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PRESIDENT'S MESSAGE

BUILDING BETTER BUSINESS

REDUCING ENVIRONMENTAL IMPACT

STRENGTHENING NATIONAL CONTRIBUTION

PRESIDENT'S MESSAGE

Embracing Challenges for Continued Success

On August 22, NGC celebrated 43 years of serving Trinidad and Tobago with distinction. We have built a legacy of greatness out of enterprise and unyielding vision, and our staff and retirees all deserve the highest praise for their invaluable contributions.

As we begin another year of service to our country, we are ever mindful of changes in the local energy landscape, and the pressing need to remain relevant as a business. Expectations are high, and stakes even higher, for our Company to demonstrate growth, and indeed, vitality. Our challenge is to produce results with less financial latitude. We at NGC, and the wider NGC Group, have proven ourselves equal to that challenge.

We have realised that making positive impact – not just on our bottom line, but on national development – does not require grand designs or sweeping change. The footprint of small-scale innovations and new investments can be magnified if they are strategically timed and placed.

Within our organisation, there has been much room for process improvement – in how we transact business with customers, how we monitor and manage our infrastructure, and even how we engage our employees. Low-hanging fruit in the form of digital and technological innovation present easy fixes for some of our internal inefficiencies, and we have introduced simple tools which promise great returns.

From a business perspective, while we continue to make progress in our search for new sources of gas, we are also looking further downstream for business opportunities to supplement our earnings. Group subsidiaries National Energy and Phoenix Park Gas Processors Limited (PPGPL) are exploring alternatives such as Cross-Laminated Timber (CLT) and condensate marketing, as well as business niches in the emerging Guyanese energy sector. While these portfolio offshoots may be tributaries to our primary income streams, their contributions will have amplified effect in the context of depleting reserves and depressed product prices.

Our social investments are also allowing us to achieve maximum impact on a national scale at minimal cost. For instance, we have entered into strategic partnerships with entities such as IAMovement and the MIC Institute of Technology (MIC-IT), which will, respectively, help us to build an energy literate and conscious population, and a sustainable steelpan industry. We are also partnering with

Mark Loquan, President, NGC

The University of the West Indies (The UWI) to quantify the carbon sequestered by our reforestation efforts, and our contribution to meeting the national emissions reduction target under the Paris Agreement. The potential gains from these investments extend far beyond the project scopes, and will ripple outward to touch a much larger population than we will directly engage.

Whether it means approaching the way we do business from new angles, or seeking out partnerships and investments with greater resonance, innovating in small ways can effectively trigger broad-based change. In this issue of *Gasco News*, we are pleased to highlight some of the projects we have undertaken or plan to pursue which have bearing on the big picture of business and national development. ■

Mark Loquan

Mark Loquan, President

Leveraging Technology

A Game Changer for Business

Transformative thinking in the digital age must involve leveraging technology to drive change

For over 43 years, NGC has given impetus to Trinidad and Tobago's development and success, on the back of pioneering business models and internationally benchmarked industry technology. Faced with new challenges, the NGC Group has been exploring how innovative tools and Information and Communications Technologies (ICT) can help sustain the momentum of growth for company and country even amidst arresting change.

Over the past few months, the Group has calculated that substantial increments in productivity, efficiency and profits can be achieved by automating processes or simply utilising ICT more effectively. Here are some of the innovations that have had or promise a big impact on the Group's bottom line.

PUTTING DRONES TO WORK

Recreational use of Unmanned Aerial Vehicles (UAVs), commonly called drones, has ballooned in the past few years, as have their commercial applications. These devices – once primarily military gadgets – are becoming cheaper, smarter and more readily available. Many companies have begun to find useful ways to integrate the aircraft into their business processes.

NGC's Geospatial Information Services Department (GISD) saw great potential for drones in its line of work, and lobbied for the Company to trial a small model UAV. In 2016, in a pioneering move for state entities in Trinidad and Tobago, a DJI Inspire 1 quadcopter equipped with a Zenmuse X3 camera was drafted into use at NGC. Piloted remotely by GISD staff, the drone flew 36 'missions' in its first two years, and quickly proved a valuable asset to the Company.

NGC's Geospatial Information Services Department (GISD)saw great potential for drones in its line of work, and lobbied for the Company to trial a small model UAV.

In the past, in order to conduct aerial mapping/surveillance of NGC's Right-of-Way (ROW), facilities or project sites, NGC had to contract external suppliers using helicopters, manned-aircraft or UAVs, at significant cost. For new pipeline projects, engineers relied on decades-old satellite imagery to determine lay of the land and inform pipeline routes. This was supplemented by on-the-ground reconnaissance, which was time-consuming, potentially dangerous and impractical for inaccessible areas. The acquisition of a drone eliminated these problems and made data capture considerably more efficient.

In 2016 and 2017, the quadcopter saved NGC over TT$2.5 million in outsourcing costs related to project monitoring, aerial mapping, videography and photography. ROW maintenance was made easier with the ability to routinely monitor and detect encroachment, landslips or other changes in terrain. Planning for new pipelines or diversions was simplified, consuming fewer man-hours and reducing safety risks.

A truly versatile asset, the drone also profited other business units across the NGC Group. It offered NGC's Corporate Communications Division unique vantage points for photography and videography of facilities and events. It allowed the Company's Health, Safety, Security and Environment (HSSE) Division to provide up-to-date and precise imaging of its infrastructure to the Energy Sector Security Initiative database. The drone was also used to carry out aerial videotaping of a historic compressor move on the Beachfield Condensate Storage and Compressor Facility project, and provides monthly project monitoring on-site. The GISD was even called upon to assist PPGPL with investigation of suspected corrosion on a product storage tank, and National Energy with aerial imaging of the Union Industrial Estate (282 acres).

Drone capture of diversion of 24-inch pipeline from Beachfield to Picton (April 2016)

Also on the GISD's radar for possible future implementation are innovations such as High Definition Laser-Scanning (HDS), Robotic Total Stations, Building Information Models (BIM), Augmented Reality (AR), High Resolution Rendering, Animation and 3D Printing.

On another level, having an in-house drone provided the additional benefit of skills training in a burgeoning field. The GISD's drone operators were able to acquire valuable experience that could in itself become an asset to the NGC Group in the future. Just as private companies can be contracted to do aerial surveillance, the Group may soon be able to market its expertise to deliver this service to other companies in Trinidad and Tobago. In fact, the country as a whole can benefit from this experience – as a state enterprise using the technology, NGC's team was asked to assist in drafting legislation to regulate the use of UAVs in Trinidad and Tobago.

Given the plethora of benefits to be derived from using drones – as evidenced by the quadcopter in its trial run – NGC sees value in procuring a larger model. The Company will soon acquire a 'surveying grade' quadcopter, capable of carrying larger payloads such as infrared cameras, Light Detection & Ranging (LiDAR) sensors and possibly gas detection sensors. This will expand and enrich the suite of services offered by the Company's GIS Department.

Also on the GISD's radar for possible future implementation are innovations such as High Definition Laser-Scanning (HDS), Robotic Total Stations, Building Information Models (BIM), Augmented Reality (AR), High Resolution Rendering, Animation and 3D Printing to produce anything from 3D relief maps to spare parts.

BRINGING PEOPLE CLOSER

For anyone who has seen a young person engrossed in a tablet – nose inches away from the screen and headphones throwing walls up to outside communication – it is easy to conclude that technology and the digital age are isolating. However, with the software and applications that exist today, it has never been easier to connect and communicate.

The NGC Group has been seeking to leverage that potential of technology to bring people together, in order to enhance productivity and build workplace relationships.

Yammer

In August 2018, NGC launched a social networking platform for intra-enterprise communication called Yammer. Similar in feel and purpose to Facebook, Yammer is a platform which allows employees to create and customise accounts, post comments and links, start and join groups, follow co-workers, share photos and connect with like-minded individuals across the organisation. For a company with employees stationed at several different work sites and offices – some far-removed from its Point Lisas base – having a digital space for employees to meet and build relationships on the basis of shared interests is extremely useful. The feeling of being connected to other members of staff helps create a sense of belonging, and leads to a more engaged employee body. This in turn drives productivity. Thus far, 35 percent of employees are connected to the network, with others being encouraged to join.

Microsoft teams

To enhance productivity, the Company is pushing for the formation of more cross-functional work units using the programme Microsoft Teams. This programme gives

NGC's first podcast

employees a virtual meeting room where they can collaborate and share ideas in order to deliver projects that may require inputs from different departments across the entire NGC Group. The premise is simple – eliminating the need for physical meetings makes co-ordination easier and helps employees work faster and more efficiently.

Podcasts

Another initiative being championed as a way to deepen engagement is the production and sharing of employee-centred podcasts. Within the organisation, there is a wealth of knowledge across a range of disciplines, but there are scarce avenues for sharing that knowledge with the wider employee body. Podcasts – digital audio recordings usually produced in a series of episodes that can be streamed or downloaded – are an effective way to facilitate knowledge transfer. As opposed to live sessions which require physical presence, podcasts can be listened to whenever and wherever convenient to the employee. This works especially well for those stationed in the field or in places such as Tobago and Guayaguayare where opportunity to participate in knowledge-sharing initiatives may not be readily available.

