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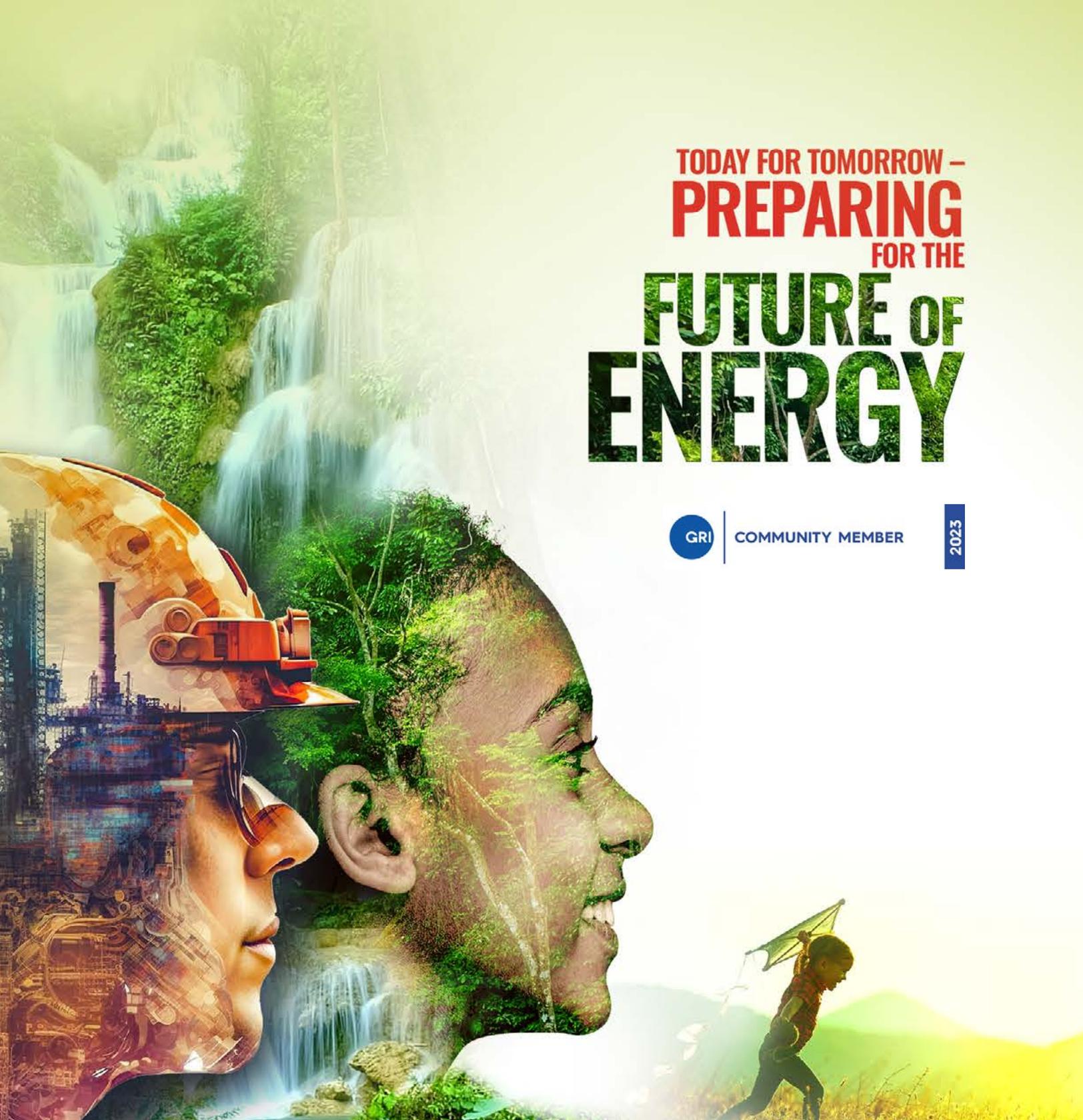
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TODAY FOR TOMORROW –
PREPARING
FOR THE
**FUTURE OF
ENERGY**



COMMUNITY MEMBER

2023





PRESIDENT'S MESSAGE

Today for tomorrow | 01

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Today for tomorrow

Every year, the World Economic Forum (WEF) issues a report cataloguing the major short-term and long-term risks facing the planet, based on insights from hundreds of experts across academia, business, government, the international community and civil society.

Reflecting on the global risk landscape over the past three years, as assessed by the WEF, the volatility of this time in history is clear to see. This decade is already overshadowed by consecutive and interconnected global crises linked to health, economic, humanitarian, geopolitical and environmental concerns, which continue to evolve in unpredictable ways.

What stands out, however, is that even as the world grapples with the multidimensional fallout of a pandemic and war, climate action failure and/or extreme weather events have been named the top long-term risks for the past three years.¹ This assessment makes it clear that the risks posed by climate change continue to seethe in the background, and at some point in the near future, are projected to supersede all other threats. We cannot afford to leave that burner unattended.

We need to think ahead and plan for tomorrow.



Planning for tomorrow

In this issue of *GASCO News*, our main focus is on the idea of anticipatory planning and investment to pre-empt - or at the very least manage - the risks of tomorrow, in ways that simultaneously generate economic and societal benefits.

For example, to support climate action, we need to invest in renewable energy technologies. As a region, there is vast potential in this area, which can help us reduce our reliance on imported fossil fuels while shrinking our carbon footprint. This investment will have the added benefit of strengthening our energy security, since domestic energy production will protect us against the vagaries of external markets.

At the same time, we need to be cognisant of the externalities and tradeoffs of renewable energy value chains. How do we manage waste and the environmental footprint of clean energy production processes? The last thing we want is to unwittingly create new problems through our efforts to solve existing ones. Fortunately, there is room for entrepreneurship and innovation to make clean energy even cleaner, using engineering solutions and reverse supply chains.

Even as we work to bring emissions in check and slow the pace of climate change, we need to take steps to remediate the damage that has already been done. The WEF has identified biodiversity loss as one of the top risks associated with climate change and unsustainable development practices. Restoration of degraded forests is one approach to help address that loss, as revealed in a study recently conducted by The University of the West Indies at NGC's reforestation sites in South Trinidad.

These and other topics will be explored in the articles that follow. We hope they give some insight into both why we must and how we can plan for the risks of tomorrow. ■

Mark Loquan
President

¹ <https://www.weforum.org/reports/global-risks-report-2023/>; <https://www.weforum.org/reports/global-risks-report-2022/>; <https://www.weforum.org/reports/the-global-risks-report-2021/>



TODAY FOR TOMORROW – PREPARING FOR THE FUTURE OF ENERGY

ESTIMATED READ TIME: 6 MINUTES





“ Even as we push to harness renewable sources of energy, we need to seize every low-hanging opportunity to lower our net carbon output in the interim. ”

KEY TAKEAWAYS

Although climate action is urgently needed, making the necessary changes in our energy mix and consumption practices requires time, and alignment among stakeholders with often competing priorities.

