

THE VESSEL

THREADING TOMORROW WITH TODAY



EDITOR'S REMARKS

by Renisha Hercules

In recent times, two important themes have been the focus of industrial and governmental endeavours - managing and overcoming the COVID-19 pandemic and fuelling the energy transition whilst developing and implementing strategies to reduce Green House Gas (GHG) emissions by 2030. The circumstances arising from these situations have sparked an era of innovation, mainly characterized by rapid vaccine development and an increase in entrepreneurial activity.

This publication is a collection of works speaking to these themes, all of which share the common thread of leveraging the human and technological resources we have today to define and position our future, hence the theme "***Threading tomorrow with today***". The writers, the IChemE TTMG sub-committee members and myself hope to inform, encourage and inspire our readers through this publication.

Do enjoy this fifth issue of The Vessel!

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RETURN TO NORMAL...WITH CARE

A MESSAGE FROM OUR CHAIR

As vaccine uptake increases, comfort levels for many individuals will also increase. For others, not so much. However, vaccinated or not, that children's saying comes to mind – "Ready or not, here I come", where the 'I' is Life, announcing its busy, daring self, not concerned with whether we have adjusted or figured out what works or no longer works in the grander scheme of things. So, are we ready?

If there is one thing we should remember as we begin to emerge from this pandemic, is that we must first take care of ourselves before we can take care of others. As we navigate back to what we had grown accustomed to pre-pandemic, we should probably pause to think about which habits and ways of living/working are worth retaining against those we should discard. What changes will we keep? What will we no longer do? Are you ready?

With activity still on a lull, the ideal time to strategise our emergence from the pandemic is now. Whether the world will be full throttle in 2022 or 2023 is yet to be seen, but I do encourage you to consider the self-care tips included in this article as we "return to normal (rtn)", trying to integrate some semblance of peace, productivity and progression in our lives.

Beyond this personal reflection which I have asked you to join in on, we at IChemE TTMG have done a group reflection and seen the need to continue educating our membership about new developments in the local and global landscape. These include sharing knowledge on the relevance of a hydrogen industry and renewable energy within our local context. This issue provides some details of technical talks on these topics by some impressive local speakers.

We have gone a step further and have begun looking at ways to develop the business acumen of our membership, not just so they can adapt to the changing working environment, which in itself has become so much more competitive, but also to have individuals poised to be more resilient against the changing times, as the pandemic has shown us is necessary, and equipping them to recognise opportunities to sustain themselves and their families. We urge you – take the time to connect with us as we continue the above endeavours.

I wish you a safe, holistically productive, stress and anxiety free return to normal and do hope you enjoy this issue of The Vessel.

SELF CARE TIPS

Care for Others

Understand that others (too) may be facing some sort of struggle in their own spaces and we should approach colleagues cautiously, with care and consideration. This can be via in-person interaction, sending an email or discussing a challenging topic with a superior or line worker. Remember to show care.

Prioritization and Periodization

Prioritization of one's mental health and aiming for stress reduction should be considered an act of self-preservation. What helps you to de-stress? Is it time alone, time with family and friends or relaxing in nature (all the things the pandemic revealed to us)? Consider integrating some downtime and/or more relaxing work amidst your toughest days to manage anxiety and stress levels and reducing 'multi-tasking'. Instead, try working dedicatedly on one thing at a time for shorter periods of time. One size does not fit all but reflection on what method works for you is key. Companies are in it for the long haul, and we should be too. Take breaks in your workday and periodize your work efforts to avoid burnout. Make a commitment to seriously plan your work while managing yourself and your health.

Be Reflective and Intentional

The pandemic gave us a lot of time with ourselves and/or with family. As we go back to the busier life, will we abandon these things again? Will we abandon certain areas of our lives? There is in fact enough time in the day. The question we must ask in returning to normal is, are we spending it on the right things? Once you have done this reflection on what matters most to you, intentionally do it and not mistakenly if you happened to get time. Clear time for it. Be intentional. That 3km run, the 10-minute break, that gardening activity or weekend paint job or even visiting family who lives 'so far' can help in adding balance to your lives.



MONIFA GRAHAM

Introducing the IChemE TTMG Management and Steering Committees 2020-2022

Steering Committee



Chairperson
Maurice Massiah
IChemE Senior Ambassador



Secretary
Vashti Goorahlal



Treasurer
Wayne Mohan



UWI & BOETT Representative
**Professor Emeritus
Winston Mellowes**



UTT Representative
**Associate Professor
Marian Watson**



APETT Chemical
Division Chair
Sara Bernard

NB: This committee also comprises 3 Industry Representatives (2 of which must be members of the APETT Chemical Division council). These representatives will be appointed in future.

Management Committee



Chairperson
Monifa Graham



Assistant Secretary
Judith Armorer



Assistant Treasurer
Dr. Keeran Ward



Technical Training and
Mentorship (TTM)
Committee Lead
Andre Perseval



Networking, Fundraising,
Social and Recognition
(NFSR) Committee Lead
Renisha Hercules



Applied Research
Committee (ARC) Lead
**Dr. Shelly
Singh-Gryzbon**

EVENTS RECAP

JANUARY-JULY 2021

MARCH

IChemE TTMG Annual Kick-Off Event

Host: IChemE TTMG Steering and Management Committees

In the opening of our webinars for 2021, our annual kick-off event was held virtually, for the first time, due to the on-going COVID-19 pandemic. The event showcased a new management team, comprising members linked to both academia and industry. This hybrid team brings a fresh take on Applied Chemical Engineering, centered around IChemE's learned society agenda. The event hosted introductions by the Management Committee chairperson, Monifa Graham and Steering Committee Chair, Maurice Massiah, and included a reiteration of the mission and vision of IChemE TTMG. The webinar also provided insights into our 2021 events such as technical workshops on the sustainable energy transition and getting chartered with the support of the TTM sub-committee, to funding innovation through the ARC sub-committee and upcoming networking and fundraising activities through the NSFR subcommittee. The occasion was met with trivia sessions, prizes and entertainment from performers such as Johanna Chuckaree (a.k.a. @dpianogirl on Instagram), rounding off the night with sheer excitement for the year ahead.

The IChemE TTMG Steering and Management Committees would like to thank the attendees of the Annual Kick-Off Event 2021.

We look forward to your continued support in the upcoming year.



APRIL



Renewable Power and its Application in Trinidad & Tobago

Presenter: Dr. Indra Haraksingh, Senior Lecturer—MSc. Renewable Energy Technology at U.W.I., St. Augustine

Host: Technical Training and Mentorship (TTM) Committee

Members were given a tailored presentation on 'Renewable Power and its Application in T&T' by Dr. Haraksingh. Her presentation focused on different types of renewable energy (solar, hydro, wind, biomass, biogas, geothermal) and their applications in the context of the Caribbean, with various examples of renewable projects in Barbados, Guyana, Jamaica and other Caribbean islands. Some of the technical, social, economic and environmental challenges were captured in the presentation for these Small Island Developing States

(SIDS) and objectives of CARICOM energy policies and strategies to address these issues were highlighted.

One of highlights included the descriptions of small-scale T&T renewable projects, benefits and challenges of renewables in T&T together with a listing of recommendations that covered: upgrading of existing T&T electrical grid systems to transmit Solar PV and Wind Turbines electricity production, changes to T&T legislation around noise for wind turbines and SMART metering to allow new renewable electrical grid tie-ins, resource testing (land and electrical generation capacities) of wind farms and comparisons of Levelized Avoided Cost of Electricity (LACE) vs Levelized Cost of Electricity (LCOE) to determine feasibility of renewable projects in T&T.