A number of episodes have already been launched and several more are currently in production, featuring stories from and interviews with employees across the Company.

AUTOMATING PROCESSES

Underwriting all ICT innovation is a desire to make processes more efficient and ultimately, more cost-effective. In this period of low gas prices and diminishing reserves, the NGC Group has been working to bolster its profitability by seeking cost-savings wherever possible. The Group has recognised that streamlining processes using ICT innovations can translate into significant value and savings, and has consequently been upgrading its systems to take full advantage.

SAP Ariba

One of the big projects underway is the integration of the SAP Ariba platform into the procurement process. SAP Ariba is a best-in-class cloud solution which integrates the entire supply chain. It is an end-to-end, procure-to-pay automated system which allows buyers and suppliers to digitally manage transactions from contracts to payments. It provides access to the largest business network in the world, connecting millions of suppliers and customers across the globe, with all types of goods and services. The Group currently utilises the SAP enterprise management software, and determined that extending the software with SAP Ariba modules was low-hanging fruit to digitise and reduce the costs associated with a critical business process.

The system allows for submission of Requests for Information and Proposals, as well as responses to same; monitoring of receipt of bids either through the usual route or through an auction event; drafting and negotiation of contracts; and submission of electronically signed contracts, purchase orders and invoices. From a seller's perspective, if the NGC Group wishes to sell an item, goods or service, interested parties on the global Ariba network will be able to express their interest in purchasing.

By implementing SAP Ariba, the Group will benefit from savings in process improvement, price reductions through auctions and negotiations, and access to a wider competitive pool of suppliers.

LIC Portal

A big part of success in business derives from having engaged and satisfied customers. Communication is key to achieving this outcome. Traditionally, NGC's gas customers would telephone their relevant points of contact to discuss concerns or direct questions, or they could interface directly with field officers during routine metre checks. However, NGC wishes to deepen the relationship and strengthen lines of communication with its customers, particularly those in the Light Industrial Commercial (LIC) sector.

The Company's IT Department has been developing a targeted LIC Portal, designed to serve both existing and potential customers. Customers would be able to use the web-based portal to apply for natural gas connections, track the status of applications, liaise directly with customer service representatives, and generally better manage their accounts with NGC. Such a system improves service delivery by making applications faster and easier, making communication more timely and straightforward, and keeping NGC accountable to its customers. The centralised portal will also allow multiple NGC employees to share oversight of customers, instead of one-to-one liaisons. All this in turn builds a solid foundation for future business.

Technology is constantly evolving, and with every innovation comes opportunity for improvement. As a forward-thinking organisation with sustainability and growth top of mind, the NGC Group is yoking technology and ICT to move the Company toward a profitable future. ■

Cross-Laminated Timber

New Opportunity for Linking Energy and Manufacturing

Over the last decade, the Trinidad and Tobago (T&T) economy has experienced a number of challenges, most of which are as a result of the strong correlation between our economy and the oil and gas industry, upon which a significant portion of our direct and indirect government revenues are dependent. It is well known that one strategy to buffer the economy from the boom-bust cycles of this volatile industry is diversification.

Diversification entails, among other things, creating opportunities in non-energy sectors by utilising the country's comparative advantages. One such advantage is our ability to produce petrochemicals (ammonia and methanol to be precise) at a globally completive price. This provides T&T with an ideal platform upon which a derivative downstream chemical industry can be built. Downstream industries involve the production of secondary and tertiary derivatives which result in greater value being added to the nation's natural gas resources. Investments in downstream industries also create increased opportunities for higher levels of employment during plant construction and commercial operations.

At present, melamine, which is a tertiary derivative of ammonia, is produced at the Point Lisas Industrial Estate and is available for immediate downstream development. Melamine is the building block for a number of intermediary chemical products, including but not limited to, resins, adhesives and coatings. All of these intermediary products are inputs into the manufacturing of various end products. As such, from a diversification standpoint, the establishment of a derivative melamine sub sector provides an ideal opportunity to link our country's petrochemical sector to our manufacturing sector.

National Energy, through its Investment Facilitation Department, is currently identifying opportunities whereby melamine-based intermediaries could be used as a basis for the establishment of new manufacturing opportunities. One such opportunity identified was in the manufacturing of engineered wood products, in particular, a new product called Cross-Laminated Timber (CLT). The engineered wood industry utilises significant amounts of melamine-based adhesives during its manufacturing process. In fact, when our melamine is exported, a significant amount ends up in the engineered wood industry as adhesive. The two main inputs into engineered wood products are adhesive and of course wood. Given the significant melamine production capacity currently available in T&T, as well as the ample supply of wood/lumber locally and regionally (Guyana, Suriname, and Venezuela), National Energy has embarked on an exercise to determine the feasibility of establishing a CLT manufacturing facility in Trinidad. This facility will utilise locally available melamine and local/regional lumber to produce CLT, which is currently used in Europe and North America mainly as a building/engineering solution that is faster, environmentally safer, and relatively cheaper than traditional building materials (steel and concrete) used in traditional construction.

WHAT IS CROSS-LAMINATED TIMBER (CLT)?

CLT was developed in Austria in the early 1990s. It has been popular in Europe for more than 20 years, with extensive research and a documented track record supporting its widespread use. In the early 2000, construction with CLT increased dramatically in Europe, partially driven by the green building movement as well as code changes and improved marketing and distribution channels. There are hundreds of impressive buildings around the world built with CLT that show the many advantages this product can offer to the construction sector.

In North America, CLT is relatively new but is quickly gaining momentum. Canada has been the first mover in the Western Hemisphere and has successfully introduced CLT into its residential, commercial, and high-rise construction sectors. The country has implemented a number of policies that promote the use of wood-based engineering solutions for construction. One such policy is its 'Wood First' policy, which is a law that requires the use of wood as the primary building material in all new provincially (government) funded buildings. Only if the contractor can demonstrate that the building can be constructed at a lower cost using traditional material will they be permitted to do such.

The United States is attempting to catch up with its Canadian counterparts and last year, the American National Standards Association approved the ANSI/APA PRG 320-2012 Standard for Performance-Rated CLT, a product standard that details manufacturing and

Cross-Laminated Timber | CONTINUED

performance requirements for qualification and quality assurance. Additionally, the US has introduced the "Timber Innovation Act" in its Senate to encourage research into wood-based engineering solutions, authorise an annual "Tall Wood" building competition, and approve federal grants for public education on the benefits of building with wood, and assist architects and builders who are interested in utilising this new technology.

CLT was also recently included in the 2015 International Building Code (IBC). Up until now and in areas that have not yet adopted the 2015 IBC, several innovative architects and designers have already specified and built CLT structures in the US and Canada, having had them approved under their local building code as an alternative building system.

MANUFACTURING PROCESS

A CLT panel consists of several layers of kiln-dried lumber boards stacked in alternating directions, bonded with structural adhesives, and pressed to form a solid, straight, rectangular panel. CLT panels typically consist of an odd number of layers (usually, three to seven or more). A five-layer panel is shown in Figure 1 on page 13.

This cross lamination provides dimensional stability, strength and rigidity, which makes CLT a viable alternative to conventional framing, concrete, masonry and steel in many applications. It can be used for an entire building, as both the lateral and vertical load resisting system, or for select elements such as the roof, floors or walls. CLT as a structural panel element is also used as a superior industrial matting, bridging and retaining wall product that replaces heavy timbers, steel, and concrete.

Advantages of CLT*

DURABILITY

With proper design and maintenance, wood structures can provide long and useful service lives equivalent to other building materials. The key is careful planning and understanding of environmental loads and other external factors likely to impact a building over its lifetime.

ENVIRONMENTAL

CLT is manufactured from trees harvested in sustainably managed forests.The raw materials are normally sourced from small and medium trees. This cultivation practice maintains and enhances the long-term productivity and health of the forest. Wood is the only major building material that grows naturally and is renewable. Life cycle assessment studies show that wood outperforms steel and concrete in terms of embodied energy, air pollution and water pollution. CLT also has a lighter carbon footprint and engineered wood manufacturing requires significantly less energy than concrete and steel. This translates into a significant reduction in greenhouse gas emissions.

SEISMIC RESILIENCE

Because of their dimensional stability and rigidity, CLT panels create an effective lateral load resisting system. Researchers have conducted extensive seismic testing on CLT and found panels to perform exceptionally well with no residual deformation, particularly in multi-storey applications. In Japan, for example, a seven-storey CLT building was tested on the world's largest shake table. It survived 14 consecutive seismic events (magnitude of 7.2 and acceleration of 0.8 to 1.2g) with almost no damage. CLT also offers good ductile behaviour and energy dissipation.

ACOUSTICS

Test results show that because the mass of the wall contributes to acoustic performance, CLT building systems provide superior noise control for both airborne and impact sound transmission. CLT building systems offer additional acoustic benefits with the use of sealants and other types of membranes to provide air tightness and improve sound insulation at the interfaces between the floor and wall plates.

