ventilation and Control Measures:

Implement systems or strategies to minimize the infiltration of PM10 particles into the building, such as:

- Proper sealing of entryways.
- Use of entryway mats to capture particulates.
- Positive pressurization in spaces prone to particulate ingress.

Complying with ASHRAE Standard 24

In LEED v5, there are a few ways to earn points for complying with ASHRAE 241, Control of Infectious Aerosols.

- **EQ Credit:** Resilient Spaces (1 point): Projects can earn 1 point for designing occupied spaces with the capability to operate an Infection Risk Management mode that provides the minimum equivalent clean airflow rates outlined in ASHRAE 241.
- **EQ Prerequisite:** Fundamental Air Quality (1 point): If using stand-alone in-room air cleaning systems, they must be tested for effectiveness and safety per ASHRAE Standard 241. nbsp; Sources and related content

Energy Saving in Air Filtration Section in LEED v5

In LEED Version 5, the Energy Saving in Air Filtration section is addressed as part of optimizing indoor air quality (IAQ) while maintaining energy efficiency. Since air filtration can significantly impact energy consumption due to fan power requirements, LEED promotes strategies that balance high IAQ with reduced energy use.

Here's how energy savings in air filtration are incorporated:

1. Efficient Filtration Standards

- **Objective:** Improve IAQ without excessive energy penalties from filtration systems.
- **Key Strategies:** Use filters with high efficiency (e.g., MERV 13 or higher) that are also designed for low-pressure drops; Select filters with low resistance to airflow to minimize the energy required for fan operation.
- **Energy-Saving Benefits:** Reduces HVAC system energy consumption by decreasing the load on fans; Ensures optimal airflow while maintaining filtration efficiency.

2. Advanced Filtration Technologies

- **Objective:** Leverage innovative air cleaning technologies that enhance IAQ without high energy costs.
- **Examples: Electronic Air Cleaners (EAC):** Use electrostatic precipitation to capture particles, offering a lower-pressure drop compared to traditional media filters.

- **Hybrid Systems:** Combine HEPA filters with energy recovery ventilators (ERVs) to offset energy costs while maintaining superior IAQ.
- **Energy-Saving Benefits:** It reduces energy penalties associated with frequent filter changes or high-resistance filters. It maintains high IAQ performance with lower energy input.

3. Variable Air Volume (VAV) Systems with Demand Control Ventilation (DCV)

4. Efficient Fan Systems

5. Filter Maintenance and Monitoring

6. Integration with Energy Recovery Systems

Credit Opportunities of Energy Saving in LEED Version 5

These strategies contribute to both Energy and Atmosphere (EA) and Indoor Environmental Quality (IEQ) categories:

- **EA:** Optimize Energy Performance (Up to 20 points).
- **IEQ:** Enhanced Indoor Air Quality Strategies (Up to 5 points).

Air Quality Technology's MESP: A LEED-Ready Solution

Air Quality Technology’s patented MESP solutions redefine how IAQ challenges are addressed. These systems excel in performance, energy efficiency, and environmental sustainability, making them ideal for projects aiming to achieve LEED certification under v5.

1. Advanced Filtration Technology

MESP systems employ cutting-edge electronic air cleaning technology to effectively remove particulates, including PM2.5 and ultra-fine particles, surpassing traditional filtration methods. With a filtration efficiency equivalent to MERV 14 standards, MESP ensures compliance with LEED v5 requirements.

2. Washable Filter

MESP includes a highly durable, washable filter, which provides significant cost savings over time and supports sustainable building practices. This feature reduces the need for frequent filter replacements, promoting long-term environmental and operational efficiency.

3. Real-Time Monitoring and Integration

MESP units integrate seamlessly with building automation systems, providing continuous monitoring and reporting of key IAQ metrics such as CO_2, particulate matter, and VOC levels. This feature supports the 12-point incentive for IAQ monitoring in LEED v5.

4. Sustainable and Energy-Efficient Design

Unlike conventional filtration systems, MESP technology minimizes pressure drop, significantly reducing energy consumption. By lowering HVAC system loads, MESP contributes to both operational cost savings and improved building sustainability, aligning with LEED’s energy efficiency goals.

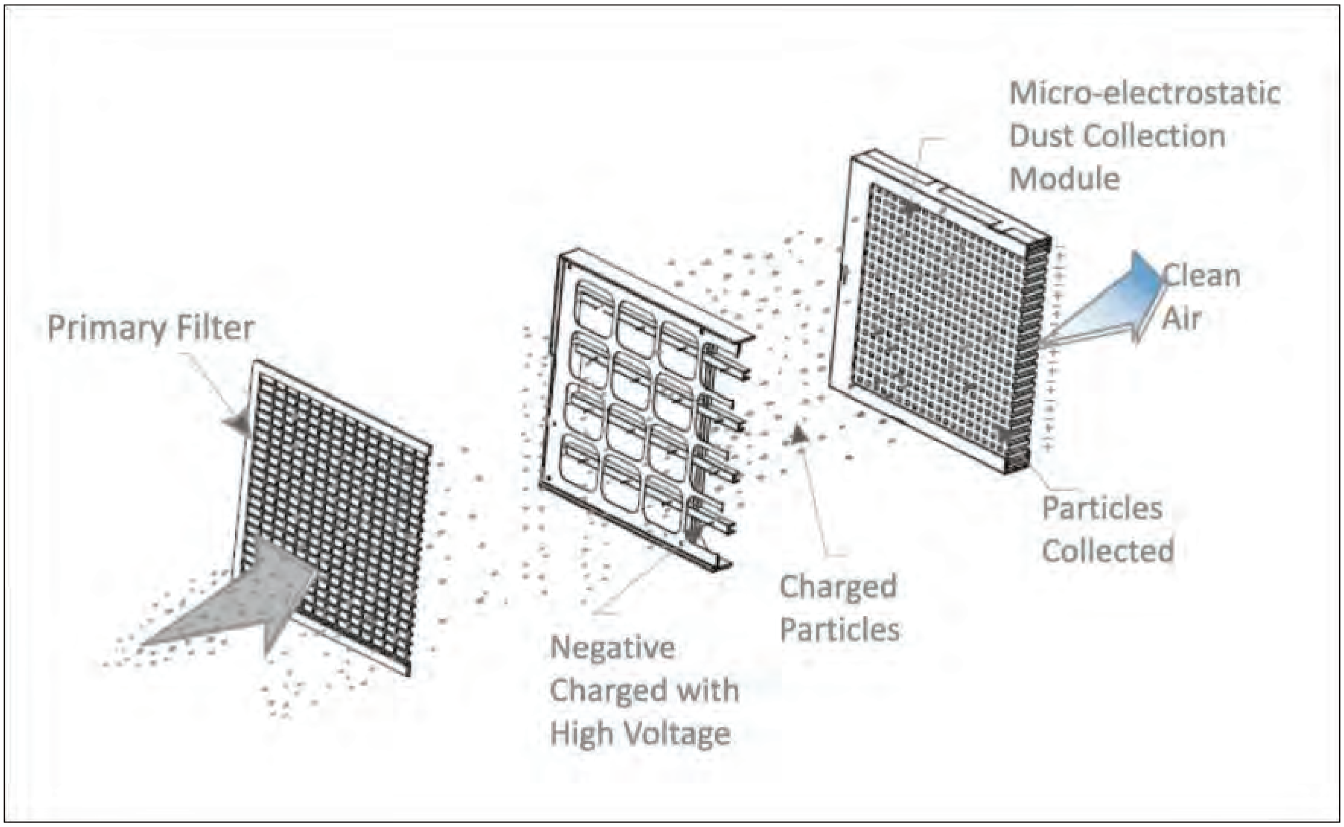
5. Infection Risk Management

MESP solutions include advanced disinfection capabilities, effectively neutralizing airborne pathogens. These systems meet ASHRAE Standard 241 requirements, providing robust infection risk management in high-occupancy settings like schools, offices, and hospitals.

6. Modular and Customizable Implementation

MESP units are modular, enabling tailored solutions for diverse building needs. Their compact design allows for easy retrofitting of existing HVAC systems, ensuring minimal disruption during installation.

The Competitive Advantage: Why Choose MESP for LEED v5 Projects?



By incorporating MESP technology into building designs, developers and facility managers can unlock several advantages:

- **Maximized LEED v5 Points:** MESP supports compliance across multiple IAQ criteria, ensuring projects achieve higher certification levels.
- **Enhanced Occupant Health and Comfort:** Superior air quality directly improves occupant well-being and productivity.
- **Cost-Effective Sustainability:** Energy-efficient operations reduce long-term costs while meeting environmental goals.
- **Future-Proofed Infrastructure:** MESP prepares buildings for evolving IAQ standards with scalable and adaptable solutions.

Technical Comparison HEPA/MESP

	HEPA	MESP
Efficiency (particle capture 0.3 microns)	Excellent 99.97 %	Excellent + 99.99%
Pressure Drop Resistance	Poor 150-450Pa	Excellent 10-50Pa
Energy Cost	Poor 610x610 filter= fan energy x 5 MESP	Excellent Comparable MESP 1/5 HEPA cost
Maintenance Cost	Poor Final and pre-filters require replacement and disposal	Excellent Occasional cleaning takes a few minutes, soapy water and dry
Service Life	Poor Pre filter and HEPA block in relation to the environment	Excellent Properly maintained MESP filter is permanent; never needs replacing
Noise	Poor High-pressure drop = High noise	Excellent Low-pressure drop=quiet air flow

Technical Comparison UVC-GI / MESP

	UVC-GI	MESP
Efficiency (Microbial deactivation)	60% on first pass	+ 99.99% on first pass
Pressure Drop Resistance	75Pa	10-50Pa
Energy Cost	95W per Lamp per 200L/sec	5 to 13 W
Maintenance Cost	Pre-filters and UVC-GI Lamps require replacement and disposal	Occasional cleaning takes a few minutes, soapy water and dry
Service Life	Pre-filter and Lamp replacement as required	Properly maintained MESP filter is permanent; never needs replacing
Exposure length	Requires extended exposure area	Requires on max of 150mm exposure
Cassette depth	Depth of min 350mm	Depth between 90 and 150mm
Noise	Low noise	Excellent Low-pressure drop=quiet air flow

Case Studies: Success Stories with MESP

A high-rise in Dhaka integrated MESP systems into its HVAC design, reducing energy costs by 25% while maintaining LEED Gold certification.

Tackling Air Pollution in Bangladesh with Innovative and Economical Solutions

Air pollution is a pressing environmental and public health crisis in Bangladesh. Rapid urbanization, industrial growth, and reliance on traditional energy sources have contributed to dangerously high levels of air pollutants, impacting the well-being of millions. Addressing this challenge requires a multi-faceted approach, combining proven strategies with innovative and economically viable technologies tailored to the specific context of Bangladesh.

Understanding the Sources:

Before delving into solutions, it's crucial to understand the primary sources of air pollution in Bangladesh:

- **Vehicular Emissions:** Traffic congestion and older, poorly maintained vehicles contribute significantly to pollutants like particulate matter (PM2.5), nitrogen oxides (NOx), and carbon monoxide (CO).
- **Industrial Activities:** Industries such as brick kilns, textiles, and tanneries release substantial amounts of pollutants, including particulate matter, sulphur dioxide (SO2), and various toxic chemicals.
- **Open Burning:** Burning of agricultural waste, solid waste, and biomass fuels for cooking and heating is a major source of particulate matter and other harmful pollutants.
- **Transboundary Pollution:** Air pollution from neighbouring countries also affects Bangladesh's air quality, particularly during certain seasons.