EVENTS RECAP

JANUARY-JULY 2021

JUNE

Renewable Energy Transition in the Caribbean

Presenter: Ms. Siana Teelucksingh, Senior Project Manager, Rocky Mountain Institute

Host: Applied Research Committee (ARC)

In this session, Ms. Teelucksingh deconstructed the renewable energy transition process. Using case studies from neighbouring islands including Jamaica, St Lucia and St Vincent and the Grenadines, she highlighted that while the outcomes of energy transition may differ, the fundamentals of the process remained the same and is captured within the three main pillars of the Rocky Mountain Institute (RMI) Islands Energy Program: Inclusive Energy Planning, Project and Program Implementation and Energy Leadership. She also demonstrated the benefits of the Integrated Resource Plans (IRPs) for the energy transition process. These include alignment of stakeholders on energy sector goals and approaches, analysis of multiple resources to avoid dependence on any single technology, identification of solutions and recommendations for a successful energy transition, and determination of which projects to pursue in the near and medium-term with associated costs. Ms. Teelucksingh emphasized the importance of proper planning, discussion and involvement of all stakeholders including government, utilities and regulators, for a successful energy transition.



JULY

Developing a Hydrogen Industry in Trinidad & Tobago

Presenter: Dr. Vernon Paltoo, President, National Energy Corporation of Trinidad & Tobago

Host: Applied Research Committee (ARC)



In this session, Dr. Paltoo provided insights into Trinidad & Tobago's energy industry and described current and future initiatives geared towards transitioning into a sustainable, carbon neutral economy by 2050. Through the world scale production of petrochemicals, Trinidad & Tobago is a significant producer of carbon dioxide, 50% of which originates from the production of grey hydrogen from natural gas for use in the petrochemical industry. While natural gas will continue to be a key energy source for the coming decades, the world is transitioning to renewable energy and energy efficiency to address climate change through reduction in greenhouse gas emissions. Dr. Paltoo described current efforts in the development of green hydrogen, which is anticipated to be used in three key areas, including transportation, power generation, and the petrochemical industry. However, while renewable energy technologies (such as wind, solar and hydropower) are being developed, carbon capture and storage and blue hydrogen will be key technologies in ensuring a reduced carbon footprint.



THE IMPORTANCE OF ENTREPRENEURSHIP AND WHY ENGINEERS SHOULD ADOPT A LEADING ROLE

Author: Dr. Roger Deo, Esch Engineering, Innovation & Entrepreneurship Awards 2018, 2019 & 2020. CIAC conference Dragon's Den Finalist 2019 (Quebec), Director & Founder ChemRMP Technologies Inc. 2020. Former Chemical Engineering Lecturer UWI.

Who is an entrepreneur and what do they do? If your response is along the lines of “They do something with business” or “They sell stuff”, I urge you to continue reading. Entrepreneurship in Trinidad & Tobago has developed a negative connotation. The main reason is that we have a predominately resale culture. The perception that wealth can only be generated through external goods is the leading business mindset. The purchasing of consumables creates a draw on foreign exchange reserves. This issue is further complicated by foreign exchange generation being confined to a few select industries. Herein lies the problem. Recent external shocks have demonstrated how sensitive, vulnerable and fragile the economic circumstances can be.

A solid and robust entrepreneurial sector at the national level can provide enhanced employment levels, create new wealth/value and increased levels of government spending due to taxation. Advantages to Trinidad & Tobago include a robust economy capable of weathering external pressures and improved economic stability and resilience. At an individual level, accepting higher risks can lead to higher rewards. Many of the current technology giants such as Apple, Facebook, Whatsapp, Uber, Lyft and Netflix were all founded by intelligent people who used computers. Netflix was a DVD delivery service before it became a content creation and delivery platform. They all started at some point as an idea on paper.

Entrepreneurs are looking for problems, which, if they solve, can create value. Thus, entrepreneurship activities can become the vehicle for social transformation and improvement. Trinidad & Tobago has many problems that plague different areas such as food production, housing, construction, water utilities (wastage/storage/usage), energy, transportation, etc.

There is a global push for companies, governments and organizations to become more innovative. Real innovation has a quantitative impact on cost, value created, time saved, improved competitiveness, increased productivity and profitability. Therefore, companies need to be innovative to remain competitive.

Implementing successful innovation requires a culture that embraces new technology, eases barriers to creativity and is knowledge-driven. Leadership is critical in any innovative organization that is mission-driven while supporting a learning culture.

Learning cultures can only be achieved through the acceptance of failure. Innovative organizations recognize that in order to be successful, you have to fail fast and often, learn, adapt and iterate. This has been contrary to the current belief system of citizens, where there is a perceived stigma to failure. I remember supervising research projects at the university – so many students were preoccupied with getting the right results on the first try. I was always a bit bemused by this as I knew that they had not yet acquired sufficient skill or knowledge. In any new experiment, “you don't know what you don't know” until you try.

Innovation requires funding, and the commercialization of research is critical. Applied research should be valuable in converting that Master's or Ph.D. level thesis into a product, method or service. Academic, local and regional values should be aligned and focused with economic goals. A network of investors, business entities and government agencies should be available to provide experience, mentorship and financial support, which would be essential in getting any new endeavor off the ground.

The most prominent technology companies are led by remarkable people with specific skill sets in Science and Mathematics, who then attained Business or Economics experience. They are knowledgeable problem solvers, data driven decision makers, solution designers and testers who are capable of managing risk. All these qualities are inherent in engineers, thus they are suitable for creating new businesses.

The economic future of Trinidad and Tobago hinges on the creation of new value. As markets change, what has worked in the past may not work in the future. Entrepreneurial activity and the ability to attract and retain the best talent will be crucial in developing new industries and the economic stability of Trinidad & Tobago.

THE FUTURE STARTS WITH INDUSTRIAL ARTIFICIAL INTELLIGENCE (AI)

Author: Claudius Stewart, Former Lead Commissioning Manager

Aspentech hosted the **OPTIMIZE 2021** conference on May 18th – 20th 2021 entitled “**OPTIMIZE 2021 – FUTURE STARTS WITH INDUSTRIAL AI**”. The conference was held virtually with papers presented by Aspentech and their respective clients. This presentation by Aspentech President and Chief Executive Officer, Antonio Pietri, demonstrated that Industrial AI is a digitalization revolution that is set to dramatically accelerate the digital transformation of capital-intensive industries to the self-optimizing plant and smart enterprise. This paper will focus on the use of Aspentech’s Industrial Artificial Intelligence which has the potential to benefit customers to the self-optimizing plant and smart enterprise.

The Dual Challenge

The dual challenge was defined as meeting the demand for energy and resources for a growing population with increasing standards of living while also addressing stability goals. The conference focused on the use of greater digitalization as a

means to address stability, thus assisting in this challenge. Industrial AI can assist in this challenge as follows:

1. The global population is expected to increase from 7.8 billion in 2020 to 9.7 billion in 2050 ⁽³⁾. As such, the overall global energy demand growth is expected to grow by 50% by 2050 ⁽¹⁾ while the global middle and upper class is expected to grow by 40% by 2030 ⁽⁴⁾.
2. 1.2 billion out of 7.8 billion people has little to no electricity ⁽⁶⁾.
3. In 2050 it is expected that 2 billion out of the 9.7 billion global population would be over 60 years old ⁽⁷⁾. As such it is expected that 42% of the medicine pipeline has the potential to be personalized machines ⁽⁵⁾.
4. The world has become a volatile, uncertain, complex, and ambiguous (VUCA) environment. The dual challenge is to meet the growing demand ^{(1),(4)} for resources from a growing population with increasing standards of living while also addressing sustainability goals (see **Figure 1**).

