

THE VESSEL

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IChemE

Trinidad and Tobago
Members Group



SPECIAL FEATURE

Interview with Wayne Mohan, IChemE Process Safety Fellow

Get to know the first Process Safety Engineer in Trinidad & Tobago to achieve Fellow Membership Status. Gain valuable insight into the field of Process Safety through a series of questions posed to Wayne, who has decades of experience in the industry.

2023 Event Look Ahead

Learn of the events planned for 2023/2024, inclusive of our Mentorship Programme, which is open to individuals at all levels (from student to experienced individuals), as well as our upcoming webinar series Get Chartered, to be held in October and November 2023, where detailed insight on the 3 stage Chartership application process will be provided.

Volunteer Opportunities

Volunteering with IChemE TTMG provides the opportunity to support a sub-committee (NFSR, TTM or ARC), build your network within the local Chemical/Process Engineering community and the ability to participate actively in the TTMG's planning for events and webinars.

Visit www.icheme.org > Communities > Members Groups > Trinidad & Tobago to register for events and access past webinar recordings and newsletters.

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FROM THE DESK OF THE TTMG CHAIR—CANUTE HUDSON

It is certainly a pleasure connecting with the members and non-members of IChemE Trinidad & Tobago Member Group (TTMG) crew. Let me first begin this edition by thanking Maurice Massiah for his stewardship as TTMG chair from inception in 2015 – 2022. Anyone who knows him knows he did this job tirelessly putting systems and processes in place to allow TTMG to become what we know it to be today.

Who is your incumbent Chair? I am married with two children. Professionally, I have a BSc. Degree in Chemical and Process Engineering, MBA in Oil and Gas Management, Project Management Professional (PMP), and I am a Registered Engineer in Trinidad and Tobago and a Fellow of the IChemE.

I have over 25 years experience in the petrochemical and LNG industries with more than 20 years in the LNG Industry. At Atlantic LNG, I have held discipline and supervisory process engineering, and project management roles with increasing seniority. In addition, I have published, presented and chaired sessions at several LNG international conferences.

Moving away from the introduction, IChemE TTMG continues to be the conduit through which IChemE's strategy is executed in Trinidad and Tobago. As a parent organization, IChemE continues to re-tool and refocus. As a learned organization, IChemE has not only set out executing its Strategy to 2024, but also doing work to develop strategy to 2028. See more on the current strategy at the link <https://www.icheme.org/strategy2024>.

One strategic theme of the refocused strategy that I would like to highlight is "Process Safety". This will continue to be a common theme within TTMG as you would notice in the upcoming calendar of events. In addition, moving forward, TTMG continues to challenge itself by presenting topics of interest that are key in the industries. A key example was the "Women in Engineering" webinar held on June 22, 2023. Our Management Team organizers and panellists did an excellent job of keeping the discussion real and relevant. Like you, I cannot wait for a similar event next year.

As the TTMG evolves we have embarked on a critical piece of work to review, refocus and refresh our

Charter in line with IChemE and energy transition requirements. You would also see an increased focus on our student population in terms of engagement and support.

In terms of exemplars, we have shining examples in Professor Emeriti David McGaw and Winston Mellows, who as IChemE members, have made and continue to make significant contributions to the wider society. Let us continue to build on the good work these distinguished gentlemen have laid before us. In fact, building on past work done by national organizations, beyond my tenure I see the TTMG as the vehicle through which Chemical and Process Engineering and Process Safety professionals have one voice in the Trinidad & Tobago energy diaspora and transition landscape. Join us so that we can hear your voice.

Lastly, building on transition, this year's "Vessel" has themes around Process Safety and an interview with a Process Safety Fellow, Wayne Mohan. Do enjoy!



Canute Hudson
IChemE TTMG Chairman

Embracing Sustainability: A Chemical Engineer's Transition from Oil & Gas into a Niche Beauty Business

by Amanda Roopnarine, Founder of Alchemy TT

In 2016, after accumulating seven years of valuable working experience and investing additional years specializing in my field, I made the challenging decision to depart from my role as a Facilities Engineer in the upstream Oil & Gas industry. Driven by a sense of dissatisfaction within my working environment and a yearning for change, I embarked on a new path motivated by the desire for personal growth and a harmonious way of living.

This article details how I have applied the principles learned as a chemical and process engineer to build a sustainable and environmentally conscious brand. Through the creation of innovative, high-quality, natural products like scalp oils, aura mists and candles that deliver transformational results on an energetic level, I aim to inspire readers to embrace their values, pursue their passions, embrace sustainability, and foster a more conscious approach to personal care, thereby impacting the well-being of our planet.

Defining the Problem and Inspiration:

The beauty industry is often associated with glamour and self-care, but the ugly side of the beauty industry is that it is also notorious for its excessive packaging waste. This poses a significant sustainability challenge, with 95% of cosmetic packaging ending up discarded, according to the [British Beauty](#)

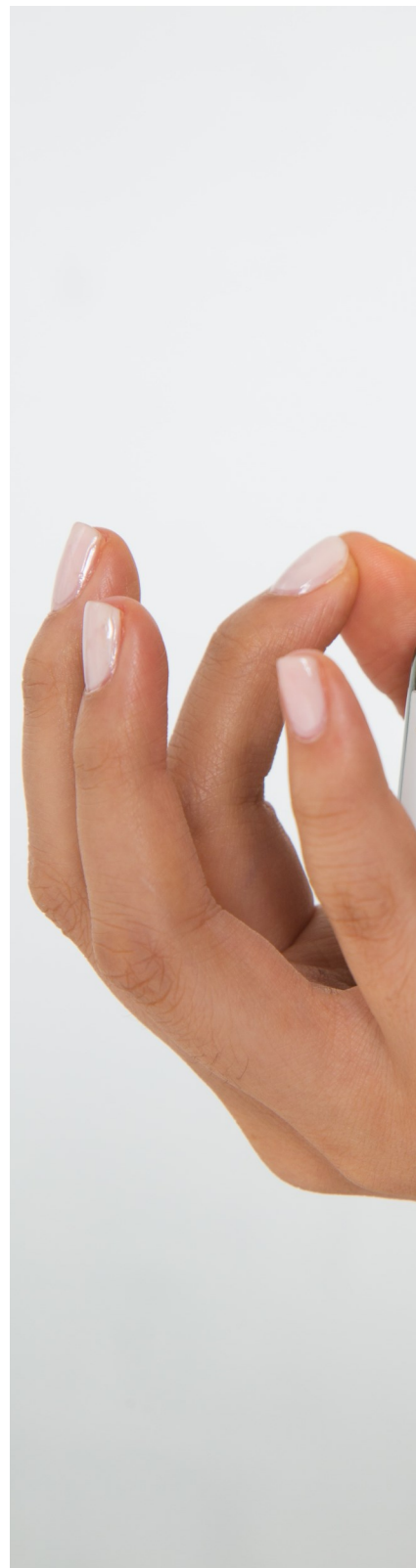
[Council](#). Shocking statistics from TerraCycle reveal that the industry generates over 120 billion units of plastic packaging waste annually.

Urgent action is needed to combat climate change, compelling brands to swiftly transition towards ecological and sustainable practices. However, a deeper inspiration drives our commitment to sustainability. Witnessing the devastating impact of certain industry practices on ecosystems and wildlife, such as the destruction of orangutan habitats caused by the palm oil industry and the catastrophic effects of deforestation-related flooding, I knew that change was necessary. This realization has propelled me on a journey to create a more sustainable alternative.

Integrating Sustainable Practices & Minimizing Environmental Impact:

Drawing upon my expertise as a chemical engineer and harnessing my passion for sustainability, I embarked on a journey to build a beauty brand that provides consumers with innovative solutions through our products. The goal was to deliver not only effective and exceptional results but also prioritize environmental consciousness.