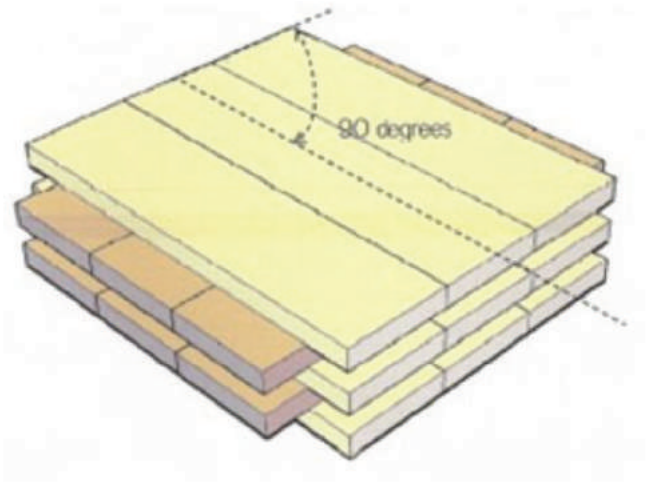
THERMAL PERFORMANCE

CLT's thermal performance is determined by its U-value, or coefficient of heat transfer, which relates to panel thickness. Thicker panels have lower U-values; they are better insulators and therefore require little or no insulation. Since CLT panels can be manufactured using CNC equipment to precise tolerances, panel joints also fit tighter, which results in better energy efficiency for the structure. Because the panels are solid, there is nearly zero air infiltration into the building envelope. As a result, interior □ temperatures of a finished CLT structure can be maintained with just one-third the normally required heating or cooling energy.

STRENGTH & STABILITY

CLT panels form a robust, structurally strong building system. The cross-lamination used in its manufacturing process provides for superior dimensional stability and offers significant sheer strength performance at a very unique weight to strength ratio compared to other common structural materials. Wood is on average five times lighter than concrete and steel.

Figure 1: CLT Panel



CHALLENGES OF CLT

CLT may present higher maintenance costs and universal standards are still being developed for wide-scale application. There are also cultural barriers with respect to using wood as a building material which can limit adoption of CLT locally.

BENEFITS TO T&T

As stated earlier, establishing an engineered wood industry in T&T would bring opportunities for diversification and domestic value creation. However, with regard to the establishment of a CLT facility in T&T, the benefits would specifically accrue in the country's construction sector. CLT's use as a structural product in the construction industry will provide local contractors with a product that can be used in place of, or in conjunction with, the current concrete and steel options.

MOISTURE MANAGEMENT & VAPOUR DIFFUSION

Wood is naturally hygroscopic and inherently serves as a moisture management system within a building envelope. Ideally manufactured at 12% moisture content, wood's inherent ability to absorb and emit moisture can naturally stabilise an indoor environment. The vapour-permeable nature of wood allows CLT to transfer molecular moisture without trapping it and creating conditions for mold and decay. CLT buildings 'breathe', minimising the risk for mold growth and maximising the comfort of their occupants.

FIRE RESISTANCE

CLT's thick cross-section provides valuable and superior fire resistance. Due to its mass, CLT panels char slowly. Once charred, combustion slows and eventually stops as the oxygen source is removed. CLT assemblies also have fewer concealed spaces, which reduces a fire's ability to spread undetected. CLT structures suffer less degradation than concrete and steel structures in a catastrophic fire event.

COST EFFECTIVENESS

Comparing the cost of CLT versus certain concrete, masonry and steel building types and including the advantages of faster construction time and lower foundation costs, the estimated total costs of CLT structures can be very competitive.

DESIGN FLEXIBILITY

CLT has unique structural properties that allow architects and designers increased flexibility of design allowing for distinctive and innovative projects. Due to wood's inherent ductility and unique strength to weight ratio, wood offers many advantages over the other common structural materials such as masonry, concrete, and steel.

SPEED OF BUILD

From one-person builders to large construction companies, CLT structural systems will arrive on-site ready to assemble, saving time and money with a swift and accurate building process.

REDUCED WASTE

CLT panels are manufactured for specific end-use applications, which results in little to no job site waste. Plus, manufacturers can reuse fabrication scraps for stairs and other architectural elements.

* Information on benefits of CLT sourced from *Associated Construction Publications* (ACP), a non-profit US trade publication which has covered the US construction sector for over a century - https://www.acppubs.com/topics/279-rocky-mountain-construction

Cross-Laminated Timber | CONTINUED

CLT's weight benefit (five times lighter than steel and concrete) will give local contractors increased design flexibility and the potential to construct in areas that may have been deemed geotechnically challenging. An example of this benefit was seen in a residential complex constructed over a subway tunnel in Dalston Lane, London. In this example, there were strict weight restrictions placed on the developer, which were only manageable with the use of CLT, as it cut the weight of the building by almost 8,000 tonnes. The weight reduction was so great that the developer was able to add two additional storeys to the original design, further improving the project's economics and return to investors.

Additionally, local contractors would be able to benefit from increased speed of construction as the pre-fabricated manufacturing process of CLT means that walls and floors can be manufactured as large slabs that can be joined together on site, thereby eliminating time lost during the drying of cement. Using the same example above, the Dalston Lane developer was able to cut the project's timeline by 15 percent, allowing the residential units to be listed on the market in a shorter time frame.

The establishment of an engineered wood industry could act as a boost to the country's forestry sector, as it will provide a high-value local off-take for domestic lumber. Additionally, it can help promote the introduction of improved forestry management systems as the sustainability of an engineered wood industry is directly linked to the sustainability of our forests. This will promote more reforestation programmes, initiatives that help to prevent forest fires, and greater awareness of both the environmental and economic benefits of properly managing forests.

POSSIBLE BENEFITS TO THE REGION

The establishment of an engineered wood industry in T&T would have significant benefits for the wider Caribbean region as these countries would have the ability to export logs to T&T for processing, firstly into lumber, and secondly into a high-value engineered wood product. Some countries that would benefit greatly from this would be Guyana, Suriname, and Venezuela. The ability to export low value timber to T&T to manufacture a high-value construction product that can be used to build houses and mid-rise residential and commercial buildings would no doubt be an attractive prospect.

Additionally, a number of tests are currently being conducted in North America to test CLT's ability to withstand hurricane-force winds. Thus far the results are encouraging. If the outcome is favourable, this would present a huge opportunity for storm-resistant housing development in the region, particularly for those Caribbean countries located directly within the hurricane belt.

Townhouse (semi-detached) built using CLT – London

ENGAGING STAKEHOLDERS

National Energy is advancing its examination of the feasibility of establishing a CLT manufacturing facility in T&T. Part of this exercise is an ongoing consultation with relevant stakeholders. During this process, National Energy conducted an Engineered Wood Seminar in November 2017, to which a wide cross section of stakeholders was invited. Among those present were representatives from the Ministry of Energy and Energy Industries; the Economic Development Advisory Board; InvesTT; Trinidad and Tobago Bureau of Standards; private construction companies; the Ministry of Finance, Trinidad and Tobago Contractors Association; the Environmental Management Authority (EMA); PPGPL; NGC CNG; Forestry Division; Town and Country Planning Division; Commissioner of State Lands; MHTL; UDECOTT; The UWI and UTT.

National Energy also engaged Canadian firm, Forest Economic Advisors (FEA), who are a globally recognised leader in the area of market intelligence for forestry products. FEA's leading advisor on the engineered wood industry, Art Schmon, an industry veteran with 40 years' experience, was invited as the keynote speaker Mr. Schmon sees huge potential for CLT in T&T and believes that our local supply of melamine, access to lumber regionally, and our strategic geographic location are key factors to success in establishing a CLT facility.

Building on the success of the Engineered Wood Seminar, National Energy continues to work closely with key stakeholders, all of whom are excited by the potential that this opportunity holds and the environmental and economic benefits that it promises, if implemented.

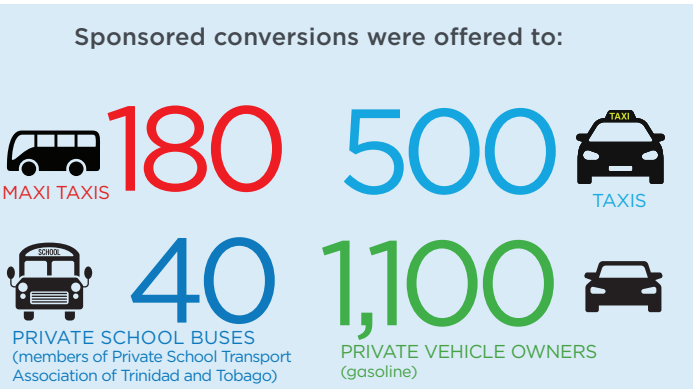
CNG Takes Off With Sponsored Conversions

CNG customer fills up

While high mileage vehicle owners and drivers see the value in adopting CNG as a vehicular fuel, some persons found it difficult to source the initial TT$12,000 (starting) capital needed to convert. In June this year, NGC CNG rolled out a series of sponsored conversions to key market segments, removing this challenge for hundreds of vehicle owners.

In June, during a one-week blitz, NGC CNG staffers and promotional assistants were out at maxi taxi hubs signing interested owners up for conversion. This was followed by a two-week campaign at CNG service stations, targeting taxi owners. Once a vehicle owner had all valid vehicle information, and due diligence was performed, sponsored conversions were awarded on a first-come, first-served basis.