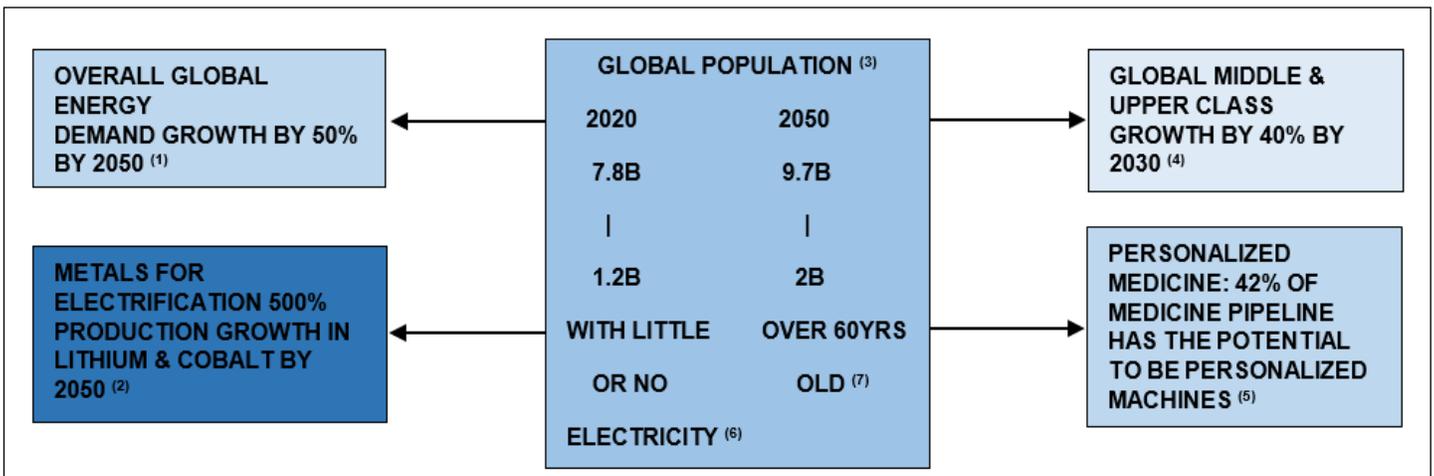


Figure 1: Dual Challenge to Meet Growing Demand for Resources.

Foundation of Industrial AI (How to shape the future)

Figure 2 shows how the foundation of industrial AI in asset lifecycle yields a comprehensive, holistic approach to achieve the highest possible financial return over the entire asset lifecycle. ⁽⁸⁾ The following factors optimize or extend the asset lifecycle in industrial AI:

1. **Performance Engineering** – needed to push the boundaries of what’s possible.
2. **Optimum Operations in Manufacturing & Supply Chain** – running to the limits of performance. For example, debottlenecking studies and plants that are operating safe-

ly at more than 100% of design capacity.

3. **Asset Performance Management** – Maximum reliability to drive uptime through actionable insights.

Industrial AI in Action

Industrial AI in action has been a result of research and development done by a team of data scientists; engineers with their creativity and innovation; and investments in buying other companies that developed methodology and capabilities to create **Hybrid Models** ⁽⁹⁾ (see **Figure 3**).

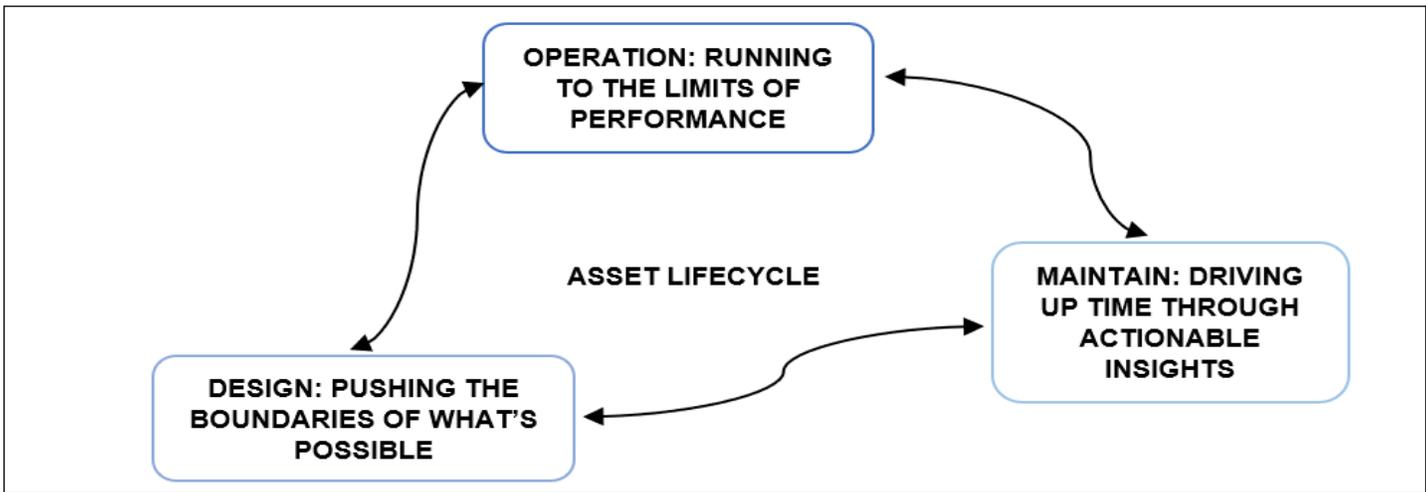


Figure 2: The Foundation of Industrial AI in Asset Lifecycle.

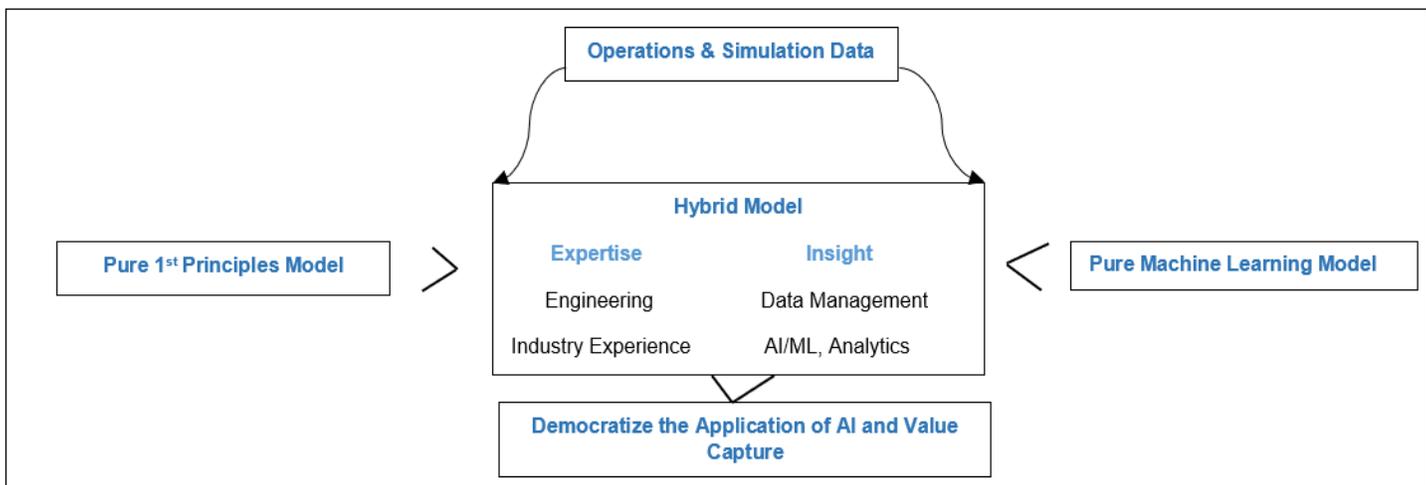


Figure 3: Hybrid Models—Industrial AI in Action.

