REGULATED INDUSTRIES COMMISSION

Review of the Status of the Trinidad & Tobago Electricity Commission 2016-2019

June 2021

This "Review of the Status of the Trinidad and Tobago Electricity Commission (T&TEC) 2016–2019", is being published for the information of all stakeholders as part of the Price Review for T&TEC.

Information Document

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ABBREVIATIONS & NOTES

V - Volt	Standard unit used to measure the electrical energy within an electric field or circuit, at a given point
kV - Kilovolt	1 kV = 1,000V
W - Watt	Standard measure of electrical power used to quantify the rate of energy transfer.
MW - Megawatt	1 MW = 1000 kilowatts (kW)
Wh - Watt-hour	The unit of energy equivalent to one watt (1 W) of power expended for one hour of time.
kWh - Kilowatt-hour	1 kWh = 1,000 Wh. Commonly used as a billing unit for energy delivered to consumers by electric utilities.
GWh - Gigawatt hour	1 GWh = 1,000,000 kilowatt-hours (kWh)

1.0 INTRODUCTION

The Regulated Industries Commission Act, No. 26 of 1998, established the Regulated Industries Commission (RIC) as the economic regulator for the electricity, water and wastewater sectors in Trinidad and Tobago. Amongst other things, the RIC is mandated to carry out studies of efficiency and economy of operation and of performance of the service providers under its purview and publish the results.

1.1 Objective of the Document

This *"Review of the Status of the Trinidad and Tobago Electricity Commission (T&TEC) 2016 – 2019"*, is being published for the information of all stakeholders as part of several documents that accompany the Price Review exercise for T&TEC. The purpose of this document is to present information on several aspects of the technical, operational and financial state of T&TEC over the period 2016-2019[1]. It provides an assessment of T&TEC's performance on an annual basis, over the period under review, as well as a comparison of T&TEC's performance against other utilities, where appropriate[2].

1.2 Structure of the Document

The remainder of this document is arranged into several sections. Section 2 describes the structure of the electricity sector in Trinidad and Tobago. Section 3 contains technical performance metrics of T&TEC across three main categories; system losses, network reliability, and standards of service. Sections 4 and 5 provide an assessment of T&TEC's operational and financial performance respectively. This is followed by Section 6, which contains a comparison of prevailing electricity tariffs with that of other jurisdictions. Finally, the document ends with some general conclusions.

[1] A Review of the Status of T&TEC for the 2010-2015 period can be accessed on the RIC's website.

[2] Information for this review has been sourced from various documents supplied by T&TEC pertaining to the period 2016-2019. Where possible, the RIC has reviewed, verified and updated the data and information that has been provided by T&TEC, for use in this document. The RIC has also performed its own calculations where required, using data provided by T&TEC.

1.3 Responding to this Document

This document is being released for information, however, if you require clarification or wish to comment on any aspect of this document, the RIC can be contacted at the following address:

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2.0 THE ELECTRICITY SECTOR

The electricity sector in Trinidad & Tobago comprises a number of stakeholders. The Regulated Industries Commission (RIC) is the economic regulator for the electricity sector in Trinidad and Tobago, and its powers and functions are set out in Act No. 26 of 1998 (the RIC Act). Under the First Schedule of the RIC Act, the electricity service providers which fall under the RIC's purview are:

- The Trinidad and Tobago Electricity Commission (T&TEC);
- The Power Generation Company of Trinidad and Tobago (PowerGen); and
- Trinity Power Limited (formerly Inncogen Limited).

At present, the Trinidad Generation Unlimited (TGU)[3], an electricity generation company, does not fall under the purview of the RIC. Other stakeholders with responsibility for policy-making and administrative oversight of the electricity sector include the Ministry of Energy and Energy Industries (MEEI) and the Ministry of Public Utilities (MPU). A brief overview of the respective roles of the major stakeholders and key data, where applicable, specific to their respective functions are outlined below.

2.1 Overview

The state-owned electricity transmission and distribution utility, the Trinidad and Tobago Electricity Commission (T&TEC), purchases bulk power from three (3) independent power producers (IPPs) and sells this electricity to customers through its transmission and distribution network[4]. The supply side of the electricity sector involves a combination of private and state-owned generation facilities, and state-owned transmission and distribution operations. The Power Generation Company of Trinidad & Tobago (PowerGen), Trinity Power Limited and Trinidad

[3] Trinidad Generation Unlimited (TGU) was formed in 2006 as a joint venture between the Union Estate Electricity Generation Company (UEEGC), wholly owned by the Government of Trinidad and Tobago, and the AES Corporation, USA. Commercial operations commenced in August 2011. In 2013, UEEGC acquired all existing shares held by AES, making TGU 100% state owned.

[4] T&TEC is a monopsony buyer of electricity from the IPPs and a monopoly seller to customers. A monopsony (single) buyer would usually have considerable market power over its suppliers, however, the existence of 'take or pay' contracts between T&TEC and the IPPs constrains the utility's market power. Take or pay is a contract provision whereby the buyer has an obligation to pay for a specified amount of electricity whether or not there is demand for that electricity. Although T&TEC occupies a monopoly position with respect to sale of electricity to its customers, the economic regulator constrains the utility's market power and protects the interests of consumers, in this regard.

Generation Unlimited (TGU), provide the majority of electricity to T&TEC for transmission and distribution to all of its customers. At the end of 2019, the combined generating capacity of the three IPPs was approximately 2,000 megawatts (MW). T&TEC also has its own generation capacity of approximately 90MW located in Tobago, which is the primary source of electricity on the island. All of the electricity generated in Trinidad and Tobago is from locally sourced natural gas. T&TEC sells over 8,000 gigawatt hours (GWh) of electricity to its customers annually.

On the demand side of the sector, customers are organized into different classes, based largely on their demand characteristics. The main customer classes are residential, commercial and industrial. The total number of customer accounts was 493,965 at the end of 2019, with residential customers accounting for the majority of the customer base. However, industrial and commercial customers were responsible for the majority of the total electricity demand.

2.1.1 Generation

As at the end of 2019, PowerGen owned and operated two (2) power plants located in Point Lisas and Penal, housing a total of twenty-three generating units; twenty-one were solely gas-fired, while two were capable of operating either by oil or gas. In 2019, the total installed capacity of PowerGen, broken down by plant, was as follows:

- Point Lisas – 763MW[5]
- Penal – 234MW

The generating units at the Point Lisas power plants are configured in a simple-cycle arrangement, that is, each generating unit is supplied with fuel to generate electricity and the waste heat is vented into the atmosphere. The Penal power plant was the first plant to introduce the combined-cycle process where waste heat from the exhaust of two (2) 67MW gas turbines, was utilized by two Heat Recovery Steam Generators (HRSGs) to produce additional electricity. In 2016, PowerGen upgraded its gas turbines at the Penal combined-cycle plant which resulted in an increase in output of 34MW.

[5] Installed capacity for the Point Lisas Power Station was retrieved from PowerGen's website in December 2020 at http://www.powergen.co.tt/Locations/Point-Lisas-Power-Station.

At the time that PowerGen was established, T&TEC retained responsibility for a limited amount of generation at the diesel-powered Scarborough Power Station in Tobago. In order to reduce transmission losses[6] and reduce dependence on diesel fuel, T&TEC commissioned the Cove Power Station in 2009 at the Eco-Industrial and Business Park in Lowlands, Tobago. This new plant had a combined installed capacity of 64MW, which was expanded by the addition of a 20MW generating unit in 2018. The Scarborough Power Station was maintained as a back-up generation supply facility and in 2019, had an installed capacity of 4.5MW. The Cove and Scarborough plants combined have the capacity to generate electricity to meet the demand on the island of Tobago. Previously installed submarine cables[7] between both islands are being maintained to supply electricity to Tobago, in the event of an emergency.

Trinity Power Limited (Trinity Power) is a privately owned, locally incorporated company which took over management and operations at the plant formerly operated by Inncogen Limited[8]. The power plant consists of three (3) gas-combustion turbines rated at 75MW each, configured in a simple-cycle arrangement. The electrical energy generated by the turbines interconnects to T&TEC's Brechin Castle electricity substation, which is located obliquely opposite to the plant.

Trinidad Generation Unlimited (TGU) is the newest generation plant in the electricity sector. This facility was established mainly to provide electrical power to a proposed Aluminium Smelter Plant[9] and some generation to T&TEC and began commercial operations in August 2011. In July 2013, the government of Trinidad & Tobago (GORTT) became the sole owner of TGU. The plant has an installed capacity of 720 MW and its eight (8) generating units are configured in the combined-cycle mode. There are six (6) 75MW GE gas turbines that produce a combined output of 450MW. The waste heat from the exhaust of these gas turbines can feed six (6) Heat Recovery Steam Generators (HRSG) and the steam produced is used to power two (2) 135MW turbines for a combined additional output of 270MW.

