



# GUYANA'S GAS-TO-POWER POTENTIAL

BY KATHRYN HILLIS



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## Introduction

In May 2015, the fortunes of the small Caribbean nation of Guyana were forever changed when ExxonMobil and its partner Hess Corporation discovered oil 120 miles off the coast in the Stabroek block.<sup>1</sup> Hess estimates that the discoveries amount to 9 billion barrels of recoverable crude oil.<sup>2</sup> Production and shipment of petroleum from Guyana began in February 2020. Oil exports were accompanied by predictions that the

wealth of the country would skyrocket along with its development. The oil discovery shocked Guyana, a developing and largely agricultural nation of roughly 800,000 people. The oil discovery continues to reverberate and was at the forefront of the country's recent election and change in government. At current estimates, the country will eventually produce almost a barrel of oil per citizen every day.<sup>3</sup>

The relationship between the Guyanese government and the International Oil Companies (IOCs) operating in the country

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<sup>1</sup> Baddour, "Massive Guyana Oil Find."

<sup>2</sup> Starr, "Resource Estimate at Guyana's Stabroek Block Raised to 9 Billion BOE"

<sup>3</sup> Kurmanaev, "A Small Country."

has not been without issue. Many local and international observers have called the production-sharing contract between the government, ExxonMobil, and Hess unfair, stating that the royalties paid to Guyana are far too low. While the current president, Irfaan Ali of the People's Progressive Party (PPP), expressed interest in renegotiating the terms during his recent campaign, he has struck a more cooperative tone since taking office.<sup>4</sup>

Most recently, President Ali approved ExxonMobil's permit to drill in the Payara development field, its newest offshore project. The permit was approved only after the parties reached agreement on increased environmental regulation.<sup>5</sup> In a break from some of the campaign-season rhetoric, the Ali administration appears willing to work with foreign oil companies while demanding certain protections. However, there remain key challenges to address with regards to the development of Guyana's oil and gas sector. Most prominent is what the country should do with the natural gas that is also being produced offshore.

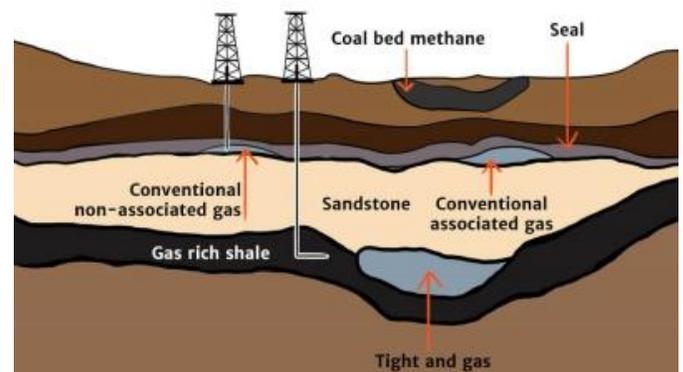
## Natural Gas Overview

In a petroleum reservoir, there are almost always some lighter gas molecules present in addition to the heavier hydrocarbon molecules that comprise crude oil. The gas contains light hydrocarbon molecules, the lightest of which form methane, commonly referred to as natural gas and the heaviest, if present, form liquefied petroleum gas (LPG), including ethane, propane or butane. When the reservoir is primarily developed for crude

oil production, the gas molecules are called associated gas.<sup>6</sup>

While all components of natural gas and LPG have uses and some commercial upside, they are less valuable and have more informal markets than crude oil. Unlike oil, which can be moved stably in liquid form, associated gas requires specific equipment to gather and transport it to market. When the cost of gathering and transporting product to end consumers is greater than the profit from its sale, or there is no gas infrastructure, oil producers commonly burn off the gas in a process called flaring. Flaring, in addition to wasting product, emits a significant amount of carbon dioxide into the atmosphere and ultimately exacerbates the warming of the planet.<sup>7</sup>

### Locations of Natural Gas



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Source: Solar Schools, *Natural Gas*

In Guyana, ExxonMobil has been flaring associated gas from the Starbroek block since production began, burning an estimated 9 billion cubic feet of gas.<sup>9</sup> Given that Guyana currently lacks the infrastructure or market to

<sup>4</sup> Luhavalja, "Guyana Election."

