CESaRE
Impacts
December 2022
www.cesarejournal.org

Featured article

A Digital Paradigm: Taking the Guesswork out of Architectural Design and Building Performance

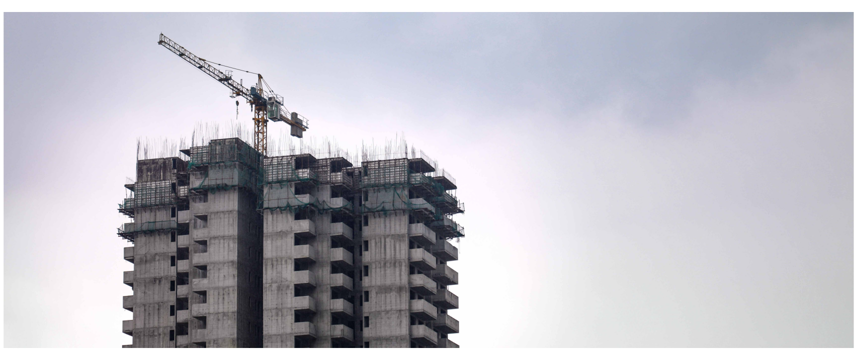
By Alyssa-Amor Gibbons

The Journal of Caribbean Environmental Sciences and Renewable Energy
CESaRE Impacts Magazine
Issue 7 - December 2022

Contents

Articles

Feature



Credits

Publisher
CESaRE: The Journal of Caribbean Environmental Sciences and Renewable Energy

Editor-in-Chief
Dr. Kalim Shah

Editor Interns
Zsaria Diaz
Vaidika Pooran

Design and Layout
Anna Power
Michael De Souza
Daniel Perreira

Editorial Inquiries
inquiries@cesarejournal.org
+1 (868) 766-2681

Cover
Kawser Hamid

Images
Editor’s Page - **Paige Deasley**
Filler Page - **Pokrie**
Pg.1 - **Sports Photography**
Pg.2 - **Pixabay**
Pg.3 - **Kindel Media**

Contents Continued

Images Continued

Editor's Note

Staying the Course in Uncertain Times

With this issue, dear readers, we find ourselves in the midst of increasing global uncertainties, just as we cautiously relish emergence from the COVID-19 pandemic. We are, for example, experiencing 'aftershocks' of the pandemic coupled with the geo-political strife of the Ukraine-Russia war and domestic socio-political frictions from Bangladesh to Brazil and from the UK to 'across the pond' in the US. The Caribbean is not isolated from the ripple effects of many such tensions, even though seemingly far away. I would argue that we risk submergence of the Caribbean sustainable development agenda under the weight of these events, but it is exactly in these times that our propagating of the sustainable development cause will build our regional resilience. Global energy shortages and supply chain defects will affect us, yes, but so too can the increased rates and intensities of climate-induced extreme weather events that have us on the edge of our seat every 'hurricane season'.

The articles we selected in this issue reflect several research directions that address Caribbean sustainability priorities. Gibbons provides the Feature Article that gives us insight on remarkable new and evolving data and information technology tools for sustainable 'green' building design and urban planning. Tools such as Artificial Intelligence (AI) and Machine Learning (ML) hold much promise for evidence-driven decision-making processes now and moving forward. Similarly, Pooran reports on the innovative ways that Machine Learning techniques can and have been utilised in the waste management and recycling sector to improve systemic efficiencies and even aid in predictive models that anticipate waste generator behaviors. On the sustainable energy transition front, Alvada summarises the ongoing research going on in Trinidad and Tobago's power generation sector. Particularly, potential efficiency gains through different energy source pathways such as combined gas cycle with solar and wind renewables. Ram brings our attention to the potential for battery energy storage systems to replace gas-powered turbines. Moreso, this article places the technology discourse in the broader and relevant context of finance and implementation strategy. Lastly, Roopchand provides her report on a very interesting panel discussion on "Opportunities in Ocean Science" at the recently held Virtual Island Forum 2022. Panelists provided their perspectives and advice on gaps to fill in terms of human resources, expertise and capacity; needs for better coordination of regional and country-to-country activities, and the often-complicated tangles of projects being financed in islands generally, but with little cumulative or sustained scale up outcomes.

Until next time…..stay calm and sustainable!

Kalim Shah, Ph.D.
Editor-in-Chief

Fighting for our Future from the Frontline: 100% Renewable in Jamaica

Written by: **Justin Ram**

We have all borne witness to devastating weather conditions across the globe, from the Australian wildfires of 2020 to the Pakistani floods of 2022. These deadly natural disasters can all be linked to one common denominator, climate change. While the warming of the planet has worldwide ramifications, Small Island Developing States (SIDS) are put at a particularly significant risk and the Prime Minister of Barbados, Mia Amor Mottley, highlighted this at the United Nations Climate Change Conference in 2021 (COP26) when she implored "What must we say to our people living on the frontline in the Caribbean?".

Thankfully, the Caribbean community has made many strides in their efforts to mitigate climate change, one of which is the adoption of an international treaty known as the 'Paris Agreement' which seeks to limit the increase of global temperatures to 2°C. In order to achieve this there has to be a severe reduction in global greenhouse gas (GHG) emissions which cannot be achieved without the utilisation of renewable energy. In light of this, Chen et al. (2020) explored the ways in which Caribbean energy grids could become 100% renewable using Jamaica as an example.

In their paper, the researchers firstly noted that Carib-

bean nations' energy markets are dependent on the importation of fossil fuels and therefore become vulnerable to their fluctuating prices. Due to this, it was suggested that a transition to using renewable energy would not only facilitate GHG emissions reduction, but also provide a more economically stable source of power generation. Renewable energy comes in a variety of forms but it was identified that solar and wind energy are the most readily available in Jamaica and have also become cost-competitive with conventional energy sources. Jamaica has already realised this and has made efforts to mitigate GHG emissions, with utilisation of alternative energy accounting for up to 8% of all energy consumption in 2018. This marked a significant reduction in fossil fuel imports. The national GDP spent on fossil fuels decreased from 9% in 2015 to 3.5% in 2018, facilitating savings of US$ 22.75 million.