[6] T&TEC previously supplied power to Tobago via submarine cables which resulted in transmission losses.
[7] These submarine cables have been significantly de-rated because of issues with cable-integrity.
[8] Inncogen had been in operation since 1999. In 2003, Trinity Power Ltd took operational control of the facilities previously operated by Inncogen.
[9] The Alutrint Aluminum Smelter project was cancelled, however, the TGU plant was constructed before the decision to cancel the project was taken.

2.1.2 Transmission & Distribution

T&TEC is a body corporate constituted under the provisions of the Trinidad & Tobago Electricity Commission Act, Chap. 54:70 (T&TEC Act) of the laws of the Republic of Trinidad & Tobago. T&TEC falls under the purview of the Ministry of Public Utilities and is a statutory body with the exclusive right to transmit and distribute electricity throughout Trinidad and Tobago.

T&TEC's major activities focus on the operation and maintenance of the country's existing electrical transmission and distribution network and also planning and executing expansion of this network to meet the needs of its customer base. T&TEC's service areas are grouped by geographical division; North, South, East, Central and Tobago.

T&TEC's infrastructure network includes high voltage transmission lines which conduct electricity from the power generation plants to major substations located all across the country. Sub-stations dispatch electricity to smaller, local sub-stations for distribution to service areas, over a network of distribution power lines.

At the distribution level within the service areas, pole-mounted transformers further reduce voltages for use by residential and commercial customers. Industrial customers usually operate machinery that require higher voltages and normally receive electricity directly into on-site transformers that cater to their specific electricity needs.

2.1.3 Consumption

T&TEC's customer base primarily comprises residential, commercial and industrial customers[10]. Assignment to a particular customer category is based on the purpose of the customer's electricity consumption, the characteristics of the customer's electrical infrastructure and the profile of the customer's load demand. Within each class, there are sub-divisions which further distinguish between the types of customer according to electricity usage characteristics.

[10] At present, there are four customer classes that make up T&TEC's customer base; the fourth being Street Lighting. Administratively, the respective Regional Corporations are now responsible for meeting the costs for Public Lighting, which includes Street lights, Highway Lights and illumination of Recreational Grounds.

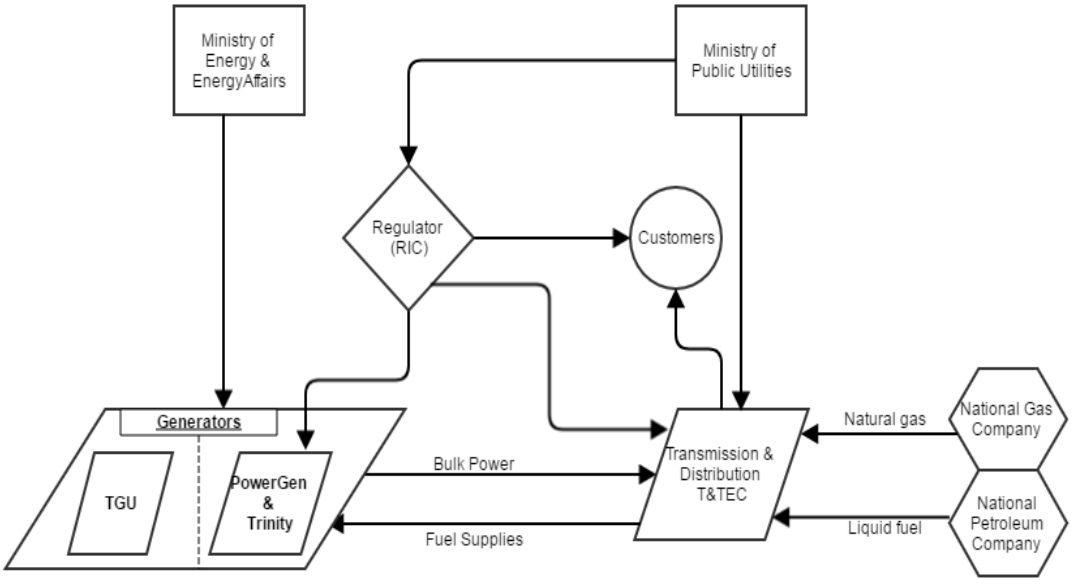
In 2019, there were approximately 435,439 residential customer accounts representing 88% of the customer base, 54,422 commercial customer accounts or 11% of the customer base and 4,058 industrial customers, which accounted for less than 1% of total number of customers. While industrial and commercial customers comprise a small proportion of the overall customer base, together, these customers account for roughly 70% of total electricity consumption. The geographic distribution of the customer base in 2019 was approximately 30% of T&TEC's customer base located in the South, 27% located in the East, 19% in the North, 18% in Central and 6% in Tobago.

Total consumption of electricity declined by 3.01%, from 8,662.92 GWh in 2016 to 8,401.57 GWh in 2019.

2.2 Key Stakeholders and Relationships within the Electricity Sector

Figure 1 below highlights some of the key stakeholders and relationships within the electricity sector in Trinidad and Tobago.

Figure 1: Key Stakeholders and relationships within the Electricity Sector



3.0 TECHNICAL PERFORMANCE

Electricity is essential to modern life and economic activity, therefore, it is important for T&TEC to meet minimum standards of service in the provision of electricity to its customers. Disruption in the electricity supply creates costs which may outweigh the value of the electricity forgone, depending on several factors including the nature of usage, frequency, time of occurrence and duration of the disruptions. In addition to disruptions, inefficiencies in the electricity value chain and commercial risks may translate to financial costs (losses) to the utility.

A closer look at specific electricity supply indicators for systems losses, reliability and quality of service over the period 2016 to 2019 are indicative of T&TEC's technical performance and service efficiency over the period.

3.1 System Losses

System losses are a major concern for an electricity utility because they represent losses in revenue. When T&TEC pays for energy it receives from the generators and losses are recorded, less is available for sale to the customer. In essence, system losses are an inefficiency that must be borne by the utility and ultimately by its customer base, therefore, losses should be minimized. The total system losses of any electricity supply system consist of a combination of technical and non-technical losses[11]. The system losses on T&TEC's network are calculated as the difference between the electricity sold to customers and purchased from the generators, expressed as a percentage.

Table 1 shows the total system losses (%) across T&TEC's network which increased from 7.99% in 2016 to 9.22% in 2019[12]. In this regard, T&TEC did not meet the total system losses target of 6.75%, which was set by the RIC in its 2006-2011 Final Determination.

[11] Technical losses occur naturally and consist mainly of energy loss in electricity system components such as transmission and distribution lines and magnetic losses in transformers. Hence, technical losses cannot be reduced to zero in any power system. Non-technical losses are caused by actions external to the power system and consist primarily of electricity theft, non-payment by customers, and errors in accounting and record-keeping.

[12] Over the period 2010-2015, T&TEC's total system losses ranged from 6.46 to 7.08.

Table 1: Total System Losses for T&TEC

Year	2016	2017	2018	2019
Total System Losses	7.99%	8.08%	8.26%	9.22%

Source: TTEC

T&TEC's total system losses for the period 2016-2019 were notably higher than the 5% value for system losses reported by the United States Energy Information Administration (EIA) for a group of selected utilities in the United States[13]. However, T&TEC's performance is better, when compared to some utilities within the Caribbean region. Over the period 2016-2019, system losses for the electric transmission and distribution utility in Jamaica and Belize averaged 26.5% and 11.8% respectively[14].

3.2 Network Reliability

Network reliability can be assessed by measuring the frequency and duration of interruptions in the electricity supply to customers. An unreliable supply of electricity may result in a decrease in revenue to T&TEC and impacts customers of the utility, through closure of businesses, as well as negatively affecting the quality of life of consumers in general. Network reliability metrics can serve as a guide to determining problematic areas in the electricity delivery system. The RIC assessed the reliability of T&TEC's supply according to the indicators listed in table 2.

Table 2: Network Reliability Indicators[15]

	2016	2017	2018	2019
SAIFI (Interruptions per customer)	4.7	4.5	3.9	4.8
SAIDI (minutes)	400	417	389	463
CAIDI (minutes)	86	93	99	97

Source: TTEC

[13] The U.S. Energy Information Administration (EIA) estimated that state-wide electricity transmission and distribution losses averaged about 5% from 2015-2019.
[14] Information retrieved from the Annual Reports of the respective utilities.
[15] SAIFI is System Average Interruption Frequency Index. SAIDI is System Average Interruption Duration Index. CAIDI is Customer Average Interruption Duration Index.

The System Average Interruption Frequency Index (SAIFI) statistically represents the average number of sustained interruptions per customer, per year, over the entire electricity network. SAIFI increased marginally over the four-year period of 2016-2019. During the first three years, T&TEC's performance in SAIFI improved from 4.70 to 3.90 interruptions per customer, however, it declined in 2019 to 4.8. In the Caribbean region, average SAIFI values over the 2016-2019 period were widely dispersed, as follows: 0.34 in St Lucia, 0.56 in Dominica, 6.22 in Barbados, 7.73 in Grenada, 16.45 in Jamaica and 17.08 in Belize[16]. Internationally, the median SAIFI value for a group of selected North American Utilities (NAU) under the IEEE Standard[17] was 1.12 interruptions per customer in 2019. Therefore, the likelihood of T&TEC's customers experiencing an outage in 2019 was greater than the customers within this group.