CNG Takes Off With Sponsored Conversions | CONTINUED



Then in July, in an unprecedented nationwide 'Enter and Win' promotion, sponsored conversions were offered to private vehicle owners, who were encouraged to visit CNG stations and complete an entry form to be eligible to win.

Every two weeks, 100 winners were selected from each of two featured NP stations, beginning with NP Point Fortin and NP Diego Martin. The promotion then moved to Unipet Brentwood and NP Orange Grove, followed by NP St. Christopher's and NP Tumpuna North in August. September saw the promotion moving to Unipet Tacarigua and NP Beetham, followed by NP Carrousel and NP Chaguanas.

The winners were assigned to licensed converters. Anna Alisa Goindoo, Sales and Marketing Manager, NGC CNG was pleased with the response to the promotion. She said, "The response to the sponsored conversions has been an overwhelming one which is positively impacting on us meeting our 2018 target, filling out the CNG stations' and converters' capacity and increasing the CNG volumes."

Ms. Goindoo continued, "Increasing the number of CNG vehicles on the road continues to yield positive feedback from the citizens and the government. Having these persons as CNG ambassadors has increased the invaluable 'word-of-mouth' marketing needed to generate additional sales. We are seeing heightened brand awareness as a result of these sponsored conversions, as CNG is moving top of mind in the public domain."

Putting technology to work

Managing the promotion winners on a weekly basis could have been a challenge for NGC CNG, but thanks to an internal Online Converter Database and Incentive Portal, developed in-house by members of NGC's IT Department, the process ran without a hitch.

The taxi, maxi and private school bus applications were all uploaded to an Incentive Portal, where the screening committee managed approvals and follow-ups. Once an applicant was selected as a recipient of the sponsored conversion, he or she was contacted by an NGC CNG salesperson, who completed the process of signing a contract and assigning the winner to a licensed converter. Details of the private vehicle winners of the 'Enter and Win' competition, who were selected from the station entries, were uploaded to an Online Converter Database. Each winner was assigned to a licensed converter, who was then able to schedule assessments and conversions of the vehicles. Each converter has individual access to the portal, with NGC CNG having oversight of all informational inputs.

Using technology to manage the massive volume of applicants for conversions has helped NGC CNG immensely. According to Ms. Goindoo, "Having the online tracking system as an integrated management tool means higher efficiencies for processing of the applicants for us internally, as well as for the converters. Converters are able to schedule assessments and conversions, as well as manage their inventory based on the demand inputted into the online system. The ability to track live data gives a real-time status needed to manage set targets."

Ms. Goindoo added, "The system facilitates collecting, organising and managing customer information. The database allows for an improved relationship with the customers as real-time status updates can be given to them regarding their conversion. Increasing this service to customers in turn helps increase the customer loyalty while decreasing customer agitation. This positive interaction leads to referrals and ultimately increases sales prospects."

Coming soon

A gasoline conversion costs $12,000 and takes a day and a half. There are three licensed converters in Trinidad and Tobago: Massy ACL located in Arima, Burmac CNG in Chaguanas and Dumore Enterprises in South Oropouche. The Vehicle Management Company of Trinidad and Tobago (VMCOTT) is expected to receive its converter's license later this year.

NGC CNG and VMCOTT signed a contract earlier in 2018 which will see VMCOTT providing the labour to facilitate the annual conversion of a minimum of 500 government-owned vehicles and vehicles owned by employees of state entities who are entitled to travelling allowances. NGC CNG will inject 100 percent of the capital to purchase the kits and tanks for this initiative. The cost of the conversion will be borne by the respective government-owned agency or employee.

In total, NGC CNG is sponsoring 1,820 conversions across the various market segments which will give a major boost to CNG sales and the CNG industry as a whole.

Reducing Environmental Impact

Keeping Cool with Greener Technology

Globally, as temperatures trend upward, the energy demand for space cooling is rising.

Studies indicate that between 1990 and 2016, the energy consumed for cooling has more than tripled, and is expected to increase due to continuous development in the hottest parts of the world[1]. In the context of the whole, cooling residential and commercial spaces accounts for 10 percent of worldwide electricity consumption[2]. This significant energy expenditure makes cooling a fitting target for energy efficiency investment and innovation.

Currently, cooling is predominantly handled by packaged and split Air Conditioning (AC) and chiller systems that run off grid electricity. However, technological advancements in equipment – particularly non-electric chiller systems utilising absorption, adsorption and desiccant cooling principles – have made it possible to power cooling using alternatives like natural gas, waste heat recovery and solar energy.

Unfortunately, the market penetration of these technologies has been limited by their high capital cost and infrastructure challenges. Figures from 2016 showed that only one percent of space cooling was powered by natural gas[3]. However, the International Gas Union (IGU), per its *Global Gas Report* 2018, is optimistic that these technologies will be more widely introduced in the growing economies of Asia, Africa and the Middle East as an efficient solution for large scale commercial cooling.

How does it work?

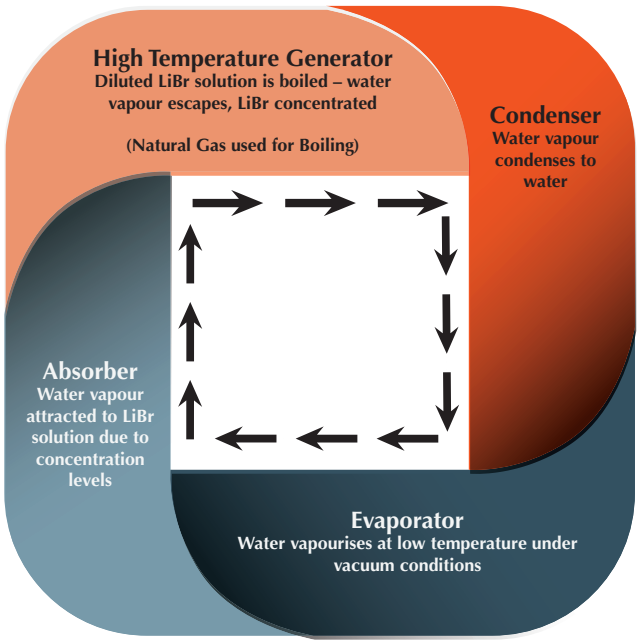
Since 1997, NGC has been an advocate for using natural gas for cooling instead of grid electricity. Today, this technology is utilised at NGC's and National Energy's Head Offices, as well as by some companies in the Light Industrial Commercial sector.

NGC's system uses the processes of vaporisation, evaporation and absorption in a closed cycle. The system comprises five major parts: an absorber, evaporator, generator, expansion valve and condenser.

In the evaporator, cold liquid refrigerant, usually water, absorbs heat from the chilled water loop that runs through the area to be cooled and forms water vapour. In the absorber, a salt solution – the absorbent (lithium bromide, LiBr) – extracts the water vapour from the evaporator and becomes diluted.

The mixture is pumped to a generator where heat from natural gas is used to boil off the water and strengthen the salt solution which is then returned to the absorber. The boiled-off water vapour goes to the condenser where it is converted into hot water by expelling heat to water from the external cooling towers. The hot water then passes through an expansion valve that reduces the pressure and consequently the temperature of the hot water. It is then returned to the evaporator for the process to begin again[4].

[1,2,3] International Energy Agency – The Future of Cooling Opportunities for Energy Efficient Air Conditioning 2018
[4] Gregory McGuire, GASCO NEWS APRIL 2000 VOL.13 NO.2



How NGC's natural gas-powered cooling system works

Improving the system

Although using natural gas for cooling is more energy efficient than electric AC systems, there is room and opportunity for even greater efficiency with solar cooling technologies.

Solar thermal cooling uses solar collectors to provide heat to drive a cooling process, usually in combination with thermally driven absorption or adsorption chillers. Solar electric cooling uses photovoltaics to generate electricity and drive vapour compression chillers. These technologies are being used in Europe, Asia, Africa and Australia, although large scale uptake has been limited due to the intermittency of solar energy.

In Trinidad and Tobago – or even specifically at NGC – it may be possible to adopt a hybrid approach for absorption systems by incorporating both natural gas and solar technology. Solar-powered chillers could fire on available solar energy during the day, while the system could switch to natural gas on cloudy days and at night. Once such a model is implemented, and its viability proven, the country could significantly reduce electricity consumption from domestic and commercial cooling.

The local scenario

Separate European Union and Inter-American Development Bank reports have highlighted that in Trinidad and Tobago, there exists significant potential to conserve energy expended by AC, HVAC and chiller systems in the commercial, industrial and hotel sectors[5] . These energy savings could be realised by switching to alternative cooling technologies – such as the one utilised by NGC – and can have appreciable impact on power demand and emissions.

Moreover, conditions may now favour adoption of greener cooling technologies, particularly natural gas-powered systems. Conditions include:

- Rising annual temperatures, which are driving the demand for cooling upward
- Competitive pricing of natural gas relative to other energy sources – natural gas could even become more cost-effective if electricity rates increase
- Existence of natural gas infrastructure within proximity of major commercial, industrial and hotel districts
- Efficiency of natural gas cooling systems – gas-powered chillers can consume 19 percent less gas than power generation companies would use to power equivalent electric units
- Incentivisation of uptake – The Ministry of Finance is encouraging more sustainable energy practices by offering companies a 150 percent tax allowance on investments that can lead to at least 15 percent energy savings in the commercial, hotel and light manufacturing sector through engaging a certified Energy Service Company.