While these initiatives are encouraged and necessary to ensure the commitments made under the Paris Agreement are kept, the paper explained that the local electricity provider in Jamaica, Jamaica Public Service Company Limited (JPS), experiences power quality and grid stability issues due to the introduction of renewable energy from wind and solar. It further explained that the issues with solar can be attributed to the effects of cloud coverage which lead to a fluctuation in power output. To combat this, JPS uses fast-responding gas turbines to correct the output problem but there are instances where these do not act quickly enough resulting in an overgeneration of power which can be damaging to the energy grid.

As an alternative, the researchers proposed that a Battery Energy Storage System (BESS) replace those gas-powered turbines as this type of system was observed to have a faster response time. Additionally, the paper suggested that such an implementation would be cost-beneficial as an analysis over a ten-year period showed that there would be a five year payback period with a cumulative net present value of US$ 43.7 million, based on present day figures.

It is envisioned that in order to achieve an energy grid supplied by 100% renewable resources in Jamaica, a two phased approach must be implemented. The first phase covers the period spanning 2020-2030 where the goal is to ensure wind and solar energy encompass up to 30% of the energy mix. This includes the implementation of the BESS

utilising lithium-ion batteries. During this phase it is suggested that retired fossil fuel plants be replaced by renewable energy sources and that no new fossil fuel plants be constructed. Phase Two, which spans 2030 to 2055, endeavours to ensure an energy mix made up of 100% wind and solar energy. It also proposes the use of vanadium redox flow batteries in the BESS as they are expected to become more cost efficient in the future.

Finally, the researchers elucidated the economic value of transitioning to 100% renewable energy in a Jamaican context and assert that solar plants will actually be cheaper to install than fossil fuel plants, and the operation and maintenance costs will also be lower. Additionally, the implementation of a BESS to replace the current conventional energy reserve system (gas turbines) will not only allow for a more stable energy grid but will also further assist in the worldwide effort to limit the global temperature rise to 1.5°C. While Jamaica is already taking steps to become 100% renewable, the findings from Chen et al. (2020) show a clear pathway to achieve this, thereby contributing to the mitigation of climate change as well as providing a more stable energy source.

Justin Ram is a qualified Attorney-at-Law and is currently the Regulatory Affairs Officer within the Trade and Business Development Unit at the Trinidad and Tobago Chamber of Industry and Commerce. He serves on multiple governmental committees as the Chamber's representative and also contributes articles to the Chamber's weekly newspaper columns. Justin is a passionate advocate for climate change awareness and is a supporter of the growing ESG Community. Justin holds a Masters of Law from the University of Westminster.

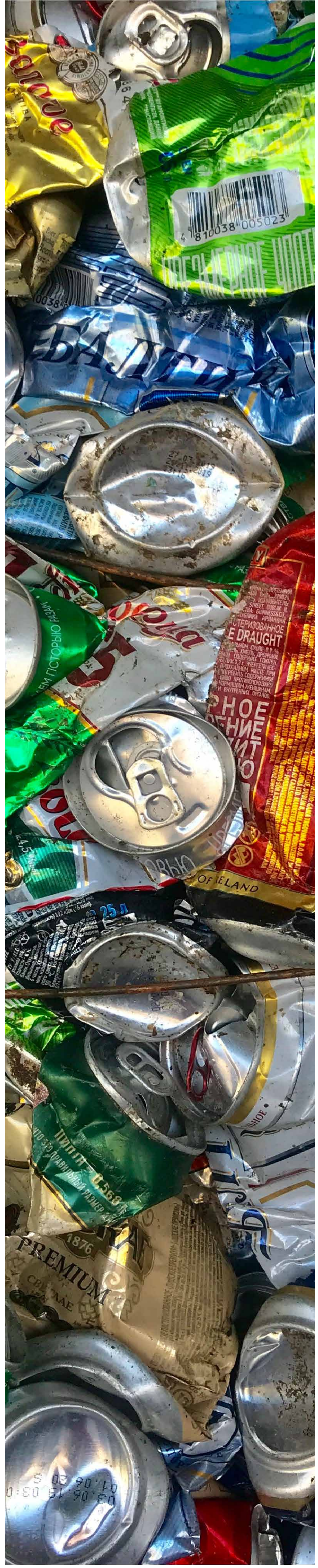
Improving the Circularity of Waste in Latin America and the Caribbean using Machine Learning

Written by: **Vaidika Pooran**

Latin American and Caribbean countries have faced many challenges when it comes to the management of municipal solid waste (MSW). Increasing populations of these countries have significantly escalated the quantity of the waste that is generated. However, most countries have not adapted their systems of waste management. Rather, they still use landfills and incineration as their main solid waste disposal method. Latin American and Caribbean countries produce approximately 541,000 tonnes per day of municipal waste (UN Environment, 2018). The lack of proper disposal and management of MSW can be hazardous both to human health and the environment due to factors such as emissions of greenhouse gases, water and soil contamination and air pollution. Furthermore, these countries lack recovery opportunities such as Waste-to-Energy systems and recycling. Currently, the recycling rate of these countries is low, approximately 4.5%, even though 32% of the MSW is recyclable (Bijos et al., 2022). There are several challenges that Latin American and Caribbean countries face that hinder further development of the management of MSW. The study conducted by Bijos et al. (2022) analyses the use of Machine Learning methods to address these challenges and improve the circularity of MSW in the region.