The System Average Interruption Duration Index (SAIDI) statistically represents the average length of time that a customer is without electricity per year. SAIDI on T&TEC's network ranged between 6.4 to 7.7 hours between 2016 and 2019. On average, T&TEC customers would have experienced interruptions totaling 7.7 hours in duration in 2019, which is the highest for the four-year period. In the Caribbean region, average SAIDI values over the 2016-2019 period were as follows: 0.3 in St Lucia, 0.8 in Dominica, 4.0 in Barbados, 5.2 in Grenada, 37.6 in Jamaica and 22.9 in Belize[18]. In a benchmarking study done on a group of NAU, the average value for the duration of interruptions experienced by customers in 2019 was 2.1 hours[19].

The Customer Average Interruption Duration Index (CAIDI) is the ratio of SAIDI to SAIFI. It represents the average outage duration that an individual customer would experience. CAIDI can also be viewed as the average restoration time. In 2019, T&TEC customers experienced interruptions averaging 97 minutes in duration, showing an increase from the 86 minutes observed at the start of the period in 2016. In the Caribbean region, average CAIDI values over

[16] Retrieved from GovData360 - Getting electricity: System average interruption frequency index (SAIFI); The World Bank. https://govdata360.worldbank.org/
[17] Institute of Electronic and Electrical Engineers (IEEE) United States, Distribution Reliability Working Group, Benchmark Year 2020, Results for 2019 Data.
[18] Retrieved from GovData360 - Getting electricity: System average interruption duration index (SAIDI); The World Bank. https://govdata360.worldbank.org/
[19] Institute of Electrical and Electronics Engineers (IEEE), Benchmarking Year 2020 (Based on 2019 data).

the 2016-2019 period were as follows: 53 in St Lucia, 86 in Dominica, 38 in Belize, 40 in Grenada, 137 in Jamaica and 80 in Belize[20]. For the selected group of NAU, the median value for the average duration of interruptions experienced by customers in 2018 was 116 minutes[21]. In 2019, T&TEC's customers were therefore, more likely to have their electricity supply restored quicker than the customers of over half of the NAU in the group.

The trends in the reliability metrics from 2016 to 2019 suggest that T&TEC did not consistently improve in any of the three measures of service reliability over the period. Although there was an improvement in SAIFI and SAIDI in 2018, performance in both metrics declined in 2019. The utility was also unsuccessful in reducing the duration of the outages experienced by customers (CAIDI), even though there was some improvement between 2018 and 2019. The average value for CAIDI for the previous three-year period (2013-2015) was 73.3, as compared to the average value for the 2016-2019 period of 94. This increase in the value for CAIDI suggests that T&TEC's performance with respect to the time taken to restore power to its customers, declined in the period under review.

3.3 Quality of Service Standards

The RIC first implemented the Quality of Service Standards (QSS) scheme for the Electricity Transmission and Distribution Sector in 2004, and these Standards were last revised in 2017. The QSS is comprised of both Guaranteed Electricity Standards (GES) and Overall Electricity Standards (OES) which cover consumer expectations of consistency, reliability and accountability from the service provider. The Guaranteed Standards establish service levels which must be met on an individual customer basis by the service provider, whereas, the Overall Standards cover broader areas of service and generally relate to the reliability of the service with respect to a group of customers. T&TEC's compliance with these Standards forms part of an effective incentive regulation framework.

[20] Ratio of SAIDI to SAIFI (in minutes).
[21] Institute of Electrical and Electronics Engineers (IEEE), Benchmarking Year 2020 (Based on 2019 data).

Over the period, 2016 to 2019, the quality of the electricity supply was assessed across the eight Guaranteed Standards and seven Overall Standards grouped by three main areas of concern (reliability, service quality and customer service). Table 3 below summarizes T&TEC's performance for each standard.

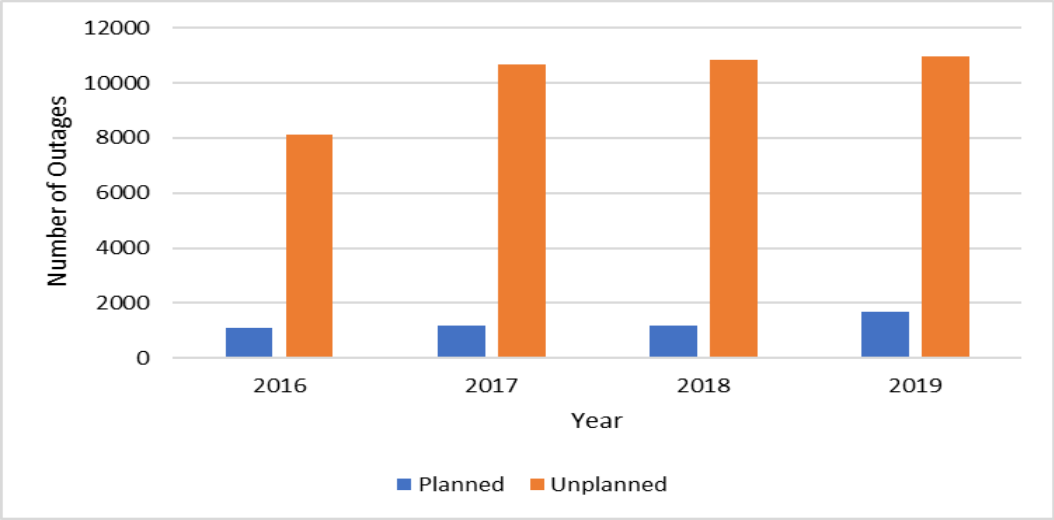
Table 3: T&TEC QSS Performance Summary 2016-2019

Area of Concern	Standard's Performance Measure (QSS Code)	Performance Assessment (2016-2019)
Reliability	Response and restoration time after unplanned (forced) outages on the distribution system. (**GES1**)	Very good with compliance rates ranging from 99.04% to 99.76%. However, breaches under this standard affect the largest number of customers relative to the other standards.
Service Quality	Investigation of Voltage Complaints. (**GES5**)	Very good with compliance rates ranging from 98.4% to 99.8%.
	New Connection of supply (Specifies service drop and meter installation only). (**GES7**)	Very good with compliance rates ranging from 99.9% to 100%.
	Street lights maintenance. (**OES5**) • Street lights – within 7 days • Highway lights – within 14 days	Inconsistent: compliance rate in first performance measure declined to its lowest level (21.3%) in 2017. The compliance rate for the second performance measure varied from 57.0% to 89.6% over the period.
Customer Service	Billing Punctuality (new customers). (**GES2**)	Very good with compliance rates for new residential and non-residential customers ranging from 92.1% to 100%.
	Making and keeping appointments. (**GES4**)	Excellent with a compliance rate of 100% over the period.
	Responding to billing and payment queries. (**GES6**)	Excellent with a compliance rate of 100% over the period.
	Payments owed under guaranteed standards. (**GES8**)	Poor compliance rates in 2016 and 2017 (1.5% and 0% respectively). Tracking and automatic payments of claims subsequently improved to the extent that no one was owed a payment under GES8 in 2018 and 2019.
	Frequency of meter reading. (**OES1**)	Excellent with a compliance rate of 100% over the period.
	Billing punctuality. (**OES2**)	Very good with compliance rates ranging from 90.2% to 100%.

Area of Concern	Standard's Performance Measure (QSS Code)	Performance Assessment (2016-2019)
	Response to customer queries/requests (written). (**OES6**) • Initial response within 10 days • Final position within 30 days	Inconsistent; compliance rates ranging from 85.8% to 99% for the initial action and 54.1% to 97.1% when further action is required. The highest compliance rating for both actions were in 2019.
	Notifying customers of receipt of claim under guaranteed standard GES1. (**OES7**)	Excellent with a compliance rate of 100% from 2016 to 2019.
Service Quality / Customer Service	Reconnection after payment of overdue amounts or agreement on payment schedule. (**GES3**)	Very good with compliance rates ranging from 99.91% to 99.96%.
	Responding to meter problems. (**OES3**)	Very good to excellent with compliance rates ranging from 96.8% to 100%.
	Prior Notice of planned outages. (**OES4**)	Very good with compliance rates ranging from 90.9% to 96.8%.

As discussed earlier, reliability of the electricity supply is an important consideration for customers. In figure 2 below, the total number of electricity outages (planned and unplanned) experienced annually from 2016 to 2019 is displayed.