Reducing our environmental impact is a core component of the business. Through rigorous research and development, I'm proud to have formulated products that deliver exceptional results while con-



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tributing to a greener future. I avoid using harsh chemicals, microplastics, and other harmful substances that can pollute our waterways and harm marine life. Instead, I opted for natural and biodegradable ingredients, even though they may be more expensive, such as packing peanuts that dissolve in water. By doing so, we ensure that our products break down safely and do not leave a lasting impact on the environment.

Applying Principles Learnt from Chemical and Process Engineering:

The principles that I leverage in my beauty business are a direct application of the key concepts I learned during my BSc in Chemical and Process Engineering. Areas such as batch process optimization, material selection, chemistry, process safety, quality control, environmental sustainability, and continuous improvement and innovation have proven to be invaluable in driving the growth and success of my operations.

Through utilizing batch manufacturing based on consumption demand and process optimization techniques, I can streamline production, reduce waste, and improve overall efficiency. By understanding material chemistry, I'm able to make informed decisions regarding ingredient selection and compatibility. Adhering to process safety and quality control principles ensures the safety, integrity, and consistency of our beauty products.

Our commitment to environmental sustainability is reflected in our strategic vendor alliances, resource optimization efforts, and use of eco-friendly packaging materials. Moreover, my passion for continuous improvement and innovation drives ongoing enhancements in our product development and sustainability practices.

Promoting Ethical Ingredient Sourcing:

The basis of our business model prioritizes sustainable ingredient sourcing, avoiding harmful substances, and ensuring cruelty-free practices, including avoiding any animal testing. This commitment has led us to establish strong partnerships with suppliers who share our dedication to sustainability. By taking these measures, we ensure that our products do not contribute to deforestation, habitat destruction, or harm to wildlife. Furthermore, we provide customers with eco-conscious products that align with their personal values, delivering high-quality products while contributing to the preservation of our precious ecosystems.

Minimizing Product Packaging Waste & Collaborating for Change:

I have proactively implemented sustainable packaging solutions, opting for eco-friendly non-plastic materials that are recyclable or made from recycled sources. Through these measures, we aim to

Embracing Sustainability: A Chemical Engineer's Transition from Oil & Gas into a Niche Beauty Business

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reduce single-use plastic consumption while maintaining the beauty industry's aesthetic appeal. Our commitment to collaboration drives meaningful change. We prioritize partnerships with manufacturers and service providers committed to energy efficiency, waste reduction, and minimizing their ecological footprint. By sharing knowledge, resources, and best practices, we can collectively create a more sustainable and environmentally responsible beauty industry. Additionally, I actively seek partnerships with organizations that align with our values, supporting initiatives such as tree-planting programs for every product sold and striving towards carbon neutrality.

Motivation, Risk & Rewards:

My entrepreneurial journey was one of profound self-discovery, fueled by a burning desire to create a healthy, balanced work environment, rather than being driven solely by financial gain.

However, from a financial perspective, I was mindful of the risks involved, given my risk-averse nature. I had diligently allocated 5-10% of my monthly salary to an "opportunity fund," which allowed me to confidently fund my passion-driven business from personal savings without succumbing to immediate financial pressures.

It's critical to recognize that profitability may not be immediate and that achieving success requires

time, dedication, and the willingness to cultivate new skill sets.

Inspiring Change:

In the words of Gandhi, "Be the change you wish to see." I firmly believe that the responsibility for a sustainable future lies with each individual. By supporting businesses that prioritize sustainability and making conscious purchasing decisions, I think we can collectively create a positive impact on our environment. Use this article to embrace sustainability in your daily lives and become catalysts for change, creating a greener and more sustainable world for future generations.

By fostering a profound understanding of the impact of our choices and actions, I believe we can collectively create a ripple effect of positive change, fostering a future that harmonizes with the well-being of our planet and all living beings. Let us come together to create a more sustainable and conscious world for generations to come.

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ICHEME TTMG

2023 Events Recap



ANNUAL KICK-OFF EVENT (VIRTUAL)

On March 9th, the IChemE TTMG Annual Kick-Off Event was held via Microsoft Teams. The event kicked off with an entertaining short movie, where the TTMG Chair, Canute Hudson, called on the *TTMG Task Force*, a.k.a. the newly elected Management Committee, to assemble for their 2022-2024 term. The team's mission is to continue to let IChemE TTMG be the conduit through which IChemE's strategy is executed in Trinidad and Tobago, with this year's focus areas being Process Safety and Sustainability. This set the stage for an eventful and informative session, where planned events for the upcoming year were presented and an interactive game session was conducted.

9
Mar



MASTERCLASS: DESIGN OF EXPERIMENTS (DOE) AS AN OPTIMIZATION TOOL IN INDUSTRY AND FORMULATION SCIENCE WEBINAR

On March 23rd Dr. Akeem Mohammed joined us for our first ever masterclass where we deep-dived into the use of Design of Experiments (DOE), a powerful tool in modern day research and industry. The class will cover the background, uses and basics of DOE and how it could be applied to industry, and research and development as a means to save time and resources while getting faster time to market, lower development costs, lower operating costs, increased quality control, and more. The audience was engaged and very enthusiastic! We look forward to more of these masterclasses where we bring new tools and software to our IChemE TTMG group.



23
Mar

APPLYING THE CAPITAL VALUE PROCESS TO ENGINEERING WEBINAR

The Technical Training and Mentorship (TTM) committee hosted a webinar on the Capital Value Process on 27th April 2023, by Mr. Mark Baldeo, lead project management consultant with Arkulus Solutions. Here, the IChemE TTMG membership got expert guidance into introductory aspects of project management, the five stages of CVP, as well as "rules of thumb" on the typical deliverables process engineers should focus on at each stage of our projects. This content was a key first step in the TTM's plan to provide insight and knowledge from industry experts on the more novel aspects of our field, that process engineers may encounter on a day to day basis. We look forward to providing even more engaging sessions as we move into 2024.

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Apr



2023 Events Recap



INTERNATIONAL WOMEN IN ENGINEERING DAY (INWED) PANEL DISCUSSION

22
Jun

On the 22nd June, 2023, IChemE TTMG welcomed an esteemed panel of outstanding female leaders from various sectors, in honor of “International Women in Engineering” Day. Ariana Emanuel, Supply Chain Manager at Shell Norco Facility; Cassandra Dewan, Audit to Optimize Engineer at SLB and Jaime-Ann Babwah, Head Technical Services at PPGPL, touched on topics such as psychological safety, safety culture and sustainability. These topics were aligned to the INWED theme for 2023, “Making Safety Seen”. Our audience had the opportunity to engage with the panelists and benefited from their invaluable insight, such as their advice to less experienced engineers entering the job market.



UNDERSTANDING DATA SCIENCE AND MACHINE LEARNING

Kevan Rajaram, Director of Data Services at PwC, a lead Data Scientist in the fields of Mathematics, Statistics and Economics, gave insight into how data manipulation can be applied to structured and unstructured data. He also brought light to machine learning as a subfield of Artificial Intelligence, as it focuses on developing algorithms and models that allows computers to make decisions and predictions. This discussion, though not within the typical realm of Chemical and Process Engineering, allowed our members to appreciate the impact that Data Science and Machine Learning can have across various industries, thereby broadening our outlooks and perspectives.

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Aug



A PROCESS SYSTEMS ENGINEERING APPROACH TO FLEXIBLE PROCESS DESIGN AND DISTRIBUTION

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Sep

On the 26th September, 2023, IChemE TTMG, in collaboration with The University of the West Indies, St. Augustine Campus, was honoured to host Dr. Maria Papathanasiou who delivered an amazing, in-person, technical seminar, at the University of the West Indies! Dr. Papathanasiou is an esteemed Senior Lecturer (Associate Professor) at the Department of Chemical Engineering, Imperial College London. She shared knowledge on how computer-modeling can enable adaptive process design, sustainable operation and optimal process performance, harnessing the power and economical sustainability of computer-based experiments within pharmaceutical and energy systems. Participants were exposed to various applications of Chemical and Process Engineering and gained an appreciation for how it can be applied in different industries. Participants had the opportunity to mix, mingle and network after the technical seminar.