For that reason, even as we push to harness renewable sources of energy, we need to seize every low-hanging opportunity to lower our net carbon output in the interim.

These include using natural gas as a transition fuel, addressing methane emissions, and using carbon offsets.

We also need to build a strong defence through climate change adaptation strategies.

Conversations about the future of energy invariably evolve into conversations about climate action and adaptation.

We have heard in many permutations of language, on many platforms, that our planet stands on the precipice of climate chaos. However, unlike in cinematic scenarios, we cannot expect some deus ex machina to pull us back from the edge at the last second. Instead, our hope for

salvation lies in our own collective determination not to fall, by making the necessary adjustments to our energy diet (inter alia).

That said, though we know what is at stake and are already seeing the climate chaos unfurl, why has it been so difficult for us to galvanise forceful and meaningful action against climate change? Particularly within the energy space, why is it so difficult for the world to curb the runaway emissions problem? As

climate lobbyists tell it, is the need for decarbonisation not sufficiently urgent to justify hard limits on further fossil fuel development?

Though it seems a simple enough choice – adjust or face perilous consequences – the truth is that making the changes we need to make in our energy mix and consumption practices requires time, and alignment among stakeholders with often competing priorities.



How do you convince billions of people around the world who depend on coal and oil for power generation and heat that they need to accelerate a shift to alternative energy sources that could be less reliable, more expensive, or logistically challenging to integrate in the short to medium term? The immediacy of hunger and poverty will always obscure the long view. For countries that have just begun to develop hydrocarbon reserves and generate wealth for their people, how do you say - your growth is inconvenient?

The reality is that we cannot dismantle fossil fuel-based energy systems overnight. Not only is it infrastructurally infeasible, but attempting to quit fossil fuels without proper planning will destabilise economies and societies.

This is not to say that pressure to transition quickly is not needed. Certainly, every day of inaction brings us closer to the edge.

However, even in countries where decarbonisation of energy is high priority, the systemic overhauls required to make the transition will take time to realise.

For that reason, even as we push to harness renewable sources of energy – which we are doing aggressively – we need to seize every low-hanging opportunity to **lower our net carbon output in the interim**. At its core, this is fundamentally a sustainability challenge – finding a way to meet our energy needs today in a way that does not make life more difficult for us tomorrow.

For one, this means capitalising on transition fuels such as natural gas, which has the lowest emissions profile of the fossil fuels and a healthy market supply. This is one reason why The NGC Group has been assessing options to support micro-LNG projects across the Caribbean, that can potentially displace some of the crude oil from the regional energy mix. It is also a reason to welcome the progress that has been made on restructuring Trinidad and Tobago's LNG production business. A more streamlined Atlantic will strengthen the country's LNG export capacity, and by extension, our ability to help fuel the global energy transition.

Of course, we harbour no delusions that natural gas is 100 percent clean. It is equally important to find solutions that can reduce the carbon output from the gas value chain today.



▮▮ For those emissions we cannot avoid, we need to compensate with offsets so that net emissions can remain low. One mechanism is to invest in carbon sequestration projects, whether by creating artificial sinks (eg. injection wells) or natural carbon vaults, as NGC did with our large-scale reforestation programme. ▮▮

One approach is to ensure as much of it stays in the pipeline as possible, by focusing on asset integrity and leak detection and repair. For us at NGC, methane mitigation is a priority focus of our business, because we understand its climate impact. For those emissions we cannot avoid, we need to compensate with offsets so that net emissions can remain low. One mechanism is to invest in carbon sequestration projects, whether by creating artificial sinks (eg. injection wells) or natural carbon vaults, as NGC did with our large-scale reforestation programme.

Even as we take action today to change the current and future global emissions profile, we must confront our ghosts of emissions past. We cannot soon escape the cumulative impact of carbon emitted since the age of industrialisation, so we need to build a strong defence through climate change adaptation strategies.

The meteorology of our planet is changing rapidly, with concerning implications for agricultural cycles and soils, the biosphere, human settlement patterns and the integrity of our built environment. While we work in earnest to prevent further deterioration of climate stability, we need to start adapting our habits and habitats, so we can build more resilient societies and continue to meet our basic human needs for food and shelter in a warmer, wetter world.

This is one reason behind NGC's recent investments and partnerships around food and nutrition security, green infrastructure and sustainability education. Over the coming months, we will intensify our focus on these and other adaptation strategies.

Given energy's many intersections with other development and sustainability challenges, forecasting



the future of energy is a complex exercise. One need only look at the impact of the war between Russia and Ukraine to appreciate that future energy markets can be influenced by factors beyond our control:

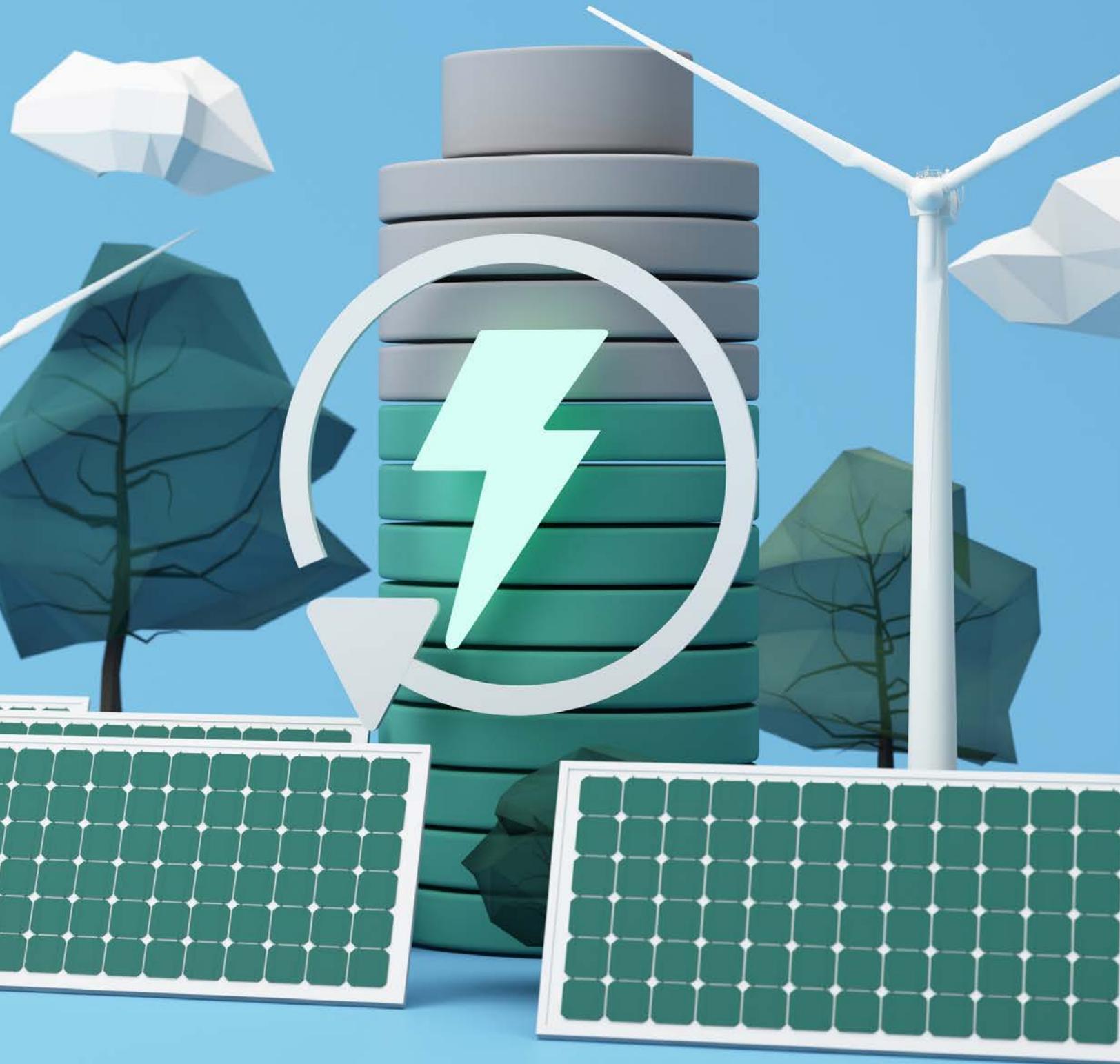
- How will political and cultural priorities shift in the coming years?
- Will technology deliver the anticipated acceleration in the transition to renewables?
- Will promised financing for green projects be readily available?
- Will countries be willing to forego immediate development aspirations and value clean over cheap and fast?
- How will climate change shape our energy needs and markets?