That said, there are some hurdles that can potentially hinder uptake at this time:

- High initial capital output for equipment purchase
- Rigorous maintenance routine, neglect of which will drastically affect system performance
- Shortage of proven business cases for investing in the technology within the local market
- Life cycle must be considered to assess potential long-term energy savings
- Need for broad-based public sensitisation to natural gas safety
- Quality, reliability and performance of chillers vary among brands

Nevertheless, our country urgently needs to address its electricity consumption. Companies and research institutions should therefore consider partnering to arrive at workable solutions to any issues that may stand in the way of adopting these greener technologies. It is, after all, in the national interest that we moderate the rising cost of keeping cool.

[5] A Unique Approach for Sustainable Energy in Trinidad and Tobago Inter-American Development Bank 2015 and EU Technical Assistance Facility for the Sustainable Energy for All Initiative – Sustainable Energy Implementation Plan 2021/2030 for Trinidad and Tobago Draft August 2017
[6] From NGC's internal ETECK Tamana Park District Cooling Proposal March 2006

Learning the True Value of Energy Conservation

Despite being the foremost contributor to government revenues, natural gas is still an enigmatic product for some Trinbagonians. Where the spires of the Pointe-à-Pierre refinery and petrol at the pump have stood as proxies for the oil industry in the public mind, natural gas flows unseen beneath the earth, and is not retailed to the general population. For this reason, public education has been a core function of NGC's Corporate Communications Division.

As new complexities emerge in the gas business, it is even more important that the population understands the industry – not simply because it impacts the entire country, but because the public has an important role to play in surmounting current challenges, particularly as they relate to electricity consumption and the opportunities associated with alternative energy. This is one reason why NGC is partnering on an exciting new public education initiative with non-profit organisation IAMovement for its Climate Talk 2018 series.

What exactly is the problem?

Natural gas has three main end-uses in Trinidad and Tobago: it is sold directly to Atlantic LNG for liquefaction and export; it is sold via NGC to power generation companies for production of electricity; and it is sold via NGC to downstream industries and businesses for use as a fuel or feedstock. Just over half of all gas produced offshore is piped to Atlantic (for the first seven months of 2018 the figure stood at 57 percent), and the remainder must be shared among the power and manufacturing/ commercial sectors.

Here lies the conundrum. In order to stimulate growth and development, a national policy was implemented whereby the gas price to power generation companies would be fixed at a fraction of the market price, so that electricity costs could be kept low. Low-priced electricity makes the country an attractive destination for investment, and has been one of the drivers behind the successful Trinidad Gas Model of Development. The public also benefits from relatively low utility bills, which liberates capital for other expenses and contributes to a higher standard of living. Useful to note is that only when power generation companies have received their full quota of gas, can NGC move to supply its other customers.

The current natural gas scenario in Trinidad and Tobago presents two main challenges to the status quo. Firstly, supply is short – diminishing reserves and investment delays have reduced the quantities of gas that NGC receives to share between power and industry. Since power generation is supplied first, there is a shortfall in supply to downstream industries. The second issue is price. Scarcer gas means NGC must pay a higher premium to upstream producers to acquire the product. This price increase must be filtered to its customers in order for the business to keep its head above water. However, the price paid for gas used to generate power remains subsidised, so NGC is taking a bigger hit from sales to this sector. The Government is looking to implement a power tranche policy whereby upstream suppliers would be required to sell gas allocated for power generation at a lower cost, which will reduce the subsidy burden on NGC and the state. This policy notwithstanding, supply remains a challenge. Customers who pay the true market price for gas are not always able to receive their full quota because of supply constraints. The customers suffer from reduced supply, and NGC suffers from reduced margins on its gas.

The downstream sector, and primarily the petrochemical companies producing high-value commodities for export (such as ammonia and methanol), are major contributors to the national economy. Not only does the sector earn valuable foreign exchange, but it employs thousands, both directly and indirectly. Reduced supply to this sector translates into lower productivity, and revenue losses for the entire country. Restoring the sector to its full strength in a time of short supply requires a recalibration of how gas is shared between power generation and downstream industries.

In the simplest terms, the quantity of gas sold to power generation companies must be reduced, without jeopardising the ability of the country to meet its energy needs. What is required is a reduction in demand, which can

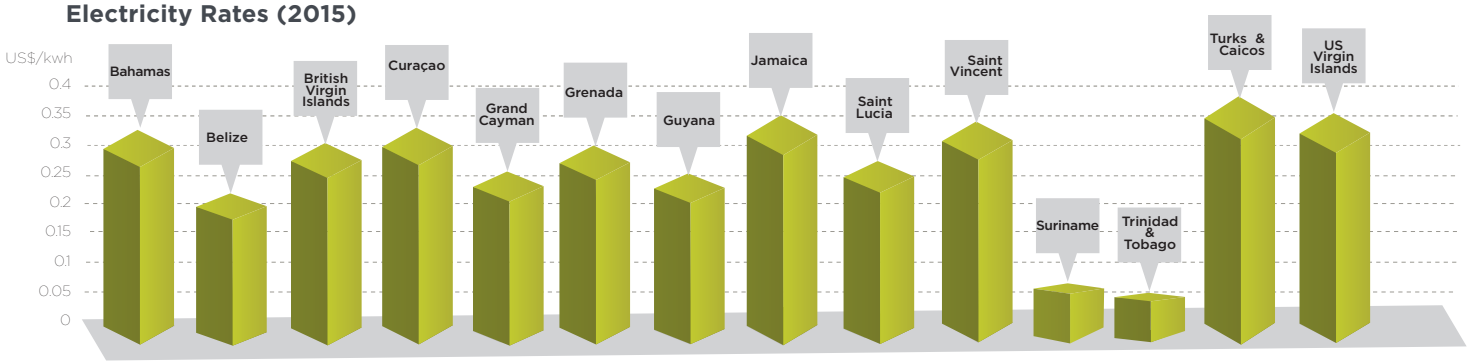


Chart showing comparative electricity costs across the Caribbean

be achieved by generating electricity from alternative sources (Renewable Energy, RE) or more easily, by encouraging the public to use electricity more efficiently (Energy Efficiency, EE).

Enter IAMovement

IAMovement is a non-profit organisation founded in 2014 to effect positive social and environmental change in Trinidad and Tobago. Among the organisation's key focus areas are EE and RE projects. Already, IAMovement has produced a documentary called 'Small Change', which looks at the social and economic gains of EE and RE implementation, and initiated a larger education programme called 'Climate Talk'.

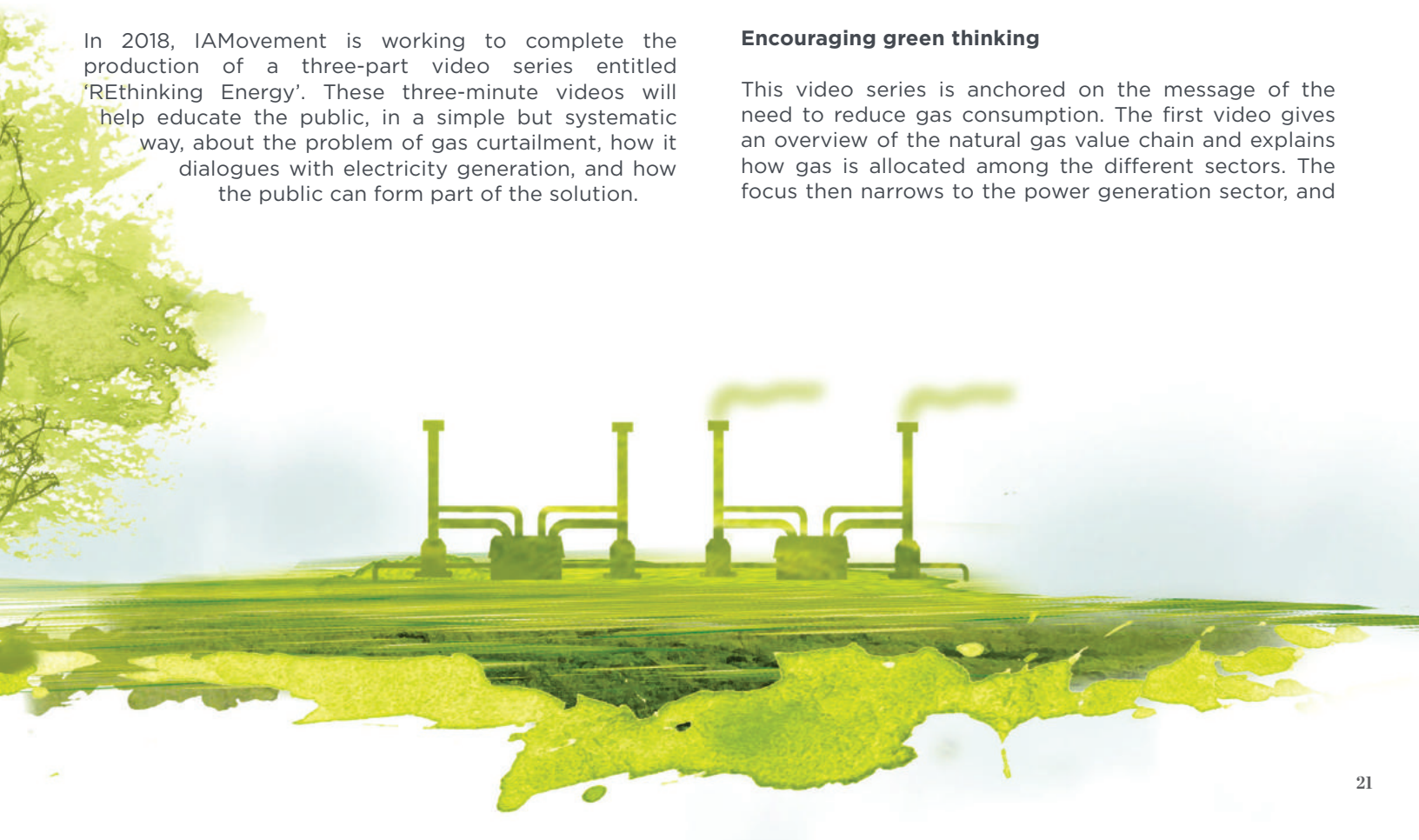
In 2018, IAMovement is working to complete the production of a three-part video series entitled 'REthinking Energy'. These three-minute videos will help educate the public, in a simple but systematic way, about the problem of gas curtailment, how it dialogues with electricity generation, and how the public can form part of the solution.