ICHEME TTMG

2023 Events Recap



STUDENT OUREACH SESSIONS AT THE UNIVERSITY OF THE WEST INDIES (UWI) ST. AUGUSTINE CAMPUS AND THE UNIVERSITY OF TRINIDAD AND TOBAGO (UTT) POINT LISAS CAMPUS

04
Oct

On the 4th October, 2023, the IChemE TTMG team completed Student Outreach Seminars at both UWI and UTT. Dr. Jeffery Smith, the IChemE TTMG UWI representative, hosted a hybrid in person/virtual session at the University of the West Indies. Management Committee Chairperson, Judith Armorer, and Steering Committee Chairperson, Canute Hudson, led the session. Mere hours later, NFSR Subcommittee lead, Renisha Hercules, and past Treasurer Wayne Mohan, led a student outreach session at the University of Trinidad and Tobago. Dr. Marian Watson kindly facilitated this hybrid session at UTT. These sessions addressed areas such as the benefits of becoming a member of IChemE, the benefits of volunteering with IChemE Trinidad & Tobago Member Group and upcoming events and areas to get involved such as volunteering, mentorship, & networking.



Student Outreach at the University of the West Indies & the University of Trinidad & Tobago

A Process Systems Engineering Approach to Flexible Process Design and Distribution



Thermal Pyrolysis: Converting Waste Tyres into Energy

by Aaron A. O'Neal, Sherice Allaham, Suzette Kolahal, Kareema Hosein

B.A.Sc. Process Engineering, Process Engineering Programme, University of Trinidad and Tobago (UTT)

This article is based on a Final Year Design Project done in support of the UTT BASc Process Engineering programme.

Approximately 3 million tyres are imported into Trinidad and Tobago annually due to the absence of a local tyre manufacturing plant. As a result, 1-1.5 million scrap tyres are generated each year^[4], contributing to around 210,000 tonnes of commercial waste that is sent to landfills^[3]. The lack of proper tyre recycling procedures leads to the burning of most of this waste, causing severe environmental and health consequences for humans and animals.



Figure 1: Burning of tyre waste in Trinidad and To-

The thick smog resulting from tyre burning exacerbates health conditions such as asthma, sometimes even leading to death (Figure 1).

To address this issue, thermal pyrolysis can be employed to reduce tyre waste and establish a circular economy. This process utilizes high temperatures in the absence of oxygen to convert end-of-life tyres into carbon black, synthesis gas and pyrolytic oil. These components can then be reused in the tyre manufacturing process (Figure 2).

A thermal pyrolysis plant, designed using the Aspen HYSYS (v10) software, aims to convert waste tyres into alternative forms of energy (Figure 3).

Based on our design, a 10 m³ waste tyre pyrolysis plant can process 1-2 tonnes of waste tyres per

day. It can produce approximately 115 kg of pyrolytic oil, 20 kg of carbon black, and 475 kg of synthesis gas from processing 1 tonne of isoprene, the primary component in automobile tyres. The plant demonstrates a 51.84% internal rate of return (IRR) and a net present value (NPV) of US\$69,965,197, with a capital expenditure of US\$3,627,315 over a 10-year period.

This sustainable process offers various environmental, social, and economic benefits:

Environmental:

- Recycling tyres reduces the overall quantity of waste in landfills.
- Emissions from tyre burning are minimised as the process occurs in an inert environment - without oxygen.



Figure 2: Pictorial representation of tyre conversion in the pyrolysis process.

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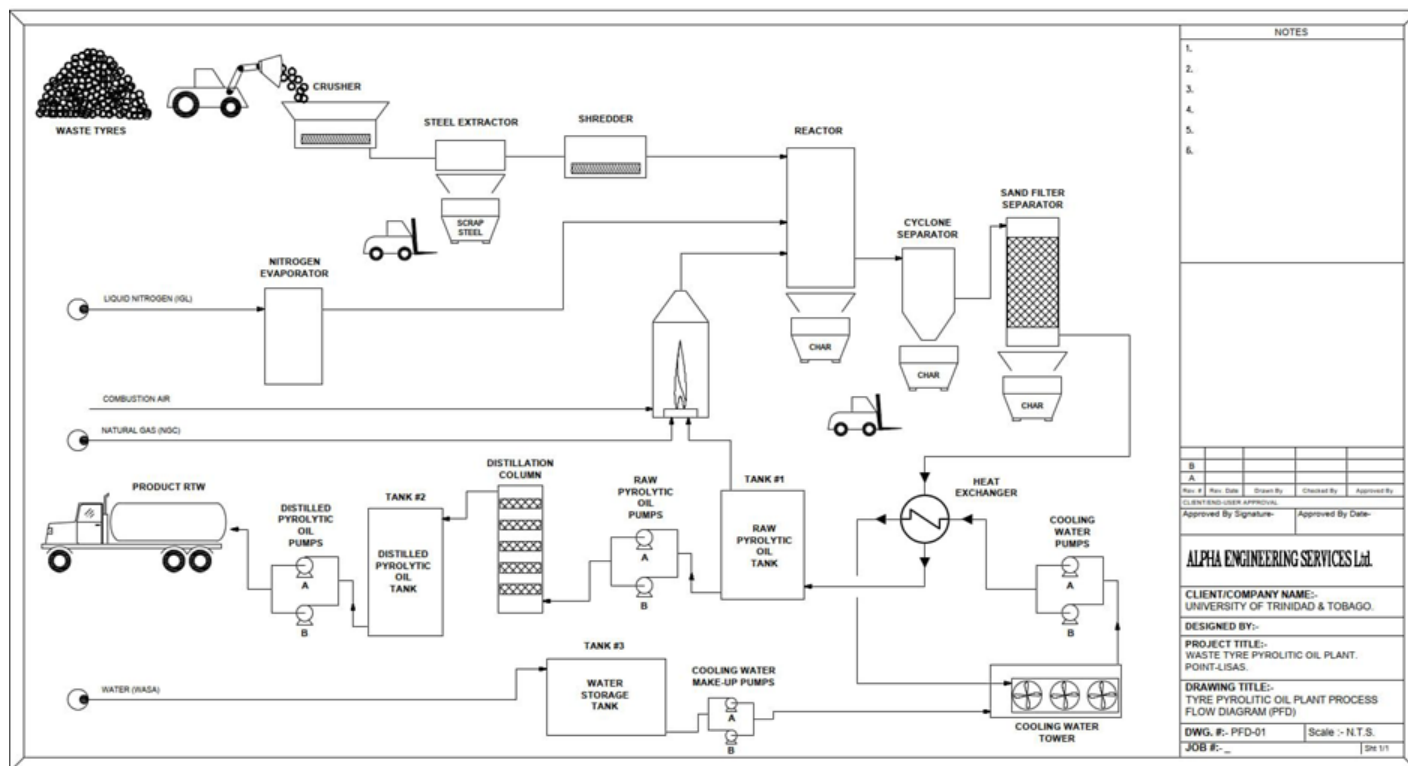


Figure 3: Process Flow Diagram of Tyre Pyrolysis Process.

Social:

- Employment opportunities are created for the local and wider community, such as scrap iron dealers and neighbourhood tyre collectors.

Economic:

- The circular economy is promoted as all products obtained from the process are reused, reducing the dependence on raw material exploration.
- Scrap metal extracted from tyres can be sold to scrap iron dealers.
- Carbon black has multiple applications as pigment, filler in rubbers, a component in road paving, as well as in the production of activated carbon [5].
- Uncondensed syngas is recycled back to the

reactor furnace as an additional energy source, making the system more self-sufficient.

- Pyrolytic oil can be further distilled and used as a fuel additive in domestic and commercial applications [6].