Navigating those uncertainties will be challenging, no doubt, but hearteningly, our domestic energy sector has demonstrated malleability in the past few years. We have advanced solar, wind, green hydrogen, and biofuels projects, even as we work to strengthen our natural gas sector. Come what may, our people are resourced and driven enough to guide us through change. Importantly, The NGC Group and other leading energy companies have had the climate-awareness and foresight to begin diversifying, to ensure Trinidad and Tobago has a long and *sustainable* future in energy.

We are determined not to give up. ■

THE SHADES OF GREEN - ADDRESSING THE UNINTENDED CONSEQUENCES OF CLEAN ENERGY PRODUCTION





ESTIMATED READ TIME: 7 MINUTES



KEY TAKEAWAYS

There are tradeoffs and externalities of clean energy value chains that we need to address before they evolve into problems, including waste and environmental impacts associated with production processes and deployment of clean energy technologies.

Early identification of risks and challenges allows us to find pre-emptive solutions and create commercial opportunities in the process.



At the close of the 19th century, the city of New York was grappling with an urban crisis. With thousands of horses pulling carriages and cabs through its streets every day, millions of pounds of manure were being produced and deposited along its thoroughfares. Mechanisms for collecting and disposing of this waste could not keep pace, leading to a host of mobility, health and sanitation issues.

So it was that when Henry Ford’s affordable automobile was introduced some years later, the innovation was hailed as a solution for cleaning up the transportation sector. Cars replaced horses, and manure became a problem of the past. At the time,

however, it was not foreseen that within a century, that solution would contribute to a world-scale climate crisis.

This story is worth remembering as we enter a new age of energy. Today, we are looking to harness renewable forms of energy to help halt and reverse climate change. However, just as the automobile replaced old challenges with new ones, there are tradeoffs and externalities of clean energy value chains that we need to address before they evolve into problems. Early identification of risks and challenges allows us to find pre-emptive solutions and create commercial opportunities in the process.

THE CHALLENGE OF WASTE

By definition, renewable energy is inexhaustible in supply – any sunlight, wind, wave energy and geothermal heat we use are replenished through natural processes. However, the infrastructure with which we capture and convert those forms of energy has a finite lifespan.

Solar panels, wind and water turbines, pumps and generators are built using materials and mechanical parts that inevitably deteriorate and lose efficiency. The narratives around renewable power seldom speak of the waste generated when those parts or entire systems are replaced or decommissioned, or the emissions produced during their manufacture.



Recycling waste from damaged or decommissioned solar arrays presents both challenges and opportunities.

Consider solar arrays as an example.

THE AVERAGE LIFESPAN OF A SOLAR PANEL IS AROUND **30 YEARS**.



On paper, this seems to be a long enough timeframe to make waste from the industry manageable. However, as with many other appliances and devices we use today, consumers do not always run solar systems through their full lifespan. Technology and innovation are making panels more efficient, affordable and accessible, and tax incentives are encouraging greater uptake. Not only are more consumers entering the market, but existing users are seeing practical benefit and economic merit in replacing their older systems earlier than necessary.

IN 2016, THE INTERNATIONAL RENEWABLE ENERGY AGENCY (IRENA) HAD PROJECTED THAT GLOBAL WASTE FROM SOLAR PV PANELS COULD TOP

78Mn tonnes

BY 2050¹

HOWEVER, BASED ON THE RATE OF TURNOVER AND ADOPTION WE SEE TODAY, OTHER RESEARCHERS SUGGEST WE WILL GENERATE THAT VOLUME MUCH SOONER.²

One challenge with that waste is that most solar PV modules are comprised of glass which often cannot be recycled because of

impurities.³ Moreover, when dumped into landfills, toxic chemicals such as lead and cadmium can be leached out of the modules into soil and groundwater sources.

To the extent that they can be recycled, there are additional challenges that make the process burdensome. For instance, the fact that most panels have long lifespans and are composed of low-value glass has disincentivised investment in recycling infrastructure.⁴ There are consequently few facilities that provide that service, making the cost of recycling high. In the US, it costs around US\$25 to recycle a solar PV panel, while it costs US\$1-2 to transport it to a landfill.⁵

That said, the challenge of solar waste management presents a lucrative opportunity for investors and innovators.

¹ https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf?rev=49a75178e38c46288a18753346fb0b09

² <https://hbr.org/2021/06/the-dark-side-of-solar-power>

³ <https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/?sh=65f37933121c>

⁴ <https://hbr.org/2021/06/the-dark-side-of-solar-power>

⁵ <https://www.wired.com/story/solar-panels-are-starting-to-die-leaving-behind-toxic-trash/>



82%

OF THE WORLD'S MINING AREAS TARGET MATERIALS THAT ARE CRITICAL FOR RENEWABLE ENERGY PRODUCTION.⁹

Rystad Energy has predicted that recyclable materials from PV panels at the end of their lifespan will be worth more than US\$2.7 billion in 2030 - up from only US\$170 million in 2022 - and approach US\$80 billion by 2050.⁶

This is because of increasing demand for panels and higher demand for their mineral and material inputs. Entrepreneurship in end-of-life management of solar panels can therefore generate significant economic returns and employment opportunities.