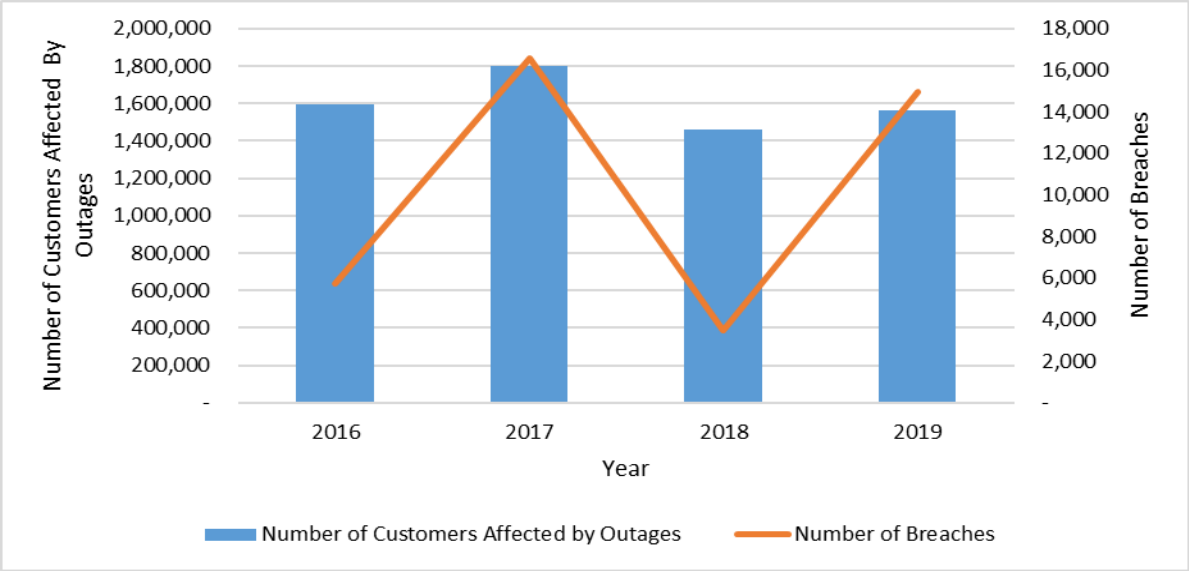
Figure 2: Total Number of Outages



Planned outages are scheduled by T&TEC to facilitate work that the utility deems necessary to improve the reliability of supply. There was a 55% increase in planned outages over the period, from 1,084 in 2016 to 1,679 in 2019. Unplanned outages however, can be caused by several factors. The most cited causes of unplanned outages by T&TEC include blown transformer fuses and vegetation management (tree contact resulting in severed wires). Unplanned outages were highest in 2019 at 10,950, representing a 35% increase from 2016 (8,116).

Under GES1, a breach or non-compliance[22] occurs when there is an outage incident and the electricity supply to an individual customer is not restored within ten hours of the outage report being received by the utility. In figure 3 below, the number of breaches under GES1 fluctuated within the last four years. There was a significant increase from 5,726 in 2016 to 16,576 in 2017. This was followed by a decline in 2018 to 3,474 and then another sharp increase to 14,958 in 2019. Inclement weather and service crew delays were the main reasons provided for T&TEC's failure to restore service within ten hours.

Figure 3: Number of Customers Affected by Outages and Number of Breaches



[22] Non-compliance is recorded when the service provider has not achieved the stipulated level of performance for a standard.

With respect to service quality, T&TEC is statutorily required to supply its customers at specified voltage levels with a tolerance of 6% above or below the nominal supply voltage[23]. Under GES5, where a customer has reported that their supply may be outside the permitted voltage range, T&TEC must visit and rectify the problem within 15 working days. The average annual number of voltage complaints for the period 2016-2019 was 3,519, and the highest number of voltage complaints (3,671) were received in 2016.

Public lighting is also included in the quality of service standards as it is an important public service that enhances the welfare of citizens. T&TEC is responsible for monitoring the condition and performance of public lighting assets, which include the development and implementation of plans for the installation, operation and maintenance of street lighting. Table 4 shows that the number of failed street light reports doubled from 2016 to 2017 and remained relatively high at 41,151 at the end of 2019. In addition, the high number of failed street lights not repaired within 7 days over the entire period is of concern, as the lack of adequate public lighting has been cited as a safety concern in many communities. This is an indication that a comprehensive course of action needs to be taken by T&TEC to reduce the rate at which street lights become defective, and increase the rate at which repairs are completed, so that T&TEC can improve its compliance performance under this standard.

Table 4: Street Light Repairs

	2016	2017	2018	2019
No. of failed street light reports received	22,031	44,831	43,525	41,151
No. repairs not completed within 7 days	15,444	35,263	21,995	18,962

Source: TTEC

[23] T&TEC is also governed by the Electricity Supply Rules under the Electricity (Inspection) Act Chapter 54.72 to supply its customers at specified nominal voltages.

4.0 OPERATIONAL PERFORMANCE

In this section, the RIC examines the operational performance of T&TEC, to assess how well the utility is managing its resources. Improving the efficiency of operations can have a positive impact on the utility's financial performance. Since T&TEC is a monopoly, it is imperative that the utility operates in a manner that delivers good quality service to its customers, while also efficiently managing its costs. In this regard, the analysis of the operational performance of T&TEC can be used to guide the utility to make more efficient use of its resources, as well as to inform regulatory decision-making.

4.1 Labor Efficiency Indicators

The operation and maintenance of a reliable electricity transmission and distribution network require significant labour resources, which contribute considerably to the total operating costs of the utility. T&TEC employed approximately 3,174 persons in 2016 and this decreased by 5.7% to 2,991 in 2019.

The evaluation of how efficiently the utility's labour resources are being employed can be done through the use of indices. Labour efficiency is the ratio of labour (input) to a factor of output, such as sales. Sales can be measured in revenue (TTD) or in units (kWh). T&TEC's management can use labour efficiency indicators to guide its decisions on actions that need to be taken to improve its productivity levels. Labour efficiency indicators also serve as a gauge of how well T&TEC's staff is performing when compared to similar utilities.

The following are three well-established indicators of labour efficiency[24]:

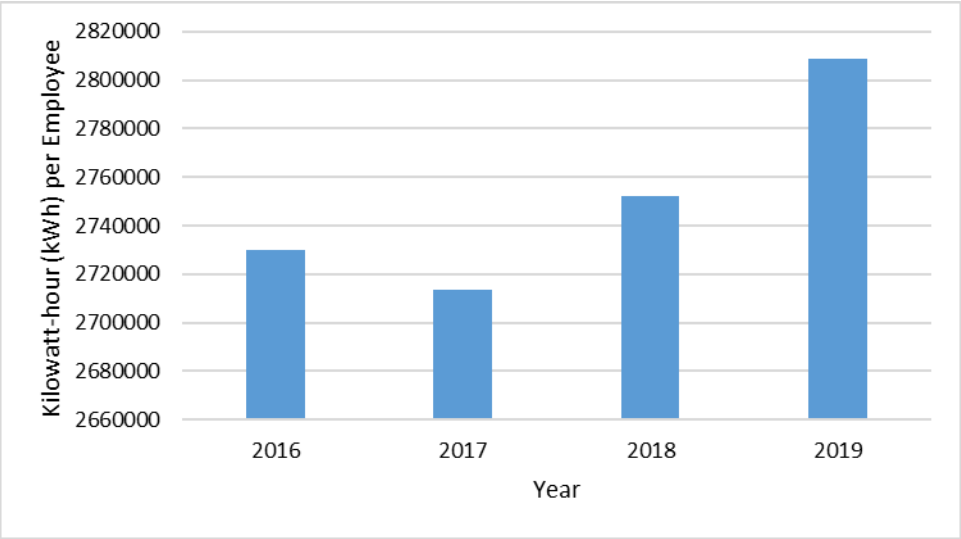
1) kWh sold (units) per employee;
2) Sales (TTD) per employee; and
3) Customers per employee.

The kWh sold per employee ratio gives an indication of how efficiently T&TEC uses its staff to generate sales of units of electricity (kWh). Figure 4 shows the trend in kWh sold per

[24] These are partial productivity indicators and should be used in conjunction with other factors.

employee[25] over the period 2016-2019. T&TEC had the lowest kWh sold per employee in 2017, steadily increasing to the highest kWh sold per employee in 2019. This suggests that labour-assisted efficiencies during 2019 helped T&TEC achieve higher levels of kWh sold with fewer employees.

Figure 4: kWh sold Per Employee



The Sales per employee ratio gives an indication of how efficiently T&TEC uses it staff to generate revenue from electricity sales. A higher ratio is indicative that more electricity sales have been achieved with the given workforce, suggesting a higher level of labour efficiency. Figure 5 illustrates electricity sales (TTD) per employee[26] for 2016-2019. The highest level of staff efficiency based on this indicator was in 2019, which corresponds with the kWh sold indicator. A broader comparison of each year within the period reveals that the two indicators are consistent. Notwithstanding, it should be noted that inconsistencies between the two indicators can assist in identifying non-technical inefficiencies, such as system losses and billing errors.

[25] The kWh sold per employee ratio is calculated by dividing the total number of kilowatt-hours sold by the total number of employees.
[26] The sales per employee ratio is calculated by dividing annual electricity sales by the total number of employees.