Pure 1st principles model and pure machine learning model are fed into hybrid model. The hybrid model utilises a combination of engineering and industry experience, insight in data management and artificial Intelligence (AI)/ Machine Learning (ML) to democratize the application of artificial intelligence (AI) and value capture.

Conclusion

Artificial intelligence can be applied within industry resulting in benefits such as improved digitalization to meet the demands of the dual challenge, acceleration of digital transformation for capital-intensive industries, optimization of the asset lifecycle, development of hybrid models and sustainability in cases to produce a safe and greener atmosphere.

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GETTING TO KNOW MR. KERRY RAMPERSAD, LAND BUSINESS UNIT LEADER AT HERITAGE PETROLEUM COMPANY LIMITED

Tell us about yourself and current role in Heritage.

I'm originally from Tabaquite, former Naps (Naparima College) student who studied Chemical and Process Engineering as my first degree at UWI, St. Augustine. I'm married and have an 11 year old daughter. I thoroughly enjoy the gift of being a dad. In my free time (don't have too much these days), I relish watching and playing sports and I appreciate traveling, a good lime and music.

In addition to my role as Land Business Unit Leader at Heritage Petroleum Company Limited (HPCL), I'm also Founder and Director of a Non-Government Organization (NGO), "Lynette Rampersad 'Give a Little, Help a Lot' Foundation", in honour of my late mother. This NGO has really impacted my life and I am grateful each day for the simple blessings so that I can support others in need.

Currently at Heritage, my portfolio of responsibility expands geographically from Point Fortin to Guayaguayare, with a team of over 240 colleagues. In the Land Business Unit, my responsibilities include Health, Safety, Security & Environment (HSSE), Operations, Maintenance, Drilling, Workovers, Planning, Project Management, Engineering, Laboratory, Contract Management and Managing Tools and Equipment.

I see my role as creating the necessary environment to ensure that my teammates reach their full potential. Positive by-products of doing this are employee satisfaction, hence motivation to meet or exceed goals.

What influenced your decision to pursue Chemical and Process Engineering?

As a child, I loved ideas and finding solu-



tions to challenges. My talent in Mathematics propelled me to choose the Science combination at school. At Naparima College, I was elated and proud of being the school's Chemistry gold medal winner in my year. These passions channeled my path and direction to pursue a BSc in Chemical & Process Engineering.

Having this foundation in Chemical & Process Engineering also charted my appetite for certifications. Hence, I later did an MSc in Production Engineering, an International MBA to gain the business acumen, a Diploma in Leadership so that I can lead teams optimally and a Diploma in Law to ensure I adhere to the legal aspects of all efforts.

How do you apply principles of Chemical/Process Engineering in your current role?

The learnings from Chemical and Process Engineering really started the journey of my career. The degree landed me my first role in Mittal Steel as a Chemical and Process Engineer, then in Process Engineering

of a downstream methanol plant, followed by design Chemical and Process Engineering at an Engineering firm both locally and internationally. Having this downstream and design experience fostered the opportunity for me to enter upstream Oil and Gas and catalyzed (no pun intended) my ascension to Engineering Manager. I later took on the role of Production Manager in a downstream petrochemical plant and now at Heritage, I'm leading the Land Business Unit.

I provided this context to indicate that Chemical and Process Engineering really plotted the foundation of my journey thus far. The learnings, coupled with self-motivation, allowed me to successfully move from one step of my journey to the next. It paved the way by equipping me with a solid technical engineering foundation, strategic thinking, innovation, due-diligence, teamwork and project management skills. A Chemical and Process Engineering base also outfitted me with the necessary skills to be able to contribute to a diversity of portfolios in different facets of businesses ranging from upstream, downstream, midstream, iron and steel, design engineering, production, maintenance and even sub-sea Oil and Gas.

What has been your biggest accomplishment?

My biggest accomplishment is understanding and creating an environment that coaches and influences colleagues to reach a higher potential.

It gives me a humbled feeling of pride when colleagues from teams that I lead at Repsol, CGCL and Heritage (Midstream, HSSE and Land) reach out to me on social media, email, call or text and provide feedback detailing how I have influenced

them to be innovative and think outside the box, to believe in themselves as I believed in them, to pursue a new skillset or education, to lead their teams more effectively or to even influence others to reach a higher potential. It is a heartening and encouraging feeling to hear how my coaching or leading has influenced a colleague to add tremendous positive value to self and workplace.

I have experienced the satisfaction of breaking production records, surpassing targets, successful completion of mega projects, huge cost optimization, innovative ideas materialized to completion. However, my message is that while these are amazing accomplishments, they are still pale in comparison to influencing colleagues to attain a higher potential.

What are some of the qualities that you believe make a strong leader?

I believe that a leadership style that marries technical base, strategic thinking, innovation and due diligence with high energy, people connectivity, inclusion, and development in an undercurrent of genuine care and trustworthiness makes one a strong leader.

Another significant trait is the ability to discern and to be flexible while treating with different situations, as a generic approach may not always work. This ability goes hand in hand with active listening, accepting feedback, assertive decision making and the noble trait of admission of error.

The key from my experience is that it must all be genuine, and your objectives must never be selfish but rather selfless.

Tell me about a time that you witnessed unsafe behavior in the field and how it was addressed.

I had a recent experience where there

were a few safety challenges in the space of 2 weeks. The procedure and policies were all in place, training and spot audits had been done, but still some cultural and behavioural challenges were deduced. I decided to channel some energy into improving the team's HSSE Culture on a holistic level. I formed a task force and named it the Land BU HSSE Awareness Task Force. About ten (10) colleagues voluntarily assisted and we structured the approach to focus on:

- Improving HSSE awareness and education in a fun and inclusive way.
- Creating a hype and energy injection to encourage participation, hence learning.
- Creating a cultural shift where we are HSSE Ambassadors at work and at home.
- Permeating this to actions in the work environment and home spaces.

In just 4 months, the team created an in-house short video production on Life Saving Rules, quizzes aligned to HSSE procedures, policies and best practices and we even did an HSSE Jeopardy Competition online. The videos displayed some Hollywood style talent and are used as safety moments today. The Jeopardy competition attracted over 12 teams with 70 participants and almost 40 additional team members cheering their team mates on. The questions ranged from Health to Cyber Security to Life Saving Rules, Process Safety and even Environmental. Attractive prizes were up for grabs and we hyped the rivalry creating fun and learning.

The net effect from this initiative was improved HSSE awareness and education.

In fact, for the Jeopardy, people were studying all week as the thirst to win and to gain bragging rights created a momentum. There is now a cultural shift, and this is transcending to safer work. The by-

product is that our HSSE Metrics are improving. A spin off was immense team building and empowerment from those planning to those participating.

This catapulted a major cultural evolution of HSSE awareness and practice in the team.

What do you do in your spare time?