The same holds true for other renewable energy technologies. Researchers estimate the US will have more than 720,000 tonnes of wind turbine blade material to dispose of over the next 20 years.⁷

These blades, usually made from a mix of resin and fiberglass, have little resale value, and are difficult and expensive to transport to landfills. There are, therefore, valuable commercial opportunities for startup companies exploring options for recycling these blades.⁸

IMPACT ON THE BIOSPHERE

While the problem of waste occurs at the end of the clean energy value chain, there are also threats at the top. Production of renewable energy infrastructure depends heavily on mineral inputs such as lithium, cobalt, copper and neodymium, and there are environmental concerns around mining these minerals.

However, ironically, the mining industry is notorious for its environmental footprint. In China - where most of the world's

neodymium is mined for creation of the magnets used in wind turbines, electric motors and electronics - the high environmental cost of extraction of the mineral can be seen in the Baotou Lake. Toxic sludge from the mining process - including radioactive clay - are dumped into the lake, with unquantified but irrefutable impacts on surrounding communities and landscapes.¹⁰

To treat with this issue, stricter regulations will be needed in mining jurisdictions to ensure companies treat and properly dispose of their waste and remediate the environment around mining sites. Mining can also affect endangered species, as a percentage of the world's mining sites overlaps with areas that are protected for their biodiversity.¹¹ As demand for renewables increases, so too will the footprint and intensity of mining, and the possibility of greater encroachment on sensitive habitats.

⁶ <https://www.rystadenergy.com/news/reduce-reuse-solar-pv-recycling-market-to-be-worth-2-7-billion-by-2030>

⁷ <https://www.npr.org/2019/09/10/759376113/unfurling-the-waste-problem-caused-by-wind-energy>

⁸ Ibid

⁹ <https://www.nature.com/articles/s41467-020-17928-5>

¹⁰ <https://www.bbc.com/future/article/20150402-the-worst-place-on-earth>

¹¹ Ibid



Hydro-dams can present risks for fish.

Governments and permitting agencies will need to look carefully at protected areas to ensure mining is minimally disruptive - if not prohibited altogether - in such spaces.

Wildlife can also be impacted when renewable technologies are actually deployed. For example, generating power using watercourses involves construction of large hydro-dams. These dams sometimes obstruct migratory routes of fish, and the passageways around their turbine blades can be piscine death traps.¹² The same is true of wind farms, where spinning blades can disrupt avian flight paths and improper siting of offshore infrastructure could lead to infringement on aquatic ecosystems.

Prefeasibility studies of potential deployment sites, as well as research and innovation, are critical to reducing these unintended

consequences. For example, one engineering company in the US has already pioneered a blunt-edged water turbine that is fish-friendly, and is working on developing a distributed system of smaller dams - based on biomimicry of beaver structures - to replace larger and more disruptive hydropower facilities.¹³

MANAGING IMPACT

There is no question that we need to continue investing in and expanding renewable energy technologies - no other solution addresses the climate crisis quite as effectively as the clean energy transition.

At the same time, we cannot ignore that it is not a perfect solution, and there are many actual and potential environmental ills associated with these technologies.

Fortunately, early identification of these problems can allow sufficient investment and research attention to be paid to those areas, so that the negative externalities can be properly managed before they spiral out of control. The invention of new components that do not require as many mineral inputs; innovations designed to reduce the footprint and invasiveness of clean energy structures; and the creation of circular economies around renewables to reduce, reuse and recycle materials; are just a few examples of strategies currently being used to minimise the impact of the clean energy transition. For the prescient and savvy entrepreneur, these strategies can also lead to profitable economic opportunities. Ultimately, in whatever approach we take to clean up our energy production, we must strive to find balance and ensure we do not attempt to solve one problem with another. ■

¹² <https://www.bbc.com/future/article/20200713-the-most-powerful-renewable-energy>

¹³ Ibid



IN PURSUIT OF REGIONAL ENERGY SECURITY

ESTIMATED READ TIME: 8 MINUTES



KEY TAKEAWAYS

Energy security refers to the uninterrupted availability of energy sources at an affordable price.

Factors undermining regional energy security include high dependency on imported fuels, weather events and investment roadblocks.

Diversification of the energy mix, development of regional resources, installation of more climate-resilient energy infrastructure and enabling policy environments can all help address current challenges.

Positively for our region, the necessary conversations around energy security are happening. Recognition of the threats is an important precursor to adequate preparation. If current momentum can be sustained, we can make welcome progress towards building a more secure energy future.

In 2022, following the Russian invasion of Ukraine, the disruption of energy supply chains in Europe triggered a continental scramble to find alternatives to Russian oil and gas. The resultant tightening of energy supply, logistical challenges and soaring prices have undermined European energy security. This has been a particularly destabilising consequence of the war - you cannot produce and feed, sustain and grow, defend and rebuild without a secure supply of energy.

Caribbean and Latin American territories have noted the European crisis and begun to assess their own energy needs and vulnerabilities, asking the question - are we energy secure?

With this topic now a pressing matter on the regional political agenda, it is important that we understand the goal we are pursuing. What exactly

is energy security and what are the challenges we must overcome to achieve it?

WHAT IS ENERGY SECURITY?

The International Energy Agency (IEA) defines energy security as the uninterrupted availability of energy sources at an affordable price.¹ Parsing this definition, we can pull out three conditions for energy security. Firstly, there must be enough supply to meet demand (availability). Secondly, that supply must be steady and reliable (uninterrupted). Thirdly, its cost must make it accessible to consumers (affordable price). Energy security is therefore impacted if anything stands in the way of those conditions being met.

These conditions also have a temporal dimension. Long-term energy security is bolstered when there are timely investments that ensure future supply stability. On

the other hand, short-term security is achieved when energy systems are adequately equipped to react to any sudden changes in the supply-demand balance.²

¹ <https://www.iea.org/topics/energy-security>

² Ibid

WHAT THREATENS OUR ENERGY SECURITY?

In the Caribbean and Latin America, there are several factors that weaken our energy security.

Dependence on imported fuels

At present, many Caribbean islands still depend heavily on imported crude for power and transportation. In fact, in his address at Guyana's International Energy Conference and Expo 2023, Trinidad and Tobago's Prime Minister Dr. Keith Rowley shared that imported petroleum products represent 87% of primary energy consumption in the region.³ Small wonder, then, that according to World Bank data, the Caribbean collectively has the highest dependency on imported energy

in the Western Hemisphere.⁴ The greater part of that energy comes from North and South American sources, although a percentage of the market is supplied by European, Asian and African producers.⁵

This dependency impacts the region's short-term energy security. Heavy reliance on external suppliers, coupled with insufficient domestic supply/capacity to meet demand, puts countries at the mercy of the market. Anything that impacts the source of supply – be it supply chain failures, policy changes, trade embargoes or geopolitical developments – will in turn impact the importer's ability to meet its energy needs. Even when countries have sufficient buffer in the form of multiple supply sources, there is still a risk of interruption. Challenges along logistics routes due to weather

events, accidents or even acts of terror could hinder the timely and safe delivery of energy commodities to their destinations.