Figure 5: Sales Per Employee (TTD)

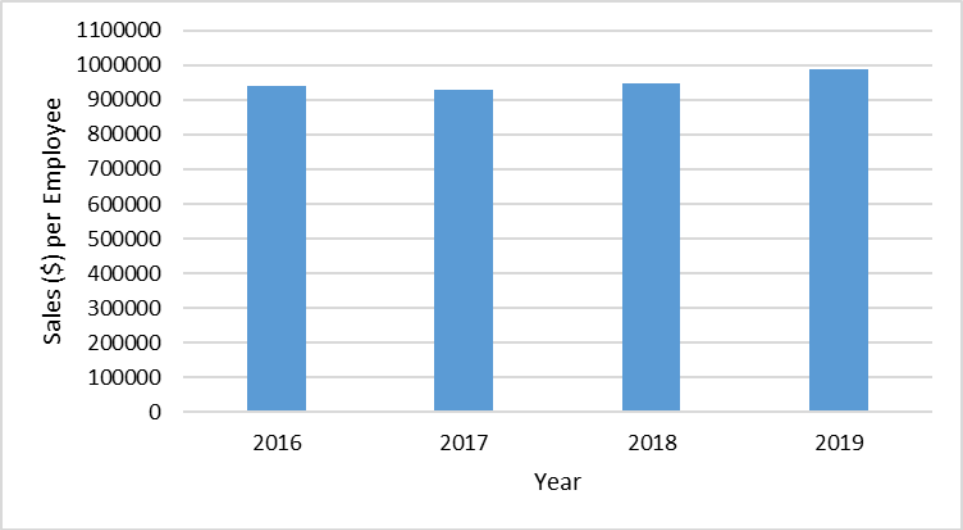
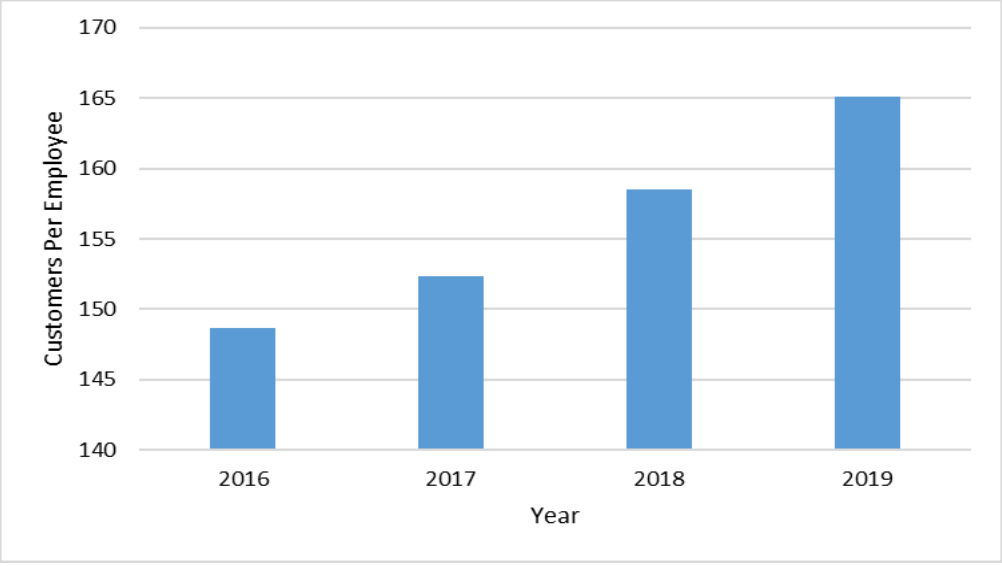


Figure 6 below highlights changes in the number of customers serviced per employee. As mentioned above, there was a 5.7% decrease in persons employed at T&TEC over the period while the number of customers increased by 4.9% from 470,565 in 2016 to 493,965 in 2019.

Figure 6: Customers Per Employee



In 2016, the customer per employee ratio[27] was 148, which consistently increased over the period to 165 in 2019. This is indicative that T&TEC's labour resources were engaged over the period, to serve a larger customer base.

4.2 Other Operational Performance Indicators

Other operational performance indicators can be used to determine whether there has been an improvement in the utility's performance over time, and may allow for assessing the rate of any gains. This can be useful for a regulator when setting a target for operational improvement.

The growth in T&TEC's customer base, electricity sales and the corresponding unit operational costs over the 2016-2019 period is shown in table 5 below.

Table 5: Other Operational Performance Indicators

	2016	2017	2018	2019
kWh Sold	8,662,919,960	8,564,536,977	8,463,412,741	8,401,569,265
Operating Cost per unit ($/kWh)	0.36	0.38	0.37	0.34
Operating Revenue per unit ($/kWh)	0.34	0.35	0.35	0.35
Number of Customers	470,565	479,632	487,559	493,965
Operating Cost per customer (TTD)	6,599	6,748	6,447	5,590

The number of kWh sold decreased by 3% while the customer base grew by 4.9% over the period. Operating cost per kWh increased by $0.02 from 2016 to 2017, decreased by $0.01 to $0.37 in 2018 and then further decreased by $0.03 in 2019. In comparison, there was a marginal

[27] The customer per employee ratio is calculated by dividing the total number of customers by the total number of employees.

increase in operating revenue per kWh sold from $0.34 in 2016 to $0.35 in 2017, which remained consistent thereafter.

There is also an increasing trend in the customer base which grew by approximately 24,000 customers between 2016-2019. Over the four-year period, an average of 88% of T&TEC's customer base consisted of residential customers. Commercial customers and industrial customers comprised an average of 11% and 1% of the customer base respectively. It is noteworthy that despite being the smallest customer class, industrial customers contributed an average of 51% of T&TEC's operating revenue. On average, residential customers contributed 35% of T&TEC's operating revenue and commercial customers contributed 14% of operating revenue. Operating costs per customer decreased by 15.3% over the period, from $6,599 in 2016 to $5,590 in 2019.

5.0 FINANCIAL PERFORMANCE

This section presents an analysis of T&TEC's financial position and its financial performance over the period 2016-2019. Financial assessment can guide the utility in making future financial decisions, and also guide the regulator, on appropriate regulatory measures that may be required. Evaluating financial performance is therefore critical to ensure the sustainability of the utility.

T&TEC's financial performance over the period was assessed by utilising its statement of comprehensive income and expenditure and its statement of financial position. The utility's statement of comprehensive income and expenditure report was examined to make observations regarding the levels of revenue and expenses[28]. T&TEC's statement of comprehensive income gives a general breakdown of revenue[29] and expenditure[30], as well as the utility's net surplus/deficit for a specific timeframe. The expenditure report gives a detailed breakdown of the utility's expenditure[31]. The other financial statement used to assess T&TEC's financial performance was the utility's statement of financial position (balance sheet) which shows the utility's financial position with respect to assets and liabilities at the end of the specific reporting period.

Overall, T&TEC was unable to fully meet its financial obligations over the four-year period. T&TEC experienced deficits throughout the period, the worst being in 2016, however, its ability to meet its financial obligations improved in the subsequent three years[32]. The following sub-sections present more details on T&TEC's financial statements, with a focus on its revenue, expenditure, assets and liabilities.

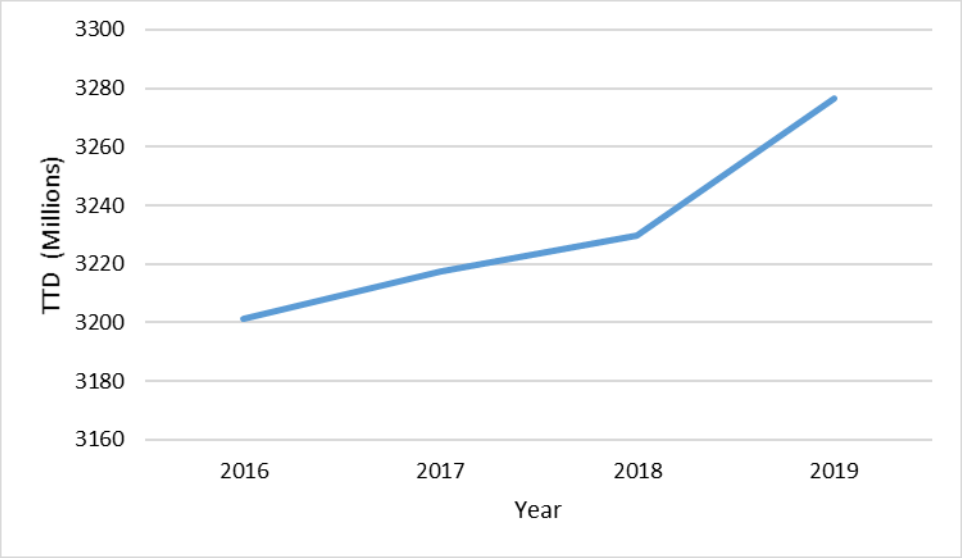
[28] The relationship between revenue and expense will show the utility's profits or deficit for a specific period.
[29] Revenue from sales of electricity, interest on overdue accounts and other income.
[30] Expenditure on broad activities: conversion, generation, transmission, distribution, engineering, administration and general (A&G), depreciation, interest on finance costs interest on suppliers' credit and loss/gain on exchanges.
[31] Expenditure on each broad activity is broken down into specific expense items.
[32] As a result of the closure of Arcelor Mittal, the largest single user of electricity in the Point Lisas Industrial Estate in 2016, there was a reduction in revenue to T&TEC but also a concomitant reduction in its fuel costs.