<sup>5</sup> "Government to Reclaim Benefits."

<sup>6</sup> Gazprom, "What is associated petroleum gas?"

<sup>7</sup> IEA, "Gas-Fuels and Technologies."

<sup>8</sup> Solar Schools, "Natural Gas."

<sup>9</sup> Kleinberg, "Flaring of Natural Gas."

utilize the gas, ExxonMobil has planned to re-inject the gas into an underground reservoir already containing oil or use it as fuel to power drilling equipment. However, due to chronic unexpected mechanical issues with the gas compression system, both methods have thus far proved impossible, leading to a significant amount of flaring.<sup>10</sup>

The negative response to flaring has been resounding, both inside and outside the country. The Center for International Environmental Law (CIEL) called on ExxonMobil and its partners to cease offshore drilling operations until the technical problems could be fixed to stop flaring.<sup>11</sup> Additionally, the former Public Infrastructure Minister of Guyana, David Patterson, stated that his department mishandled the permitting of the Stabroek block under the previous administration by not defining a smaller time window for the project's startup, during which flaring is acceptable. Patterson further asserted that the Ali administration should take a harder line with future permits, as they have done with the Payara project.<sup>12</sup> Many other Guyanese citizens have agreed with Patterson's statements, especially given the country's historical status as a carbon sink, meaning that it absorbs more carbon than its population generates due to its sizable forested areas. Guyana has been a pioneer of forest conservation in the region, making the recent carbon emissions even more objectionable to the people.

## Guyana's Power Sector Today

Unfortunately, Guyana's electricity sector is not helping to reduce carbon emissions. Currently, the country's power is generated by a fossil fuel mix of diesel and heavy fuel oil (HFO), both of which are imported and are more expensive and environmentally damaging than natural gas. It has an installed operating capacity of 348 megawatts (MW).<sup>13</sup> The electricity industry in the country is run by Guyana Light and Power (GPL), the national utility company. Due to the country's poor electrical infrastructure and vulnerable energy supply, Guyanese people experience an average of 31 days of power outages per year despite recent efforts to improve reliability.<sup>14</sup> In the hinterlands, the interior region of the country outside the coastal area, there is little to no access to the electricity grid. To compound the problem, energy demand in Guyana is only forecast to increase in coming years. Future required generation capacity is estimated to double by 2035, without accounting for the power needs of oil production.<sup>15</sup>

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<sup>10</sup> Kleinberg, "Flaring of Natural Gas."

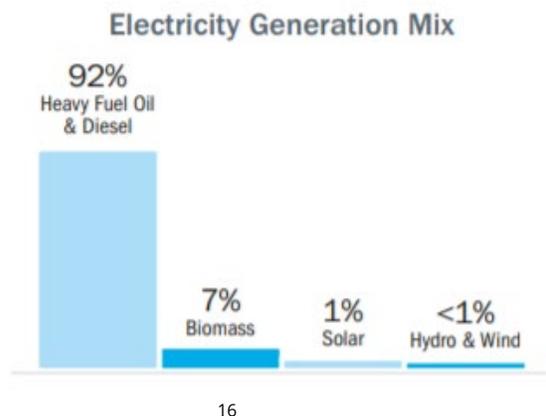
<sup>11</sup> Thomas, "International Environmental Group."

<sup>12</sup> Stabroek News, "Patterson Calls on Government."

<sup>13</sup> National Renewable Energy Laboratory, "Island Energy Snapshots."

<sup>14</sup> Wood and Rowena, "National Energy Efficiency," 7-12.