Strategies for Improvement:

To combat air pollution effectively, Bangladesh needs a comprehensive strategy encompassing the following key areas:

1. Stricter Regulations and Enforcement:

- Implementing and enforcing stricter emission standards for vehicles and industries.
- Regular monitoring of air quality and industrial emissions.
- Imposing penalties for non-compliance with environmental regulations.

2. Promoting Cleaner Transportation:

- Investing in public transportation systems, such as efficient bus networks and metro rail.
- Incentivizing the use of electric vehicles (EVs) and hybrid vehicles through tax breaks and subsidies.
- Promoting cycling and walking infrastructure in urban areas.
- Phasing out older, high-polluting vehicles.

3. Upgrading Industrial Technologies:

- Encouraging industries to adopt cleaner production technologies and energy-efficient processes.
- Providing financial and technical assistance to small and medium-sized enterprises (SMEs) for upgrading their equipment.
- Promoting the use of cleaner fuels in industries, such as natural gas and biogas.
- Implementing stricter regulations on brick kilns, including promoting the use of more efficient and less polluting kiln technologies like Zigzag kilns.

4. Addressing Open Burning:

- Raising public awareness about the harmful effects of open burning.
- Providing alternative waste management solutions, such as composting and recycling programs.
- Promoting the use of cleaner cooking and heating technologies, such as biogas stoves and solar cookers.

5. Green Infrastructure and Nature-Based Solutions:

- Increasing green spaces in urban areas through parks, urban forests, and green roofs.
- Planting trees along roadsides and in industrial areas to act as natural air filters.
- Protecting and restoring natural ecosystems, such as wetlands and forests, which play a vital role in air purification.

Innovative and Economical Technologies for Bangladesh:

While traditional strategies are essential, adopting new technologies can significantly accelerate progress in improving air quality. Here are some promising options for Bangladesh:

- **Low-Cost Air Quality Monitoring Sensors:** Deploying a network of low-cost sensors can provide real-time data on air quality at a granular level, helping to identify pollution hotspots and track the effectiveness of interventions.
- **Mobile Apps for Public Awareness:** Developing mobile apps that provide real-time air quality information and health advisories can empower citizens to take protective measures and engage in advocacy efforts.
- **Solar-Powered Air Purifiers:** Utilizing solar energy to power air purifiers can provide a sustainable and cost-effective solution for cleaning the air in public spaces, schools, and hospitals.
- **Bioremediation:** Using plants and microorganisms to remove pollutants from the air and soil can be a natural and cost-effective way to clean up contaminated areas.
- **Waste-to-Energy Technologies:** Converting municipal solid waste and agricultural waste into energy can reduce reliance on fossil fuels and decrease open burning.

Economic Considerations:

Implementing these strategies and technologies requires financial investment. However, the economic benefits of improved air quality far outweigh the costs. These benefits include:

- Reduced healthcare costs associated with respiratory and cardiovascular diseases.
- Increased productivity due to improved public health.
- Enhanced tourism and investment opportunities.
- Improved agricultural yields due to reduced air pollution damage to crops.

Conclusion: Leading the Way in Sustainable IAQ

As LEED v5 raises the bar for indoor air quality, Air Quality Technology's MESP solutions provide a proven, future-ready path to compliance. Combining cutting-edge filtration, energy efficiency, and real-time monitoring, MESP not only meets but exceeds the standards set by LEED v5.

Circular Economy: A Sustainable Future for Municipal Solid Waste Management in Bangladesh

Ashiqur Rahman
Undergraduate Student, Department of Civil Engineering
Khulna University of Engineering & Technology, Khulna (KUET)

Introduction:
Bangladesh, a densely populated country in South Asia, is grappling with municipal solid waste management problems due to rapid urbanization, population growth, and economic development, which have led to an increase in MSW generation. The current system follows a linear waste management system based on the "take," "make," and "dispose" which is proving unsustainable and inefficient. In contrast, a circular economy model (CE) provides a sustainable approach by emphasizing waste reduction, material recovery, and resource optimization. Adopting a circular economic approach provides sustainability to urban solid waste management along with the achievement of social development goals (SDGs).

The Challenges of Municipal Solid Waste Management in Bangladesh
Bangladesh generates approximately 25,000 tons of municipal solid waste daily with a major contribution of urban areas. The capital, Dhaka City alone, produces approximately 6,000 tons of waste daily.[1] Key Challenges in MSW management include:

- **Inefficient Waste Collection and Segregation:** Less than 50% of wastes are improperly collected and most of these remain unsegregated, leading to difficulties in recycling and reuse of the resources.

- **Improper Waste Disposal System:** Open dumping and landfilling remain the primary methods of waste disposal, leading to soil and water contamination, greenhouse gas emissions, and severe health issues.

- **Convention Waste Management System:** The system used all over the world nowadays is the linear economy system. This includes manufacturing products, their consumption, and disposal of waste. This model not only pollutes the environment but also generates excessive waste and fails to optimize resource utilization [2].

- **Limited Recycling and Recovery Rate:** Lack of infrastructure and policymaking leads to low waste recycling rate that hinders the optimization of resources and causes environmental pollution.

To address these problems Bangladesh must adopt a circular economy model that includes waste minimization, resource recovery, and sustainable consumption.

What is a Circular Economy?
The circular economy model involves the production, consumption, and disposal of waste for further production. It aims to minimize waste by the Recycling, Reduce, and Reuse (3Rs) concept.[2]. The main concept of the circular economy mainly consists of three basic principles:

1. **Design out Waste and pollution:** Introduction of eco-friendly product designs for durability, recyclability, and waste minimization[3].
2. **Keep products and materials in use:** Reuse, Repair, Refurbish, and remanufacture segregated wastes for further production[3].
3. **Regenerate natural systems:** Helping nature recover by making sure waste materials are returned to the environment in a way that supports its health and balance[3].

The circular economy model is increasingly recognized as a sustainable alternative to traditional linear models. With innovative technologies and effective waste management processes, it considers waste as a by-product leading to resource recovery, renewable energy production, and waste reduction. The following figure shows the basic concept of linear and circular economy models based on waste management.

a) **Linear Economy Model**

b) **Circular Economy Model**

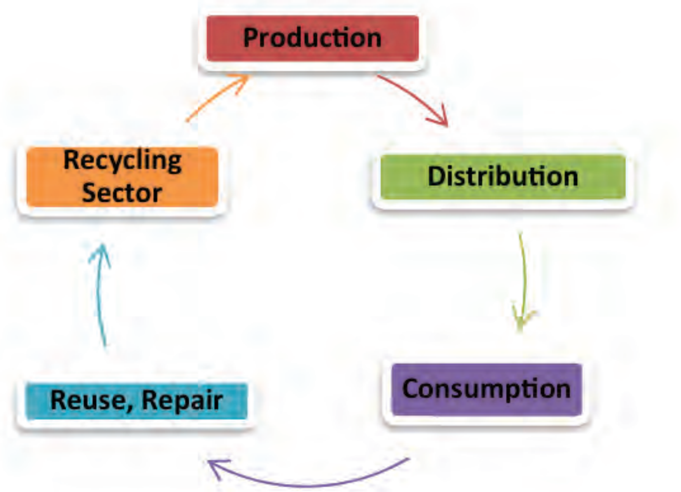


Figure 1. Linear Economy Model and Circular Economy Model

Circular Economy Practices around the World.

Several countries have been implementing the concept of circular economy in various sectors, which proves to be an environmentally friendly alternative to waste management at a limited level. According to a report by the EU Commission, a switch to the circular economy could increase their GDP by 0.5% and create 700000 new workforces. Besides, the EU discovered that a circular economy would create 4% of workers. It would increase household income by 3,000 euros and reduce CO2 emissions by 48% by 2030 for a net increase of 1.8 trillion euros.[2].

Table 1 represents major CE practices around the world.

Table 1: Major CE practices around the world

Continent	Country	Major Practices of CE around the world
North America	United States	Making of carpet out of plastic; making of homes using old shipping containers; making of jeans from waste plastic bottle; recycling, and reusing used clothes; Walmart investing to bring green practice to its suppliers.
	Canada	Making reusable, recycling, and compostable plastic packaging, recycling of cartons.
Europe	UK	Making of Plastic Highways
	Poland	Making of biodegradable cutlery.
	France	Using circular economy concepts in all stages of agricultural production.
	Belgium	C&M collecting only organic cotton.
	Portugal	Growing mushrooms from coffee waste
	Sweden	Use and making of reusable crates and pallets; recycling, and reuse of used clothes.
South America	Brazil	For the composition of mortar and, concrete the use of recycled construction material; recycling of paper and plastic.
	Uruguay	Collection of wastes for recycling.
	Chile	Recycling, and reuse of wastewater; recycling of solid wastes.
Australia	Australia	Making of lather bags using fish skin; making of reusable palates, crates & containers.
	New Zealand	Making carpets from automobile waste.
Africa	South Africa	Recycling by collection of scrap tires.
Asia	Japan	Collection, and recycling of used clothes.
	India	Making of paper out of elephant dung; collecting E-waste; collecting organic wastes, and turning them into compost fertilizer; and bus service running on renewable biogas.
	South Korea	Recycling of plastic wastes, producing recyclable paper cups.
	Singapore	Using food waste to produce fertilizer; collection of wastes, and recycling, sending of waste to energy plants.

Circular Economy: Developing Country Perspective

Developing nations tend to suffer from inefficiencies and lack concrete plans for integrating climate objectives into policy and general development strategies. These nations need to develop policies that decouple growth from adverse effects to enable continued economic growth while also fostering inclusive development to alleviate poverty and conserve the environment.[4]. Economic developments in a nation, coupled with enhanced knowledge among people about the importance of a circular economy (CE), can help improve the adoption of CE practices in developing nations.

To become sustainably developed, shifting towards a circular economy model is inevitable in almost all sectors, especially in waste collection and treatment. According to several case studies and literature, governments of developing countries face problems with policy-making, proper management, policy implementation, and technological barriers regarding the transition[5]. Moreover, cost-effective, eco-friendly sophisticated technologies are required for adopting a circular economic approach[4]. However, industries in developing countries are moving towards cleaner production and CE practices so that they can produce eco-friendly, cheaper in cost, and will be more demandable to the communities of the developing countries. Furthermore, the implications of CE also provide job opportunities and reduce unemployment problems in developing countries.

To implement a circular economic system, the government, countries, and businesses must: 1) invest in waste management and recycling infrastructure, 2) introduce strong policies and incentives for circular business models, 3) encourage innovation in circular product design and manufacturing, 4) Strengthen partnerships with global organizations for knowledge and financial support.

Examples of Circular Economy in Developing Countries.

1) Rwanda implemented a ban on non-biodegradable plastic bags in 2008 which has significantly reduced plastic waste and promoted the use of reusable alternatives (According to the UNEP Rwanda Case Study)

2) Brazil implemented the system of reverse logistics in garbage packaging, wherein manufacturers and sellers are compelled to track product harvesting and recycling. As a consequence of such methods, the volume of recycling activity has increased, and there came into existence a structured recycling business[6].

3) The Naroda Industrial Area in Gujarat has adopted industrial symbiosis, where waste from one industry becomes a resource for another. For example, fly ash from power plants is used by cement manufacturers, reducing waste and creating economic value[7].

4) Ghana has operational informal and structured e-waste recycling structures, with key systems in Agbogbloshie. An effort is being made to legalize the industry, make it cleaner, and recover such materials as gold and copper from e-waste[8].