Machine Learning (ML) is an Artificial Intelligence technique used for the analysis of data. It develops learning algorithms that are capable of making inferences, predictions and trends in data (González et al., 2019). Additionally, the algorithms are capable of adapting and learning and can therefore apply data processing to simulate human behaviour and propose improvements in different areas of knowledge (Bijos et al., 2022). ML can obtain accurate solutions in minimal time by using robust methods that are based on computing, mathematics and statistics (Abdallah et al., 2020). It can be split into supervised learning and unsupervised learning. In supervised learning, the model uses labelled data sets to train algorithms to classify data or learn the relationship between input and out data. Unsupervised learning involves the use of algorithms to analyse unlabeled data sets to find patterns. ML in the management of MSW in Latin America and the Caribbean can be used to determine expected volume and composition of the waste without incurring expenditure on experimental procedures (Bijos et al., 2022).

There are several methods that can be used in different stages in the management of MSW. In Latin American and Caribbean countries, data regarding MSW is a major challenge. Most times, there is limited data, outdated data or incorrect information that hinders the improvement and further development of the management of MSW. ML can bridge the gap in obtaining precise information that would otherwise require high expenses that most developing countries lack. Bijos et al. (2022) state that Artificial Neural Network and Deep Neural Network systems can identify complex patterns that are present in a system's variable and are mainly used in the prediction of the composition and quantification of MSW. Support Vector Machine and Support Vector Regression are mostly used for the prediction of MSW generation though they can also be used in the prediction of methane emissions from landfills. Additionally, Tree Based Methods are mainly used for the prediction of categories of MSW, energy recovery from MSW and plastic and organic fraction generation (Bijos et al., 2022). Most ML methods in the management of MSW are aimed at predicting the generation of MSW and increasing the efficiency of recycling. This can assist in recycling initiatives and waste management planning. Another challenge that is often faced by developing countries is the effectiveness of public policies and implementation of these policies. The lack of trust from the citizens often hinders the development of public policies.



Latin American and Caribbean countries can significantly benefit from the incorporation of ML in MSW management as there are many opportunities to improve circularity in waste generation. Figure 1 shows how different steps of MSW management can be made into a circular waste system.

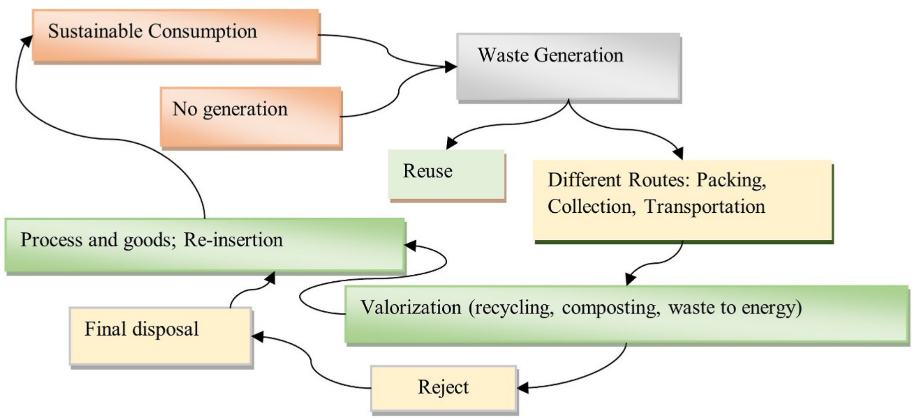


Figure 1: Steps of a circular waste system (Bijos et al., 2022)

The use of ML in MSW management can also be a source of employment and income for many countries. There is a large market for recycled goods and repurposed items as these are now more preferred over new items. The recycling of items such as plastic would also drastically reduce marine and land pollution thus improving quality of life. Machine Learning can therefore be a valuable tool for Latin American and Caribbean countries in their mission to achieve sustainability.

Vaidika Pooran is a recent graduate of the University of the West Indies, St. Augustine with a BSc in Chemistry and Industrial Chemistry. Passionate about environmental sustainability and renewable energy, she has a keen interest in the development of a sustainable future for the Caribbean.

CLICK HERE

to hear more on this topic
from Júlia Bijos

A Digital Paradigm: Taking the Guesswork out of Architectural Design and Building Performance

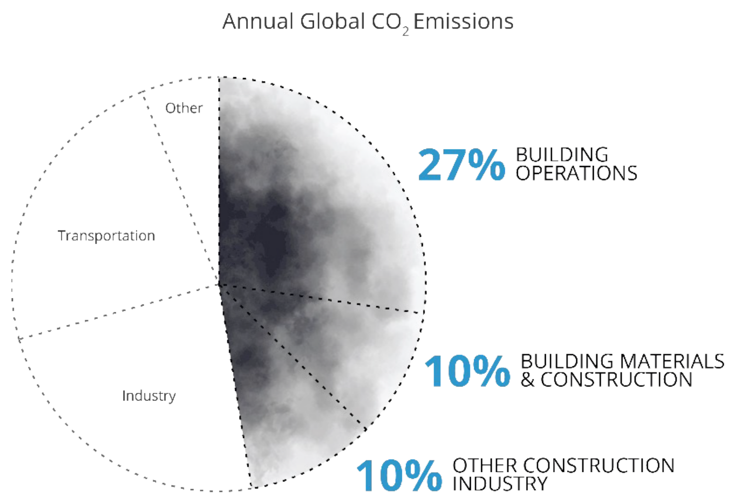
Written by: **Alyssa-Amor Gibbons**

Climate Change: The "biggest threat modern humans have ever faced" (United Nations Security Council, 2021). These words were iterated in 2021 at the UN Security Council by one of the most recognizable voices on climate advocacy: Sir David Attenborough, officially dubbed a ' Champion of the Earth '. Despite his and many others' impactful words, representing decades' worth of scientific reporting, worrying trends, and forecasted catastrophes, emission trajectories continue to increase globally.