By reusing the plant's products in the manufacturing of styrene-butadiene rubber - a major raw material in the tyre manufacturing process, the tyre manufacturing process can now become a sustainably supplemented recycle loop.

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Wayne Mohan, FIChemE (Process Safety)

Process Safety Discipline Manager, Heritage Petroleum Company Limited

For those who may not know, who is Wayne Mohan?

I grew up in Couva, having the time of my life with my two awesome brothers, and I attended the Couva Government Secondary School; those were the good old days, full of fun and unforgettable memories.

I love travelling, seeking new adventures, and exploring the great outdoors; I particularly like visiting South America because the culture is friendly and unique. Here's a funny twist, I wasn't a fan of Spanish during my school days, but life has its surprises! I fell in love with an incredible person from Colombia, so I had to learn the language for love.

Family means the world to me, and I'm blessed with four wonderful children. Three have already grown into amazing adults, while my youngest is a spirited 16-year-old who is competitive at everything and who presently holds the 2nd place position for the National Chess Champions in Trinidad and Tobago. And here's a little secret - I'm a huge movie enthusiast! Going to the cinema and getting lost in captivating stories is my idea of a relaxing time.



What is your current role in Heritage, and what roles did you hold prior to this?

I am the Process Safety Discipline Manager at Heritage Petroleum Company Limited, where I successfully implemented the OSHA 1910.119 Process Safety Management System across multiple business units.

Before that, I was the Head of Process Safety at the Petroleum Company of Trinidad and Tobago (Petrotrin), where I was entrusted with building the Process Safety Management system for the refinery. It is at this company where my professional journey began, but back then, it was called the Trini-

dad and Tobago Oil Company (Trintoc).

Taking a significant step toward my Process Safety journey, I had the incredible opportunity to work as a Process Safety Consultant for Saudi Aramco and Total in Saudi Arabia. Prior to that, my career path led me to the Process Improvement field, working with Shell Global Solutions. There, I was actively involved in driving Petrotrin's process improvements and auditing operational processes, contributing to the organisation's overall efficiency and effectiveness.

Furthermore, I would have worked in various senior positions

within refinery operations. My involvement in the operation and maintenance of several refinery processing plants has provided me with valuable insights and hands-on experience that shaped my expertise in the process safety field.

What is one interesting fact about you?

An interesting fact about me! I absolutely love magic, and I've been practising it since I was just 14 years old. It's been such an amazing journey, filled with wonder and excitement. I've spent countless hours honing my skills, mastering various illusions, tricks, and sleight of hand. It's like step-

Wayne Mohan, FIChemE (Process Safety)

Process Safety Discipline Manager, Heritage Petroleum Company Limited

ping into a world of mystery and captivating the audience with every performance. The thrill of magic never gets old, and I love sharing my mesmerising tricks with others. It's a creative and fascinating side of me that brings joy to myself and those who experience the magic first-hand! I have incorporated a few sleights of hand during some training, and that broke the ice making people more interactive in discussions and thus improving the learning process.

Why is Process Safety important within the energy industry particularly?

The application of process safety is critical in the energy industry due to the inherent risks associated with handling and processing hazardous substances such as oil, gas, and chemicals. The energy industry employs complex processes that involve high-pressure systems, flammable materials, and complex equipment. Neglecting process safety could result in devastating incidents such as explosions, fires, and toxic releases, resulting in loss of life, severe injuries, environmental damage, and massive financial losses.

Prioritising process safety can help businesses prevent accidents, protect workers, and protect communities and the environment. Implementing robust safety management systems, thorough risk assessments, continuous monitoring, and regular training ensures a culture of pro-

cess safety and risk awareness. Adhering to strict process safety standards prevents disasters and fosters public trust, regulatory compliance, and long-term operations. In the energy industry, where the stakes are high, process safety is an unwavering commitment to protecting people, assets, and the environment.

What drew you to this field?

The profound sense of responsibility and the opportunity to make a real difference drew me to the process safety field. While working in operations, I became more aware of possible catastrophic incidents due to poor decisions. People take risks; things can go wrong even with the best intentions.

The complexities and challenges of ensuring the safety of intricate industrial processes involving hazardous materials captivate me. That is why I became a Chartered Process Safety Engineer, followed by obtaining the Professional Process Safety Accreditation from the Institution of Chemical Engineering (IChemE), but I still wanted more, which is why I recently obtained the status of Fellow in Process Safety. I was the first in Trinidad and Tobago to gain these credentials; my passion, work ethic, and willingness to learn are my drivers to become the best I can be in the process safety profession.

What is the most meaningful part of your job?

The most rewarding aspect of my job is knowing that my efforts directly affect the well-being and safety of countless people. As a process safety professional, I take great pride in being a process safety guardian in the energy industry. Knowing that my efforts help to prevent accidents, save lives, and protect the environment gives me a deep sense of fulfilment and purpose in my daily work. Every technical risk assessment, safety protocol implementation, and continuous improvement initiative has a larger purpose that extends beyond the office walls. It is gratifying to see the positive outcomes of the process safety measures, which ensure that operations run safely, while putting everyone's health and safety first. The cornerstones of my role are fostering a process safety-centric culture and promoting a proactive approach to risk management, and knowing that my contributions make a significant difference is the most rewarding and meaningful aspect of my job.

The industry is changing, and so might the role you play in it. Where do you see yourself in 5 years?

Because the industry is constantly changing, our roles also change. It is critical to remain flexible and forward-thinking. So, where do I see myself in the next five years? As a professional, I

Wayne Mohan, FIChemE (Process Safety)

Process Safety Discipline Manager, Heritage Petroleum Company Limited

strive to be at the forefront of this ever-changing field. I see myself as a process safety leader, spearheading innovative initiatives and establishing higher safety standards. It all comes down to making a significant difference in the industry's safety culture and practices. I see myself constantly growing and learning, keeping up with recent advancements and best practices. My goal, whether as a leader or as an expert consultant, is to contribute to a safer and more resilient energy industry. I'm excited about the future, and I can't wait to help shape it for the better.

What advice do you have for recent/future graduates hoping to enter the field of Process Safety?

I advise recent or future graduates who want to work in Process Safety to embrace continuous learning and seek relevant experiences. Begin by laying a solid foundation in engineering or a related field. Learn about industry standards, regulations, and best practices for process safety. Internships can help you gain hands-on experience in real-world process safety scenarios. Networking with industry professionals can provide valuable insights and potential career opportunities.

Keep an open mind and be curious, as the field is constantly evolving with new technologies and methodologies. To stay up to date on the latest trends, look for opportunities to participate in safety-related workshops, seminars, and conferences.

Above all, keep in mind that process safety is about protecting both people and the environment. You'll need strong communication and teamwork skills because you'll be working with a variety of teams. Accept every learning opportunity, be proactive, and demonstrate your commitment to making the world a safer place. You can carve a rewarding and impactful career in process safety with dedication and a commitment to safety excellence.

Throughout your career, have there been any process safety events that left an impression on you or influenced your thinking?

While there have been many process incidents, the Bhopal incident was one of the process safety events that left a lasting impression on me and significantly influenced my thinking. Understanding the devastation caused by that tragedy has highlighted the critical importance of process safety in industrial operations. It

serves as a stark reminder of the potentially disastrous outcomes when safety protocols are not prioritised or diligently followed. The Bhopal disaster¹ taught me the invaluable lesson of the far-reaching consequences of a single safety lapse on human lives, the environment, and communities. It has reinforced my commitment to promoting a process safety-first mindset and implementing stringent measures in all aspects of my work. Learning from this and other events, I am more committed than ever to making a positive difference in the industry through proactive risk management and fostering a strong process safety culture. My goal is to transform Trinidad and Tobago's process safety landscape.