Prospects and practices of Circular Economy around the World

According to the reports of Trading Economics, in Bangladesh, the unemployment rate is expected to be 4.2% in 2020. To achieve economic resilience and meet the requirements of SDGs, Bangladesh needs to take the initiative to create more employment opportunities along with sustainable industrial development that incorporates the “3R” concept (Recycle, Reduce, and Reuse) acting as a principal component for a Circular economy model. In this target, the Bangladeshi government introduced the 3Rs strategy for waste management plan in 2010, aiming to reduce secondary waste generation and increase waste recycling.
According to experts, Bangladesh has a huge opportunity as we do not sell directly to the consumers; thus we could emphasize a circular economy model with big apparel and fashion chains that are ready to look for a circular business model. However, Bangladeshi industries have started to implement the circular economy model on a medium scale which incorporates the 3Rs principle.

Table 2 Practices and Opportunities of the CE model in Bangladesh.

Industry	Current Practices	Opportunities
Garments	✓ Reverse resources are trying to build a marketplace for garment waste ✓ Simco spinning and producing yarns from discarded cotton clips ✓ Filotex Ltd is the first company in Bangladesh working in the Circular fashion concept.	If the bi-products of garments waste is recycled inside Bangladesh, the income in this sector can get double adding $4 billion to the industry, and will create new job opportunities.
Plastic	✓ Only 9.2% of the plastic waste of Bangladesh is recycled every year. ✓ In Dhaka city of Bangladesh; 137.57 tons of plastic is recycled per day, but the health and environmental issues are not properly looked after	The collection of plastic waste can help to reduce pollution and save a significant amount of money in foreign exchange.
Construction	✓ No mentionable practices	Research in Bangladesh found that recycled brick has the potential to satisfy international standards like ASTMC33 and have a strength of about 2,500–5,000 psi
Ship Breaking	✓ About 20 lakh metric tonnes of obsolete ships are recycled every year in different yards in Bangladesh. Most of the parts of vessels are recyclable, which constitute mostly steel. ✓ This industry is also creating huge revenue and making new employment opportunities.	No mentionable prospects.
Paper	✓ The Karnaphuli paper mill of Bangladesh uses less than 10% or less recycled fibers in the total furnish, though the private factories use a significant portion of recycled fibers with virgin fibers.	No mentionable prospects

Challenges and Barriers to Implementing the CE Model in Bangladesh

Apart from having huge opportunities and contributions to the job market as well as revenue generation, the country is facing some barriers to implementing the circular economy model on a larger scale. Several case studies and Several case studies have been conducted, and perspectives have been considered to identify the social and technical barriers prevailing in the implementation of the CE concept on a commercial scale.

According to Dr. Muhammad Saiful Islam, a faculty member of the Department of Civil and Environmental Engineering at Shahjalal University of Science and Technology, there are three major technological barriers in establishing the model: 1) lack of knowledge and skills in new technology; 2) unclear benefits of applying this eco-friendly technology; 3) lack of public awareness. He also mentioned that the policy barriers such as lack of research-based knowledge and user-friendly technology, improper policy framework and guidelines on how to implement the model, lack of of skilled manpower to monitor and evaluate whether the model is applied in the field properly, lack of organizational skills and knowledge to implement the model in the field, lack of funding and resources

Agreeing with Dr. Muhammad Saiful Alam, Engineer Sahadat Hossain, an environmental consultant working on the World Bank's project also mentioned the role of stakeholder effort is inevitable in implementing the CE model. Because most of the producers or stakeholders are not willing to pay attention to the environment. Moreover, the lack of awareness, motivation as well as knowledge of understanding about CE among the mass population also plays an important role in applying the CE model.

Conclusion

The circular economy model is one of the most prominent concepts that offers environmental sustainability, waste reduction, resource optimization as well as huge employment opportunities. The transition to the circular economy in Bangladesh's waste management sectors offers a huge opportunity to environmental, social, and economic benefits. By obtaining an integrated waste management strategy, strengthening the regulatory framework, and fostering public-private relationships along with stakeholder's participation Bangladesh can execute the CE model on a full scale. By adopting circular economy principles, the country can transform its waste management system, turning challenges into opportunities and paving the way for a greener, more prosperous future.

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Urban Drainage System: Modern Hydrological Analysis and Future Impact

Raisa Tabassum
Undergraduate Student, Department of Civil Engineering
Khulna University of Engineering & Technology, Khulna (KUET)

Introduction

Urban drainage system is one of the most important structures, that requires quite a long-term analysis and designs to be implemented. All of these analyses are important to make a sustainable and efficient drainage network that can hold and enable the stormwater to flow out. Previously, hydrological modeling and analysis were not popular among the practitioners, the researchers, as well as the academics. Those analyses were dependent only on the usage of GIS systems; those were time-consuming and tiring too. Modern technologies in hydrological studies developed due to the increasing demand for real-time forecasting, updated climatic data, and rapid urbanization around the world(Sui & Maggio, 1999) . The software is used to predict flood hazards and also to model urban flood occurrence along with rainfall-runoff simulations. Since, engineering practices are made up of analysis and design, analyzing the hydrological issues of the urban drainage and then proposing a new design is the utmost target of such execution (Md Shafiul Islam et al., n.d.). The best way to be accurate in the modern hydrological analysis is to combine both the GIS and Hydrologic models. This type of integration can be able to give a proper result and ensure the best use of the available data(Sui & Maggio, 1999). This article is going to show the reason behind the development of advanced hydrological modeling techniques over GIS tools and systems and will also mention some of the sophisticated software used worldwide to accomplish contemporary drainage systems.

Why is Modern Software Taking the Place of GIS Tools?

Though GIS has advanced capability to do spatial analysis, watershed analysis, or floodplain mapping, it is also required to integrate data from different resources and then work with them using faster and smoother tools. This type of integration can offer dynamic modeling with updated data, runoff flow simulations, and so on. Without additional tools or software, GIS cannot perform flow simulations, soil and sediment characterization, and automatic calibration-validation with observed data. Also, GIS software like ArcGIS or QGIS primarily did not built to perform only on hydrological analysis, so it takes a longer time to process larger hydrologic data and analyze them. In ArcGIS by ESRI, computation of hydrological modeling can be done using some extensions like ArcHydro and HEC-GeoHMS. Also, QGIS uses some water modeling-based special plugins like QSWAT and TauDEM.

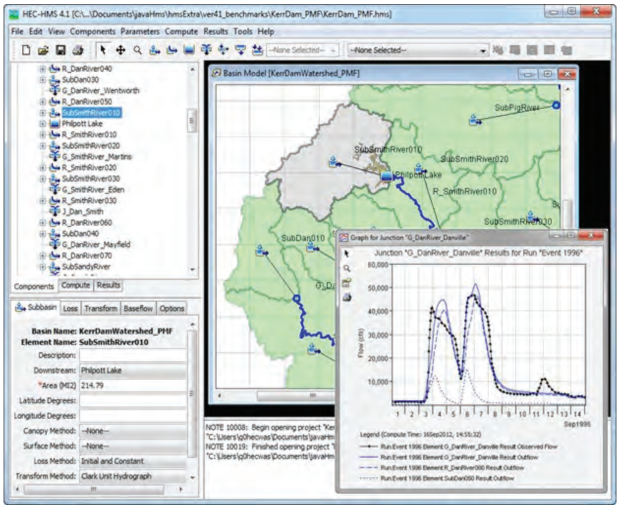
Some Hydrological Modeling Software:

1. **HEC-HMS:** Hydrologic Engineering Center - Hydrologic Modeling System, developed by the U.S. Army Corps of Engineers to develop hydrologic modeling and analyzing with the given data, simulating the rainfall-runoff along with the amount of discharge through a basin/subbasin. Compared with the observed data, this software can manually or automatically calibrate and validate with the model data. This tool also provides the report containing hydrographs, stream flow and time series

data and discharge or runoff volume. Taking all into account, a user can make important decisions, at the remote corner of the world. It is a free software and till now it has already published numerous versions (HEC-HMS 1.0 – 1995, HEC-HMS 2.0 – 2000, HEC-HMS 3.0 - 2000, HEC-HMS 4.0 – 2010, HEC-HMS 5.0 – 2016, HEC-HMS 6.0 – 2019, HEC-HMS 7.0 – 2023). (Source: https://www.hec.usace.army.mil/confluence/hmsdocs/hmsum/latest)

2. **EPA SWMM:** Environmental Protection Agency Storm Water Management Model, developed by the U.S. Environmental Protection Agency (EPA). It has various applications e.g., urban stormwater management and drainage regulations, flood control and mitigations, future urbanization, and stormwater management modeling. Using this tool, not only analysis is done but also the tool is helpful to identify the economical pipe or conduit size thus designing the drain. This software can simulate using a defined time span of equal or more than one year and also can model the sediment transport and erosion-deposition of urban drains during heavy rainfall events. It is free software, and many versions have been released till now (SWMM 1.0 – 1971, SWMM 2.0 – 1975, SWMM 3.0 – 1988, SWMM 4.0 – 1994, SWMM 5.0 – 2009, SWMM 5.1 – 2013, SWMM 5.2 – 2018, SWMM 5.3 – 2020).
   (Source: https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=354181&Lab=CESER)

3. MIKE URBAN: MIKE URBAN is a hydrologic modeling software developed by DHI Group (Danish Hydraulic Institute), that can simulate not just stormwater management systems but also it can work with domestic wastewater and drinking water systems. It can work in an integrated mode along with wastewater collection, freshwater distribution, and then stormwater drainage in one model at a time. It also integrates with GIS to get access of spatial data and then visualize the network. It is not a free software and the version that has been published till now are MIKE URBAN 2000, MIKE URBAN 2004, MIKE URBAN 2008, MIKE URBAN 2012, MIKE URBAN 2016, MIKE URBAN 2018, and MIKE URBAN 2021.
   (Source: https://www.dhigroup.com/technologies/mikepoweredbydhi/mikeplus)



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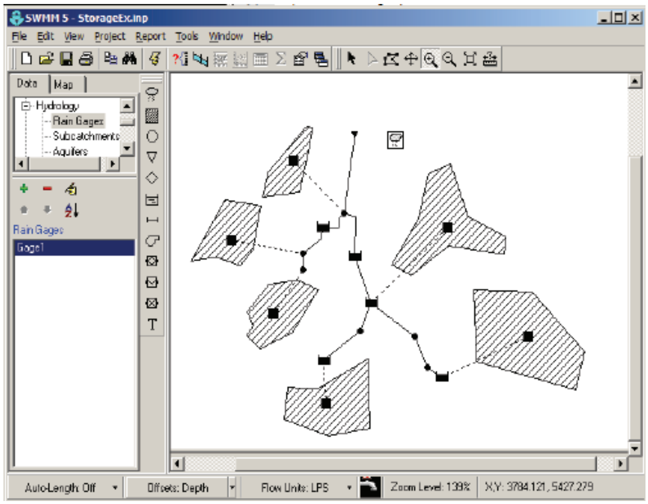
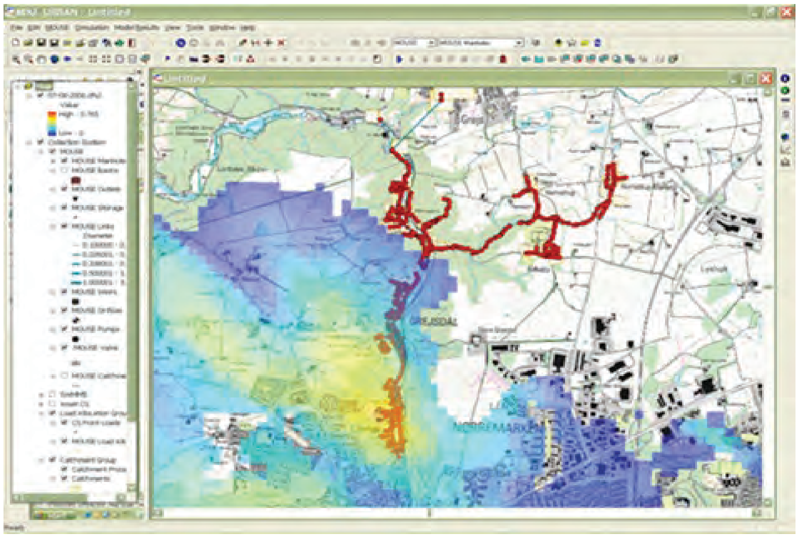


Source: https://pythonhosted.org/SWMM5_EA/Working%20Principles.html



Source: https://dhiuk-demos.blogspot.com/2013/

In conclusion, modern hydrological modeling software like HEC-HMS, EPA SWMM, and MIKE URBAN has transformed urban drainage system design by integrating GIS with advanced hydrological simulations. More effective and sustainable urban water management is made possible by these tools, which provide accurate modeling of stormwater runoff, flood control, and drainage performance. As urbanization grows, these technologies will be essential for creating resilient drainage systems to address climate change and rapid development challenges.