Importation of fuels also has implications for the cost of energy. Caribbean consumers pay the highest electricity rates in the Western Hemisphere – prices are on average four times higher than in the United States, in large part because of the dominance of imported fuels.⁶ Moreover, as price-takers, regional energy importers must absorb any surges in market prices, such as those that have occurred due to the COVID-19 pandemic and the Russia-Ukraine war. Except where they are offset by transfers and subsidies, higher purchase costs for fuels on the international market are passed along to consumers. More expensive energy inflates prices and drives up the overall cost of living.

AT GUYANA'S
INTERNATIONAL ENERGY
CONFERENCE AND
EXPO 2023, DR. KEITH ROWLEY
SHARED THAT IMPORTED
PETROLEUM PRODUCTS
REPRESENT

87%

OF PRIMARY ENERGY
CONSUMPTION IN THE REGION



³ <https://guardian.co.tt/news/the-prime-ministers-speech-at-guyanas-international-energy-conference--expo-6.2.1633618.f2ed9444f7>

⁴ <https://www.csis.org/analysis/reimagining-us-strategy-caribbean>

⁵ https://wits.worldbank.org/CountryProfile/en/Country/LCN/Year/2020/TradeFlow/Import/Partner/all/Product/27-27_Fuels

⁶ <https://www.csis.org/analysis/reimagining-us-strategy-caribbean>



Energy infrastructure is vulnerable to extremes of weather.

Weather events

In recent years, Latin American and Caribbean territories have begun to increase investment in renewable energy technologies. Of the energy sources being harnessed, solar, wind and hydropower are most prevalent. However, the infrastructure used in these systems is vulnerable to extremes of weather.

For example, wind turbines currently on the market were not designed to withstand the force of Category 5 hurricane winds.⁷ Although some innovators are working to address this, existing wind farms in the Caribbean are at risk, considering the increased frequency and intensity of hurricanes.

Severe storms can also damage solar arrays. In the wake of Hurricanes

Irma, Harvey and Maria in 2017, some solar systems in Puerto Rico, the US Virgin Islands and Barbuda were destroyed by winds and debris.⁸ System failures were linked to installation methods and site-specific conditions.

Hydropower plants, which leverage flowing water, can be impacted by changes to the hydrological cycle due to global warming. According to the IEA, “the increased probability of extreme precipitation events such as heavy rainfall, floods and droughts across the world...will increase risks to hydropower generation by altering water availability, increasing sediments, or causing physical damages to assets.”⁹ For Latin America in particular, which generates almost half its electricity using hydropower, these risks can pose a significant threat to energy security.

It is worth noting that renewable systems are not the only energy infrastructure that can be compromised by weather. Storms and hurricanes often cause electricity failures, as winds and floods damage power lines. After Hurricane Maria levelled transmission and distribution infrastructure in Puerto Rico and the US Virgin Islands in 2017, some citizens had no grid power supply for months, in what is documented as the longest blackout in US history.¹⁰ As hurricanes become more prevalent and severe, the region could experience more frequent grid disruptions.

Investment

As mentioned before, long-term energy security hinges on timely investment in future sources of supply. If the region hopes to achieve a degree of energy independence

⁷ <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL073537>

⁸ https://rmi.org/wp-content/uploads/2018/06/Islands_SolarUnderStorm_Report_digitalJune122018.pdf

⁹ https://iea.blob.core.windows.net/assets/8fa86b9d-470c-41a6-982e-70acd3fbdda4/ClimatImpactsonLatinAmericanHydropower_WEB.pdf

¹⁰ <https://edition.cnn.com/2018/04/16/us/puerto-rico-blackout-second-largest-globally-trnd/index.html>

In pursuit of regional energy security | CONTINUED

UNDER THE CARIBBEAN SUSTAINABLE ENERGY ROADMAP AND STRATEGY, THE REGION IS TARGETING A RENEWABLE ENERGY ELECTRICITY PENETRATION OF

47%

BY 2027
BUT AN ANNUAL
INVESTMENT OF US\$1.2
BILLION WILL BE NEEDED TO
ACHIEVE THIS GOAL.



in the near future, there needs to be heavy investment in renewables today. As it stands, Aruba, Dominica, the Dominican Republic and Jamaica are among a small handful of countries where renewables account for more than 10 percent of the energy mix.¹¹

Under the Caribbean Sustainable Energy Roadmap and Strategy, the region is targeting a renewable energy electricity penetration of 47% by 2027.¹² However, the region is not on track to easily achieve this goal. An annual investment of US\$1.2 billion – sixteen times the current investment level – will be needed.¹³

The Caribbean Development Bank believes financing for this investment will likely need to be provided by the private sector, since Caribbean governments tend to have heavy debt loads that make it difficult for them to obtain new loans, even from multilateral agencies.¹⁴ However, as the World Bank notes, the relatively small scale of investments

in many Caribbean countries often makes transaction costs for private financiers prohibitively high.¹⁵ The lack of clearly elaborated clean energy policies, regulations and incentives can also deter investors, who need to be sure of their returns.

HOW CAN WE BECOME MORE ENERGY SECURE?

So how do we address some of these challenges and build our short and long-term energy security?

High on the agenda should be accelerating progress toward greater self-sufficiency in energy. This includes developing regional hydrocarbon resources to help supply the market. Looking within the region for energy supplies – at Trinidad and Tobago, Guyana and Suriname, for example – can mitigate the supply chain and logistics risks

associated with importing fuels from distant locations. This is one of the drivers behind NGC's focus on micro-LNG, and its exploration of opportunities to supply Caribbean territories. It is also a factor underpinning recent calls by regional leaders for the Caribbean to be allowed to pursue development of its resources.

At the same time, it is understood that we need to diversify our region's energy mix and increase our installed capacity in renewable energy. The region has enormous potential in this area. The challenge is, of course, ensuring that any new capacity installed is climate resilient.

Innovation will be key in this regard. One of the Caribbean Development Bank's proposals is to install climate resilient rooftops, which can generate electricity and withstand extreme weather events, in 75% of homes in the region by 2035.¹⁶

¹¹ <https://www.caribank.org/newsroom/news-and-events/speeches/keynote-energy-transition-caribbean-challenges-and-opportunities>

¹² <https://www.creec.org/our-work/policy-implementation/>

¹³ <https://www.caribank.org/newsroom/news-and-events/speeches/keynote-energy-transition-caribbean-challenges-and-opportunities>

¹⁴ <https://www.reuters.com/business/energy/caribbean-must-speed-renewable-energy-transition-manage-oil-shocks-official-says-2022-04-27/>

¹⁵ <https://blogs.worldbank.org/latinamerica/clean-energy-caribbean-triple-win>

¹⁶ <https://www.caribank.org/newsroom/news-and-events/speeches/keynote-energy-transition-caribbean-challenges-and-opportunities>

Decentralised systems which allow for more independent power producers to supply the grid, can further build resilience by creating a distributed power generation base - akin to sharing one's eggs among multiple baskets.



Achieving this goal will however require collaboration between private and public sector actors. Learning from others is also important. After hurricane Ian battered Florida in 2022, many communities were left without power, but lights in one solar-powered town remained on.¹⁷ Case studies such as these offer insight into what conditions or physical setups contribute to more resilient renewable energy infrastructure.