How can Process Safety Engineers contribute to a Learned Society? (ref: <https://www.icheme.org/strategy/aims/aim-2/>)

Process safety engineers are critical contributors to a learned society such as the Institution of Chemical Engineers (IChemE). We can improve industry safety knowledge and practises by actively participating and sharing our expertise. Participating in the Learned Society's knowledge-sharing events, conferences, and

¹ The Bhopal Incident is widely considered the worst industrial disaster in history. On December 3, 1984, a pesticide plant in Bhopal, India released approximately 40 tonnes of highly toxic methyl isocyanate (MIC) into the atmosphere. There were thousands of fatalities, hundreds of thousands of injuries, as well as long term health, environmental, and economic impacts. Read more at [Bhopal - The Worst Industrial Disaster in History - English | AIChE](#).

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workshops is one important way. Process safety engineers can share case studies, research findings, and best practices to promote a culture of continuous learning and improvement.

Process safety engineers can exchange ideas, address challenges, and collectively drive advancements in safety technologies and methodologies by collaborating with other professionals. Active participation in technical committees and working groups within the Learned Society increases their impact.

Process safety engineers can also mentor and guide early-career professionals, passing on their knowledge and experiences in order to shape the next generation of safety leaders. They can make such contributions to raise safety standards, promote collab-

oration, and make the industry safer and more resilient.

Are there any resources you frequent, such as websites, books, or standards, that you'd like to share with our readers who may be interested in learning more about process safety?

There are several valuable resources that I frequently refer to for those interested in learning more about process safety. The Institution of Chemical Engineers (IChemE) is a great place to start; they also have valuable resources, such as technical papers, webinars, and industry standards related to process safety. Their Safety Centre is an excellent source of information.

The American Institute of Chemical Engineers (AIChE) has established the Centre for Chemical Process Safety (CCPS). They al-

so provide a wealth of process safety publications, guidelines, and best practices.

Furthermore, the Occupational Safety and Health Administration (OSHA) website provides extensive information on process safety regulations and guidelines.

Highly recommended books include "Chemical Process Safety" by Daniel A. Crowl and Joseph F. Louvar, "Introduction to Process Safety for Undergraduates and Engineers" by Edward M. Marszal, and "Guidelines for Risk Based Process Safety" by the Center for Chemical Process Safety (CCPS).

These resources provide valuable insights and knowledge to improve process safety understanding and practice, making them essential references for anyone interested in delving deeper into the field.



TO WAYNE MOHAN FOR HIS APPOINTMENT TO THE GRADE OF PROCESS SAFETY FELLOW WITH ICHEME

Process Safety and Asset Integrity Management for Ageing Facilities

by Rae-Ann Joseph, Team Lead–Process Safety, Atlantic LNG

The typical design life expectancy for a facility ranges between 20-35 years. However, actual operating life may be shorter due to factors such as operation and maintenance of equipment outside of recommended practices and ageing. Ageing is the effect whereby an asset suffers some form of deterioration to a material extent, with an increasing likelihood of failure over its lifetime. If the deterioration goes undetected, or is not addressed in a timely manner, this has the potential to render equipment unfit for purpose and can affect its functionality, availability, reliability, and safety and in-

troduce new risks to a facility's operation.

A study of major hazard incidents across Europe between 1980 and 2006 showed roughly 60% of the incidents were related to loss of technical integrity and 50% of those were attributed to ageing plant mechanisms such as erosion, corrosion, and fatigue.

Figure 1 provides a breakdown of these incidents and highlights two top causes: mechanical failures due to corrosion and erosion, and electrical, controls and instrumentation (EC&I) related failures.

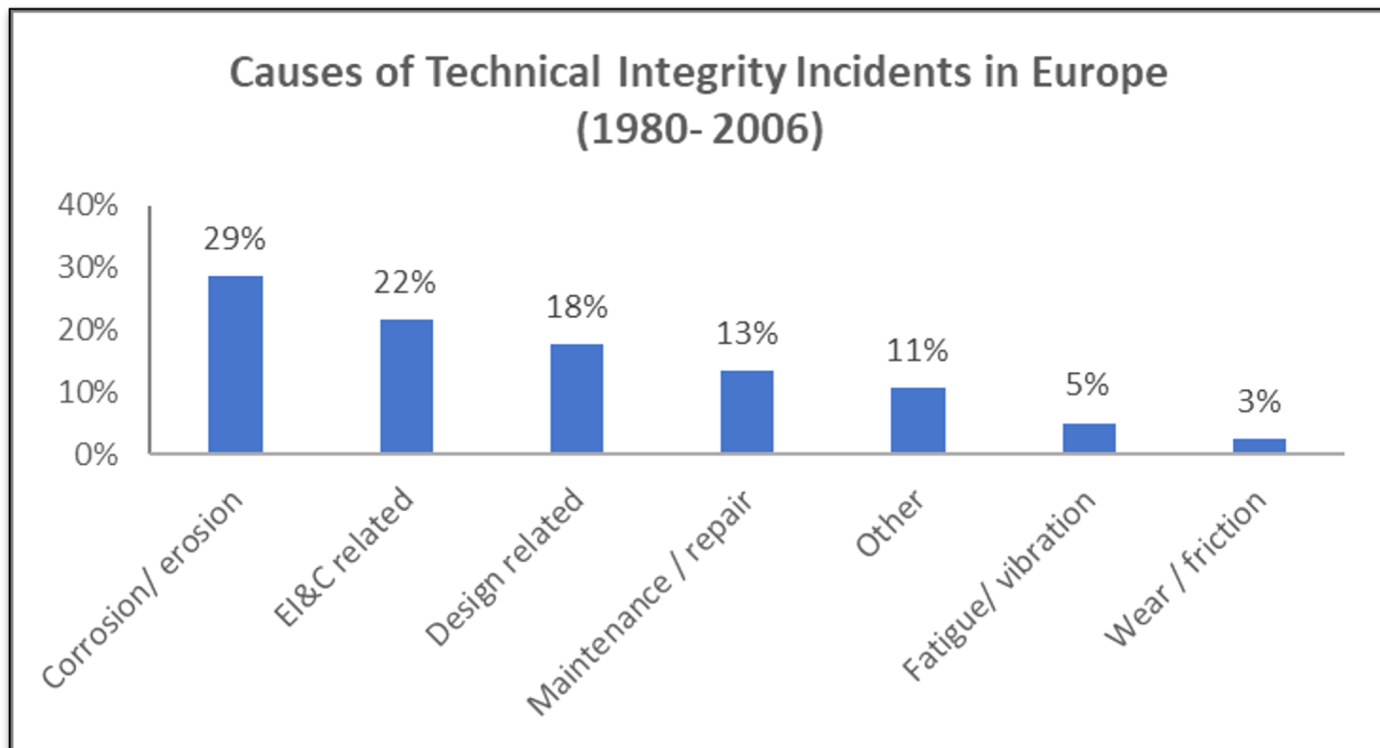


Figure 1: Breakdown of Causes for Technical Integrity Incidents¹.

Listed below are some examples of ageing mechanisms that may be encountered on a mature operating facility:

- External corrosion primarily due to coating failures under insulation and in susceptible locations e.g., under pipe supports, and fire-

proofing. There are a variety of corrosion mechanisms some of which occur more frequently than others e.g., localized corrosion such as pitting, environmental cracking and fretting.

- Obsolescence and failures in obsolete instrumentation e.g., transmitters

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- Cyclic stresses and fatigue in machinery and structures.
- Recurring leaks on valves, instrument fittings and connections.

While ageing is inevitable, the risk can be counteracted using robust maintenance, inspection, and asset integrity strategies to ensure integrity of a facility's assets and fitness for service throughout its lifecycle. As a facility matures, risk management strategies and mechanical integrity programmes must also evolve to reflect the current and future needs of the operation. These strategies must consider several factors, including²:

- Inherent hazards of the operation.
- Technical integrity risks that may arise during design, installation, and operation.
- Susceptibility to ageing-related deterioration or damage.
- Types of ageing mechanisms for various categories of equipment
- The extent to which ageing is being effectively managed.