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Pollution Control in Action: The Power of Regulatory Bodies

Lowhe Mahafuj Miraj
Undergraduate Student, Department of Civil Engineering
Khulna University of Engineering & Technology, Khulna (KUET)

Introduction

Pollution remains one of the most significant global challenges, threatening human health, ecosystems, and the planet's climate. As industries expand and urbanization accelerates, the need for effective pollution control measures becomes increasingly urgent. Regulatory bodies, established by governments and international organizations, play a pivotal role in addressing this issue.

Figure 1: A factory releasing thick smoke into the sky, with polluted water nearby

These agencies are tasked with creating policies, enforcing regulations, and promoting sustainable practices to mitigate pollution and protect the environment. Their work is indispensable in ensuring a cleaner, healthier future for all.

Setting Environmental Standards

A primary responsibility of regulatory bodies is to establish environmental standards that limit the release of harmful pollutants into the air, water, and soil. These standards are grounded in scientific research and aim to balance industrial growth with environmental preservation. For instance, agencies like the Environmental Protection Agency (EPA) in the United States and the European Environment Agency (EEA) define permissible levels of emissions for industries, vehicles, and other pollution sources. By setting clear and enforceable limits, regulatory bodies provide a framework for industries to operate responsibly, ensuring that their activities do not exceed environmentally safe thresholds.

Monitoring Compliance and Enforcement

Regulatory bodies are also responsible for monitoring compliance with environmental regulations. This involves conducting regular inspections, collecting data, and analyzing pollution levels to ensure that industries and individuals adhere to established standards.

Figure 2: Environmental inspectors in safety gear, checking pollution levels at an industrial site.

Advanced technologies, such as remote sensing and real-time monitoring systems, have significantly enhanced the ability of these agencies to track pollution sources and identify violations. When non-compliance is detected, regulatory bodies have the authority to impose penalties, fines, or even halt operations until corrective measures are implemented. This enforcement mechanism acts as a deterrent, encouraging industries to adopt cleaner technologies and practices.

Promoting Sustainable Practices

Beyond enforcement, regulatory bodies actively promote sustainable practices. They collaborate with industries, researchers, and policymakers to develop innovative solutions for pollution control. For example, many agencies encourage the adoption of renewable energy sources, waste reduction techniques, and circular economy models.

Figure 3: A wind farm, solar panels, or a recycling plant promoting eco-friendly solutions.

By offering incentives such as tax breaks, grants, or subsidies, these organizations motivate businesses to invest in environmentally friendly technologies. Additionally, regulatory bodies often engage in public awareness campaigns to educate citizens about the importance of reducing pollution and adopting sustainable lifestyles.

Addressing Transboundary Pollution

Pollution does not respect geographical boundaries, making it a global issue that requires international cooperation. Regulatory bodies often work across borders to tackle transboundary pollution, such as air and water pollution that affect multiple countries.

Figure 4: Representatives from different countries at an environmental summit.

Organizations like the United Nations Environment Programme (UNEP) and the World Health Organization (WHO) facilitate collaboration among nations to develop global strategies for pollution control. International treaties and agreements, such as the Paris Agreement on climate change, exemplify how regulatory bodies can drive collective action to address environmental challenges on a global scale.

Challenges Faced by Regulatory Bodies

Despite their critical role, regulatory bodies face numerous challenges in their efforts to control pollution. Limited resources, political interference, and resistance from industries can hinder their effectiveness. In some cases, weak enforcement mechanisms or outdated regulations allow polluters to continue harmful practices without facing significant consequences.

Additionally, the rapid pace of industrialization and urbanization in developing countries often outstrips the capacity of regulatory bodies to monitor and control pollution effectively. Addressing these challenges requires stronger governance, increased funding, and greater public support for environmental protection initiatives.

Figure 5: A judge's gavel with environmental laws or penalty notices for industrial pollution.

The Path Forward

To enhance the effectiveness of regulatory bodies in pollution control, several steps can be taken. Strengthening international cooperation, investing in advanced monitoring technologies, and empowering local communities to participate in environmental decision-making are crucial strategies. Integrating environmental considerations into economic policies and development plans can ensure that sustainability becomes a core principle of growth. Regulatory bodies must also adapt to emerging challenges, such as plastic pollution and electronic waste, by updating regulations and promoting innovative solutions.

Conclusion

Regulatory bodies are at the forefront of the fight against pollution. Through the establishment of standards, monitoring, enforcement, and promotion of sustainable practices, these organizations play a vital role in safeguarding the environment and public health. While challenges persist, the continued efforts of regulatory bodies, supported by governments, industries, and citizens, offer hope for a cleaner and healthier planet. By working together, we can ensure that pollution is effectively controlled, paving the way for a sustainable future.

This article highlights the indispensable role of regulatory bodies in pollution control and underscores the need for collective action to address this global challenge. As we move forward, the collaboration between governments, industries, and individuals will be key to achieving a pollution-free world.

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Eco-Engineered Urbanism: Building Smart Cities from Polluted Foundations

Ismat Jahan Ina
Undergraduate Student, Department of Civil Engineering
Khulna University of Engineering & Technology, Khulna (KUET)

Introduction: Beyond just cutting pollution, the idea of a smart eco-city aims to create a comprehensive urban ecosystem with interconnected, eco-friendly, and efficient waste, transportation, energy, and infrastructure systems. Cities can improve the quality of life for their residents and address urgent environmental issues by utilizing cutting-edge technologies like artificial intelligence (AI), renewable energy systems, green infrastructure, and the Internet of Things (IoT). A multidisciplinary engineering approach integrating digital innovation, environmental science, and urban planning is necessary for this transition. The path to eco-cities is both challenging and rewarding, involving everything from the installation of electric mobility and renewable energy grids to the application of intelligent water recycling and waste management systems. It requires cooperation between communities, businesses, and governments to build smart cities that are not only smart but also sustainable resilient and inclusive.

Cities in Crisis: The Rising Tide of Pollution and Urban Decay

Inefficient systems, overcrowding, and pollution affect many cities across the world. Urban regions frequently have air quality that is above permissible limits, polluting waterways, and overburdened waste management systems. Climate change makes heatwaves, floods, and resource scarcity worse, making these problems worse. A drastic change is urgently needed, and engineering is the key to enabling sustainable urban futures.

The Rise of Smart Eco-Cities: Where Technology Meets Sustainability

Smart eco-cities are metropolitan regions that use cutting-edge technology, like big data analytics, artificial intelligence (AI), and the Internet of Things (IoT), to maximize resource utilization, lessen their negative effects on the environment, and improve the quality of life for locals. Smart eco-cities are built with sustainability at the center, in contrast to traditional cities, which frequently put economic growth ahead of environmental preservation. They build a smooth, environmentally friendly urban ecosystem by combining intelligent systems, green infrastructure, and renewable energy. According to eco-engineered urbanism, cities should work in balance with the environment and use technology to

reduce pollution and improve quality of life. Energy efficiency, resource conservation, and climate change resilience are all features of these smart eco-cities. They combine intelligent systems, green infrastructure, and renewable energy to produce a smooth urban ecology.

Renewable Energy Integration

Reducing carbon footprints and attaining sustainability need the integration of renewable energy into smart eco-cities. Here are some important factors to think about:

Solar Energy: To produce power, photovoltaic (PV) systems and solar panels can be mounted on building facades and rooftops. This closeness to customers lowers transportation costs and energy losses.

Wind Energy: To capture wind energy, wind turbines can be positioned thoughtfully around cities. It is possible to incorporate small urban wind turbines into public areas or structures.

Energy Storage: To handle the sporadic nature of renewable energy sources, effective energy storage devices, like batteries, are crucial. For usage in times of low production.

Smart Grids: To monitor and control the distribution of electricity, smart grids make use of sophisticated technologies. They are able to optimize energy use, secure a steady and dependable energy supply, and integrate many renewable energy sources.

Green Buildings: Including renewable energy technologies, like solar panels and geothermal heating, in building designs can help cut down on energy use and encourage sustainability.

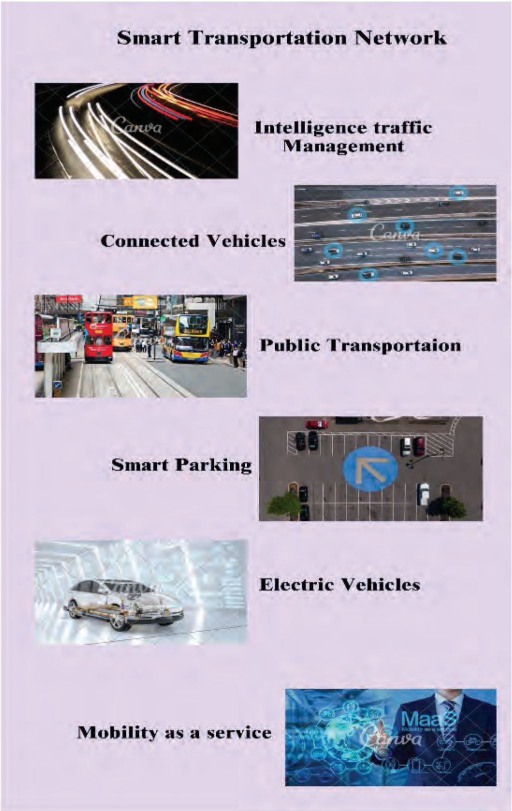
Public Transportation: Emissions and air quality can be improved by electrifying public transportation systems and incorporating renewable energy sources, such as solar-powered charging stations for electric trains and buses.

Smart Transportation Network

A smart transportation network makes use of cutting-edge technologies to improve urban mobility's sustainability, safety, and efficiency. The following are important elements and advantages:

Intelligent traffic management: It is the process of monitoring and controlling traffic flow via sensors, cameras, and data analytics to cut down on congestion and speed up travel times.

Connected vehicles: Connected vehicles are those that have Internet of Things (IoT) devices installed that can communicate with traffic infrastructure and one another to improve safety and route optimization.
Public Transportation: Enhancing the effectiveness and dependability of public transportation networks, such as buses, trains, and subways, by integrating real-time data.



Smart Parking: Traffic congestion is reduced and less time is spent looking for parking thanks to smart parking systems that direct cars to open spots.

Electric Vehicles: Promoting the use of electric vehicles (EVs) and setting up the infrastructure required for their widespread adoption, such as charging stations, are two aspects of this.

Mobility-as-a-Service (MaaS): Platforms known as Mobility-as-a-Service (MaaS) combine several mobility services into an easily navigable interface, enabling customers to schedule, reserve, and pay for a variety of transportation options.

Safety Enhancement: In order to increase road safety, technologies such as automated emergency response, pedestrian detection, and collision avoidance systems are used.

Environmental Benefits: Benefits to the environment lowering emissions and encouraging environmentally friendly modes of transportation to lessen the negative effects of urban mobility.