A few months later, the IPCC Working Group 1 issued a report which evidenced a chilling conclusion of the irreversible impacts already set in motion by climate change (IPCC, 2021). To summarize, the alarm bells were again sounded, they were deafening, and in the impassioned words of climate advocates, including Barbadian Prime Minister Mia Amor Mottley, "Code Red…Code Red…" (Mottley ,M.A., 2021) to planet Earth.

We are living in an era defined by climate change. Global discussions have been increasingly dominated by its repercussions. We all know that this threat is driven largely by greenhouse gas emissions caused by human activity (National Research Council, 2020), however, the sense of urgency and ambition that saw the establishment of crucial mitigation frameworks, such as the Paris Agreement, seems to have faded.

At a macro scale, it is a broad strokes indictment of human life on earth, but at a day-to-day microlevel – the one experienced by the average global citizen – what are we actively doing that contributes to the degradation of our planet? According to the World Resources Institute, when we break it down to the main contributors of greenhouse gas emissions, Carbon Dioxide (CO_2) emissions from fossil fuel and industrial processes account for 74% of contributions (Ge, M et al., 2020). Of the annual global CO_2 emissions, the built environment generates nearly 50% of this (GlobalABC, 2021).



Data Sources: Global ABC Global Status Report 2021, EIA

This commanding percentage makes the built environment industry a linchpin in the race to shift our current global trajectory from a high-carbon economy to a low-carbon (or better yet, no-carbon) one. Coupled with the fact that our buildings and infrastructure are our first defence in providing shelter and protection from the climate itself, the sector therefore has a threefold responsibility to the world at large. It must find the synergy between responding to the call to reduce its carbon footprint through improved efficiency, but equally important, it must rise to the challenge of being resilient in the face of increased risk of extreme and unpredictable weather events. All whilst still contributing to the overall wellness of occupants.

It is simply not enough for buildings to look pretty and to tick the boxes of implementing 'green' design strategies. Our built environment needs to perform against metrics that allow us to quantify and validate the degree to which it addresses the challenges of sustainability, wellness, and resilience. As an architectural designer who lives and works in one of the islands most vulnerable to the impacts of climate change, I take these challenges personally. I believe that it is high time that we take the guesswork out of building performance for the sake of our Caribbean cities and communities.

One of the most effective tools we have as designers in achieving this ambition, is the adaptation of emerging technologies to assist early in the design process. Building Information Management and Data-Driven Construction methodologies allow us to conceptualise and then model an intelligent digital twin of each project in virtual reality before the project is physically built.

Think of these digital assets as computerised carbon copies of each design solution. The metadata within the model helps architects to optimise the coordinated building design based on several environmental performance metrics that affect the overall sustainability and resilience of the project. These may include site selection based on factors such as flood risk mitigation, reduced energy consumption, improved water efficiency, regenerative material sourcing, indoor air quality, occupant comfort, the overall reduction in carbon footprint, and reduction of greenhouse gas emissions…just to name a few.

This level of control is exciting because we move away from the more myopic traditional 2D (and sometimes 3D to 4D) world of drafting, rendering, and scheduling, to an all-encompassing 7-dimensional approach that reimagines the building process all the way through to budget trade-off analysis (5D), sustainability (6D) and facility management (7D).

We can manage and assess a vast array of variables and make insightful design decisions based on output gathered from the model. Allowing the computing power to navigate these often-conflicting inputs means that we can integrate Artificial Intelligence (AI) to suggest 'better' design options based on the initial concepts. This is powerful because we can now make decisions not based strictly on aesthetics or construction cost, but on more nuanced and relevant factors such as the project's projected utility consumption over its life cycle, or the true embodied carbon of the materials used during the procurement, construction, operation, and decommissioning of the project. We get a more holistic view of the building's environmental impact from concept to end of life (EOL).

Within the regional context of the Caribbean and other Small Island Developing States (SIDS), this digital approach is particularly powerful when we start to address the issue of disaster preparedness and management. The additional advantage of this approach is that within this virtual space, where there is no loss of human life nor costly damage to infrastructure, we can begin to stress test individual buildings and urbanscapes by throwing real-world climate scenarios their way. If they fail in this 'safe space', we can tweak the designs for improved performance, reducing casualties and damage.

We need look no further than Grenada to see the power in leveraging digital twins for collaborative and predictive decision-making. In 2021, Grenada undertook the exercise of developing a nationwide 3D digital twin using LIDAR and high-resolution imagery. This twin was then used to visualise outcomes of different climate change scenarios to develop policies and solutions to address the country's vulnerabilities. For example, a simple layer of information such as the proximity of a project site to a waterbody could be used to foresee the impact that increased rainfall from an extreme weather event or climate-change-led sea level rise could have in the future.

St. George Harbor, Grenada without sea level rise projection (Peters, L.,2022)

Projection of 2m sea level rise in St. George Harbor, Grenada (Peters, L.,2022)