5.1 Assessment of T&TEC's Income and Expenditure

5.1.1 Total Revenue

T&TEC's total revenue comprises operating and non-operating revenue. Operating revenue is the income received from the sale of electricity. In addition to operating revenue, an average of 5% of T&TEC's total revenue comes from other areas of business such as pole rentals, contracting, and dividend income, which is referred to as non-operating revenue. There was a small increase in T&TEC's revenue over the four-year period of 2.34%, with the highest year on year increase from 2018-2019 of 1.45%.

Figure 7: Total Revenue



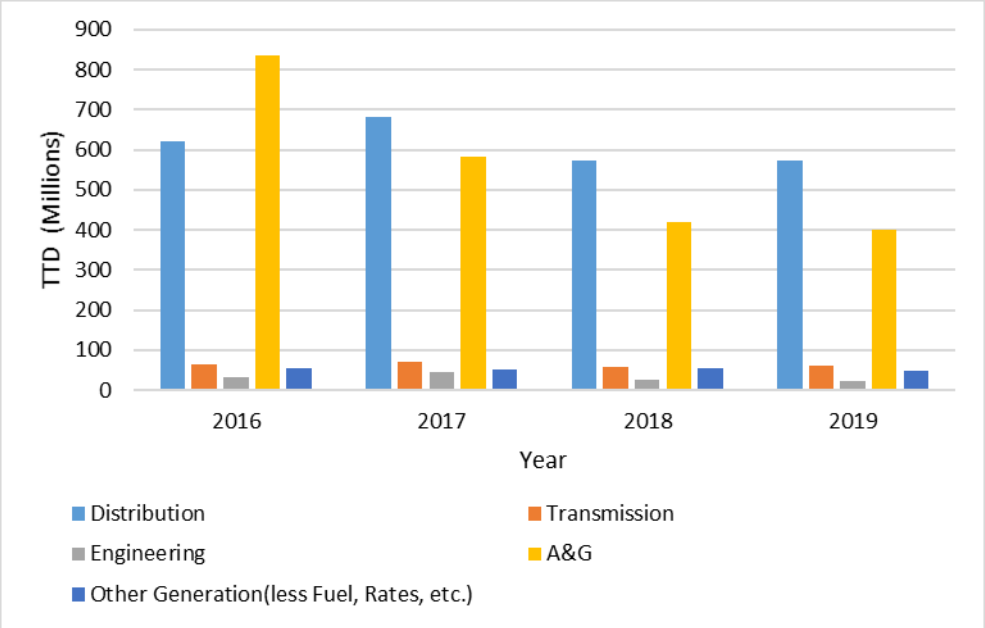
5.1.2 Total Expenditure

T&TEC's expenditure can be categorized broadly into controllable and uncontrollable costs, depending on the degree to which the utility's actions can determine or influence actual expenditure. Controllable costs include those incurred by the utility which can be increased or decreased at the discretion of its management, whereas, uncontrollable costs are those which the service provider has little or no influence over.

5.1.2.1 Controllable Costs

Costs which are directly controlled by T&TEC include a portion of other generation costs[33], transmission, distribution, engineering, and administration and general costs. Figure 8 below shows relatively stable controllable costs between 2016-2019, with the exception of distribution and administrative and general (A/G) costs.

Figure 8: Controllable Costs



Distribution costs increased by 10% between 2016 and 2017, decreased by 16% between 2017 and 2018 and remained relatively steady between 2018 and 2019. The decrease that was noted between 2017 and 2018 was due to a decrease in maintenance costs attributed to distribution.

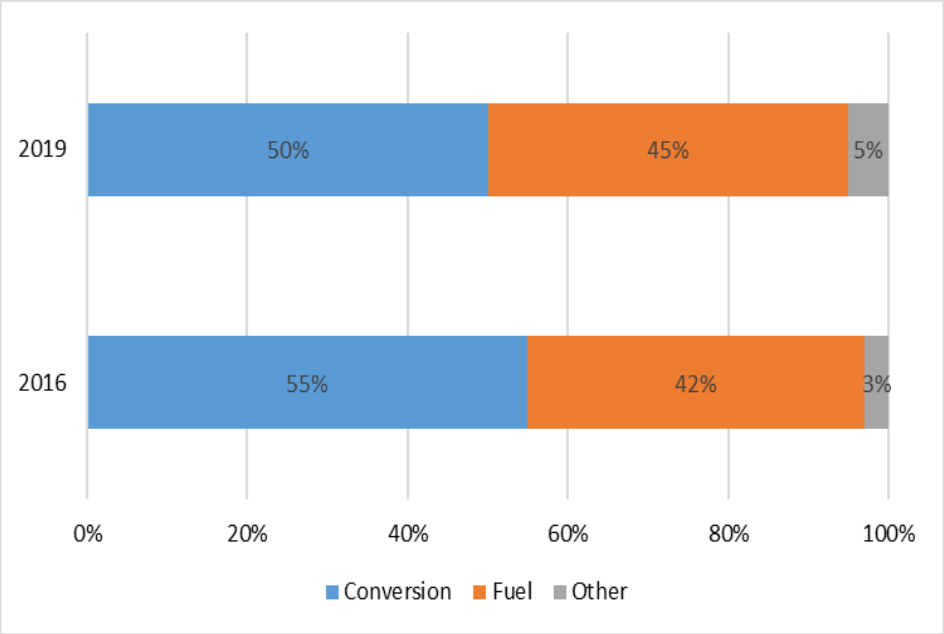
A&G costs were the only costs that experienced a drastic decrease of 50% during the four-year period. This was mainly attributable to the pension plan administration expenses being significantly higher in 2016 compared to the succeeding three years.

[33] Other generation costs comprise of controllable and uncontrollable costs. Those that are controllable comprise of operations and maintenance costs associated only with generation activities.

5.1.2.2 Uncontrollable Costs

One of the major components of expenditure is generation costs, which primarily comprise of conversion, fuel and other costs[34]. Figure 9 below depicts the breakdown of generation costs in 2016 and 2019. Conversion costs[35] and fuel costs[36] are considered uncontrollable because these are included in PPAs and are subject to long-term contractual agreements. T&TEC therefore, has very little or no control over these costs, and they are generally treated as a pass-through costs[37].

Figure 9: Breakdown of Generation Costs



Conversion costs represented 55% and 50% of T&TEC's overall generation costs in 2016 and 2019 respectively. Fuel costs, which represented 42% of the overall generation costs in 2016, increased to 45% of generation costs by 2019.

[34] Other costs that are uncontrollable comprise of rates, taxes and insurance.
[35] The cost of Conversion is the fee charged by the independent power producers to convert the gas purchased by T&TEC into electricity.
[36] Fuel costs are an expense incurred by the utility, based on the unit price paid for fuel utilized in the generation of electricity and the volume of fuel consumed.
[37] Costs that are passed on to the customer. T&TEC has very limited to no influence on volumes, prices, risk allocation, or choice in power procurement (purchases), a full pass-through of costs is generally allowed by the regulator.

Figure 10 below shows that conversion costs decreased from $1,251 million in 2016 to $1,056 million in 2019. Over the period, there was an overall decrease in consumption of electricity by 255 GWh and thus the reduction in conversion costs is ascribable to this. T&TEC's average annual fuel cost over the period was $948 million, ranging from $934 million in 2016 to $989 million in 2019[38]. Conversion and fuel costs represented a total of 46% of total expenditure in 2016 and 48% of total expenditure, in 2019.