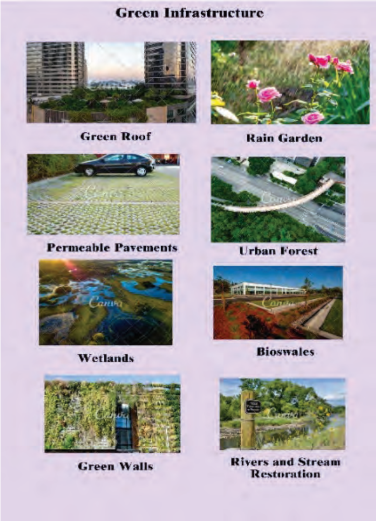
Circular Waste Management

A circular economy, also known as circular waste management, aims to minimize environmental impact and reduce waste through responsible manufacturing, recycling, and reuse. It promotes reduced waste, material recycling and reuse, and the management of organic waste through anaerobic digestion and composting. Additionally important are appropriate hazardous waste management and energy recovery from non-recyclable garbage. These behaviors are encouraged by laws and policies like waste reduction goals and extended producer responsibility (EPR). In this strategy, community involvement and technology advancements—such as sophisticated sorting systems and waste-to-energy technologies—are essential for fostering a resource-efficient and sustainable waste management system.

Water Resilience

Water resilience in smart eco-cities uses green infrastructure, integrated water management, and water recycling and reuse to guarantee a sustainable and dependable water supply. Sustainable water use habits are promoted by community involvement, and water systems are monitored and managed using cutting-edge technologies like sensors and the Internet of Things. Urban planning incorporates climate adaptation techniques to survive harsh weather events, improving water resilience overall.

Green Infrastructure



Green infrastructure is a system of natural and semi-natural components intended to control water flow, improve urban health, and offer a number of social, economic, and environmental advantages. It consists of elements like rain gardens, green walls, wetlands, bioswales, urban forests, permeable pavements, green roofs, and the restoration of rivers and streams. Cities can reduce the effects of climate change, manage water resources responsibly, and improve the quality of life in urban areas by combining these factors. Together, these elements absorb and filter rainfall, lessen surface runoff, encourage groundwater recharge, boost biodiversity, improve air quality, offer insulation, and create visually appealing spaces, all of which contribute to the resilience and sustainability of urban environments as a whole.

Smart Building

A smart building is an advanced technical structure that optimizes critical activities, such as energy management, HVAC, lighting, and security, by utilizing automation and contemporary advances. IoT devices, which collect and share data to enhance performance and occupant experience, are at the heart of smart buildings. Energy-efficient HVAC systems, smart thermostats, and automatic lighting are all made possible by a Building Management System (BMS), which monitors and controls these processes in real-time. Customized temperature settings, adaptive lighting, and air quality monitoring are just a few of the elements that prioritize occupant comfort in these buildings. Controlled access systems, smart locks, and surveillance cameras are examples of advanced security methods that protect people and property. Sustainability is a key component that reduces environmental effect by utilizing eco-friendly materials, water-efficient technologies, and renewable energy sources. Predictive maintenance that is fueled by data analytics and machine learning also lowers maintenance expenses and downtime by spotting possible problems before they become serious. Additionally, smart buildings can be integrated with larger smart city infrastructures, such transportation and smart grids, to increase overall sustainability and efficiency.

The Role of Technology in Smart Eco-Cities

The foundation of smart eco-cities is technology, which makes it possible for real-time monitoring, optimization, and innovation. The following are important technologies:

IoT Sensors: Gather information on traffic, energy use, air quality, and other topics to help in decision-making.

AI and Big Data: Examine enormous volumes of data to forecast future patterns and optimize urban systems. Blockchain: Improves energy trading and resource management's efficiency and openness.

Digital Twins: Before designs are put into action, planners can test and refine them using virtual city models.

Conclusion - A Sustainable Urban Future

The emergence of smart eco-cities signifies a paradigm change in urban planning, where sustainability and technology work together to build a better future. By adopting this perspective, we can create cities that are not just intelligent but also resilient, equitable, and environmentally friendly. Smart eco-cities have already started to shape the future of urban living and are no longer just a pipe dream. This article offers a thorough analysis of the subject, fusing scientific knowledge with practical applications and a call to action for sustainable urban change.

Addressing the Solid Waste Management Challenges in Khulna City Corporation

Jubayad Bin Showkat
Undergraduate Student, Department of Civil Engineering
Khulna University of Engineering & Technology, Khulna (KUET)

Abstract *Solid waste management (SWM) remains a significant challenge in urban areas, particularly in rapidly growing cities like Khulna City Corporation (KCC). This paper explores the current waste management practices, identifies key challenges, and proposes solutions for sustainable waste management in KCC. The study highlights inefficiencies in collection, transportation, disposal, and recycling processes and recommends strategic interventions, including technological advancements, policy reforms, and community participation.*

Keywords: Khulna City Corporation (KCC), Solid Waste Management (SWM), NGO, Sustainable Waste Management

Introduction: Bangladesh is still a champion in the highly dense urban city list of the world. The urban population growth rate has been slowing down since 2025 and it is lower than the growth rate observed in the past, which is an effect of urban development and migration. In the midst of all these efforts, waste management, especially in the major cities, still presents a significant problem. In fact, Khulna, the third-largest nearby city, disposes of roughly 1,200 to 1,400 tones of waste daily, Khulna City Corporation (KCC) picks up approximately 800 to 900 tonnes of waste a day, but still, about 400 to 500 tons is left uncollected. This waste is either left open, in the drain, or in the water bodies, which invites serious environmental and health risks. Furthermore, e-waste has become an increasingly pressing problem, with the city producing about 5-8 tonnes on a daily basis. Currently, the KCC is unable to control this kind of waste, and it results in bad health hazards such as toxic chemicals like lead, cadmium, and mercury in discarded electric objects[7]. To solve these problems, the KCC organizes a project to set up a waste management plant on the Shalua landfill. Some of the aspects of this plant are the processing of 375 tones of waste daily into diesel fuel, electricity, and compost fertilizer and it is supposed to be finished by June 2025. The paper‘s overall objective is to carry out an analysis on the municipal solid waste management of Khulna, pointing out crucial problems and suggesting the most effective and affordable solutions to enhance the efficiency and sustainability of the system[6][8].

Methodology: This study employs a mixed-method approach, including field surveys, interviews with municipal authorities, and analysis of secondary data from government reports and academic sources. Data collection focuses on waste generation rates, collection efficiency, landfill conditions, and recycling initiatives.

Survey and Graphs: Households, the local community (NGO), and the City Corporation are all collaboratively involved at various levels in the community-based waste management method. The traditional method, on the other hand, blamed the city corporation and the household, results correct management procedure not to par. Therefore, the community could manage the system at a sustainable level with KCC even if there was no longer any external help from NGOs. The traditional method involves generating garbage at home and often storing it until a specific volume has accumulated. The transfer of this garbage from the roadside cans to the final disposal facility is the responsibility of the municipal corporation [5]. A survey of current municipal directives, funds, and alliances with non-public waste management bodies was done to find problems and inefficiencies.

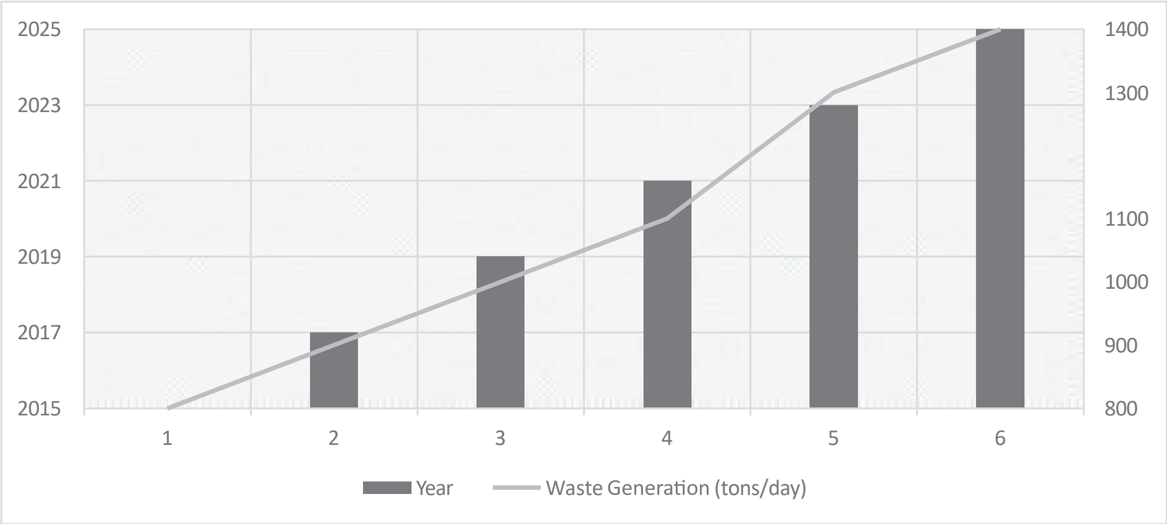


Figure 1: Illustrating the increasing municipal waste generation in Khulna over the years. It shows a steady rise from 800 tons per day in 2015 to 1,400 tons per day in 2025.

Table 1: Daily Waste Composition in Khulna City

Water Type	Organic Waste	Plastic	Paper	Metal & Glass	Other
Percentage (%)	65	12	08	05	10

Cause and Effect: Incorrect trash disposal is a factor in air, water, and soil contamination. In particular, toxins are emitted during the open incineration of waste, and, on the other hand, leachate from the landfills prevails spoiling of the groundwater. In general, these troubles end up with more people getting respiratory diseases and waterborne diseases. By the year 2020, Khulna City plans to install 5,000 compact dumpsters throughout its territory. The city corporate authorities have already begun trash cans in strategic locations across Khulna. The dumpsters are being installed in congested areas initially on a priority basis. But city residents are unaware of it and the city corporations haven't advertised it, it isn't operating as intended. By this time, numerous bin lids have been discovered to be missing, and their bolts have been damaged.to prevent waste from accumulating on the two cities' highways, these containers have been made available[2].In Khulna city, waste from the enterprises is recycled using a three-step process: While women are looking for reusable bottles and cardboard from the waste to sell on the home front, the street kids collect useful garbage from the waste baskets and finally, some scavengers sort out the still useful items from the city trash dump. The mentioned ones the discarded old items are changed into something new for sale or other purposes [3]. Bangladesh's organic-rich solid waste, which has a manageable C/N ratio (Ahmed and Rahman 2000), is suitable for composting. Large-scale centralized composting has struggled due to its high costs, but during the extraction of waste, local manual methods can be cheaper and more efficacious [2]. Every single day in the city of Khulna merely 70%–72% of trash is collected, and the rest of it is left in bins or on the street, a situation that causes health and environmental problems. The establishment of a waste recycling factory not only accelerates the recovery of resources, especially for the 80–90% organic waste but also reduces the amount of plastic waste [4]. Establishing recycling facilities for predominantly organic waste can ensure sustainable resource recovery and cleaner urban spaces.