The messaging of this campaign tells a story that NGC needs the public to hear. This alignment of IAMovement's purpose and NGC's need led to NGC's decision to partner with the organisation for the delivery of the Climate Talk 2018 series, REthinking Energy.

The REthinking Energy series, which is already in train, is designed as a cross-country education programme focused on RE and EE. The programme, which is aimed to be presented at a minimum of 30 schools, includes screenings of the videos, followed by panel discussions, open floor dialogue and an impromptu quiz. At the end of the series an essay competition will be launched with participating schools.

Encouraging green thinking

This video series is anchored on the message of the need to reduce gas consumption. The first video gives an overview of the natural gas value chain and explains how gas is allocated among the different sectors. The focus then narrows to the power generation sector, and



Snapshots from IAMovement video

the price that is paid for gas relative to the price paid by other downstream companies. The differential in earnings from sales to the power sector versus industry amounts to considerable revenue lost over time. It has been calculated that by keeping gas prices artificially low for power generation, the country would have foregone monies that could have funded construction of 500 schools or 10 new hospitals, paid for cancer vials for 56,000 cancer patients or 150,000 salaries. This is known as the opportunity cost.

As the video goes on to say, the intent is not to communicate that power generation should not be a priority deliverable. However, electricity can be generated from other sources, while alternative inputs for petrochemical production are harder to find. Moreover, if citizens used electricity more prudently, conserving through thoughtful consumption and investment in energy-saving appliances and fixtures, the demand on the power sector would fall, as would its need for gas. Indeed, there is substantial room and need for improvement – in 2017, *The Economist* ranked Trinidad and Tobago the #1 most energy inefficient country in the world, based on the energy required per dollar of GDP generated.

The second video takes a slightly different approach to convince citizens of the need to change electricity consumption practices. It examines in some detail the cost of producing power, which encompasses:

- The purchase of gas from NGC;
- The conversion of gas into electricity, which is carried out by independent power producers contracted by the Trinidad and Tobago Electricity Commission (T&TEC) under Power Purchase Agreements;
- Maintenance, upkeep and new infrastructure for the power grid, to ensure reliable and secure transmission and distribution; and
- Administrative and ancillary costs to support T&TEC's operations.

When all costs are totalled, the true price of electricity is circa US$0.11/$0.12 per kilowatt hour (kwh). However, as a result of the subsidy (the fixed gas price), the price paid by consumers is typically US$0.05/kwh. According to Trinidad and Tobago Electricity Commission's (T&TEC's) Chairman Keith Sirju, the company has been operating at a loss since 2011, and discussions to correct this debt position are taking a close look at the current consumer rate, which has not been adjusted for eight years[1]. If rate increases are introduced, the public will have a compelling financial incentive to reduce power consumption.

Preparation for this eventuality is therefore a necessity. A third video is being scripted to explore EE and RE solutions that would reduce local gas consumption, encourage sustainable economic development and maximise returns to Trinidad and Tobago. There has also been discussion around adding a fourth video to the series to profile the benefits of CNG vehicles, with emphasis on how they can contribute to Trinidad and Tobago's emissions reduction target under the Paris Agreement on climate change. The production of the series is currently underway in partnership with NGC, the German Embassy and the Energy Chamber of Trinidad and Tobago.

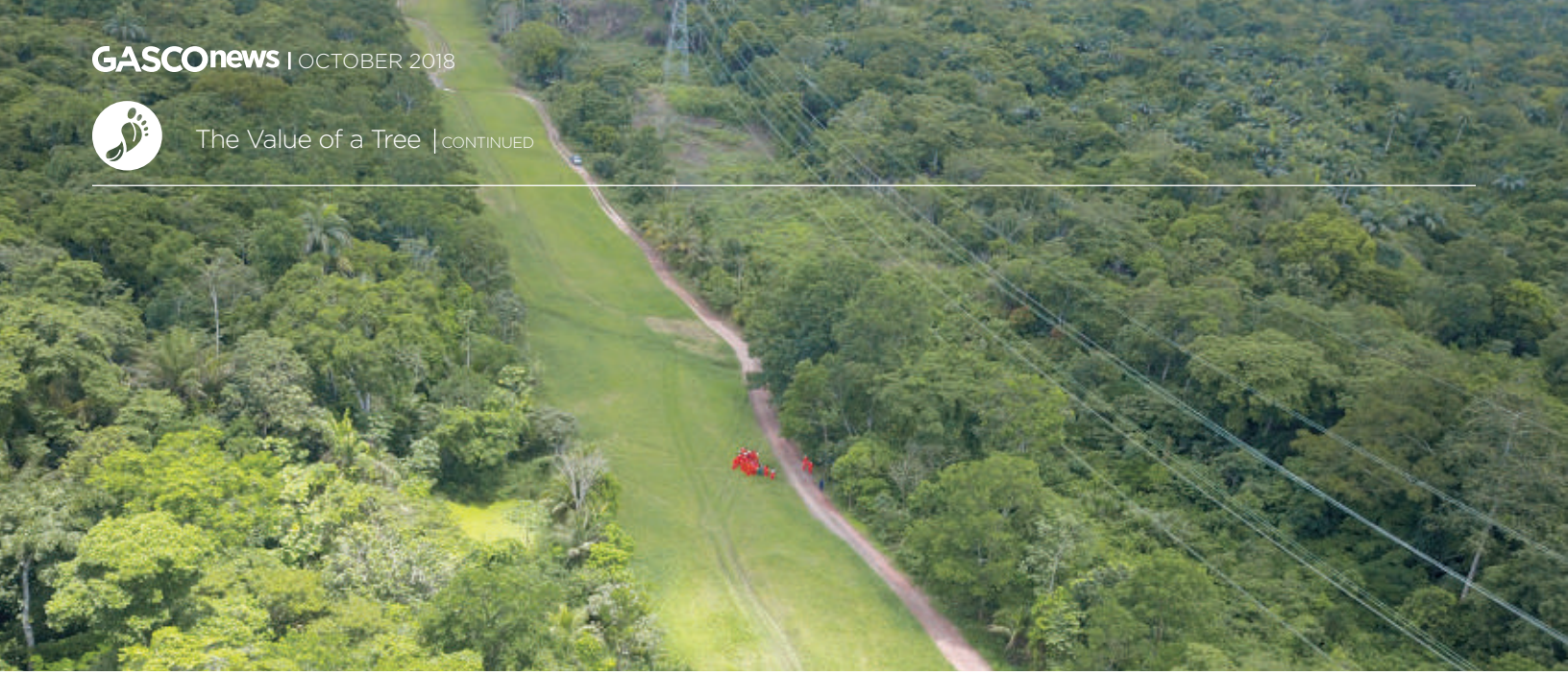
Big picture, bottom line

NGC's partnership with IAMovement represents an investment in public education that will hopefully plant the seeds of change for a more energy conscious population. This is a necessary precursor to reducing demand in the power generation sector, and liberating molecules for use in other industries. Ultimately, both company and country stand to profit. ■

[1] https://www.cnc3.co.tt/press-release/ttec-examines-rate-hike-offset-bn-annual-wage-bill

The Value of a Tree

Measuring the Carbon Impact of NGC's Reforestation Programme



NGC's Right of Way, Rousillac. *Photo by Daniel Prentice*

Driving through Rousillac in south Trinidad, you'd come upon a dirt road that veers off the main toward the forest and NGC's Right of Way. There, a stripe of trees appears to have been sheared off the landscape, leaving a close-cropped carpet of green flanked by forest on either side.