Figure 10: Uncontrollable Costs

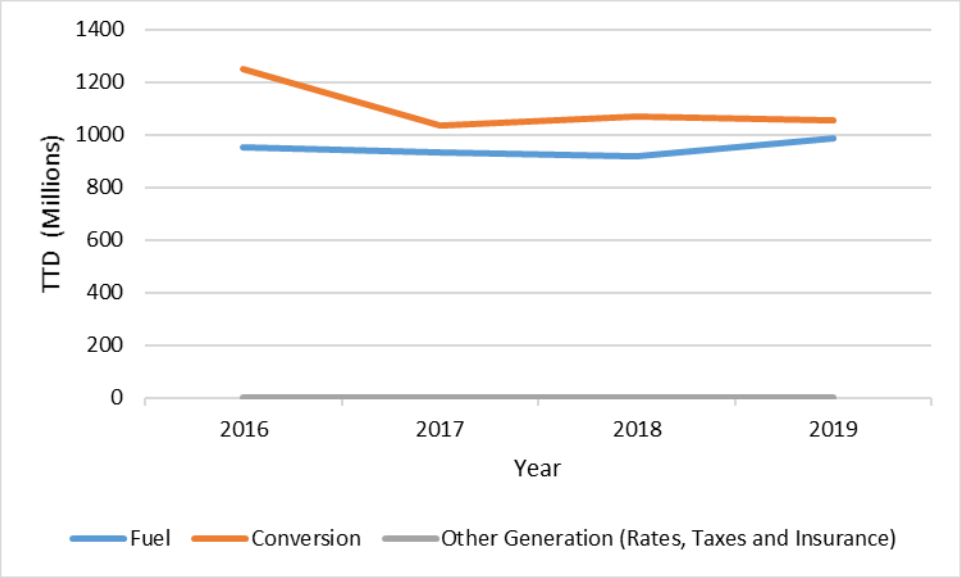


Figure 11 shows the changes in T&TEC's total revenue[39] and total expenditure[40] over the period 2016 to 2019. While T&TEC's revenue increased year on year, the increase over the entire period was small (2.3%) over the four-year period. Over the period, total expenses declined from 2016 to 2018 by 16% with a subsequent increase in 2019 of 6.2%. There was an overall decrease in expenditure between 2016 and 2019 of approximately $529 million over the period, this was

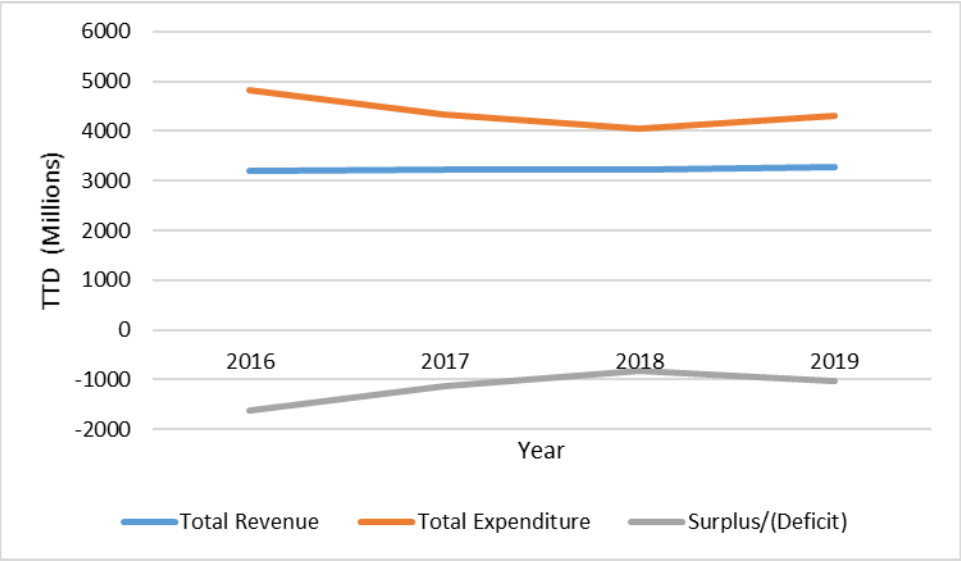
[38] T&TEC indicated that their fuel cost increased in 2019 as one of the Heat Recovery Steam Generators (HRSGs) went down in that year, resulting in greater use of less efficient plant. The HRSG returned to full operation in early 2020.

[39] Total revenue is derived from income from sales of electricity and income from other sources including but not limited to reconnection fees, pole rentals and meter relocations.

[40] Total expenditure is derived from expenses related to the operations, administration and financing of T&TEC. Expenses include but are not limited to conversion costs, Generation, Transmission and Distribution costs, administrative and general costs, depreciation and foreign exchange costs.

mainly due to a reduction in Administrative and General expenses in excess of $430 million. Although revenue increased and expenses decreased, T&TEC still continued to be in a deficit position for the entire period.

Figure 11: Total Revenue and Total Expenditure of T&TEC



5.2 Operating Profit

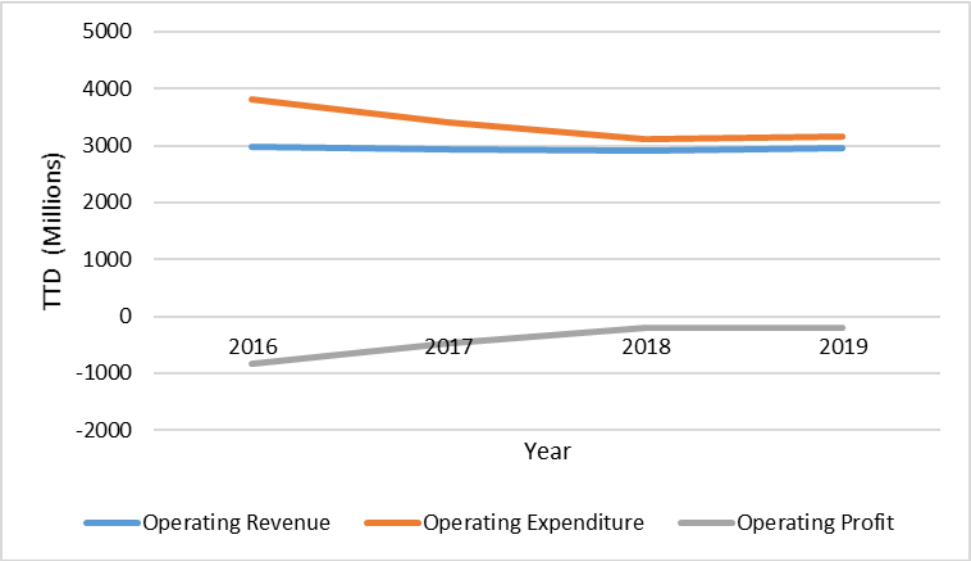
Operating profit is achieved when operating revenue exceeds operating expenditure in a particular financial year. Operating revenue is one component of total revenue and it comprises revenue acquired from the sale of electricity to T&TEC's customers[41]. Operating expenditure comprises the costs related to the generation, transmission, distribution, staffing and overhead costs associated with the provision of electricity[42].

Figure 12 shows that operating expenditure was greater than operating revenue in all four years within the period. However, while operating revenue was relatively flat over the period, operating expenditure decreased in the first three years and increased in the final year. Operating revenue decreased by almost $30 million dollars over the four-year period, while the largest

[41] Other components of total revenue include interest from investments and pole rentals.
[42] Other components of total expenditure include loss on exchange, finance costs and depreciation.

decrease in operating expenditure of $340 million dollars occurred between 2017 and 2018. This was mainly attributable to a decrease in transmission, distribution[43] and A&G[44] costs.

Figure 12: Operating Revenue Vs Operating Expenditure



5.3 Assessment of T&TEC's Assets and Liabilities

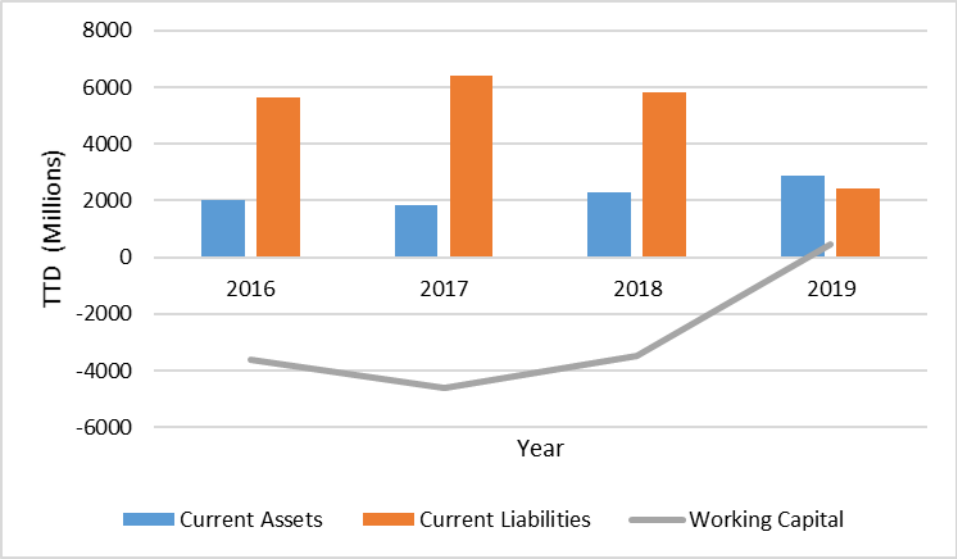
5.3.1 Assets and Liabilities

The utility's assets include buildings, machinery and equipment, vehicles, debtors and cash, all of which support T&TEC's transmission and distribution operations. Liabilities include long term loans, government advances and bank overdrafts, which are used to finance assets and other activities that enhance operations. Assets and liabilities can be classified as short-term (or current) and long-term (or fixed)[45].