Decentralised systems which allow for more independent power producers to supply the grid, can further build resilience by creating a distributed power generation base - akin to sharing one's eggs among multiple baskets. Since renewable energy setups are modular and standalone, failure in one part of

the grid need not impact the whole. Appropriate legislative frameworks and feed-in tariffs will be needed to help build these distributed power generation systems.

Importantly, governments have a responsibility to create enabling environments, to encourage all the investment that must happen if the region is to become more energy secure. Regional collaboration could be key, as a combined market has more purchasing power and allows for economies of scale, while standardisation of certain regulations and processes can significantly improve the ease of doing business. All of these can make the region more attractive to investors.

POSITIVE STEPS

Positively for our region, the necessary conversations around energy security are happening. Recognition of the threats is an important precursor to adequate preparation. If current momentum can be sustained, we can make welcome progress towards building a more secure energy future. ■

¹⁷ <https://edition.cnn.com/2022/10/02/us/solar-babcock-ranch-florida-hurricane-ian-climate/index.html>



UNDERSTANDING REVERSE SUPPLY CHAINS

ESTIMATED READ TIME: 5 MINUTES



KEY TAKEAWAYS

A reverse supply chain is a network of activities, processes, and resources involved in the movement of goods from the end user back to the original production source for the purpose of recapture, reuse, or disposal

There are a number of economic, environmental and legal benefits associated with RSCs, but the Caribbean faces several challenges when it comes to their implementation.

A reverse supply chain (RSC) is a network of activities, processes, and resources involved in the movement of goods from the end user back to the original production source for the purpose of recapture, reuse, or disposal. This type of supply chain is often associated with the return of goods for repair, refurbishment, recycling, or disposal in an environmentally responsible manner.

Those RSCs that closely coordinate with their respective forward supply chains create what we call a closed-loop system. This happens when product design and manufacturing decisions are made with eventual recycling, reuse and reconditioning in mind.

RSC management involves coordinating the various activities

involved in this process, such as logistics, inventory management, and disposal. While reverse logistics (RL) primarily concerns itself with transportation and storage of materials, reverse supply chain management takes a wider and more holistic perspective and deals with products returning to manufacturer or third parties. Figure 1 shows a simple reverse supply chain.

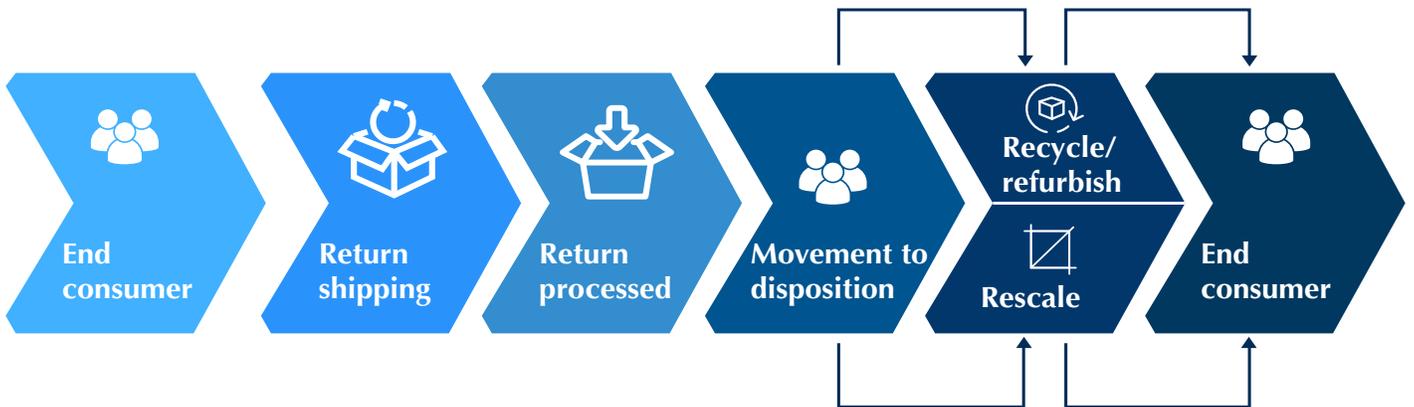


Figure 1: Reverse Supply Chain

RETURNS TO MANUFACTURERS, OR PRODUCTS RETURNED TO THIRD PARTIES, MAY BE NECESSARY FOR A VARIETY OF REASONS, INCLUDING:



Products ‘as new’ where too much of one item were ordered, or wrongly delivered. With new products being introduced (a feature of the linear economy), the excess new stock becomes obsolete



Used or faulty/damaged products, where manufacturing faults, wear, tear and damage occur during shipping or over the product’s lifetime, requiring repair or overhaul



BEST BEFORE

Products at the end of their life, which are no longer useful or wanted

WHY USE RSCs?

For companies, there are several main factors that encourage the use of RSCs, one or more of which may be in play: economic drivers, corporate citizenship, legislative requirements, and risk reduction due to better data protection. Economic drivers for RSCs are related to initiatives around cost minimisation, the generation of revenues or cost savings from remanufacturing, reuse of materials, and product refurbishing. This also includes enhanced return on investment, as units being depreciated add to the bottom line in time for a profitable ROI. Reuse and recycling as a result of implementing reverse supply chains to reduce excess waste in a production process also lead to improved competition in manufacturing.

Companies might also be interested in RSCs due to their awareness of the benefits of positive corporate citizenship and the will to co-initiate voluntarily sustainable approaches to community development, according to environmental and social principles and best practice. Companies that genuinely embrace “green” concepts and processes around sustainability are often held in higher esteem by customers and the general public.

RSCs can be a crucial part of a company’s sustainability efforts, as it helps to reduce the amount of waste that is sent to landfills and reduces the need for raw materials to be extracted from the environment. With a general impetus toward sustainability initiatives, well implemented RSCs are poised to play their part.

Finally, RSCs offer increased data protection, as recycling - when done in accordance with international best practices - helps ensure that company data on their equipment is removed in its entirety, further reducing business risks. As concerns about cybersecurity increase, any initiative that protects consumer data as part of a RSC improves company perceptions.

CHALLENGES

That said, developing countries have challenges in implementing RSCs to reduce waste and improve the useful life of products, compared to more developed countries, especially as most processes in the supply chain are not under their control.

ON THE GREEN AGENDA

Developing countries tend to have less integrated supply chains than their developed country counterparts, which suggests that there are greater inefficiencies along

the primary supply chain, never mind the reverse chain.

While a product can get to a customer, it is significantly more difficult for that consumer to send

the product back up the chain for reprocessing or disposal. The integrated systems (information technology, logistics and otherwise) simply do not exist or are not cost competitive.