A facility must develop and implement plans for ageing assets in its strategic objectives. In 2020, Atlantic LNG developed long-term maintenance and asset integrity management plans for each of its trains to identify key activity drivers, required resources and budgets for equipment and disciplines to address key operating threats and opportunities over a five-year cycle. These plans include major projects such as upgrades for obsolescent equipment, equipment overhauls, special maintenance campaigns and evergreen fabric mainte-

nance campaigns which can be executed during planned shutdowns or online where it is safe to do so.

To help drive these plans, management also needs to innovate and explore the use of available technology to find solutions. The use of digitalization tools such as Power BI dashboards, artificial intelligence (AI), machine learning to predict equipment failures and specialized tools or software for risk management, corrosion management and fabric maintenance should be applied to innovate, drive continuous improvements, and facilitate cumulative risk analysis and reviews.

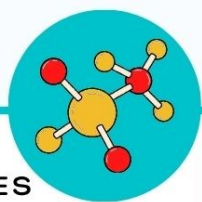
It is important for operating facilities personnel to be proactive and vigilant in efforts to identify and manage potential hazards and ageing mechanisms, and then strategically address concerns using robust and agile processes for risk identification, asset integrity, operating and maintenance to ensure safe continued operation of facilities for its lifetime.

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THE LOOK AHEAD

NOVEMBER 2023 INTO
MARCH 2024



GET CHARTERED SERIES

In October 2023, Part 1 of a three stage series on the Chartership Application Process was held. Join us for Stages 2 & 3 which will be held in November 2023. Attendees will benefit from a detailed description of the application process for Chartership, presented by IChemE's Global team.



UNDERSTANDING LOPA WEBINAR

This webinar will provide a discussion around the key constituents of LOPA and how the application of the LOPA process can be used to determine if there are sufficient layers of protection against an accident scenario in the process industry.



END OF YEAR MIXER (DECEMBER)

The NFSR Committee will be hosting an in-person end-of-year mixer. We look forward to mixing and mingling with our members in a casual setting. Come unwind, meet the committee and other professionals from the community.



MENTOR-MENTEE PROGRAMME LAUNCH (JANUARY 2024)

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.

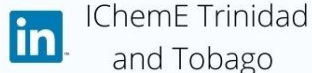


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The Green Hydrogen Transition for the Ammonia Industry in Trinidad and Tobago

by Jaden Brereton, BSc. Chemical and Process Engineering

Introduction

Trinidad and Tobago (T&T) is home to a lucrative ammonia industry dating back to 1959, with first operations ran by Federation Chemicals Limited which was acquired by Yara Trinidad Limited (Ministry of Energy & Energy Industries 2023). These plants are situated on the Point Lisas Industrial Estate and require sufficient power to ensure that all their processes function efficiently. At present, the ammonia plants make use of T&T's natural gas networks to power their operations. Whilst natural gas presents itself as a clean burning fuel, more sustainable alternatives such as renewable energy sources need to be sought.

In doing so, we can begin the process of achieving an environmental reset, one we desperately need amidst the high concentration of greenhouse gases (GHG) that currently plague our atmosphere. In alignment with the United Nations 2030 Agenda for Sustainable Development, T&T has pledged its commitment to reduce its emissions by 15% by 2030, particularly in the transportation, electricity generation and industry sectors (United Nations 2022). One way of ensuring that this initiative can be achieved is through the use of green hydrogen

as a renewable feedstock in the ammonia manufacturing process.

Hydrogen is a common feedstock utilized in the petrochemical industry, for processes such as crude oil refining and in the production of ammonia and methanol. However, hydrogen can be characterized in a spectrum based on how it is produced. Three such categorizations of hydrogen are grey hydrogen, blue hydrogen and green hydrogen.

Grey Hydrogen

This type is produced through the steam reformation process, where natural gas with the assistance of steam undergoes a conversion, resulting in a by-product of carbon dioxide (see Figure 1). Its categorization as "grey" is given due to the consumption of fossil fuels and the release of carbon dioxide in the process (Deloitte 2021).

Blue Hydrogen

This type is produced via the steam reformation process, but utilizes carbon capture technology to mitigate the environmental effects of the eventual carbon dioxide emissions (see Figure 2). Though

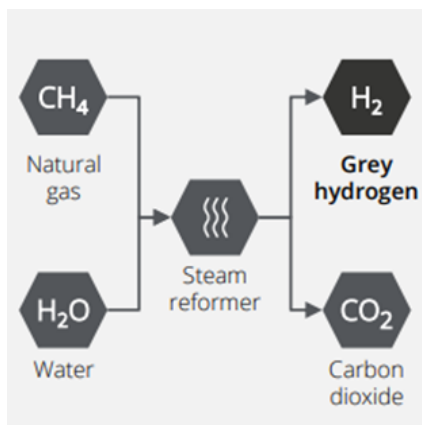


Figure 1: Grey Hydrogen Production Line Diagram (Deloitte 2021).

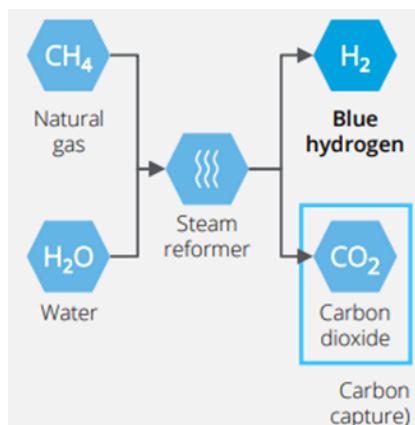


Figure 2: Blue Hydrogen Production Line Diagram (Deloitte 2021).

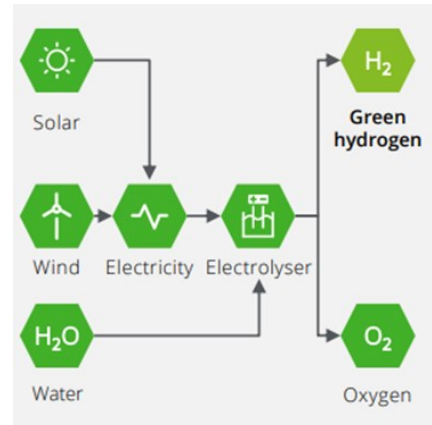


Figure 3: Green Hydrogen Production Line Diagram (Deloitte 2021).

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the process is still fossil fuel dependent, inclusion of the carbon capture process allows for the capture of 90-95% of carbon dioxide emissions (Deloitte 2021).

Green Hydrogen

This type of hydrogen is produced through the electrolysis of water, where an electric current is applied to break water molecules into its constituents hydrogen and oxygen (see Figure 3). Electricity generated from renewable sources must be used. The hydrogen produced is considered "green" due to no usage of fossil fuels and no emissions of carbon dioxide in the process (Deloitte 2021).