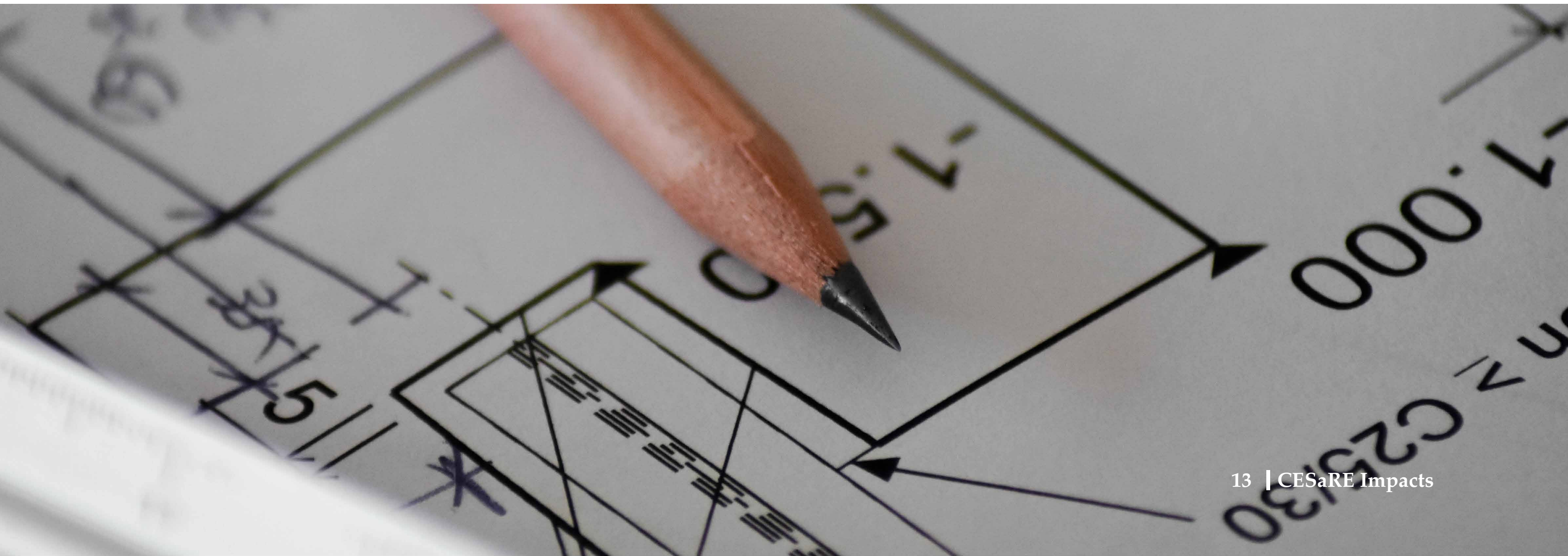
This level of insight in developing urban policies at a large scale can then lead to the implementation of carefully considered planning guidelines that, for example, would outline the minimum foundation heights of construction projects in flood risk zones; ensuring that all occupiable spaces, or important mechanical/electrical rooms and equipment, are constructed above the predicted flood line. A simple analysis but a crucial foresight that greatly improves the coastal resilience of an island nation. This is just a small example but if the right measures are implemented before disaster strikes, approaches like this can make a big difference.

Regardless of where we call home on this planet, we are heading into a worrisome climate future, the extent of which depends on the actions we take today. For those of us on the 'frontlines', we can't afford to delay our efforts to shore up our resilience. Our lives and livelihood depend on it.

In the midst of a world that is worried about antimicrobial resistance and the next pandemic event, or whether we should colonise Mars or terraform the moon, it remains in the forefront of my mind that all of us in the Caribbean are one bad weather event away from neither of those things mattering. Therefore, as we tiptoe cautiously into this future, we should do so no longer guessing and hoping for the best when it comes to our built environment. Instead, we should do so whilst actively designing and leveraging our technological capabilities to prepare for the worst.

Alyssa-Amor is an Architeer - a multidisciplinary designer of environmentally conscious, energy-efficient, and resilient architecture; architecture that reflects a deep reverence for our interconnectedness with nature. With an MEng(Hons) in Structural Engineering and Architecture, and specialisations in Building Information Management (BIM), she has fostered a passion for delivering architecture that is in constant pursuit of next-level intelligence and optimisation through synergistic design.

Alyssa-Amor is a TED speaker and winner of the recent TED Idea Search Latin America; A New Era. Holding several LEED and WELL designations, she consults as a Sustainability Advisor within the North American and Caribbean region, infusing her knowledge and experience into her boutique architectural practice, Studio Amor.



Sustainability within the Power Sector of Trinidad and Tobago

Written by: **Alsandría Alvada**

Anthropogenic sources have been a great stressor when trying to curtail the effects of climate change and create sustainable approaches to mitigate these effects. Small Island Developing States (SIDS) are slowly transitioning by taking up efficient approaches, but they need to step up because the climate change situation is becoming more urgent. Bhagaloo et al. (2021) conducted a case study in Trinidad and Tobago on its potential to switch to efficient technology within the power sector. Currently the country utilises hydrocarbon resources which support the petrochemical sector. This sector operates on "low efficiency simple-cycle (SC) gas-based technologies." This outdated technology consumes more than 50% of generated electricity, hence the study done by Bhagaloo et al. (2021) encompasses environmental and techno-economic assessments to examine the power sectors' capabilities for energy efficiency and resource improvements.

In this assessment, twenty cases were examined which incorporated renewable energy penetration, electrification of the petrochemical sector through power to X systems, and single cycle and combined cycle operations. The method used in this study considered both current and future sources of energy gathered from reports and national projects. These were directly connected to various assessments of environmental and techno-economic impacts. For each scenario, mass and energy balances were derived and impacts on resources and energy efficiency were calculated.

Single cycle technologies support one of the largest power plants in Trinidad and Tobago, providing an efficiency of 24.4% to an installed capacity of 842 MW. For the gas-based systems, a business-as-usual case was developed, entailing a single cycle subsystem with a capacity of 757.8 MW.

Investigation of the potential of a combined cycle system to meet the current demands after decommissioning of the current single cycle found that there was an improved efficiency of 50%, as shown in previous work in this field. Based on the cases developed, greater energy efficiency was achieved through the combined cycle and power to X technologies. With the decommissioning of most of the single cycle capacity, combined cycle technologies could provide the equivalent net grid power while using limited natural gas. Compared to combined cycle technology, the power to X cases produced lower efficiencies in the range of 45-49% while combined cycle gave an efficiency range of 50-53%. Moreover, with the implementation of solar and wind, gas consumption was further reduced.