OTHER PROBLEMS INCLUDE:



Documentation issues (different language and otherwise)



Quality assurance issues



The inadvertent procurement of counterfeit products



Quantity demanded by foreign suppliers making local sales not practical



Payment methods/ currency issues



The use of outdated technology in the domestic market



Web of distrust between supplier and local agent/ consumer



Specifications of products



Import clearance procedures



Failures to meet delivery time



Value added tax imposed on imported goods or excise duties which make reverse supply chain goods more expensive than traditional linear economy goods

Finally, the distance of Caribbean economies from developed markets and related logistical difficulties has militated against RSCs. However, over the years, there have been initiatives to reuse end-of-life products (clothing, scrap iron) as inputs in new products.

More significantly, certain economic sectors have restructured themselves to minimise waste and maximise repair, refurbishment, and recycling.

One example is the secondhand car market in Trinidad and Tobago and other Caribbean islands. "D Bamboo" has become a centre for repurposing, recycling and reuse of second-hand and end-of-life car parts and cars, and the model has even been extended to other countries such as Barbados.

With the ongoing thrust towards sustainability, other economic sectors would do well to make their

products more sustainable, using RSCs wherever feasible. Effective RSCs provide a sustainable way to reprocess products, whether reused, refinished, refurbished, recycled into new product, or disposed of as waste. This maximises the value of returned goods and minimises the environmental impact of disposal. For manufacturers in industries as diverse as carpets to computers, RSCs are now an essential part of business. ■



NGC's REFORESTATION PROJECT ENHANCING BIODIVERSITY

ESTIMATED READ TIME: 4 MINUTES





KEY TAKEAWAYS

Biodiversity is critical to combat climate change and sustain life on the planet.

Following its reforestation programme, NGC engaged The UWI to assess the impact of the programme on biodiversity at the project sites.

The UWI study revealed that there was a higher relative abundance of red brocket deer, ocelot, tayra, tamandua and red-tailed squirrel at the NGC reforestation sites.

WHAT IS BIODIVERSITY AND WHY IS IT IMPORTANT?

Biological Diversity – or Biodiversity – refers to the diversity within species, between species and of their interconnected ecosystems (World Economic Forum 2023). Biodiversity is critical to combat climate change and sustain life on the planet. The variety of plant and animal life contributes towards the world’s food supply, raw materials for manufacturing, and employment of people. A healthy biodiversity leads to a healthier and more secure supply of food, materials and medicine, and more vibrant economies. Biodiversity is strongly correlated to climate change. For example, ecosystems such as rain forests, produce oxygen and help keep the planet cool. Loss of rain forests accelerates global warming. In turn, increased temperatures result in loss of biodiversity, leading to spiralling negative impacts on the planet.



NGC’S REFORESTATION PROJECT

Human activity over the past 50 years has resulted in the loss of 60 percent of vertebrate species and 50 percent of all plants (World Economic Forum 2020). However, humankind has the power to reverse these trends and prevent further loss of biodiversity. Recognising its role as a leader in the movement towards a low carbon future, NGC embarked on a study in 2022 to ascertain the impacts of the Company’s signature 315 Reforestation Project on biodiversity.

NGC initiated the Reforestation Project in 2005 to replace forests that had been inevitably removed to make way for the Company’s Cross Island Pipeline (CIP) and Beachfield Upstream Development (BUD) Projects.

NGC committed to the ‘No Net Loss Principle’ as part of its Corporate Social Responsibility programme, in alignment with the National Environmental Policy of Trinidad and Tobago. NGC worked in collaboration with the Ministry of Agriculture, Land and Fisheries Forestry Division and communities to replant 315 hectares of forest in the south-west and south-east forest conservancies in Trinidad.

**FROM 2005 TO 2018,
100,000+
seedlings
of 17 species
of trees**

WERE PLANTED AT THE MORNE L’ENFER FOREST RESERVE NEAR LA BREA AT ROUSILLAC AND GUAPO, THE VICTORIA-MAYARO FOREST RESERVE IN MORUGA, AS WELL AS MAYARO AND RIO CLARO.

THERE WAS A HIGHER RELATIVE ABUNDANCE OF RED BROCKET DEER, OCELOT, TAYRA, TAMANDUA AND RED-TAILED SQUIRREL AT THE NGC REFORESTATION SITES.



IMPACT ON BIODIVERSITY

In 2022, NGC engaged The University of the West Indies (The UWI) to conduct a study to determine the impact of the Reforestation Project on biodiversity. The UWI had previously conducted studies to estimate the amount of carbon dioxide sequestered by the project both above and below ground and was familiar with the reforested area. The main objective of the study was to determine how the reforestation programme had enhanced tree and mammal biodiversity in selected areas. The study was conducted at Grants Trace, Rousillac, and Guapo Parrylands, Morne L'Enfer, as sufficient data was available to conduct species richness calculations in these large areas.

Data outputs from the Rapid Botanical Survey (RBS) conducted by The UWI National Herbarium in collaboration with the Forestry Division and Oxford University in 2005, was compared with data recorded for Phase 1 of NGC's Reforestation Project in 2018. The RBS took place shortly before the

NGC replanting exercise commenced, and therefore provided a reliable reference point for comparison. A range of indices was employed to determine the impact on biodiversity including:

- **Species richness** - calculated using the Margalef Index (d), a measure of the total number of species (S) present for a given number of individual trees (N)
- **Equitability or evenness** - expressed as Pielou's Evenness Index (J'), a measure of how evenly the individual trees are distributed among the different species
- **Diversity** - measured using the Shannon-Wiener Diversity Index (H'), a measure of the proportion of the entire community made up of a particular species. The higher the value of H', the higher the diversity of species in the community.

The results showed that there was an increase in all indices following NGC's reforestation programme, providing emphatic evidence that the programme enhanced biodiversity.

The impact of the reforestation initiative on eight species of wild terrestrial mammals was also assessed: red brocket deer, ocelot, tayra, nine-banded armadillo, common opossum, southern tamandua, red-rumped agouti, and red-tailed squirrel. This was achieved through the deployment of 10 Reconyx HC 600 Hyperfire camera traps. The cameras were set to capture three images every time they were triggered with no delays between captures. Over a period of 50 days, a total of 2,761 photos were taken in the Morne L'Enfer Forest Reserve near La Brea at Rousillac and Guapo, Parrylands.

While there was no baseline data on the relative abundance (number of camera captures per 100 trap days) for the study sites, the survey results could be compared to similar survey sites in the Trinity Hills and Central Range of Trinidad. The comparison revealed that there was a higher relative abundance of red brocket deer, ocelot, tayra, tamandua and red-tailed squirrel in the NGC reforestation sites.