Improvement in Operational level Problems of Solid Waste Management:
Khulna City Corporation (KCC) is struggling with the accumulated waste in the final disposal site of Rajbandh. They are using the conventional method in accumulating the wastes for waste disposal purposes. As a result the key elements of the environment including the air, water and soil are being polluted day by day. The living environment beside the disposal site of Rajbandh is deteriorating. Considering the above facts, KCC should go for the Sanitary landfilling process at the Rajbandh landfill site. The term sanitary landfill is nothing but an operation in which the waste to be disposed of are compacted and covered with layer of soil at the end of each days operation. So Immediate necessary initiatives must be taken to introduce sanitary landfilling system so that the collected wastes could be treated and disposed in the most scientific means. Resource recovery has been a great means to any City Corporation in the modern world to ensure comfortable human living from the heinous impact of solid waste. The resource recovery process can reduce solid waste problem in the locality. The way to resolve this issue is to recover resources from the waste at the source and to make efficient conversion of it into potential products. For example- Biogas and organic fertilizer can be produced through efficient operation of waste i.e. composting. With a view to doing the waste segregation as well as the waste recovery system. KCC employees need to be well trained for this job. Besides necessary actions need to be taken to make the people aware of the waste segregation which is a prerequisite for enhancing effective recycling. Apart from that, the KCC needs adequate modern vehicles to support the current actions. Sufficient number of modern vehicles can reduce the accumulated problems and enhance solid waste management in KCC.

Conclusion: A Clean and sound environment is a prerequisite for safe living. If we want to provide a livable environment for our residents, it is an urgent need to take necessary initiatives to address the issue of solid waste. A massive consciousness raising program regarding the importance of sustainable solid waste management throughout the country, especially in the Khulna city area is badly needed. Print and electronic media can play crucial role in this regard. KCC must keep a wide spreading eye to cover up the environmental losses by formulating effective plans or framework and proper implementation of it to keep the environment safe and sound.

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Industrial Pollution Control management and its effectiveness in perspective of Bangladesh and UAE

Fatin Ilham Sinan
Grade: 11, International School of Choueifat, UAE

Industrial pollution control management is a critical aspect of environmental governance, particularly in countries with rapidly growing industrial sectors like Bangladesh and the United Arab Emirates (UAE). Both countries face unique challenges and opportunities in managing industrial pollution, given their economic structures, regulatory frameworks, and environmental priorities. Below is a detailed comparison of industrial pollution control management and its effectiveness in Bangladesh and the UAE:

1. Industrial Pollution Control Management in Bangladesh

Overview of Industrial Pollution in Bangladesh

- Bangladesh's industrial sector is dominated by textiles, leather, pharmaceuticals, and manufacturing, which contribute significantly to water, air, and soil pollution.
- The rapid growth of industries, particularly in urban areas like Dhaka and Chittagong, has led to severe environmental degradation due to inadequate waste management and enforcement of regulations.
- Key pollutants include untreated wastewater, chemical discharges, air emissions, and solid waste.

Regulatory Framework

- Environmental Laws: The **Bangladesh Environment Conservation Act (1995)** and the **Environment Conservation Rules (1997)** are the primary legal frameworks for pollution control.
- **Department of Environment (DoE)**: The DoE is responsible for enforcing environmental regulations, issuing environmental clearances, and monitoring compliance.
- Environmental Clearance Certificate: Industries are required to obtain this certificate, which mandates the installation of pollution control measures.

Pollution Control Measures

- **Effluent Treatment Plants (ETPs)**: Mandatory for industries like textiles and tanneries to treat wastewater before discharge.
- **Air Pollution Control**: Use of scrubbers, filters, and other technologies to reduce emissions.
- **Solid Waste Management**: Regulations for proper disposal and recycling of industrial waste.

Effectiveness

- **Challenges**:
    - Weak enforcement of environmental laws due to corruption, lack of resources, and political influence.
    - Limited technical and financial capacity of industries to adopt pollution control technologies.
    - Informal industries often operate without compliance, exacerbating pollution.
- **Progress**:
    - Some industries, particularly in the textile sector, have adopted ETPs and other measures to comply with international standards (e.g., for export markets).

- Awareness of environmental issues is growing, and civil society organizations are playing a role in advocating for stricter enforcement.

2. Industrial Pollution Control Management in the UAE

Overview of Industrial Pollution in the UAE

- The UAE's industrial sector is dominated by oil and gas, petrochemicals, construction, and manufacturing, which contribute to air pollution, greenhouse gas emissions, and waste generation.
- Rapid urbanization and industrial growth have placed pressure on natural resources, particularly water and air quality.

Regulatory Framework

- **Federal Laws**: The **UAE Federal Law No. 24 of 1999 for the Protection and Development of the Environment** is the primary legislation governing pollution control.
- **Ministry of Climate Change and Environment (MOCCAE)**: Responsible for policy formulation, regulation, and monitoring of environmental standards.
- **Abu Dhabi Environment Agency (EAD) and Dubai Municipality**: Key entities at the emirate level that enforce environmental regulations.

Pollution Control Measures

- **Air Quality Management**: Strict regulations on emissions from industries and vehicles, including the use of cleaner fuels and technologies.
- **Wastewater Treatment**: Advanced treatment plants for industrial and municipal wastewater, with a focus on reuse.
- **Waste Management**: Comprehensive strategies for recycling and waste-to-energy projects.
- **Renewable Energy**: Investment in solar and nuclear energy to reduce reliance on fossil fuels.

Effectiveness

- Strengths:

- Strong regulatory framework and enforcement mechanisms.
- Significant investment in advanced pollution control technologies and infrastructure.
- Commitment to sustainability, as evidenced by initiatives like the UAE Vision 2021 and the Dubai Clean Energy Strategy 2050.

- Challenges:

- High energy consumption and carbon emissions due to the dominance of the oil and gas sector.
- Balancing economic growth with environmental sustainability remains a challenge.

3. Comparative Analysis

Regulatory Enforcement

- **Bangladesh**: Weak enforcement due to limited resources, corruption, and lack of political will.
- **UAE**: Strong enforcement with significant investment in regulatory infrastructure and technology.

Technological Adoption

- **Bangladesh**: Limited adoption of advanced pollution control technologies due to financial constraints and lack of expertise.
- **UAE**: High adoption of state-of-the-art technologies, supported by government funding and private sector investment.

Awareness and Participation

- **Bangladesh**: Growing awareness but limited public participation in environmental governance.
- **UAE**: High awareness and active participation in sustainability initiatives, driven by government campaigns and education.

Economic vs. Environmental Priorities

- **Bangladesh**: Economic growth often takes precedence over environmental concerns, particularly in the absence of stringent enforcement.
- **UAE**: Efforts to balance economic growth with environmental sustainability, though challenges remain in reducing reliance on fossil fuels.

4. Conclusion

Bangladesh: Industrial pollution control management is improving but remains inadequate due to weak enforcement, limited resources, and rapid industrial growth. Greater investment in technology, capacity building, and public awareness is needed.

UAE: The UAE has made significant progress in industrial pollution control, supported by strong regulations, advanced technologies, and a commitment to sustainability. However, the country must address challenges related to carbon emissions and resource consumption to achieve long-term environmental goals.

Both countries can learn from each other's experiences—Bangladesh can adopt stricter enforcement mechanisms and invest in technology, while the UAE can focus on reducing its carbon footprint and promoting sustainable industrial practices.

How Can We Control Industrial Pollution

Najib Mahfuz

The Problem of Industrial Pollution

Industrial pollution is a serious problem that affects our air, water, and land. Factories release smoke, chemicals, and waste that can harm people and wildlife. Over time, this pollution leads to health issues like breathing problems and contaminated water supplies. It also damages the environment, contributing to climate change and harming ecosystems. However, industries are an important part of modern life, producing the goods we use every day. The challenge is to keep industries running while reducing the harm they cause to nature. Thankfully, there are many ways to control industrial pollution and make factories more environmentally friendly.

Using Cleaner Technology

One of the most effective ways to reduce pollution is by using cleaner technology. Many factories now use special filters and scrubbers to trap harmful gases before they are released into the air. Switching to cleaner energy sources, such as solar, wind, and hydroelectric power, can also make a big difference. Some industries are redesigning their production processes to use fewer toxic materials and create less waste. When companies invest in eco-friendly technology, they not only reduce pollution but also save money in the long run by using resources more efficiently.

Managing Industrial Waste

Managing waste properly is another crucial step. Many factories produce large amounts of waste, including hazardous chemicals and non-recyclable materials. Instead of dumping waste into landfills or waterways, companies can recycle and reuse materials whenever possible. Some industries treat wastewater to remove harmful substances before releasing it back into nature. This helps protect rivers, lakes, and oceans from becoming polluted and keeps drinking water safe. Proper disposal of hazardous waste is also important to prevent soil and groundwater contamination.

The Role of Government Regulations

Government rules and regulations play a key role in controlling industrial pollution. Many countries have strict laws that limit how much pollution factories can produce. Companies that break these rules can face heavy fines or even be shut down. Regular inspections help ensure that businesses follow the law and take responsibility for their impact on the environment. Some governments also provide financial support to companies that invest in greener technology, making it easier for businesses to go eco-friendly. Strong regulations help create a balance between industrial growth and environmental protection.

How People Can Help

While industries and governments have a major role to play, people can also make a difference. Consumers can support companies that use environmentally friendly practices by choosing to buy their products. Employees can encourage their workplaces to adopt greener solutions. Raising awareness about pollution and its effects can push industries to be more responsible. When people, businesses, and governments work together, real change is possible.

A Cleaner Future

Industrial pollution is a big challenge, but it is not impossible to solve. By using cleaner technology, managing waste responsibly, and enforcing strict environmental laws, we can reduce pollution while allowing industries to thrive. Protecting the environment is a shared responsibility, and if we all take action, we can create a cleaner, healthier world for future generations.

Sources of Pollutants and Their Impact on Public Health

Radiah Mubasshira khan Afsa
Grade 8, Islamia English School, Abu Dhabi, UAE

Introduction

Environmental degradation is a major global concern caused by pollutants contaminating air, water, and soil. These pollutants primarily stem from industrial activities, agriculture, and transportation, leading to severe consequences for ecosystems and human health. Rising pollution levels threaten biodiversity, disrupt natural processes, and contribute to climate change. Understanding pollution sources and their impact on health is essential for developing effective strategies to combat this crisis and promote sustainability.

Major Sources of Pollutants

Industrial Emissions: Factories and power plants release toxic gases like sulfur dioxide, nitrogen oxides, and carbon monoxide. These contribute to acid rain, smog, and climate change. Additionally, industrial waste often contains heavy metals that contaminate water sources, leading to severe health risks.

Agriculture: Excessive use of chemical fertilizers and pesticides pollutes water bodies through runoff. Livestock farming releases methane, a potent greenhouse gas, exacerbating global warming. Overuse of land also depletes soil nutrients, reducing agricultural sustainability.

Transportation: Vehicles emit carbon monoxide, nitrogen oxides, and particulate matter, degrading air quality and leading to smog formation. Prolonged exposure to these pollutants increases respiratory and cardiovascular diseases, especially in urban areas.

Public Health Impact

Respiratory Diseases: Air pollution from industrial emissions and vehicle exhaust leads to conditions such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). Fine particulate matter (PM2.5) deeply penetrates the lungs, aggravating lung infections and reducing lung function over time.

Waterborne Diseases: Contaminated water, often due to industrial and agricultural runoff, spreads illnesses like cholera, dysentery, and typhoid. Heavy metals such as lead and mercury in drinking water can cause neurological damage and kidney failure.

Cardiovascular Issues: Prolonged exposure to air pollution increases the risk of hypertension, heart attacks, and strokes. Fine particles from emissions can enter the bloodstream, leading to artery inflammation and cardiovascular stress.

Conclusion

Addressing pollution requires collective action from governments, industries, and individuals. Governments must enforce stricter environmental regulations, while industries should adopt cleaner production methods. Individuals can contribute by reducing waste, conserving energy, and supporting eco-friendly initiatives. Raising awareness and investing in renewable energy and sustainable agriculture can significantly reduce pollution levels. Through proactive efforts, we can work toward a cleaner environment and healthier future for all.