In accordance with the renewable energy targets, solar photovoltaic and onshore wind were considered for the national grid. Installed capacities and capacity factors were cited from literature with solar photovoltaic being 112MW/28.4% and onshore wind being 120MW/38%.

In the environmental assessment, four phases of a life cycle assessment governed the impact of each case: a goal and scope definition, life cycle inventory analysis, life cycle impact assessment and interpretation. Single cycle technologies were found to contribute the highest carbon dioxide emissions of 971 kgCO2-eq/MWh annually and 6.45 million tonnes per year. Analysis on combined cycle technology showed an approximately 50% reduction of carbon dioxide emissions to 478 kgCO2-eq/MWh. Incorporating renewable energy also adds to 55.4% reduction in greenhouse gas emissions. Based on these results, it was suggested that hybridisation of combined cycle and renewable energy technology could provide cleaner electrical energy and should be promoted within the power sector.

Trinidad and Tobago has the potential to transition to cleaner energy production and, based on the cases put forth within this study, the best alternative is a combined cycle technology for current production. The addition of renewable energy can optimise this further. This hybridisation will aid in the reduction of greenhouse gases and align with Trinidad and Tobago's Paris Agreement commitments of 15% reduction in greenhouse gas emissions throughout the transportation, industrial and power sector.

Alsandría is a passionate student in the fields of Environmental Science and Renewable Energy. She is dedicated to researching and writing scientific articles that are informative and captivating. She holds a BSc in Environmental Science and Sustainable Technology and is a recent graduate of the MSc Renewable Energy Technology Programme at UWI, St. Augustine. Alsandría also writes book reviews for websites such as Netgalley and Onlinebook Club, as well as informative articles for the Better TT website.

We are Our Ocean – Opportunities for Oceans and Island People

Written by: **Adelle Roopchand**

Oceans and seas make up more than 70 percent of our planet's surface. They feed us, generate more than 50 percent of the oxygen we breathe and regulate our climate and weather patterns (United Nations Environment Programme, 2022; National Oceanic and Atmospheric Administration [NOAA] 2022). The ocean provides opportunities for over three billion people in science, food production, tourism, transport, environment conservation and many other disciplines (Anderson, 2020, Shankar, 2019). The coastal populations that depend on the ocean for their livelihoods contribute an estimated $1.5 trillion annually to the world's economy, with an expected $3 trillion by 2030 (Anderson, 2022).

The Virtual Island Summit 2022 (VIS 2022), themed 'Knowledge for Resilient Sustainable and Prosperous Islands Worldwide', included a session on 'Opportunities in Ocean Science for Island People' which focused on strengthening ocean-based economies, ocean conservation, climate finance, and island people's experiences.

The United Nations Framework Convention on Climate Change announced that the global climate change-related adaptation cost in developing countries is estimated at USD 70 billion per year. Caribbean countries face economic challenges, including low economic growth, high debts (IMF 2022), and the annual challenges of natural disasters such as flooding, drought, and hurricanes which pose a significant barrier to obtaining funding for ocean development (Apapoe et al., 2022).

According to Apapoe et al. (2022), there are four instruments that the Caribbean can use to finance the development of climate sustainability. Funding for climate change solutions is available through multilat-

eral lending organizations and development banks, such as the World Bank, Inter-American Development Bank and Caribbean Development Bank, and bilateral donors, such as the European Union and China. Funding is also available through initiatives by governments, and through the private sector which plays an important role in developing sustainable green and blue bonds and 'debt-for-nature swaps' (Apapoe, 2022; Pricewaterhouse Cooper, 2022).

The IDB 2025 Vision includes promoting action to combat climate change. In 2020, they facilitated the Global Credit Loan of US$50 million to the Caribbean Development Bank for climate finance for the Organization of Eastern Caribbean States (OECS) members. The loan supported resilience programmes for disasters and climate change and encouraged the development and growth of small to medium-sized businesses.

The World Bank is also funding a project, Unleashing the Blue Economy of the Caribbean (UBEC), which began in June 2022 and drives,

> "sustainable development partnership for the period 2022-2050 aimed at establishing investment platform to further develop the blue economy while promoting sustainable and integrated use of marine resources for economic growth, improved livelihoods and job generation while preserving the health of the ocean system" (UN, 2022).

Phase 1 of the project will be implemented in Grenada, Saint Lucia, Saint Vincent and the Grenadines and the OECS Commission. Other Caribbean countries have expressed interest in the project and will be considered for different phases within the project's period.

Caribbean countries are in partnership with the UNCDF's Risk-informed Early Action Partnership (REAP), and Local Climate Adaptive Living Facility (LoCAL) to implement climate adaptation efforts to increase resilience to climate change. Working at the local level where climate change impacts are acutely experienced, UNCDF and REAP ensure early action to serve the needs of those affected. Similar efforts are taking place in the Pacific Islands and Africa.

The UNCDF climate projects include coral reefs, as they contribute to the ocean's health and support the livelihoods of an estimated one billion people globally (UNCDF, 2022). The organisation provides a global blended finance approach to funding for coral reefs. The finance instrument supports private and public sectors and has two components; a UN-managed grant aiming to catalyse impact and create bankable projects; and an equity fund of US$500 million that will invest in some of the business ventures that come out of that first grant window.

Coordination by governmental agencies to maximise opportunities and benefits for nations is critical to ensure the ocean and land are protected to serve people (NOAA, 2022). Governments' investments should involve equitable frameworks and mechanisms to incentivise and motivate partnerships and investment. Having an enabling environment for blue economy sustainability and conservation becomes critical to initiate and complete the process to mitigate the challenges ahead. Leveraging partnerships between the private sector, resources, data experts, innovation, and investment in ocean science and technologies must be integral to the planning and operations by governments.