Spare time is very much welcomed. I spend most of my spare time with my family. Now with restrictions, we play board games and other fun sport and outdoor activities together. Recently my daughter and I did a Video Messaging course with NascAcademy, so we are into messaging with short videos from scripting to filming to acting to editing and producing.

I am also supporting my daughter Kirsten as she prepares for SEA with preparation strategies and additional papers.

I am somewhat health focused as I try to keep fit by exercising routinely and playing sports when I can. Before COVID-19, travelling to different countries and experiencing new cultures, culinary arts and sceneries, were things I looked forward to.

I am not usually a television person but recently I have been watching some movies and doing some online limes with close friends.

What career development advice would you give to young Chemical and Process Engineering graduates?

I would say three main things:

1. Adopt the right attitude and mindset from the beginning. Emotional Intelligence is a key aspect to ensuring effective connectivity and teamwork, hence success within your career. Pro-

fessionalism, trustworthiness, humility, ability to say you made an error and self-motivation are traits you would need so that you can in turn inspire others.

2. Learn, Learn, Learn and never stop learning. Ask as much as you can and never be intimidated or ashamed to ask and clarify. Absorb as much from different colleagues with vast experiences at the work place. Be open minded to learn and work smartly, engage in homework, perform due diligence, ensure factfinding and master your calculations. Be thorough as you learn. I have come across employees who say things are not in their Job Description and while this may be so, see the opportunity in the experience of doing it as this may be useful tomorrow.
3. Grab opportunities. Junctions would come in life and you need to be prepared by doing the above so that once these junctions come, you can grab the opportunities that accompany them. These can affect your career path and progress.

Given the changes in the Economy (re: COVID-19, oil and gas industry volatility or the energy transition), what transferable skills do you see Chemical/ Process Engineers possessing and how can they apply these skills to make themselves more marketable?

The world is constantly changing as population is increasing, technology is evolving, renewable energy is becoming part of policies, climate change is being affected with green house gas emissions and global warming. With Covid-19 impacting the world, a lot has also evolved and changed in how we do business and behave.

Having said this, with any challenge or change, an opportunity is born. Chemical

and Process Engineers must embrace the change and the opportunities and have that degree of flexibility, innovation and open-mindedness. Chemical Engineers must be self-motivated, disciplined, committed and master time management so that work can be done independently from home while meeting targets and deliverables without constant supervision, as remote working is the new normal.

If one can create an environment to foster and build team synergies while working remotely, this can be a huge asset as an employee. It is crucial that even with remote working, a Chemical Engineer still maintains teamwork, brainstorming and troubleshooting sessions with peers.

Online courses and keeping updated with information, technology and new accreditation would be a cutting edge. Many courses are now being done online and finding that extra energy and time to do some would go a long way to creating marketability and competitive edge.

I think messaging in videos with supporting visual rolls can help your presentation skills and give a huge advantage. While a picture tells a thousand words, a video image can double that. Being able to connect with an audience is key, so sharpening on innovative presentation skills is definitely a win.

What do you think we as Chemical/ Process Engineers can do more of to make a more tangible impact to the Trinidad and Tobago society?

I think that we have a lot of talent and resourceful Chemical/Process Engineers in Trinidad and Tobago who can pool their powerful minds together to find ways to make our beloved country more environmentally friendly. For example, the two areas I think we can impact are

Recycling and Agriculture.

Why recycling? Well, we use a lot of plastics in Trinidad and Tobago and most are not recycled. I'm certain that we have the talent to design environmentally friendly and economical plastic recycling process plants locally that can combat this challenge and in turn create jobs.

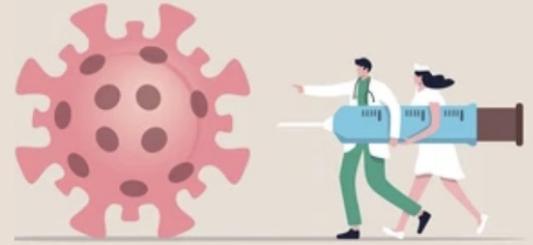
The Agriculture Industry in Trinidad can be more lucrative than it presently is if our Chemical Engineers pool together to determine the best fit ammonia-based fertilizers and even design technology to support in some labour intensive and flood prone areas. The message is that there are many areas in agriculture that we can optimize and improve.

Additionally, if a young Chemical and Process Engineer is working in the upstream Oil and Gas or downstream methanol plants and encounters a unique challenge, one may research in Google, SPE or IChemE to source papers and solutions to similar type technical problems. There may or may not be publications but chances are some Chemical and Process Engineer in Trinidad may have encountered this challenge and have some institutional knowledge that is not published. Take myself as an example – I have one SPE Publication but so many solutions to challenges that have never been published for one reason or another. The years go by and not every accomplishment or solution we publish.

We need to create the platform to tap into this and share the wealth of knowledge, competence and experiences. However, this platform must be free of egos and be open door, so that a young engineer feels enthusiastic to ask and an experienced one feels fulfilment to support. This is the cycle of life and we need to reach this point one day. One's legacy is adding value to others.

THE ROLE OF VACCINES IN THE FIGHT AGAINST COVID-19

Authors: Sachelle Solomon and Renisha Hercules



Vaccine Information Corner

Roughly 16-months ago the world “stopped” with little warning. The COVID-19 (Corona Virus) pandemic that appeared seemingly out of nowhere continues across the globe with no clear end in sight. Is there a way out? Well, the arrival of and equitable access to effective and safe vaccines is a critical start to reaching the end of this pandemic. In the time elapsed since the identification of the COVID-19 virus, the scientific community has launched several vaccine projects. Here we will dive deeper into what vaccination entails and some frequently asked questions on the topic.

What is a Vaccine

Vaccines stimulate your immune system to produce antibodies, similarly to what happens if you were directly exposed to a disease. Vaccines contain a weakened or destroyed form of the virus that causes the disease/infection. Some only contain part of the virus. Vaccination protects you from various diseases, as it prompts your body to develop immunity to that disease without contracting it first.

How Vaccines Work

Vaccines work by activating the adaptive immune system and so creating immunity. They safely introduce antigens for the immune system to “train on”, preparing itself to fight infections in the future. They train the immune system to detect and attack pathogens. The first step is to identify the pathogen/invader—it does this by detecting molecular markers called antigens. After detecting an antigen, the adaptive immune system begins mounting a bespoke response from which antibodies are created. These antibodies bind specifically to the antigen and together with immune cells called phagocytes, antibodies can destroy the pathogen. The adaptive immune system also produces killer T-cells which can detect and destroy cells infected with the pathogen. To prevent against future infections, the adaptive immune system also has a memory—it produces long lived memory T-cells which lie and wait to pump out the right antibodies and killer T cells if the same pathogen is ever seen again. This is called immunity.

Types of Vaccines

There are six (6) different types of vaccines, each of which are explained below.

1. Live attenuated – alive but weakened virus. Most like natural immunity. Provides strong disease immunity. E.g. Measles/mumps/rubella (MMR), chicken pox and flu nasal spray vaccines.

2. Inactivated – inactive/killed virus. May require booster shots. E.g. Hepatitis A, flu (shot), polio, rabies and Sinopharm vaccines.

3. Toxoid – protect against virus toxins. Weakened toxins (toxoids). May require booster shots. E.g. Diphtheria, tetanus parts of the DTaP vaccine.

4. Subunit/conjugate – specific parts of virus. Strong immunity to key part of virus. May require booster shots. E.g. Pertussis part of the DTaP vaccine, hepatitis B vaccine.