The perfectly manicured lawn, which runs to the horizon and out of view, is interrupted at intervals by yellow signposts, which advise all who might venture past that NGC's natural gas pipeline is buried there.

It is easy to imagine that this carefully tended clearing was once covered by trees, indistinguishable from the forest astride it – as indeed it was. In the course of constructing its expansive pipeline network, NGC was forced to clear a path through forests in the southland to bury lines and pipe gas cross-country for processing and distribution. However, as a responsible business and corporate citizen, the Company committed to offset this damage by replanting the equivalent acreage.

For this reason, in the thicket running alongside the Right of Way in Grant's Trace, Rousillac, just out of sight of passers-by plying the dirt road, rows of saplings reach skyward from the forest floor. One day, they will be cedar, teak, mahogany and juniper – NGC making good on its promise of 'No Net Loss'.

17%

OF GLOBAL CARBON EMISSIONS ARE ATTRIBUTABLE TO DEFORESTATION AND FOREST DEGRADATION

The next step for NGC's Reforestation Programme

NGC's Reforestation Programme was initiated in 2005, targeting a total of 315 hectares within the Forestry Division's South and South-East Conservancies. The programme aimed to plant, in seven phases, a variety of tree species in the target areas, including cedar, mahogany, cypre, crappo, olivier, balata, mahoe, cajuca, locust, galba, apamate, roble, pommerac, chennet, mango, chataigne and poui. NGC has already replanted its full target acreage in the Rousillac, Guapo, Mayaro, Moruga, Parrylands (WOMA) and Rio Claro areas. Once the saplings reach a certain stage of maturity, they are turned over to the care of the Forestry Division.

Thirteen years after the launch of this Reforestation Programme, NGC has decided to assess its big picture impact. The primary motivation for embarking on a reforestation project was recognition of the immense value that trees add to ecosystems and the environment – value that would have been lost due to deforestation. In the context of a warming planet, one of their most important services is carbon sequestration, or carbon capture and storage.

In February 2018, Trinidad and Tobago ratified the Paris Agreement within the United Nations Framework Convention on Climate Change (UNFCCC). This represented the country's formal commitment to reduce greenhouse gas emissions by a cumulative 15 percent from industry, power generation and the transport sector by 2030 from a business as usual baseline. As the energy company fuelling industry and the power sector, NGC shares the responsibility to mitigate emissions from fossil fuel combustion.

Deforestation and forest degradation account for approximately 17 percent of global carbon emissions, more than the entire global transportation sector and second only to the energy sector. The UNFCCC

SINCE 2005

>100,000

TREES WERE PLANTED BY NGC

WITH AN

85%

SURVIVAL RATE

therefore recognises that reforestation can help check rising temperatures – its REDD+ mechanism incentivises countries to reduce emissions from deforestation and build forest carbon stocks. It is therefore worthwhile to measure the carbon impact of NGC's Reforestation Programme, to assess how much it has contributed, and can continue to contribute, toward meeting Trinidad and Tobago's emissions reduction target.

What is carbon sequestration?

In order to appreciate the value of a reforestation project and the methodology for measuring its impact, it is helpful to understand the science behind carbon sequestration.

Carbon sequestration refers to the process by which atmospheric carbon dioxide is captured and stored in either solid or liquid form, through natural or artificial means. Carbon dioxide is an indispensable ingredient of photosynthesis, whereby plants manufacture food. Carbon absorbed from the air is subsequently stored in plant tissue as biomass, building the plant's roots, stem and branches.

Trees can accumulate substantial reservoirs of carbon over their lifetime, with bigger trees naturally sequestering more. When forests are cleared, their capacity to absorb carbon is lost. If felled trees are burned or left to rot, the carbon stored in tree biomass is released back into the atmosphere. This is how deforestation contributes to greenhouse gas emissions.

NGC's carbon sequestration study

Since 2005, NGC has planted more than 100,000 trees, with an 85 percent survival rate at the project sites. Given the phased execution of the programme, some trees are now mature and will have been able to capture and store meaningful quantities of carbon. The Company is interested in determining how much carbon its programme was able to sequester since 2005. Since new trees are still being planted, and some saplings are still too young to have realised their full

Hypsometer used to measure tree heights

carbon-trapping potential, NGC also wishes to project the programme's impact over the next decade as all the trees mature.

In July 2018, the Company contracted a team at The University of the West Indies (The UWI), St. Augustine, led by Professor John Agard, to carry out a Carbon Sequestration Study that will specifically determine:

1. How many tonnes of carbon have been sequestered by the NGC reforestation sites from 2005–2018;
2. How many tonnes of carbon are projected to be sequestered by the reforested sites from 2019–2030 and,
3. The approximate value of the tonnes of carbon sequestered based on market prices.

Project Manager, Dr. Lena Dempewolf explained the methodology: "In order to determine how much carbon any given tree stores, we first need to determine how much biomass the tree possesses. To do this, we measure the tree and its diameter at a standard height (diameter at breast height – 1.37m). This represents the majority of the biomass stored in the tree. The biomass in the roots and branches are estimated based on the species of the tree, as they can vary greatly across tree type. Since different species store different amounts of carbon in their tissues, core samples are also taken and the carbon-to-biomass ratios are determined. From this, we then calculate how much carbon is stored per tree measured."

It is obviously impractical to analyse every single tree for this study, so the team is focusing on random sample plots at the project sites. Dempewolf continued: "This data will be combined with a remote sensing technique called Light Detection and Ranging (LiDAR). In 2014, the Government of Trinidad and Tobago conducted a national LiDAR and aerial photography survey. Using the LiDAR data, the heights of all trees in the area of interest can be very accurately determined. The plot level carbon data and the LiDAR tree height data will be used to develop mathematical models which will estimate the carbon storage of the trees planted, as well as the total amount of carbon a particular forest type is likely to store in the future in the entire reforestation area."

Data collection, analysis and results tabulation are projected to take approximately five months.

Study pertinence and applications

At present, NGC is the only company in Trinidad and Tobago invested in a reforestation exercise on this scale. The results of this Carbon Sequestration Study will help make a scientifically corroborated case for the potential

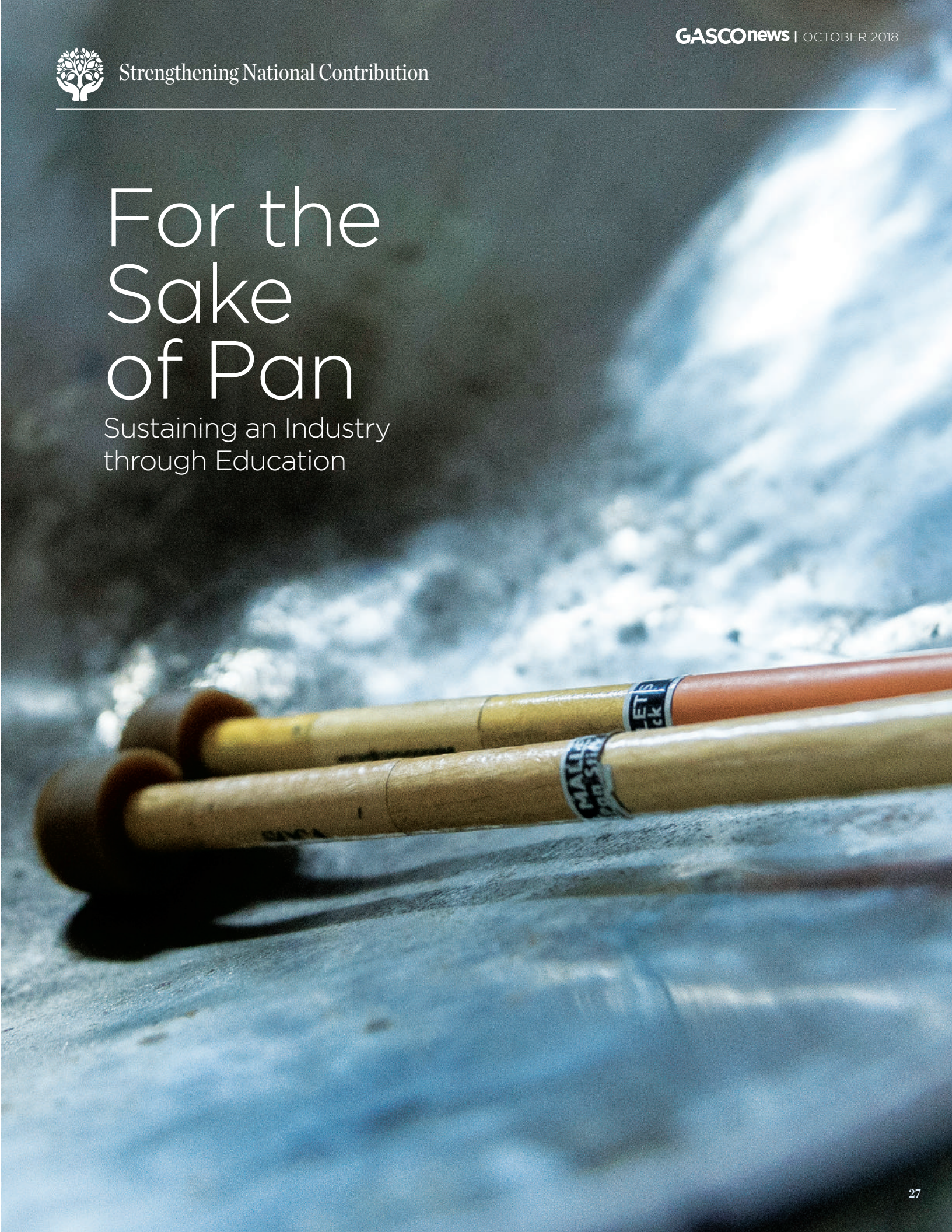
UWI team measuring tree heights

of reforestation to trap and store carbon. This can in turn be presented to corporate Trinidad and Tobago to encourage greater investment in similar projects. The government can also use the data to earn carbon credits for the country under the UNFCCC, and move the nation closer to its emissions reduction target.