<sup>15</sup> Blanco, "Natural Gas a Driver for Renewables"



The high cost and unreliability of electricity has slowed economic development and private sector investment in the country. In response, the government of Guyana has aimed to reduce the cost of energy by half over the next five years. This ambitious goal is part of the country's Low Carbon Development Program to transform the country into an environmentally friendly economy while fighting climate change. Officials say they will reach this target through a combination of hydropower, natural gas, wind, and solar power plants.<sup>17</sup>

While all the proposed energy sources are viable, natural gas is necessary to supplement the renewable alternatives. Given that Guyana will have a constant supply of its own gas once the infrastructure to bring it onshore is developed, natural gas will likely be the most reliable fuel of the four. Wind, solar, and hydropower are all dependent upon the climate and storage, particularly for solar energy, which is still being developed.<sup>18</sup> This means that there is a greater chance of outages and black outs, emphasizing the

<sup>16</sup> National Renewable Energy Laboratory, "Island Energy Snapshots."

<sup>17</sup> Office of Climate Change, "The Low Carbon Development Strategy."

important role of natural gas as a 'bridge fuel' to a fully renewable energy mix.

## Gas-to-Power

A gas-to-power system offers many benefits as natural gas is recognized as a cleaner fossil fuel for power generation, making up a quarter of global electricity systems. Although gas is not as environmentally friendly as wind or solar power, it still emits almost less than half the amount of carbon dioxide than crude oil when burned. It also emits less carbon dioxide than diesel and fuel oil, which Guyana currently uses for power generation.<sup>19</sup>

Natural gas power plants are comparatively less costly and faster to build than other types of electricity generation infrastructure. They are also more efficient at starting up and shutting down than either coal-fired or nuclear power plants, allowing for easy adaptation to a population's fluctuating energy demand. Adding to its flexibility, a gas power plant can be built to burn only natural gas, or it can be a dual-fuel power plant with the ability to burn both natural gas and diesel. Dual-fuel power plants can accommodate disruptions in natural gas supply and deliver reliable power flexibly.<sup>20</sup>

Despite these clear advantages, natural gas is still a fossil fuel and does create emissions that impact Guyana's carbon sink status. However, natural gas can be a pathway to renewable power. For instance, gas can be used as the country develops a renewable energy system and then remain as part of the energy mix to accommodate any

<sup>18</sup> Lieberman, "Pros and Cons."

<sup>19</sup> IEA, "Gas-Fuels and Technologies."

<sup>20</sup> Afework, et al., "Natural Gas Power Plant."



inconsistencies in the renewable supply due to gas plants' ability to start and stop quickly. This is particularly important as, although renewables have made great strides, their intermittency requires power and storage solutions to be part of the future development of Guyana's power matrix. Depending solely on wind or solar power for electricity can lead to outages and voltage instability. Also, a diversified power grid can hedge against market fluctuations or energy policy changes.<sup>21</sup>

Economically, natural gas power generation would provide numerous benefits to Guyana. Creating a gas-to-power system would necessitate building significant infrastructure, including a pipeline to bring product onshore, new gas power plants, and gas-powered

generation. This would create many new jobs in the country, particularly construction jobs. In contrast, oil production creates relatively few new employment opportunities and generally requires a technical engineering background, meaning jobs are often filled by foreign workers of the large IOCs operating offshore. The construction jobs from the gas-to-power project could provide steady work for the generally less-skilled Guyanese labor force until investment is made in education so domestic workers can eventually fill the technical roles that are key to the oil and gas industry.

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<sup>21</sup> Lieberman, "Pros and Cons."