Concepts of a healthy city and best practices

Rapangel Arin Yana
Grade 6
Global English School, Al Ain, UAE

A healthy city is an urban environment that promotes the physical, mental, and social well-being of its inhabitants. This concept is championed by the World Health Organization (WHO) as a part of its healthy cities program, which emphasizes sustainability, inclusivity, and public participation.

1. **Clean and Sustainable Environment**
   - Reduced air, water, and noise pollution.
   - Efficient waste management and recycling programs.
   - Urban green spaces like parks, gardens, and forests.
   - Climate resilience strategies to combat extreme weather.

2. **Accessible and Quality Healthcare**
   - Affordable and well-distributed healthcare facilities.
   - Preventive healthcare programs (vaccination, screening).
   - Mental health support and counseling services.
   - Health education and awareness campaigns.

3. **Sustainable Urban Planning**
   - Mixed-use development to reduce commute times.
   - Walkable and bike-friendly streets.
   - Smart city initiatives (IoT-based traffic control, energy-efficient buildings).
   - Zoning regulations to reduce urban sprawl.

4. **Affordable and safe housing**
   - Housing policies that prevent overcrowding and homelessness.
   - Sustainable, energy-efficient housing designs.
   - Rent control and subsidized housing programs.
   - Community-driven urban development projects.

5. **Efficient and Eco -friendly Public Transport**
   - Well-integrated metro, buses, and bicycle-sharing systems.
   - Reduced reliance on private cars to cut emission
   - Accessibility features for disabled and elderly citizens.
   - Low-cost or free transport for low-income residents.

6. **Promotion of Active Lifestyles**
   - Designated cycling and jogging tracks.
   - Free or subsidized public gyms and sports centers.
   - School and workplace initiatives to encourage physical activity.
   - Community wellness programs like yoga and meditation classes.

Sources of pollutants leading to environmental degradation and impact on public health

Etkhan Ahmed
Grade 4
Sharjah Ambassador School

Pollutants originate from various sources, contributing significantly to environmental degradation and posing serious risks to public health. Industrial activities release harmful chemicals and heavy metals into the air, water, and soil, while agricultural practices introduce pesticides and fertilisers that contaminate water bodies. Vehicular emissions emit greenhouse gases and particulate matter, deteriorating air quality and increasing respiratory illnesses. Waste disposal, including plastic waste and untreated sewage, pollutes land and waterways, affecting ecosystems and human communities alike. Additionally, energy production from fossil fuels releases sulfur dioxide and nitrogen oxides, leading to acid rain and climate change. These pollutants not only disrupt ecological balance but also elevate diseases such as asthma, cardiovascular conditions, and certain cancers, highlighting the urgent need for sustainable practices and pollution control measures.

Understanding Pollution and Its Impact on Our Environment and Health

Syed Elham Naser
Grade 7, Ambassador school Sharjah

Pollution is becoming a bigger problem every day, harming both the environment and our health. It comes from many sources, including:

Industries: Factories release harmful chemicals, heavy metals, and smoke into the air, water, and soil, leading to long-term damage.
Vehicles: Cars, buses, and trucks burn fuel, producing harmful gases like carbon monoxide (CO) and nitrogen oxides (NOx), which pollute the air and cause breathing issues.
Farming Practices: Using too many pesticides and fertilizers contaminates water and soil, affecting our food and health.
Household Waste: Trash from homes and businesses, especially plastics and food waste, clogs up landfills and pollutes the environment.
Deforestation: Cutting down trees at a fast rate leads to soil erosion, loss of wildlife, and increased carbon emissions.

How Pollution Affects Our Health

Breathing Problems: Polluted air can cause asthma, lung infections, and even lung cancer.
Unsafe Water: Dirty water can spread diseases like cholera and dysentery.
Brain and Nerve Issues: Exposure to heavy metals like lead and mercury can affect brain function, especially in children.
Heart Disease: Air pollution increases the risk of strokes and heart attacks.

How We Can Reduce Industrial Pollution

Reducing industrial pollution takes effort from both businesses and governments. Some ways to tackle it include:

Using Cleaner Technology: Factories can install filters and scrubbers to reduce harmful emissions.
Better Waste Management: Treating wastewater before releasing it into rivers and lakes.
Stricter Regulations: Governments should enforce pollution limits and promote eco-friendly practices.
Corporate Responsibility: Companies should invest in sustainable solutions and take responsibility for their impact.

Managing Our Waste Better

Proper waste management is crucial for a cleaner world. We can:

Sort Waste at Home: Separating recyclables, compostable waste, and non-recyclables helps reduce landfill waste.
Recycle and Reuse: Encouraging people to recycle plastic, glass, and paper can make a huge difference.

Turn Waste into Energy: Waste-to-energy plants can convert garbage into electricity or fuel.
Build Better Landfills: Properly managed landfills prevent contamination of the surrounding environment.

Creating Healthier Cities

A healthy city means clean air, green spaces, and good public transport. Some best practices include:

More Green Spaces: Planting trees and creating parks helps improve air quality.
Eco-friendly Transport: Using buses, trains, bicycles, and electric cars reduces pollution.
Smart Technology: Cities can use digital tools to track pollution levels and improve waste management.
Public Awareness: Educating people on how their actions impact the environment can lead to long-term change.

Using Data to Track Pollution Trends

Governments and institutions play a big role in collecting and analyzing pollution data to find solutions. Some key methods include:

Satellite Tracking: Using space technology to monitor air and water pollution.
Big Data Analysis: Studying large datasets to find pollution hotspots and predict trends.
AI and Machine Learning: Using smart technology to predict environmental risks and plan better solutions.
Community Science: Encouraging people to report pollution levels and participate in environmental initiatives.

Solutions to Reduce Pollution

Technology-Based Solutions

Renewable Energy: Switching to solar, wind, and hydropower reduces pollution from fossil fuels.
Eco-friendly Farming: Using organic methods and natural fertilizers to protect the soil and water.
Smart Sensors: Placing sensors in cities to monitor and control pollution in real time.

Government and Administrative Solutions:

Environmental Impact Assessments: Checking the environmental impact of new projects before approval.
Holding Polluters Accountable: Making industries pay for the damage they cause.
Stronger Laws: Enforcing strict environmental laws and heavy penalties for violators.
Collaboration Between Sectors: Governments, businesses, and communities need to work together to fight pollution.

Role of Regulatory Agencies

Government and global organizations help enforce pollution control measures:

Environmental Protection Agencies (EPA): Ensuring industries follow air and water quality standards.
Pollution Control Boards: Monitoring pollution levels and taking action against violators.
Global Organizations (WHO, UNEP): Setting international guidelines and pushing for sustainable policies.
Local Authorities: Managing city waste, promoting clean energy, and maintaining public spaces.

Role of regulatory bodies in pollution control

Sariyah Bint Shamiul
Rosary Private School, Muweilah | Year 8A
Sharjah, UAE

The vital role of regulatory bodies in pollution control

In the face of growing environmental challenges, regulatory bodies are essential for protecting our planet. These governmental agencies establish rules and standards necessary to combat pollution and safeguard ecosystems. In this article, we will explore the role of regulatory bodies in pollution control, highlighting their importance in securing a more sustainable future for the coming generations.

Regulatory bodies are government agencies or authorities that control specific activities, often aligning with the public's interest. When it comes to pollution control, the key role of regulatory bodies is to implement environmental laws and regulations. Some examples include the Environmental Protection Agency (EPA) in the US, the European Environment Agency (EEA) in Europe, and the National Green Tribunal (NGT) in India.

Environmental standards and permitting

An idea proposed by scientists is to set environmental quality standards, defining permissible pollution levels in the air, water, and soil. These standards guide pollution and control community efforts. Regulatory bodies can also issue permits/licenses for activities which may cause pollution if they see fit. Examples include permits for industrial wastewater discharge and licenses for handling hazardous waste. This process allows them to access environmental impacts and set conditions to help minimize pollution.

Enforcing policies and taking action

Regulatory bodies can monitor people's compliance with environmental laws through inspections and sampling. They can send inspectors to a residence without any early notice to check if the residence is in compliance with the law, and they may also send a few workers to sample the soil around the resident's house to see if it has been polluted. They can take action when any violations occur, such as issuing warnings, fines, and in severe cases, legal action. If the governments do not act upon violations, people will not take the law seriously and continue to pollute our planet regardless of the laws set by the respective regulatory bodies.

Public engagement and international cooperation

Regulatory bodies can engage with the public to raise environmental awareness, provide information on law enforcements regarding pollution, and to encourage sustainable practices. They can use multiple ways to reach the public, such as crossing international borders to invite a celebrity over to a school to talk about the issues of pollution so that the students are more engaged in the topic. They could also host a public event at a waterpark to attract the attention of the people to promote awareness of water conservation and other ways to help protect the environment. There are multiple ways to engage with the public. By making it more fun and enjoyable, people are more likely to listen to the advice given to them.

Challenges and the path forward

Although the idea of regulatory bodies and society working together to help create a better future for us all, there are some setbacks. Limited resources means not all countries will have enough money to implement environmentally friendly practices such as wind turbines, solar panels, etc. Some people may decide to go against the government’s wishes, and it could be hard to control all of them. To enhance the effectiveness of the plan to implement environmental laws, regulatory bodies need to punish violations so that people won’t feel the need to go against the law in fear of getting punished.

Examples in action

We can clearly see the positive impact of regulatory bodies when we look at examples as such. The EPA’s implementation of the Clean Air Act, a United States federal law that regulates air emissions to protect the health of the public, has significantly reduced air pollution. The European Union’s REACH Regulation addresses risks of chemicals, aims to protect human health and the environment, and makes industries responsible for assessing and managing the risks of the chemicals they use.

Conclusion

Regulatory bodies are crucial in the fight against pollution. They can implement environmental laws and set standards for us to follow. Through public development and international cooperation, they can help reduce pollution and preserve a healthy and sustainable planet for the future generations. Although, it’s not just the regulatory bodies who play a role in battling against pollution, it’s us too. As a society, we have to come together and fight against the battle of pollution, in unity and harmony.

Driving Synergy for Thriving Future

Sustainability Pledge:

DO's

- I pledge to advocate for sustainability in my community by sharing knowledge and resources with others.
- I pledge to prioritize bio-degradable goods over non-bio-degradable goods.
- I pledge to encourage afforestation and reforestation.
- I pledge to encourage green transportation.
- I pledge to pursue zero-waste initiative and practice 3R (reduce, reuse & recycle) in waste management.
- I pledge to reduce plastic pollution.
- I pledge to dispose of paper, plastic, and metal in designated recycling bins.
- I pledge to pursue reduce carbon footprint by choosing sustainable transportation options, such as walking, biking, carpooling, or public transit.
- I pledge to stand on climate victims by protecting rights, lives and livelihoods.
- I pledge to protect bio-diversity and ecosystem.
- I pledge to use energy-efficient appliances.
- I pledge to practice energy efficiency by Turn off lights and electronics when not in use.
- I pledge to prioritize renewable energy over fossil fuels.
- I pledge to promote clean design mechanism.

DON'T's

- I pledge not to ignore Environmental responsibility.
- I pledge not to liter in public places or any water stream.
- I pledge not to contribute to noise pollution.
- I pledge not to waste natural resources.
- I pledge not to support deforestation.

BEAWorld Champions Award 2024 and Yearly Get Together

Bangladeshi Engineers and Architects Worldwide (BEAWorld) successfully completed the 'BEAWorld Champions Award 2024 and Yearly Get Together' on 15th February 2025 at Al Kathim Resort, Abu Dhabi, United Arab Emirates.