Table 1 – Comparison of Indices

	Results of 2005 – 2008 Survey by The UWI National Herbarium, Forestry Division and Oxford University
	Results of 2018 Report on Phase 1 of NGC Reforestation Project

Sample	S		N		d		J'		H'	
	2005	2018	2005	2018	2005	2018	2005	2018	2005	2018
Guapo 1	118	129	138	146	23.78	25.68	0.9924	0.9945	4.735	4.836
Guapo 2	113	117	139	142	22.70	23.41	0.9937	0.9937	4.698	4.733
Rousillac 1	62	69	138	84	14.03	15.35	0.9925	0.9927	4.096	4.203
Rousillac 2	135	144	158	165	26.46	28.00	0.9941	0.9950	4.877	4.945

Where S = total number of species present

N = number of individuals

d = Margalef index of species richness

J'= Pielou evenness index (i.e., how evenly the trees are distributed among the different species)

H'= Shannon-Wiener diversity index

SPECIES OF TREES PLANTED DURING NGC'S REFORESTATION PROJECT:

Acurel (*Trichilia smithii*), Apamate (*Tabebuia rosea*), Argalie (*Clusia rosea*), Black heart, (*Clathrotropis brachypetala*), Cedar (*Cedrela odorata*), Crappo (*Carapa guianensis*), Mahoe (*Sterculia caribaea*), Mahogany (*Swietenia macrophylla*), Pois doux (*Inga laurina*), Wild camphor (*Tarchonanthus camphoratus*), Wild chataigne (*Pachira insignis*), Bois d'orme (*Guazuma ulmifolia*), Hogplum (*Spondias mombin L.*), Roble (*Platymiscium trinitatis*), Cypre (*Cordia alliodora*), Yellow Olivier (*Buchenavia capitata*), Balata (*Manilkara bidentata*), Cajuca (*Virola surinamensis*), Locust (*Hymenaea courbaril*), Galba (*Calophyllum lucidum*), Pommerac (*Syzygium malaccense*), Chennet (*Melicoccus bijugatus*), Mango (*Mangifera indica*) and Poui (*Tabebuia sp.*)

CONCLUSION

The evidence from the study shows emphatically that the NGC Reforestation Project that commenced in 2005 and concluded in 2022 has enhanced both plant and mammal biodiversity. The exercise yielded additional benefits as well, with the observation that deer appear to be switching from diurnal to nocturnal patterns. Also encouraging is the comparatively high number of ocelot recorded, given the animal's status as an environmentally sensitive species in Trinidad and Tobago.

Though the Reforestation Project began as a provision of

the Company's Certificate of Environmental Clearance for its pipeline projects, the initiative evolved over the years to become part of NGC's CSR practice and sustainability culture. Having completed all phases of the project, NGC formally handed over the replanted forests into the care of the Forestry Division on 21 March 2023. However, NGC's commitment to environmental preservation does not end here. We continue to explore opportunities to partner with stakeholders and communities through The NGC Group's Green Agenda to contribute towards environmental entrepreneurship, carbon reduction and further enhanced biodiversity. ■

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BUILDING STRONGER WITH TECHNOLOGY - THE SAP BUSINESS TRANSFORMATION PROGRAMME



ESTIMATED READ TIME: 4 MINUTES



KEY TAKEAWAYS

NGC is implementing a series of technology upgrade projects under its SAP Business Transformation Programme which target better integration and functionality for the organisation.

Benefits will include automation of manual processes, greater synergies among work units, better internal and external customer service, and better data management and visualisation to support decision-making.

NGC and its subsidiaries have been using the SAP suite of products for many years. The SAP Business Transformation Programme involves implementing new processes and systems to deliver better integration and functionality for the organisation.



In the modern era, business success has time and again been linked to how effectively companies have leveraged available technologies to cut costs, work more efficiently and innovate products and services. Today, there are countless tools and applications available to support and streamline business operations. To remain competitive, companies must therefore pull technology into the heart of their growth strategies.

Over the past few years, The NGC Group has done just that, making technology a cornerstone of its efforts to build a more agile

organisation and global energy brand. This has involved integration of both hardware and software solutions that have reduced risk and process inefficiencies.

The latest initiative being undertaken is one that will have a major impact on the way the organisation manages its data and certain key processes. It involves implementing a best-in-class technology solution from SAP - one of the world's leading producers of software for the management of business processes, or enterprise resource planning (ERP). The initiative is called the SAP Business Transformation Programme (SAP BTP).

WHY THIS PROGRAMME?

Currently, employees operate within relatively autonomous divisions and departments, using different applications and digital platforms to execute work processes and manage data. In some areas, processes are still paper-based, or use dated software systems. If one wanted to analyse trends across the company or share data between work units, this would usually involve a lengthy process to access and use the data. These systems and ways of working hinder productivity, as tasks take longer to execute, and there is no centralised repository of data to support management decision-making.

THE SAP SOLUTION

To support the company's drive to grow into a global energy brand operating at the highest international standards, The NGC Group recognised the importance of digital transformation. Specifically, the following needs were identified:

1. **Replace** the business enterprise platform used to manage day-to-day activities (eg. procurement, inventory management, vendor management, sales, asset management, people management, finance etc.) with an integrated solution using best practice processes and advanced functionalities.
2. **Introduce** a digital solution that will help integrate all disparate processes and systems into a unified structure, enable real-time information access and flows, reduce manual workloads and introduce best practice business processes.



In the same way that a group of people working in the same room can communicate more immediately and effectively with one another, the company realised that if all organisational processes and data were connected to a central platform,

employees would be able to share, visualise and process information far more efficiently.

This is where the SAP solution comes in. NGC and its subsidiaries have been using the SAP suite of products

for many years. The SAP Business Transformation Programme involves implementing new processes and systems to deliver better integration and functionality for the organisation.



HOW WILL THIS **HELP** THE COMPANY?

- **By helping remove silos and allowing real-time access to data, staff can achieve synergies and greater efficiency in how they deliver work.**
- **New processes will automate manual ones, creating more time for other activities.**
- **In addition to supporting more agile management practices, this programme will enable quick response time to meet the demands of internal and external customers.**
- **The solution will allow the company to leverage artificial intelligence (AI), machine learning, big data and analytics to see trends in the business, generate more intuitive dashboards and make better informed decisions.**



PROGRAMME LOGISTICS

This programme is being implemented across NGC, National Energy, NGC CNG and LABIDCO. At this time, over 100 persons from both The NGC Group and SAP are involved in the phased implementation of the SAP BTP.

Managing the many moving parts of this programme is a team of leaders

and support staff from across the organisation.

The transition to the new SAP system will involve the introduction of new processes, migration of data from legacy systems, and innovative ways of working. Training will therefore be provided over the coming months to ensure all employees are equipped to use the new system. This training will upskill staff and strengthen the company's talent pool. Since some processes will impact how the

company interacts with its suppliers and business partners, there will also be onboarding activities for external stakeholders once the new systems are in place.

Implementation of the programme is expected to run through the end of 2023. Upon completion, the SAP BTP will move the state enterprise leagues forward, and strengthen its sustainability and competitiveness over the long term. ■

One Moment Please

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



Leatherback sea turtle on the beach in Grande Riviere.



THE NATIONAL GAS COMPANY
OF TRINIDAD AND TOBAGO LIMITED



PHOENIX PARK
GAS PROCESSORS LIMITED



LAB|DCO
LA BREA INDUSTRIAL
DEVELOPMENT COMPANY LIMITED



Trinidad and Tobago NGL Limited



NGC CNG
Company Limited



CORPORATION OF TRINIDAD AND TOBAGO

THE NGC GROUP OF COMPANIES