Rationale

At present, the ammonia plants make use of grey hydrogen for their feedstock (see Figure 4), which is carbon intensive. In Trinidad, a carbon management study conducted by the University of Trinidad and Tobago (UTT) estimated carbon dioxide emissions of 40 million metric tonnes for the country, with eight million metric tonnes emanating from ammonia plants (Ministry of Energy and Energy Industries 2023). This drives the need for an alternative approach to be taken to help curb the carbon emissions from the ammonia industry - the incorporation

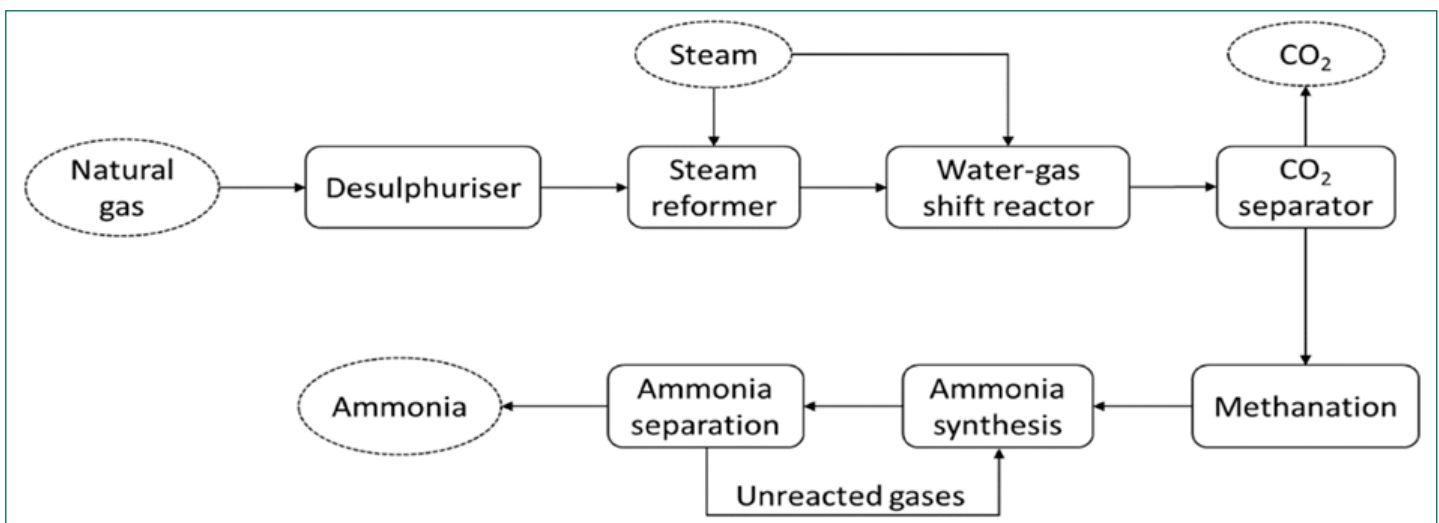


Figure 4: Grey Ammonia Production Process.

of green hydrogen as feedstock encourages this (see Figure 5).

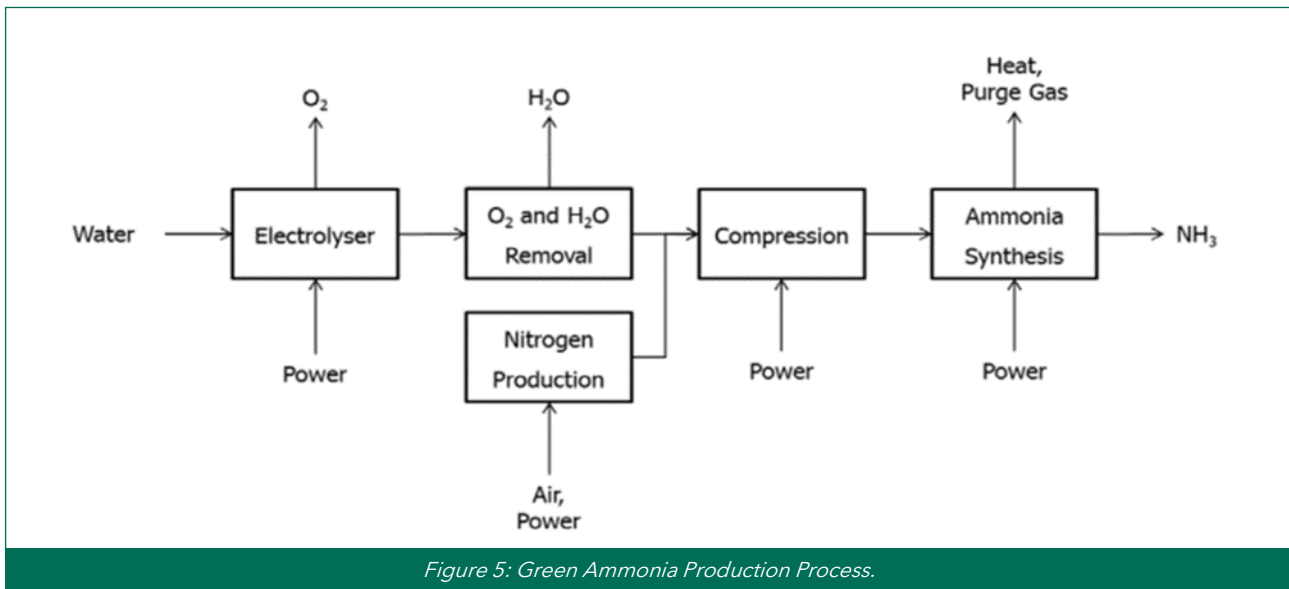
Ammonia plant operators globally have already begun thinking of ways in which they can reduce their emissions from their operations. In doing so, it is critical that the transition does not impact plant reliability and yield. Companies such as the Avaada Group have expressed their interest in setting up a green ammonia facility in Rajasthan, India, with an expected production capacity of one million tonnes per annum. In addition to this, Unigel, a Brazilian

chemical company, has also begun construction on a green hydrogen/ green ammonia plant in Bahia. It is expected that the construction of this plant be completed in 2023, and will result in the production of 40,000 tons of green hydrogen and 240,000 tonnes of green ammonia by 2025 (Blain 2022).

These upcoming projects provide a scope as to the potential of green ammonia. However, in certain cases, a complete transition to the production of green ammonia may not be feasible due to market conditions. Instead, a hybrid approach can be

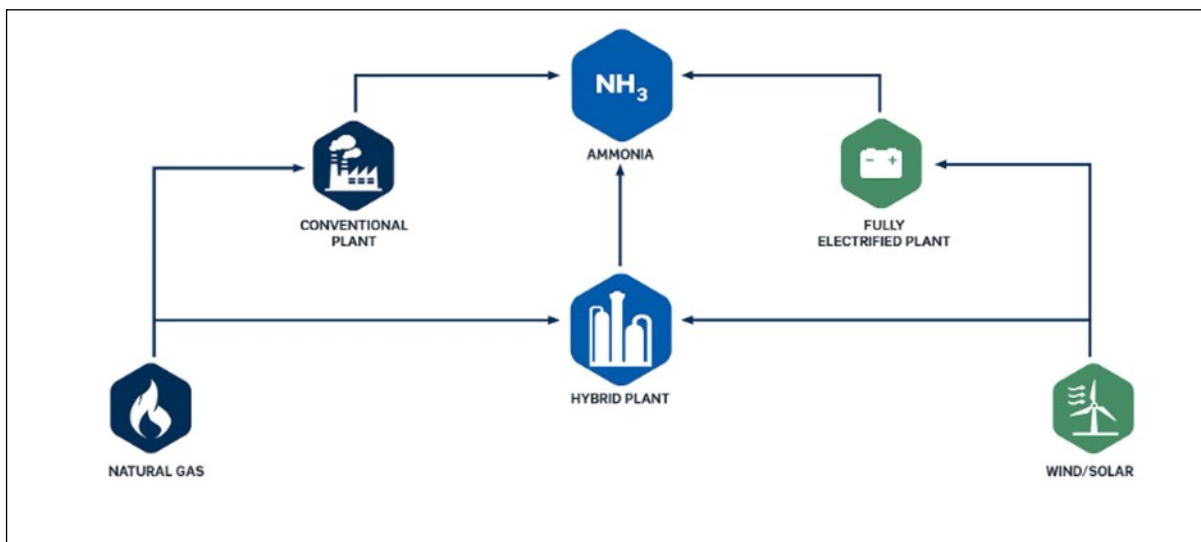
The Green Hydrogen Transition for the Ammonia Industry in Trinidad and Tobago

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adopted during the transition, where currently existing ammonia plants can be retrofitted to provide both ammonia and green ammonia. With the use of a patented technology developed by the company Topsoe, existing operations can be altered to incorporate water electrolysis, producing 10% green ammonia, with limited changes (Topsoe 2022) (see Figure 6). By adopting this approach, current production capacities can be sustained whilst maintaining interest in the transition to sustainable alternatives.