Partnerships are also essential for data gathering and sharing (Sinha, 2022). Ocean exploration for data collection towards a more scientific approach to protecting the ocean comes with challenges. Trained divers and experts require access to the ocean/sea, and expensive scientific equipment is needed for exploration. Some suggest that due to Exclusive Economic Zones, there is limited exploration of some territories' marine environments, which translates to inadequate data for scientific conclusions and for governments' informed management decisions (Felix, 2022). This also translates to a population that is uneducated on many aspects, such as species, tourism interests, possible career paths, and specific protection for the ocean. According to Felix (2022), the ocean is changing at a rate beyond our comprehension, and low-cost technologies for ocean/sea navigation and exploration could offer Caribbean countries opportunities to understand the region's open ocean better and tap into its potential towards economic growth.

Finally, Caribbean countries are signatories to agreements such as the International Code of Conduct on Pesticide Management, The Convention on Biological Diversity, and the International Convention on Civil Liability for Oil Pollution Damage. Yet, according to the United Nations Environment Programme (UNEP), the Caribbean Sea is the second most plastic-contaminated sea in the world. (UNEP/CEP, 2019). The UNEP/CEP (2018) reported that Styrofoam and plastic bags in the Caribbean are estimated at 600 to 1414 items per square kilometre.

Regionally, governments have been creating awareness for the public on best practices while markets have been transitioning to the use of biodegradable materials. Legislative approaches have been tackling the plastic pollution of the sea and ocean by banning the import of single-use plastics and Styrofoam in countries including Antigua and Barbuda, Belize, Barbados, the Bahamas, Dominican Republic, Grenada, Guyana, Jamaica, St. Eustatius, St. Lucia, and St. Vincent and the Grenadines. According to Nicholls (2018), Haiti was the first in the region to ban plastics importation, sale and marketing since 2012. Guyana banned Styrofoam products in 2016, followed by Antigua and Barbuda, St. Vincent and the Grenadines and Aruba.

Policy directives, including bans on plastic bags, can initiate a circular economy to include recycling and upcycling some ocean pollutant products, as was the case in Guam (Austin Shelton, Chair, VIS 2022). It is vital to avoid plastic pollution to protect both ocean and human life. For opportunities to continue existing in the ocean for island people, an enabling environment is critical as is greater awareness and responsibility by all to protect and conserve its blue economy towards a sustainable ocean.

Adelle Z. Roopchand is an independent Caribbean journalist and communications specialist in agriculture and blue economy, environment and rural development. She has worked with CARICOM arms including: CRFM, CARICOM IMPACS and CARDI; and the ACP-EU Technical Centre for Agriculture and Rural Cooperation. Adelle is reading for a PhD in Agricultural Extension at the UWI STA.

References

Fighting for our Future from the Frontline: 100% Renewable in Jamaica
Written by: Justin Ram

Mottley, M. (2021, November 1). Opening Ceremony for the United Nations Climate Change Conference (COP26) [Video] Youtube. https://www.youtube.com/watch?v=BsBVx_8oFm0&t=1s

Chen, A. A., Stephens, A. J., Koon Koon, R., Ashtine, M., & Mohammed-Koon Koon, K. (2020). Pathways to climate change mitigation and stable energy by 100% renewable for a small island: Jamaica as an example. Renewable and Sustainable Energy Reviews, 121, 109671. https://doi.org/10.1016/j.rser.2019.109671

Improving the Circularity of Waste in Latin America and the Caribbean using Machine Learning
Written by: Vaidika Pooran

Abdallah, M., Abu Talib, M., Feroz, S., Nasir, Q., Abdalla, H., & Mahfood, B. (2020). Artificial intelligence applications in Solid Waste Management: A systematic research review. Waste Management, 109, 231–246. https://doi.org/10.1016/j.wasman.2020.04.057

Bijos, J. C. B., Zanta, V. M., Morató, J., Queiroz, L. M., & Oliveira-Esquerre, K. P. S. R. (2022). Improving circularity in municipal solid waste management through machine learning in Latin America and the Caribbean. Sustainable Chemistry and Pharmacy, 28, 100740. https://doi.org/10.1016/j.scp.2022.100740

González García, C., Núñez-Valdez, E., García-Díaz, V., Pelayo G-Bustelo, C., & Cueva-Lovelle, J. M. (2019). A review of artificial intelligence in the internet of things. International Journal of Interactive Multimedia and Artificial Intelligence, 5(4), 9. https://doi.org/10.9781/ijimai.2018.03.004

UN Environment (2018). Waste Management Outlook for Latin America and the Caribbean. United Nations Environment Programme, Latin America and the Caribbean Office. Panama City, Panama.
Xia, W., Jiang, Y., Chen, X., & Zhao, R. (2021). Application of machine learning algorithms in Municipal Solid Waste Management: A mini review. Waste Management & Research: The Journal for a Sustainable Circular Economy, 40(6), 609–624. https://doi.org/10.1177/0734242x211033716

A Digital Paradigm: Taking the Guesswork out of Architectural Design and Building Performance
Written by: Alyssa Amor Gibbons

Ge,M., Friedrich,J., & Vigna,L. (06-02- 2020). 4 Charts Explain Greenhouse Gas Emissions by Countries and Sectors. World Resources Institute. Retrieved 10/09/2022 from https://www.wri.org/insights/4-charts-explain-greenhouse-gas-emissions-countries-and-sectors

Global Aliance for Buildings and Construction (GlobalABC). (19-10-2021). GLOBAL STATUS REPORT FOR BUILDINGS AND CONSTRUCTION Towards a zero-emissions, efficient and resilient buildings and construction sector. 15 – 16 . Retrieved 10/09/2022 from https://globalabc.org/resources/publications/2021-global-status-report-buildings-and-construction

Intergovernmental Panel on Climate Change(IPCC), (2021): Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:10.1017/9781009157896.