5. mRNA – uses mRNA instead of virus or toxins. Instructs your cells to make virus’ antigen. Do not contain live virus. Do not change your DNA. E.g. Pfizer, Moderna.

6. Viral vector – uses DNA or mRNA to instruct cells to make virus’ antigen. Genetic material wrapped in a different, safe virus. Do not change your DNA. E.g. AstraZeneca and Janssen.

COVID-19 Vaccines Available in Trinidad & Tobago

Currently the vaccines available to citizens of Trinidad and Tobago, approved by the World Health Organization (WHO), are Oxford’s AstraZeneca and BBIBP-CorV (Sinopharm). We are also expected to receive doses of Johnson & Johnson’s Janssen vaccine later this year (2021) to continue the vaccination rollout programme within the country.

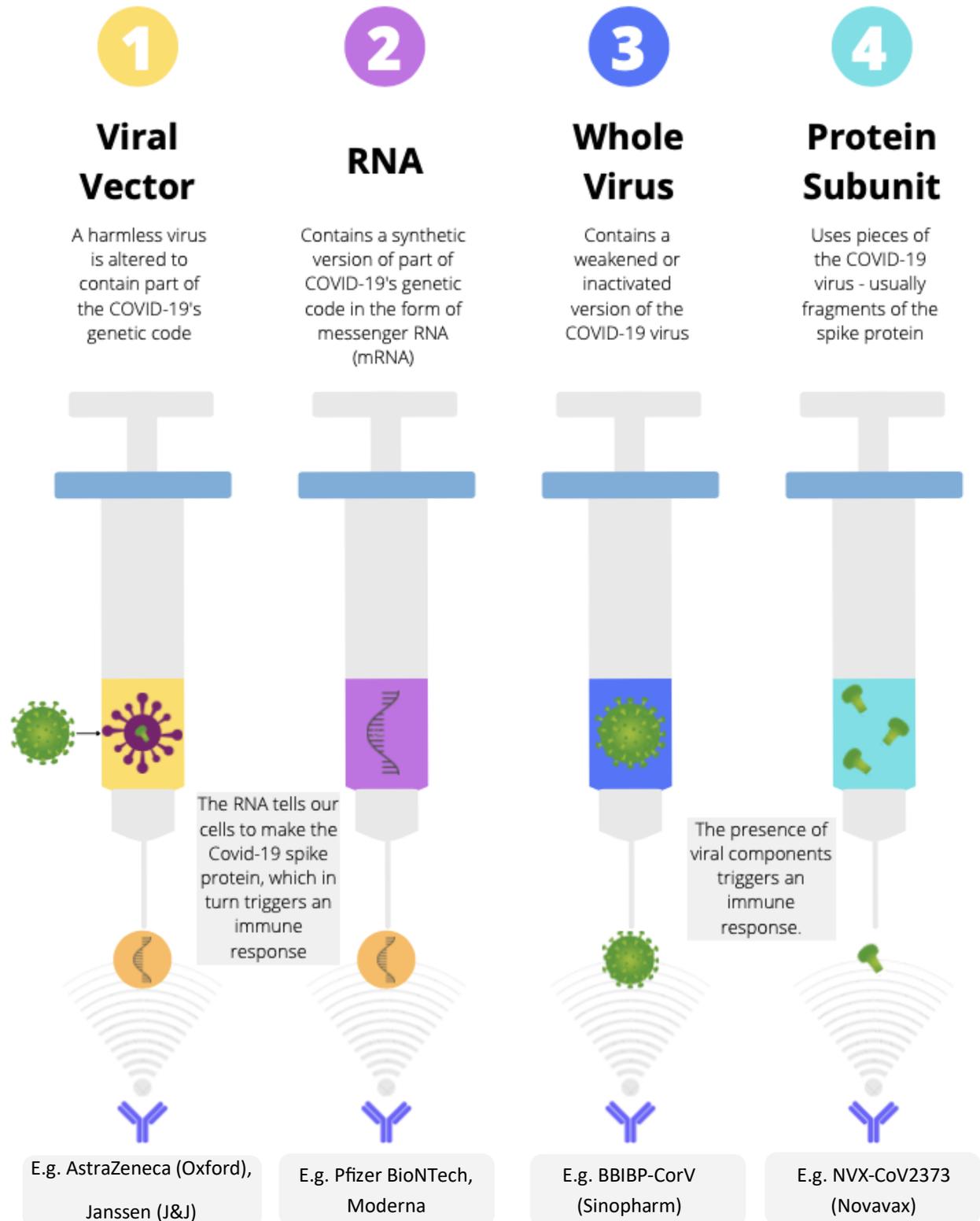
Firstly, the Oxford’s AstraZeneca vaccine is an adenovirus (viral vector) vaccine which requires two doses with an interval of 8-12 weeks between each dose. Next we have Sinopharm which is an inactivated (whole virus) vaccine. This is also a two dose vaccine, however, the time interval between each dose is 2-4 weeks. Lastly, the Johnson & Johnson’s Janssen vaccine is a single dose, non-replicating viral vector vaccine. Some other well-known, WHO approved, vaccines are the Pfizer-BioNTech and Moderna vaccines. Both of these are two-dose mRNA vaccines, where the former has a dosage interval of 21 days and the latter 28 days. These are not yet available for mass distribution in Trinidad and Tobago but are currently being used across North America.



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Mode of Operation of Some Types of Vaccines



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Vaccine FAQs

What are the known side effects associated with these vaccines?

Table 1: Showing the side effects for each vaccine.

Vaccine	Side Effects		
	Common	Rare	Very Rare
AstraZeneca	At shot area: pain, redness, swelling.	Reduced appetite, rash, dizziness, sweating	Unusual blood clots, capillary syndrome
Sinopharm			
Janssen	Body: fatigue, headache, muscle pain, chills, fever, nausea.	Dizziness/fainting	-
Pfizer			
Moderna			

What is the vaccine approval pathway?



Preclinical tests involve lab experiments and animals. Scientists must ensure that the vaccine candidate is not only effective but safe. When the candidate achieves the necessary pre-clinical results, it moves to the next stage. Next, clinical trials begin in a small group of people. As the candidate advances, it is tested on an increasing number of people where scientists and doctors are closely monitoring safety, efficacy and dosing. Upon successful completion of clinical trials the candidate moves to approval. The

Figure 1: The Vaccine Approval Pathway.

vaccine is then reviewed and approved by various regulatory agencies such as the WHO, FDA, CDC, etc. before large scale production. After approval, the licensed vaccine can then be mass produced and globally distributed.

How long does vaccine protection last?

At this moment it is not known how long vaccine protection lasts in fully vaccinated people. What is known is the severity of COVID-19 which can be significantly reduced through vaccination. Medi-

cal experts are continuously working on learning more about vaccine-induced immunity and natural immunity. Information is continuously being released as new discoveries are made.

If I have already contracted and recovered from COVID-19, do I still need to get vaccinated?

It is not yet known how long natural immunity lasts, thus its is recommended to still get vaccinated even though you have had and recovered from COVID-19. Also, studies have shown that the vaccine provides a strong boost in protection in people who have recovered from COVID-19. However, if you were treated for COVID-19 with monoclonal antibodies or convalescent plasma, it is suggested that you should consult your doctor and wait 90 days before getting a COVID-19 vaccine.

Can I get vaccinated against COVID-19 while I am currently sick with COVID-19?

It is not recommended for people actively infected with COVID-19 to be vaccinated until they have fully recovered from the illness and have met the required criteria to discontinue isolation. This also goes for persons who contract COVID-19 before receiving their second dose of vaccine.