## Proposed Gas-to-Power Projects

The Guyanese government and foreign investors have realized the benefit of using natural gas for power and are developing several proposed generation projects. ExxonMobil is currently negotiating pricing for its associated gas with the Guyanese government, which would be used to fuel a planned 300MW power plant.<sup>22</sup> However, the company would only be involved in building a pipeline to transport the gas, not constructing the onshore infrastructure. According to a feasibility study of the entire gas-to-power project done in 2017, the cost would be 304 million USD, with 165 million USD coming from pipeline construction costs.<sup>23</sup>

To create the onshore infrastructure, the Finnish company Wärtsilä, which has worked in Guyana since 1994, has been contracted by GPL to build a 46.5 megawatt dual-fuel power plant at an existing power generation complex. It will be able to run on liquid fuels like diesel until the offshore gas becomes available.<sup>24</sup> This project is ideal for allowing flexibility and increasing overall generation capacity in the country, but clearly it is just the start of what is needed to fully operationalize a gas-to-power system and monetize the associated natural gas offshore. Thus far, there have been no other concrete projects announced, though the government has formed a task force to assess the scope of potential infrastructure and conduct a new feasibility study.<sup>25</sup>

<sup>22</sup> James, "Guyana, ExxonMobil Negotiating Gas Price."

<sup>23</sup> Thomas, "2017 Study."

<sup>24</sup> Santala, "Power Plant Will Add Reliability."

In addition to public electricity generation projects, international investors are also interested in using the associated gas to power mining in the hinterlands of the country. The gas would be cooled and pressurized into liquefied natural gas (LNG) and then transported to the remote mining sites in cryogenic tanks on trucks.<sup>26</sup> Like the electricity sector, mining in Guyana is dependent on diesel for power. As one of the main industries in the country, reducing the power expenditure of mining would be a boon to Guyanese economic development, although it would divert gas away from power generation for citizens. The government has indicated that it is open to a variety of projects and is meeting with many investors, leaving room for speculation about how its promise to bring gas onshore will unfold.<sup>27</sup>

## Case Study: Ghana



To see the possible outcomes of bringing gas onshore in a developing country, Guyana can look to Ghana's Sankofa gas project. In 2007, the Sankofa natural gas field was discovered off the coast of Ghana with the potential to be

<sup>25</sup> Starbroek News, "PM See 200 MW of Power."

<sup>26</sup> Place, "Guyana engaging investors."

<sup>27</sup> Place, "Guyana engaging investors."

developed for power generation. Through a project partially funded by the World Bank, the Ghana National Petroleum Commission, and private companies Eni and Vitol, wells were drilled and the gas pipeline was interconnected to the country's pipeline network and with existing power plants. Since the startup of the project, Sankofa has provided power to 1.6 million households, decreased oil imports by 12 million barrels a year, and reduced carbon emissions by 1.6 million metric tons.<sup>28</sup>

Like Guyana, Ghana suffered from frequent power outages. Its hydroelectric power system was unreliable due to unpredictable rainfall and a reliance on fossil fuel generation derived from imports largely from Nigeria that exposed Ghana to the volatility of global oil markets. Therefore, the gas-to-power project provided many of the same benefits to the West African nation that appear relevant for Guyana including reduced power costs, lower emissions, better electric reliability, job growth and economic development. However, Ghana is a much larger country than Guyana, with a power market of total installed capacity of over 4,000MW. Ghana also had seven pre-existing natural gas or dual fuel power plants when the project began.<sup>29</sup> Therefore, although Ghana had more capacity to install, Guyana must start at square one with its gas infrastructure.

Despite the many advantages of the project, Sankofa has not been without challenges, which can hopefully be a lesson for Guyana. First, Ghana signed a long-term take-or-pay Power Purchase Agreement (PPA) with gas and power suppliers, meaning it has to pay for 90% of the gas produced from the

offshore field, regardless of actual demand. In an environment of frequent power outages where a large portion of the population lacks access to electricity, this seemed like an ideal arrangement. However, the market is now severely oversupplied, with the government paying \$500 million annually for unused power.<sup>30</sup>

Additionally, many Ghanaians argue that the tariffs in the PPA are not competitive and have caused the government to overpay for power. With a significant energy debt, the current administration has created the Energy Sector Recovery Program (ESRP) to identify uses for the gas and ensure fair future agreements. As part of this effort, Cenpower, a major power company in Ghana, has agreed to convert its plants from crude oil to natural gas.<sup>31</sup> While this is a step forward, the country will need many offtake sources for the gas and power to better manage the surplus.