T&T has room for this hybrid approach in our transition to more sustainable petrochemical operations. This initiative can be introduced through a pilot project set up at one of our existing ammonia facilities. In 2022, The Ministry of Energy and Energy Industries (MEEI) published a roadmap for a Green Hydrogen Economy in T&T. This roadmap gives an overview of the potential that T&T has for making use of hydrogen in industry to achieve our decarbonization goals. Due to the dire need for global decarboniza-



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tion, the transition to the use of green hydrogen is considered unavoidable, as it would only serve as a benefit for difficult-to-abate sectors of carbon emissions.

At present, the country is moving forward with the key items put forward in its Green Hydrogen Roadmap. These plans have been split into three (3) horizons for execution on the road to a hydrogen economy, based on a thirty-five (35) year development plan. However, to achieve these goals, significant investment would be necessary in the upstream development of the hydrogen value chain, along with expansion of existing petrochemical infrastructure (National Energy Corporation of Trinidad and Tobago 2022).

Outside of the GORTT, other entities are making waves within the hydrogen sector for the generation of cleaner hydrogen. Key players have been in continuous discussion for the facilitation of a hydrogen project. This project will bring on stream Trinidad and Tobago's first clean hydrogen production facility, and is expected to have a capacity of 27,000

MTPA. Most recently, this project achieved a milestone arriving at the tender process for the Front End Engineering Design (FEED) and Engineering Procedure and Construction (EPC) phases for construction. This puts T&T as a leader in moving forward with a clean hydrogen transition, being one of the first to arrive at this stage. However, this project can only be brought to life, with a reliable source of renewable power. At present in T&T, there are no large scale renewable power sources available. However, there are two notable projects in development. Kenesjay Green Limited (KGL) is the owner and project developer for a proposed US\$300 million NewGen Hydrogen Project in Trinidad and Tobago (energynow 2022), which will produce decarbonized hydrogen via the electrolysis of water utilising low carbon power sources from:

1. The Lightsource BP project, which comprises of two proposals involving a consortium of Lightsource bp, bp and Shell working together to develop two solar installations that have output power capacities of 20MW and 92MW in Trinidad and Tobago (lightsourcebp 2023).

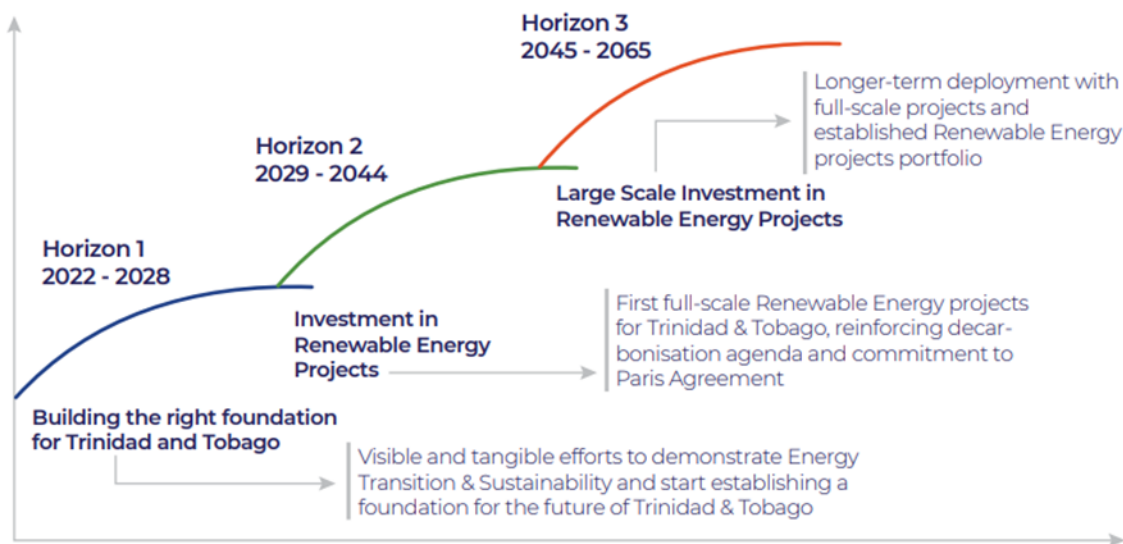


Figure 7: Timeline for Green Hydrogen Roadmap for Trinidad and Tobago.

The Green Hydrogen Transition for the Ammonia Industry in Trinidad and Tobago

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2. Energy-efficient power produced from waste heat (NewGen Energy Limited 2020).

Conclusion

The use of green hydrogen in T&T presents itself as a fruitful venture, and can result in reduced carbon emissions from ammonia production operations. In addition to this, a decline in the usage of natural gas as a feedstock in the ammonia process is anticipated, allowing it to be supplied to other processes and industries in need of a relatively clean burning fuel source.

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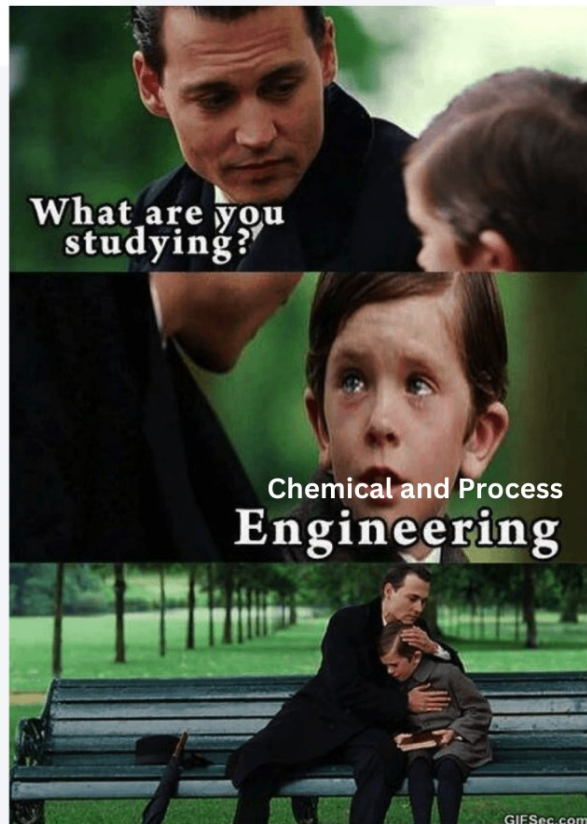
AND I SAY: "I'M A PROCESS ENGINEER"

Brainteaser #1

In front of you are three light switches. Only one does anything - it turns on the light downstairs. From where you are standing, you can't see the downstairs light, and it makes no sound. You must determine which switch operates the light, BUT you can only go downstairs to check it once. How do you figure out which switch is for the light?

Brainteaser #2

You have 2 pieces of rope, each of which burns from one end to the other in 30 minutes (no matter which end is lit). If the two pieces touch, the flame will transfer from one to the other. You cannot assume any properties of the rope that were not stated. Given only 1 match, can you use the ropes to time 45 minutes?



Solutions

#1: Since light bulbs convert electricity into light and heat, you can turn on one switch and leave it for 5-10 minutes so that if it is for the light bulb, it would get warm. Then, do the same for the second switch. Now go and check. If the light is on, then you have determined that the second switch is for the lightbulb. If it is off but hot, then you know the first switch was the one that worked. If it's off and cold (assuming it won't lose its "heat" in the time that's passed), then neither of the first two worked, and the working switch must be the last, un-flicked one.

#2: Place one of the ropes at the midpoint between the other and the light (in a "T" configuration) and then light the end of the "vertical rope". This will allow this entire vertical rope to burn from one end to the other in 30 minutes, and then the other rope to start burning from its midpoint to both ends at the same time, which would be 15 minutes each, resulting in a total 45 minutes of burning time.