Is it safe to be vaccinated against COVID-19?

All vaccines approved for emergency use by the WHO have been rigorously tested and are deemed safe and effective in preventing severe COVID-19 cases. They are also continuously undergoing testing and development over time for further improvement. However, if you have had any immediate or severe allergic reactions to the first dose of any vaccine, you should consult your doctor for further clarification.

In the meantime, whilst vaccination continues country-wide, we must maintain the public health measures that have worked thus far: wearing masks, social distancing and consistent sanitization.

Disclaimer: The information in this article is not reflective of the opinion of IChemE and should not be taken as medical advice. It is a compilation of responses to FAQs from reputable organizations such as the Ministry of Health of Trinidad & Tobago (MOHTT), the United States Centers for Disease Control and Prevention (CDC), the United States Food and Drug Administration (FDA) and the World Health Organization (WHO).

A FEASIBILITY STUDY ON CO₂ EMISSIONS REDUCTION IN THE POINT LISAS INDUSTRIAL ESTATE

Author: Danielle Lord, BSc. Chemical & Process Engineering

Trinidad & Tobago's robust oil and gas industry contributes 40% to the Gross Domestic Product (GDP). The downstream petrochemicals industry employs US \$8 billion in capital and has contributed to over 20% of total export earnings since 2011. However, the country's petrochemical industry is largely non-renewable and energy-intensive, producing 56% of CO₂ emissions. As of 2014, Trinidad & Tobago has had the second-largest per capita CO₂ emissions in the world.

I am pleased to be given the opportunity to investigate the feasibility of CO₂ emissions reduction within Point Lisas Industrial Estate – Trinidad's main industrial hub. I have recently completed my BSc. in Chemical & Process Engineering from the University of the West Indies, St. Augustine, a degree for which sustainable energy and environmental technology were my main motivators. Being from Jamaica, another Small Island Developing State, I took this opportunity to explore the engineering and policy requirements to develop CO₂ pipeline networks under the framework of Carbon Capture, Utilization & Storage (CCUS). I am grateful to my research supervisor, Mrs. Thérèse Lee Chan, for her guidance and my lecturer, Dr. Shelly Singh-Gryzbon, for providing me with the opportunity to share this work.

Background and Objectives

The ammonia process is an ideal candidate for carbon capture, as it produces high-purity CO₂ which can be readily dehydrated and compressed. In Trinidad, hydrogen is produced by steam reforming of natural gas. Post-combustion capture is integrated into the ammonia process through the CO₂ removal stage, after the High- and Low-Temperature Shift reactions. The aim of this thesis was to examine ways in which CO₂ emissions within the Point Lisas Industrial Estate could be reduced. To achieve this, two pipeline networks were developed to connect the eleven (11) ammonia plants to two (2) primary end-users: The Forest Reserve (previously owned by Petrotrin) in the Fyzabad area (South Trinidad), for potential enhanced oil recovery, and a hypothetical polypropylene carbonate (PPC) plant within the Estate. The objectives were to:

- Propose an optimum pipeline diameter based on the properties and transport of a 98% CO₂/ 2% H₂O mixture and evaluate the pipeline pressure drop;
- Evaluate the capital and operating costs of the network;
- Evaluate the potential impacts of the system on stakeholders within the environmental, economic and social domains and propose sustainability indicators using the Process Analysis Method (PAM).

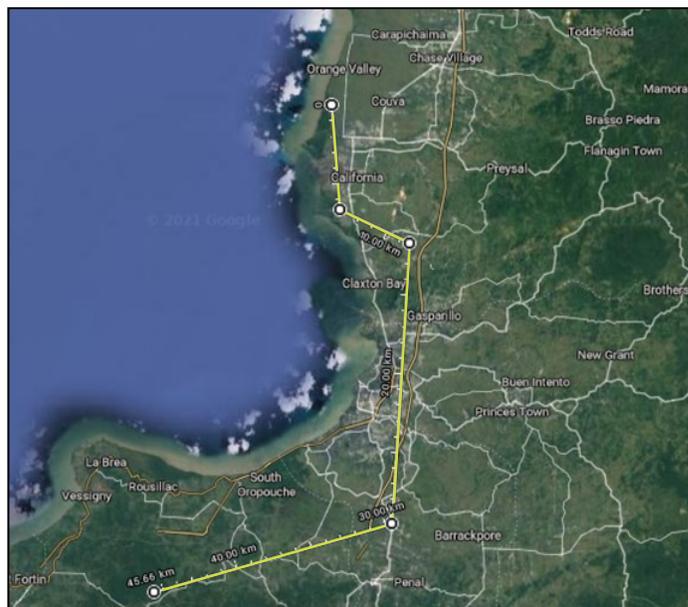


Figure 1: Map showing route of Forest Reserve Pipeline (46 km).

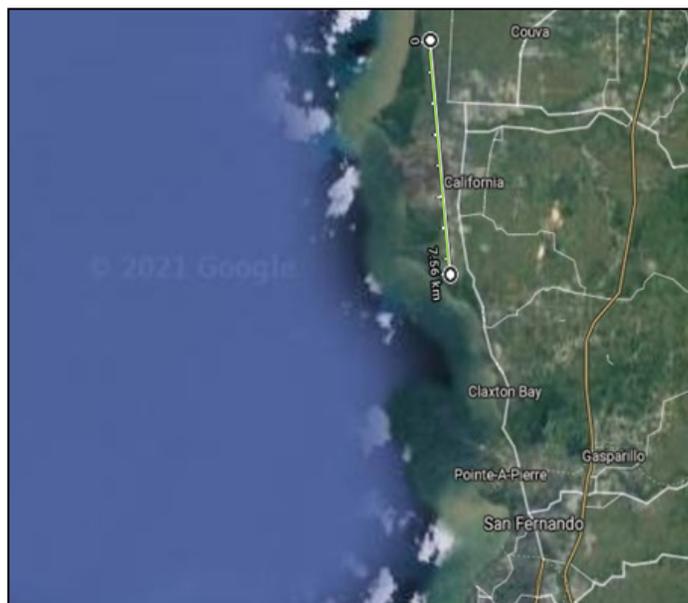


Figure 2: Map showing route of PPC Pipeline (8 km).

Method

The research objectives were met by first determining the pipeline capacities, lengths and entry conditions. The capacity of the Forest Reserve sub-system was 2 million metric tonnes, while that of the PPC pipeline was considerably less – 56,800 metric tonnes. To avoid refrigeration, supercritical transport was chosen for the 46 km Forest Reserve pipeline, which required compression >86 bar to avoid large sharp pressure drops over the range of pipeline temperatures. However, gaseous flow was

chosen for the PPC pipeline segment mainly due to its limited transport distance of 8 km. For compression prior to transport, staged reciprocating compressors with intercoolers were chosen, and one-shell-pass U-tube (BEU) heat exchangers were simulated using Aspen HYSYS.

The Peng-Robinson equation of state (EOS) was used to characterize the compressibility of the CO₂-rich mixture. Furthermore, the Rubin & McCoy model was used to determine the optimum diameter and pipeline CapEx. Construction costs for materials, labour, right-of-way (ROW) and miscellaneous items were found based on midwestern US cost coefficients. The CapEx for the remaining process equipment was then found, and the OpEx included costs for CO₂ injection, cooling water, power and the CO₂ working capital. The levelized cost per metric tonne of CO₂ transported was estimated for each pipeline. In addition to this cost analysis, both pipe segments were simulated in Aspen HYSYS to obtain the pressure and temperature profiles.