## Policy Recommendations

Clearly, Guyana must seek to avoid Ghana's mistakes with its PPAs. Despite the numerous benefits of using gas for power generation, the project could become a negative for the country if not executed properly.

First, as shown in the Ghana case, the Guyanese government needs to properly assess electricity demand. While there are significant reliability problems that need to be addressed, taking all the gas produced from the Stabroek block, especially as new fields continue to be discovered, would likely result in oversupply. The government should first focus on providing power to the coastal areas, then attempt to supply the hinterlands after

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<sup>28</sup> World Bank, "What is the Sankofa Gas Project?"

<sup>29</sup> Ayaburi, Bazilian, "Economic Benefits of Natural Gas."

<sup>30</sup> Reed, "Ghana Seeks New Power Balance."

<sup>31</sup> Bungane, "Ghana Re-Examines Gas Supply."

sufficient infrastructure has been developed in the area.

Ideally, any contract should allow for maximum flexibility in both pricing and volume to accommodate fluctuations in demand. The pricing in the agreement should be competitive and tied to the global natural gas market to ensure that the country avoids overpaying for its resources. Gas should be brought onshore through a phased approach in which the government only purchases incremental natural gas as electricity demand increases and infrastructure is developed so Guyana does not accumulate an unnecessary gas surplus.

Guyana can learn from Ghana and work to negotiate competitive terms that do not leave the country in financial strife. The current administration can build on what it has learned from forming agreements with ExxonMobil to ensure a fair PPA that is beneficial to both the private sector and the country. Additionally, any contract should be for a shorter period with the option to renew. This will allow the country to respond to changes in demand and gas prices.

If Guyana is truly focused on a green future, it also must commit to diversifying its energy mix with a variety of renewable sources as it develops natural gas infrastructure. While this will require more capital in addition to an already expensive project, it is key to ensuring that the developing nation does not become path-dependent on fossil fuels. An oversized investment in gas will create a sunk cost for Guyana, forcing it to remain solely reliant on the gas-to-power system. Rather, natural gas should be treated as a bridge fuel to provide efficient, dependable generation capacity for the state as it modernizes. The objective is to have a power grid fueled by renewable energy, with fossil fuel generation available to accommodate natural fluctuations in wind,

solar, or hydropower. To achieve this, the country will need to find the correct balance between funding fossil fuel development and renewable energy projects. This is a difficult calculation to make, but certainly one that is vital to consider for Guyana's energy security.

## Conclusion

Guyana can use its offshore natural gas resources to create a reliable power supply for its citizens and support a growing economy with improved quality of life in the country. Using natural gas for power would allow the state to decrease its need for fuel oil and diesel, the current source of power generation, which would lower electricity costs, reduce carbon emissions, and decrease dependence on imported fuel. However, as the foregoing analysis has detailed, costly infrastructure is required to bring the gas onshore and build gas-fired power plants.

Despite the benefits that come with a gas-to-power system, many questions remain around the use of natural gas that deserve further investigation. There are other potential commercial uses for the gas including LPG for the residential sector or public transit. But, a more detailed economic analysis is needed to determine viable secondary uses for the product.

In any case, the country must be careful to create a contract with gas suppliers that is fair and flexible. Guyana can learn from Ghana – both in terms of what worked well and what to avoid—as it develops natural gas and ensures that it properly estimates power demand, has competitive market-based pricing, and invests in renewable energy sources. While the country is confronted with many challenges, it is at an important crossroads that can transform it from a developing nation into a global energy leader.

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## ABOUT THE AUTHOR

**Kathryn Hillis** is a graduate student at UC San Diego's School of Global Policy and Strategy studying international affairs with a focus on environmental governance and Latin America. Kathryn previously worked at Phillips 66 in Houston, TX and has three years of experience in the energy industry. She graduated with honors in Chinese and Economics from the University of Oklahoma. Kathryn researched and wrote this paper during her fall internship with the Institute of the Americas.

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