Total eight (08) prominent Bangladeshi Engineers were awarded the **BEAWorld Champions Award 2024** at the event. The awardees are as follows:

1. Professor Dr. Ainun Nishat - The Most Inspiring Personality of the Year. He received the crest in Bangladesh.

Outstanding Presentation and Webinar Session 2024 Awardees in various categories:

1. Professor Dr. Md. Khasro Mia: For his outstanding presentation on Structural Design and Building Codes; he received the Crest in Bangladesh.
2. Professor Dr. M. Mehedy Masud: For his outstanding presentation on Artificial Intelligence and Cyber Security.
3. Engr. Akhtar Zaman P.Eng.: For his outstanding presentation on Rehabilitation of Prestressed Girder Bridges; he received the Crest in Canada.
4. Professor Dr. Md. Easir Arafat Khan: Process Safety Champion; he received the Crest in Bangladesh.
5. Engr. Md. Al-Emran Hossain: Sustainability Champion; he received the Crest in Bangladesh.
6. Engr. Shawkat Ali Khan: Structural Engineering Champion.
7. Engr. Ashraful Alam: MEP Engineering Champion; He received the crest in Bangladesh.

Special Award: Student Leadership Program

1. Samsun Nahar Nupur: For outstanding management in the Student Leadership Program.

Total 21 (Twenty one) students were awarded crests and certificates for their commendable performance on public speaking. The awardees are as follows:

1. Abdullah Tahsin
2. Ragib Nihal Sadab
3. Rayhan Ahmed
4. Nuzhat Mahdiyat
5. Ferdous Afra
6. Abdullah Tafhim
7. Areta Rabab
8. Fatin Ilham Sinan
9. Tahmeed Ahmed
10. Najib Mahfuz
11. Numaira Iram
12. Kehkashan Shorif; award received in Bangladesh.
13. Radiah Mubashira Khan Afsa
14. Rumaisa Husain
15. Sariah Bint Shamiul
16. Syed Elham Naser
17. Syeda Aisha Rahman
18. Susmoy Shuvra Barua
19. Rapangel Arin Yana
20. Khan Ridwan Amor
21. Ethkan Ahmed

The awards were presented by BEAWorld Advisors Engr. Moazzem Hossain, Engr. Maniruz Zaman Sarkar Mohan, Engr. Rafiqul Islam Talukder P.Eng. (Chief Editor, Synergy Magazine), Founder Engr. Rezaur Rahman, Organizer Engr. Amzad Hossain, Engr. Mohammad Sorforaz Khan.

The day-long program began with a “Safety and Sustainability” awareness presentation and tree planting.

The program included a debate competition, pitha festival (spring festival), cultural programs, and games. Engr. AKM Nizam and Engr. Ali Zakaria along with other senior Engineers served as judges in the students debate competition. Mrs. Rabeya Islam and Engr. Parveen Akhter Jolly played a special role in the management of the pitha festival (spring festival).

BEAWorld’s vision, mission, current activities, and future plans were presented by BEAWorld founder Engr. Rezaur Rahman. After the presentation, BEAWorld Bangladesh Chapter President Engr. Md. Al-Emran Hossain, Professor Dr. Khasro Miah, Engr. Khaja Ahmed, Engr. Ashraful Alam.

The entire event was enthusiastically presented by BEAWorld Organizer Engr. Amzad Hossain Khan and BEAWorld Student Leadership Program Head Ms. Samsun Nahar Nupur.

Engr. Moazzem Hossain, Adviser along with Engr. Al-Emran Hossain handed over BEAWorld Champion Award to Prof. Dr. Ainun Nishat as the Most Inspiring Person in 2024.

Engr. Moazzem Hossain, Adviser along with Engr. Al-Emran Hossain and Engr. Amzad Hossain Khan handed over BEAWorld Champion Award in Outstanding Presenter to Prof. Dr. Khasro Miah.

Engr. Moazzem Hossain, Adviser along with Engr. Al-Emran Hossain and Engr. Amzad Hossain Khan handed over BEAWorld Champion Award in Process Safety to Prof. Dr. Easir Arafat Khan.

Engr. Moazzem Hossain, Adviser along with Engr. Amzad Hossain Khan handed over BEAWorld Champion Award in Sustainability to Engr. Al-Emran Hossain.

Engr. Akhter Zaman, P. Eng.
BEAWorld Champion -
Outstanding Presenter

Engr. Shawkat Ali Khan
BEAWorld Champion -
Structural Engineering

Kehkashan Shorif - Taking Award from Engr. Moazzem Hossain and Engr. Amzad Hossain Khan for Public Speaking

The event was sponsored by Simplify General Contracting LLC, 701 Car Showroom Sharjah, Noor Islam Engineering Company LLC, Al Arqub Building Contracting LLC.

Other Engineers were present at the event included Engr. Pranab Mistry, Engr. Ijaz Kalim, Engr. Iskandar, Engr. Abdul Hamid, Engr. Shamiul Islam, Engr. Alamgir Hossain, Engr. Shariful Alam Khan, Engr. Shahadat, Engr. Nur Alam, Engr. Munir Hossain, Engr. Enamul Haque Jewel, Engr. Firoz Alam, Engr. Bico Roy, Engr. Mukta, Engr. Morshedul Islam, Engr. Sani Mia, Engr. Imran Hossain, Engr. Hasan Babar, etc.

Get Together-Photo Album


BEA WORLD
GET TOGETHER
2025

Engr. Rahana wins UAE Prime Minister Award-2025

We are happy to announce that Engr. Ratana has been selected as a “UAE Innovation 2025 Award Winner” by UAE Prime Minister office for her achievement on Green Geopolymer Concrete from Industrial Waste.

From BEAWorld platform, we congratulate her on her excellence in Sustainability attainment. We are pleased to announce that her research paper on this project has been published in current issue of Synergy Magazine Vol. 4.

Engr. Rahana Akter holding the position of Head of Department – Material Testing & Research Laboratory, Fujairah Municipality, UAE.

With over 18 years of expertise in civil engineering, quality management, and material testing, Rahana Akter is a distinguished leader at the forefront of sustainable construction practices and zero-carbon implementation in the industry and Construction – Advocating for green building materials, low-carbon concrete technologies, and energy-efficient construction methods to drive UAE’s.

Recognitions & Achievements
• Fujairah Municipality Career Excellence Award (2017, 2018)
• Best Employee Award (2015, 2016)
• Best Idea Award (2017)
• Certified ISO 17025:2017 Internal Auditor & Measurement Systems Analyst
• Speaker at International Conferences – The Big-5, Fujairah International Forum, and Concord Hotel Conferences on Green Building Materials & Sustainable Construction

Education & Certifications
She got her B.Sc. in Civil Engineering – Presidency University, Bangladesh.

Dr. Arafat Promoted to Professor, BUET

Dr. Easir Arafat Khan, an Editorial Board member of Synergy, was recently promoted to Professor in the Chemical Engineering Department, BUET. Over the years, Dr. Arafat has played a commendable role during times of national crisis, extending his contributions beyond his academic responsibilities. He has been pivotal in the publication of Synergy Magazine as well as the Chemical Engineering Journal published by BUET.

During this time, he has established himself as a specialist in Process Safety and Fire Prevention, conducting numerous sessions on platforms such as IEB and BEAWorld. He is also one of the key figures in organizing Symposium/Workshop on Chemical Engineering Divisions demonstrating his commitment to society and the profession. Additionally, he has authored several noteworthy articles published in various journals. He was also a valued recipient of the BEAWorld Champion Award for his contribution to Process Safety in 2024.

The Synergy family congratulates him on his accomplishments and wishes him continued success in his career growth and professional Excellence.

Fostering Future Leaders: Highlights from BEAWorld's Leadership & Presentation Sessions

BEAWorld continues to inspire and shape the next generation of leaders through its Students' Leadership Webinar Program and the Innovative Presentation Challenge. These initiatives provide young minds with the platform to engage in meaningful discussions, develop critical thinking skills, and enhance their presentation abilities. Following the success of previous sessions, Sessions 32 & 33 once again brought together young minds to engage in thought-provoking conversations on significant topics.

Session 32: A Panel Discussion on the Victory Day of Bangladesh
On December 30, 2024, participants explored the historical and contemporary significance of Bangladesh's Victory Day. The session featured a dynamic panel discussion moderated by Samsun Nahar Nupur (BA Hons, MA, B.Ed, M.Ed, M.Phil, PhD Researcher), encouraging students to reflect on the struggles, achievements, and the role of youth in shaping the nation's future. The discussion ignited a sense of patriotism and responsibility among students, emphasizing leadership rooted in history and progress.

Session 33: Debate on Achieving Net Zero 2050 – Reality or Myth?
Held on February 15, 2025, this session tackled one of the most pressing global challenges—climate change. Under the guidance of moderator Samsun Nahar Nupur, students engaged in a rigorous debate on whether achieving Net Zero by 2050 is a feasible goal or merely an aspirational myth. The discussion challenged students to critically analyze environmental policies, technological advancements, and economic implications while considering the responsibilities of individuals and nations in the fight against climate change.

Innovative Presentation Challenge: A Platform for Young Visionaries
To further empower students, BEAWorld introduced the Innovative Presentation Challenge, an exciting forum where young talents present groundbreaking ideas. The recent sessions featured a variety of presenters covering diverse and impactful topics:

Session 1 – November 29, 2024
- **Presenters & Topics:**
  - *Radiah Mubashira Khan Afsa (Grade 7) – Innovative Thinking for a Better Future*
  - *Sariyah Bint Shamiul (Grade: 07) – How can peer-pressure affect a child's mental health and decision-making abilities?*
- **Moderator:** *Engr. Rafiqul Islam Talukder, P.Eng*
- **Key Takeaways:** This session encouraged students to embrace innovative thinking, explore new ideas, and develop creative problem-solving techniques.

Session 2 – December 20, 2024
- **Topic:** *Marketing Mastery*
- **Presenters:**
  - *Syed Ilham Naser (Grade 07)*
  - *Rapangel Arin Yana (Grade 06)*
  - *Ragib Nihal Sadab (1st year)*
- **Moderator:** *Samsun Nahar Nupur*

- **Chief Guest** : *Engr. Rafiqul Islam Talukder, P.Eng*
- **Key Takeaways:** The session delved into strategic marketing concepts, the role of branding in business success, and the impact of digital media on modern marketing strategies.

Session 3 – January 17, 2025

- **Topic:** *Smart Cities: Innovation for Sustainable Future*
- **Presenters:**
  - *Numaira Iram (Grade 09)*
  - *Najib Mahfuz (Grade 10)*
  - *Rayhan Ahmed (1st year)*
- **Moderator:** *Samsun Nahar Nupur*
- **Chief Guest** : *Dr.M Mehedy Masud*
- **Key Takeaways:** This session explored how technology and urban planning can create more efficient, sustainable, and resilient cities, encouraging students to think about future infrastructure challenges and solutions.

Session 4 – January 31, 2025

- **Topic:** *Innovative Solutions to Plastic Pollution*
- **Presenters:**
  - *Ethkan Ahmed (Grade 04)*
  - *Radiah Mubashira Khan Afsa (Grade 08)*
  - *Areta Radab (Grade 11)*
- **Moderator:** *Samsun Nahar Nupur*
- **Chief Guest**: *Engr. Md. Al-Emran Hossain*
- **Key Takeaways:** This discussion focused on reducing plastic waste through alternative materials, innovative recycling methods, and policy-driven environmental solutions.

The Innovative Presentation Challenge provides students with a platform to showcase their ideas while refining their presentation and leadership skills. By participating, students gain exposure to research methodologies, creative thinking strategies, and public speaking techniques—key skills essential for future leaders.

BEAWorld remains committed to nurturing leadership, public speaking, and analytical skills among students. Stay tuned for more sessions and challenges in upcoming editions of the Students' Leadership Webinar Program and the Innovative Presentation Challenge!