To drive further action, the results can be simplified and shared with schools, so that young students can be motivated to plant trees in their backyards. The sobering reality, after all, is that our planet is fighting in earnest to keep temperatures in check, and every tree counts. ■

For the Sake of Pan

Sustaining an Industry through Education



For the Sake of Pan | CONTINUED

Brian James, General Manager Industry Services at MIC-IT and Mark Loquan, NGC President, sign MOA

In the early days of the steelpan industry, the pioneers of the instrument trialled various iterations before arriving at the schematics for the pans we use today. The body of knowledge they collectively developed was passed down through successive generations of pan makers and tuners, and today, they remain the proprietors of that knowledge.

As Trinidad and Tobago looks to push for greater support of the national instrument, demand for specialist pan makers and tuners is on the rise. Unfortunately, induction and training in the craft did not keep pace with demand for the instrument, and there is a dwindling number of skilled craftsmen in the industry today.

As a patron of steelpan, NGC recognised the importance of education and training to the sustainability of our national instrument. With this end in mind, on 26th July 2018, NGC signed a Memorandum of Agreement (MOA) with the MIC Institute of Technology (MIC-IT) for the delivery of a customised Mechanical Engineering Technology with Steelpan Manufacturing Programme to members of its supported steelbands – NGC Couva Joylanders, NGC La Brea Nightingales, NGC Steel Xplosion and Gonzales Sheikers.

The programme will introduce members of the four bands to the fundamentals of pan manufacturing, tuning, and associated skills. Fifteen pannists have been nominated by their bands to participate in the initial run of the programme, which is divided into three six-month cycles and spread across the period 2018-2021.

> This is the beginning of an exhilarating period in NGC's continued involvement with the national instrument in furtherance of our push for the sustainability of our sponsored and assisted steelbands. We expect great things to come of this partnership, not least a more secure future for steelpan music.
>
> – Mark Loquan, NGC President

It starts with an oil drum

The value of this programme cannot be appreciated without an understanding of what goes into making and tuning a steelpan. Ben Jackson, programme facilitator at MIC-IT, explained the process.

It starts with an oil drum – either new or used, depending on what's available. While you could buy an old one off a gasoline supplier for TT$40, a specially manufactured steel drum could cost you upwards of TT$600.

The first task is to hammer the top down into the concave playing surface of a pan. This process, called sinking the drum, is traditionally executed using a sledgehammer and muscle, but it can be expedited with the aid of a pneumatic hammer. The depth you take it to depends on the type of pan you are making – such as tenor or bass. Sinking and achieving a smooth finish can take hours, or longer if done manually.

The pan maker must then mark the boundaries of each note on the playing surface. Templates are generally traced to produce standard layouts for each type of pan, and a 'grooving pin' is used to etch and demarcate the notes. At this point, the pan is cut from the drum, with longer 'skirts' for lower registers (for example, bass pans have longer 'skirts' than tenors).

This also exposes the underbelly of the playing surface for the next step – a sequence of sinking and 'counter-sinking' to shape each note into a convex 'bubble' and bring it to its approximate pitch. Heating or burning the steel helps set each note, and if required, the pan is then sent for its chrome finish before it is fine-tuned.

The tuner has the final role in bringing the instrument to completion. Pinging each note with a rubber-capped pan stick, the tuner checks if the notes are true. In the past, tuners relied on naught but an expert musical ear to detect inconsistencies, but they are now aided by a computer or device which measures vibration frequency and musical pitch. To correct notes off key, the tuner gently taps the playing surface or its underside to sink or raise the surface as necessary. The process can be painstaking, though a seasoned tuner can complete the job in short hours.

Remarkably, to this day, pan manufacture continues to be a manual enterprise. For this reason, from start to finish, a single pan can take days to leave the shop. Small wonder that a newly minted steelpan will retail for thousands.

Benefit to the bands

Coming off a hectic pre-Panorama season of practice, pan sides must contract a tuner to ensure their instruments are playing their best for the competition. Beating on the drums and moving them from place to place can cause warping of the steel and slight distortion of the notes. Coaxing the notes back into key is called 'blending' and is not as involved as the tuning process for new pans. Still, blending an orchestra for Panorama can be extremely costly for bands, especially if they advance through

Pans may require tuning after being transported from one place to another

the rounds and have multiple performances to deliver. According to Richard Gill, Manager of the NGC Couva Joylanders, blending their band of approximately 90 pans for Panorama can set them back almost TT$40,000 each round.

With such a hefty price tag on blending and tuning, the prospect of having the in-house capability to service pans is undeniably attractive. Manager of the NGC La Brea Nightingales Julius Wilson believes his band can benefit considerably from training: "The NGC-funded MIC-IT programme is a godsend. Being able to manufacture and tune pans will be tremendously beneficial to our band, as it will save us a lot of money. It will also be useful to have a resident tuner who is able to fix problems or make adjustments to our instruments immediately, without us having to wait to bring someone in."

In-house tuners also have the advantage of intimate knowledge of the instruments. "Tuning is a craft," says Wilson, "Just because someone has the qualification, that doesn't mean they know how to get the best out of your particular pans." Having a locally based pan tuner who is familiar with the pans and invested in the band as a member, will be a welcome development for the NGC La Brea Nightingales, who currently rely heavily on a tuner from Arima.

The gains will be even more pronounced for the NGC Steel Xplosion, based in Tobago. While there are a number of certified tuners in Trinidad, there is only one certified in-house tuner on the sister isle. Most bands must fly their tuners in from Trinidad when their instruments require tuning or repair, which is both costly and time-consuming.

This is one reason why Kenrick Noel, Manager of NGC Steel Xplosion, is excited about the MIC-IT training

NGC's investment in the training of its sponsored bands is simultaneously an investment in the industry as a whole, as graduates can go on to specialise and service the national market.

initiative: "This is a great opportunity! NGC has pushed ahead of other companies in this regard. Many Tobago bands have Trinidad-based sponsors, and they think everything must come from Trinidad. However, with this training programme, we can take charge of our future. We must get to that point!"

Noel is also optimistic about the impetus this training will give to the band as a business. "NGC Steel Xplosion has yet to develop as a self-sufficient business. Having members trained and exposed to the industry, we can look to build our Steel Xplosion Company and perhaps manufacture and tune pans for Tobago."

Fitzroy Lewis of the Gonzales Sheikers shares the view that this programme can help his band grow and improve, especially since participants will be required to stay with the band for a period of time upon completion of the training. "Perhaps they may even start tuning for other bands," he adds, "which would be great from a financial perspective."

Building the industry

Indeed, offering training to NGC-sponsored bands is not merely about building capacity and self-sufficiency – this programme will strengthen a trade and industry that could falter without the right attention.

"Master tuners are getting older," says Gill of NGC Couva Joylanders, "and we have seen little interest among the younger generation in terms of independently pursuing pan tuning. This programme will help create interest in studying and developing the artform."

As the creators of pan, Trinidad and Tobago should have authoritative expertise in the manufacture and tuning of the instrument. However, waning interest in and espousal

NGC Couva Joylanders make music

of the trade could endanger the local steelpan industry and allow international suppliers to jump ahead in terms of production and capability. This is a sad prospect for the birthplace of the instrument.

Against this possibility, the NGC and MIC-IT partnership assumes greater importance. NGC's investment in the training of its sponsored bands is simultaneously an investment in the industry as a whole, as graduates can go on to specialise and service the national market.

They need not be limited to one service either. Besides learning how to sink, groove and tune pans, participants in the MIC-IT programme will be taught basic welding and machine shop skills. This will enable them to build pan stands, repair broken instruments, or customise tools such as sledgehammers to suit the manufacturing process. They will also be introduced to sound engineering, music technology and computer applications used in the industry. There is consequently scope for a diversity of pan-related career paths to grow out of this three-year training programme.

An avid pannist, composer and arranger, NGC President Mark Loquan, is duly excited about this initiative and its potential to impact the industry: "This is the beginning of an exhilarating period in NGC's continued involvement with the national instrument in furtherance of our push for the sustainability of our sponsored and assisted steelbands. We expect great things to come of this partnership, not least a more secure future for steelpan music."

TO REFLECT ON THE BEAUTY THAT SURROUNDS US HERE IN TRINIDAD AND TOBAGO

A seabird takes flight into the sunset at King's Wharf, San Fernando, in this photo by Sherwin Williams, NGC.