Mottley,M.A., (05.11.2021). Opening of the COP26 World Leaders Summit of the United Nations Climate Change Conference (COP26) [Speech]. https://www.youtube.com/watch?v=PN6THYZ4ngM

National Research Council (2020). Climate Change: Evidence and Causes: Update 2020. Washington, DC: The National Academies Press, 5-6. Retrieved 10/09/2022 from https://doi.org/10.17226/25733.

Peters,L. (04.30.2022). Climate Change Prompts Grenada to Create the First National Digital Twin.LIDAR Magazine. St. George Harbor, Grenada without sea level rise projection. [Image] Retrieved 10/09/2022 from https://lidarmag.com/2022/04/30/climate-change-prompts-grenada-to-create-the-first-national-digital-twin/

Peters,L. (04.30.2022). Climate Change Prompts Grenada to Create the First National Digital Twin.LIDAR Magazine. Projection of 2 m sea level rise in St. George Harbor, Grenada [Image]. Retrieved 10/09/2022 from https://lidarmag.com/2022/04/30/climate-change-prompts-grenada-to-create-the-first-national-digital-twin/

United Nations Security Council. (23.02.2021). Climate Change 'Biggest Threat Modern Humans Have Ever Faced', World-Renowned Naturalist Tells Security Council, Calls for Greater Global Cooperation [Press Release]. Retrieved 10/09/2022 from https://press.un.org/en/2021/sc14445.doc.htm

Sustainability within the Power Sector of Trinidad and Tobago

Written by: Alsandría Alvada

Bhagaloo et al. (2021). Resource efficiency as a guide to clean and affordable energy: A case study on Trinidad and Tobago. Chemical Engineering Research and Design, 178, 405-420.

González-Garay et al. (2019). Plant-to-planet analysis of CO2-based methanol processes. Energy and Environmental Science, 12, 3425-3436.

We are Our Ocean – Opportunities for Oceans and Island People

Written by: Adelle Roopchand

Anderson, I. (2022, September 11). Biodiversity and Oceans: Road to Sharm El-Sheikh [Environment and Development Forum 2022: Climate Action]. United Nations Environment Programme. https://www.unep.org/news-and-stories/speech/biodiversity-and-oceans-road-sharm-el-sheikh

Diez, S.M., Patil, P.G., Morton, J., Rodriguez, D.J., Vanzella, A., Robin, D.V., Maes, T., Corbin, C. (2019). Marine Pollution in the Caribbean: Not a Minute to Waste. Washington, DC: World Bank Group https://documents1.worldbank.org/curated/en/482391554225185720/pdf/Marine-Pollution-in-the-Caribbean-Not-a-Minute-to-Waste.pdf

Felix, MS (2022). The imperative of ocean exploration challenges and opportunities in the Caribbean. Compete the Caribbean. https://www.competecaribbean.org/ocean-exploration-challenges-and-opportunities-in-the-caribbean/

Inter-American Development Bank, IDB Group Sets Climate-Related Financing at an Annual Floor of 30% until 2030. January 30, 2020. https://www.iadb.org/en/news/idb-group-sets-climaterelated-financing-annual-floor-30-until-2023.

Inter-American Development Bank, (2014). Survey and Assessment of Environmental Taxes in the Caribbean.https://publications.iadb.org/publications/english/-document/Survey-and-Assessment-of-Environmental-Taxes-inthe-Caribbean.pdf

Island Innovation, (2022, October). Virtual Island Summit. Opportunities in ocean science for island people. https://islandinnovation.co/videos/opportunities-in-ocean-science-for-island-people/

National Oceanic and Atmospheric Administration, (2022, October 19). Ocean Facts. https://oceanservice.noaa.gov/facts/

PricewaterhouseCoopers, (2022, October 19). "Trinidad and Tobago," Corporate - Taxes on corporate income. https://taxsummaries.pwc.com/trinidad-and-tobago/corporate/taxes-on-corporate-income

Shankar, A. (2019). Perspectives in coastal human ecology (CHE) for marine conservation. Biological Conservation Volume 236, August 2019, Pages 223-235. https://doi.org/10.1016/j.biocon.2019.05.047

Shelton, A.J. (2022, September 26-28). Waste Management. In (Anthony Talouli) [Opportunities in ocean science for island people: Conservation and the Ocean] in 'Knowledge for Resilient Sustainable and Prosperous Islands Worldwide'. Virtual Island Summit 2022. Online. https://islandinnovation.co/videos/opportunities-in-ocean-science-for-island-people/

Sinha, P. (2022, September, 26-28). Climate Finance. [Opportunities in ocean science for island people: Conservation and the Ocean] in 'Knowledge for Resilient Sustainable and Prosperous Islands Worldwide'. Virtual Island Summit 2022. Online.
https://islandinnovation.co/videos/opportunities-in-ocean-science-for-island-people/

United Nations, (2022). Unleashing the Blue Economy of the Caribbean (UBEC). https://sdgs.un.org/partnerships/unleashing-blue-economy-caribbean-ubec

United Nations Environment Programme (n.d.). Why do oceans and seas matters?
https://www.unep.org/explore-topics/oceans-seas/why-do-oceans-and-seas-matter

United Nations Environment Programme, (2019) Addressing Marine Plastics: A systematic approach – Recommendations for Action. https://www.unep.org/resources/report/addressing-marine-plastics-systemic-approach-recommendations-actions

United Nations Environment Programme, & Caribbean Environment Programme (2018). Draft Report on the Status of Styrofoam and Plastic Bag Bans in the Wider Caribbean Region - Fourth Meeting of the Scientific, Technical and Advisory Committee (STAC) to the Protocol concerning Pollution from Land based Sources and Activities in the Wider Caribbean.. https://wedocs.unep.org/20.500.11822/33273

CESaRE Impacts Magazine: Issue 7

CESaRE - The Journal of Caribbean Environmental Sciences and Renewable Energy

www.cesarejournal.org