Results and Conclusions

The optimum nominal pipe size was determined to be 24 inches for both pipelines. While two-phase flow had been avoided in the Forest Reserve pipeline, a small liquid fraction (0.0001) was detected in the PPC pipeline. The Forest Reserve pipeline required nearly 38 times more compression power and 20 times more cooling water. However, despite its significantly higher capital and operating costs, its CapEx contribution was US \$17.28/tonneCO₂, while its levelized cost was US \$0.035/tonneCO₂. For the PPC pipeline, these costs were US \$137.57/tonneCO₂ and US \$0.284/tonneCO₂ respectively. Thus, the Forest Reserve sub-system was more economically viable due to

higher amount of CO₂ transported resulting in lower levelized contributions for CapEx/OpEx.

Under the PAM sustainability framework, the main impact generators included energy and utility management – particularly for the Forest Reserve pipeline, land and waste management, and management of economic material and social capital, which are intertwined. The future implementation of these networks and their ability to create value is dependent on the evolution of CCUS policy within Trinidad. This includes existing policies such as the Green Fund Levy and future policies such as a carbon tax credit. Thus, based on these findings, there exists strong justification for increased synergy between the government and private parties as well as the formation of an official, public CCUS oversight body to promote greater GHG reduction within the Point Lisas Industrial Estate.

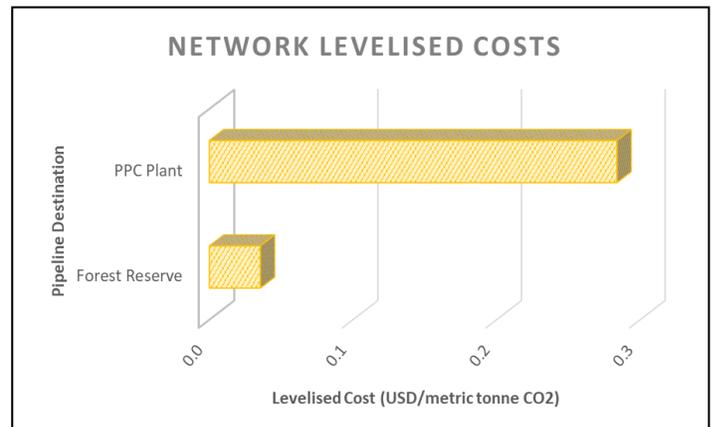


Figure 3: Graph showing the Levelised Costs (USD/metric tonne CO₂) of PPC Plant and Forest Reserve Pipelines.

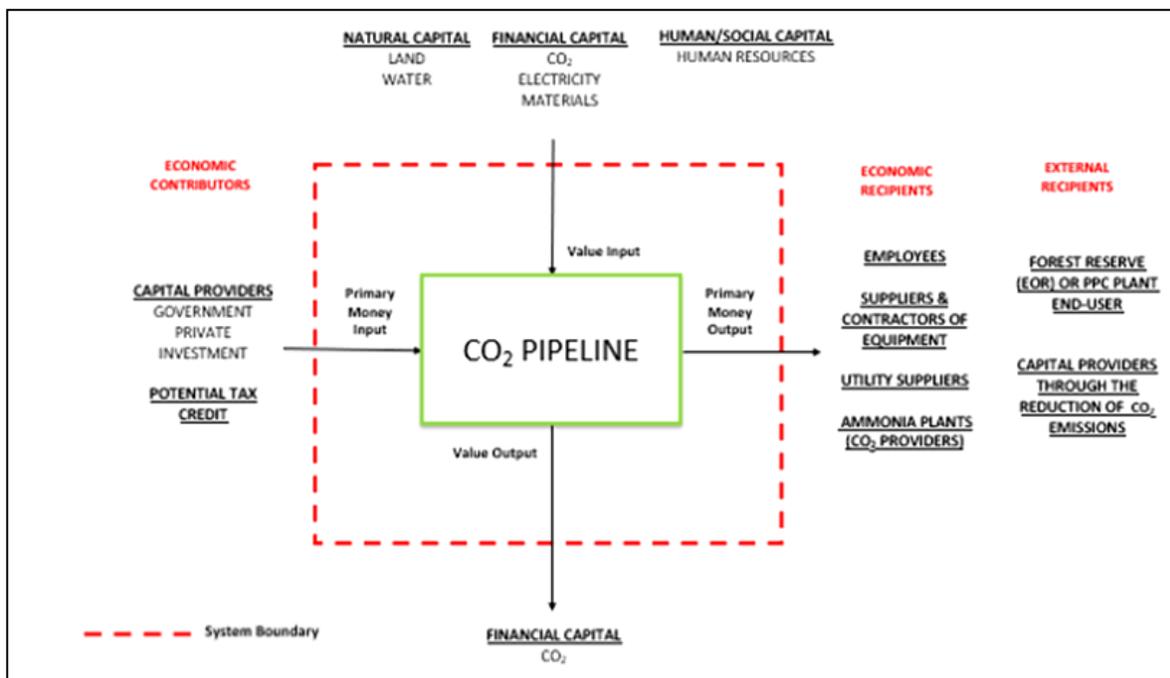
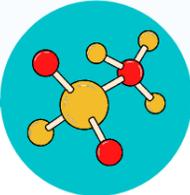


Figure 4: System Boundary under PAM.

THE LOOK AHEAD

JULY -
DECEMBER 2021



PERSISTENT ORGANIC POLLUTANTS (POPS) WEBINAR (SEPTEMBER)

The ARC committee will be hosting a technical session on Persistent Organic Pollutants.



MENTOR-MENTEE PROGRAMME LAUNCH (SEPTEMBER)

TTM will be launching the Mentor-Mentee programme, which is two-fold in nature as it will be assigning experienced mentors to assist mentees on the journey to Chartership with IChemE, as well as guiding mentees in technical, academic and/or entrepreneurial development.



UNIVERSITY STUDENT MEMBERSHIP DRIVE (SEPTEMBER)

This session is aimed at informing students of the benefits of IChemE membership, as well as the advantages of involvement with the local chapter.

ENGINEERS IN BUSINESS WEBINAR (OCTOBER)



The TTM committee will be hosting a Panel discussion on Engineers in Business, where we will engage experienced entrepreneurs who will share their invaluable insights.

LEARNED SOCIETY AND DIVERSIFICATION OF THE ECONOMY WEBINAR, PART 2 (NOVEMBER)

The ARC Committee will be hosting Part 2 to our Learned Society and Diversification of the Economy webinar.



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FUN SECTION



When you finish a project and can finally close all the tabs related to it



Have A Laugh!

A chemist, a physicist, and an engineer are sailing out at sea. The boat sinks and they're marooned on a desert island. Luckily, they have a bag with a can of food in it, but no tin opener.

The chemist tries to open the can first by trying to erode it. No luck.

The physicist takes off his glasses and focuses sunlight on the can to try and burn the lid off. No joy.

Finally, the engineer shouts "Hold on, I've got an idea! Let's assume the can is open!"



Brainteaser

If you had an infinite supply of water and a 5-litre and 3-litre bucket, how would you measure exactly 4 litres?

*The buckets do not have any intermediate markings.

*You have only the materials mentioned above.

Answer

First, fill the 5-litre bucket. Then using that bucket, fill the 3-litre bucket (being careful not to spill any). This leaves 2 litres in the 5-litre bucket. Now, empty the 3-litre bucket and pour the contents of the 5-litre bucket into it. Once again, fill the 5-litre bucket and then use this to fill the 3-litre bucket. This leaves 4 litres in the 5-litre bucket.