[43] The reduction in distribution expenditure between 2017 and 2018 was mainly due to a decrease in maintenance costs over the period.
[44] The reduction in A&G expenditure between 2017 and 2018 was mainly due to a fall in Pension Plan Administration costs over the period.
[45] Current assets are short-term assets either in the form of cash or cash equivalent which can generally be liquidated within 12 months. Current Liabilities are generally those debts and/or obligations of the company that are expected to be settled within 12 months. Fixed assets are tangible assets that cannot be easily or quickly converted into cash. Long-Term (fixed) liabilities are generally debts and obligations that take at least 12 months to pay off.

Figure 13 shows changes in the value of current assets and current liabilities over the four-year period 2016-2019.

Figure 13: Current Assets and Current Liabilities



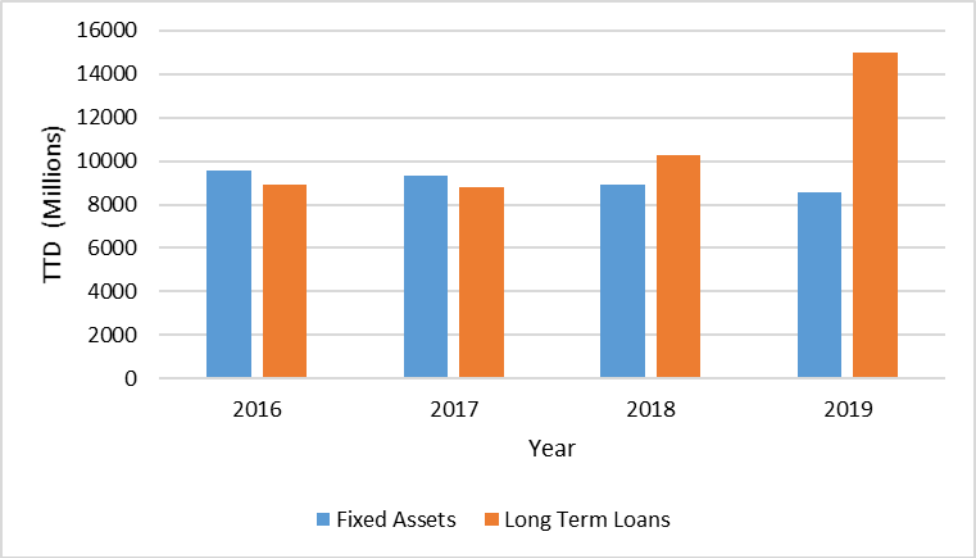
There was an overall increase in current assets over the four-year period, which was mainly due to an increase in the utility's receivables. The value of the utility's current liabilities fluctuated throughout the period, increasing from 2016 to 2017 and decreasing for the subsequent two years. The difference between the utility's current assets and current liabilities is referred to as its working capital, which is a measure of the utility's liquidity[46]. Working capital was negative for the first three years of the period, that is, current assets significantly exceeded current liabilities by an average of $3,904 million in each of the three years. However, this position changed in 2019 as a working capital of $440 million was recorded.

Figure 14 below compares fixed assets with long-term liabilities. There was a consistent decline in fixed assets over the four-year period from $9,568 in 2016 to $8,582 in 2019, an 11% decrease. The value of T&TEC's long-term loans however, increased from 2016-2019 with the

[46] Liquidity is the utility's ability to raise cash when it needs by converting current assets to cash to pay its current liabilities.

highest increase of TT$4.8 billion from 2018 to 2019. This significant increase was mainly attributed to a loan arrangement between T&TEC and the National Gas Company (NGC) in 2018 to facilitate the liquidation of the substantial balance owing to NGC.

Figure 14: Fixed Assets and Long Term Liabilities



5.3.2 Bad Debts, Provision for Bad Debts and Revenue Collected

Receivables represent the amount of electricity sales that have been billed to customers, for which the funds have not yet been collected. Provision for bad debts represent the quantum of receivables which is not expected to be collected. Table 6 shows T&TEC's receivables over the period 2016 to 2019 and its provision for bad and doubtful debts.

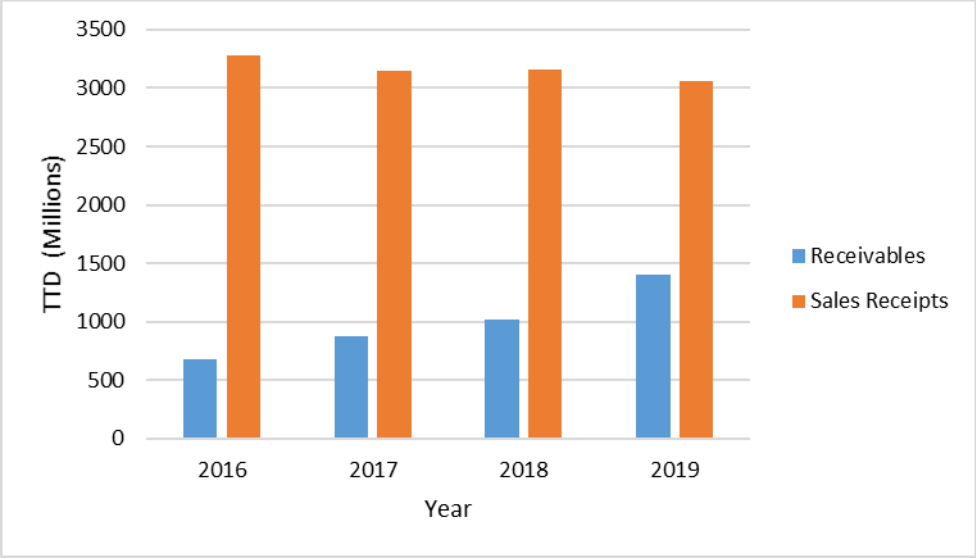
Table 6: Total Receivables & Provision for Bad Debts

	2016	2017	2018	2019
Total Receivables (Million TTD)	682	877	1,014	1,400
Provision for bad and doubtful debts (Million TTD)	8	2	3	3
Sales (Million TTD)	2,982	2,928	2,919	2,952
Provision for bad debt as a % of Sales	0.26%	0.07%	0.10%	0.10%

There was a steady increase in T&TEC's receivables from $682Mn in 2016 to $1,400Mn in 2019, an increase of $816 million over the period. T&TEC also made provisions for bad and doubtful debts[47] which generally remained below 1% when expressed as a percentage of sales for the corresponding period.

In figure 15 below, a breakdown of billed income (sales receipts) of T&TEC over the four-year period is presented. Receivables comprise the amount owing by 'Light and Power' customers[48], which increased by $718 million over the period.

Figure 15: Breakdown of Billed Income



[47] According to International Accounting Standards 37, either a provision for doubtful debts or write off of irrecoverable debts must be made where it is expected that a portion of the receivables will not be recovered.
[48] The RIC only considers T&TEC's receivables which fall under its purview of regulated services. There may be debtors for items such as for pole rentals, etc. which are not considered in this report as only revenue for Light and Power are considered for utility accounting purposes.

6.0 RATES & TARIFFS

Tariffs are charges levied by utilities for services that they provide to customers. Cost reflective tariffs allow the utility to cover efficient costs and can help incentivize customers to consume at efficient levels and reduce wastage, therefore, both the utility and its customers can benefit from cost reflective tariffs. To determine the total cost of service, regulators normally use a 'building block' model that calculates total costs as a combination of the operating expenditure, depreciation and the allowable return on capital (rate of return). An assessment of each of the 'building blocks' is a key determinant of the revenue requirement, however, consideration must also be given to the implications of the pricing structure on consumers and promotion of efficient use of electricity. Therefore, rate determination is a major function of the economic regulator as it affects the utility, its customers, consumers and the economy at large.

6.1 T&TEC Tariff Schedule

The last rate adjustment for T&TEC occurred before the period under consideration in this document therefore, there were no changes to the tariff schedule between 2016-2019[49]. The prevailing tariff structure that applies to customers of T&TEC is shown in table 7 below. There are four main classes of customers: residential, commercial, industrial and street-lighting.

The residential class operates on an inclining block structure consisting of three blocks[50]. The commercial customers are grouped into two rate classes and each class carries a flat energy charge per bill. Residential and commercial (Class B) customers are billed bi-monthly, with all other customers being billed monthly. There are ten different classes of industrial customers ranging from 'small industrial;' to 'very large industrial'. Each rate carries its own demand charge per kVA of billed maximum demand per month.

[49] Within the 2006-2011 rate determination period, the last rate increase occurred in 2009, and covered the period 2009-2010. No increase was granted for 2010-2011, as the prevailing tariffs allowed for the utility to recover the allowed revenue.

[50] The residential rate block consists of three blocks; the first 400kWh consumed is charged at 0.26 per kWh, the next 600 kWh consumed is charged at 0.32 per kWh and over 1000 kWh is charged at 0.37 per kWh.

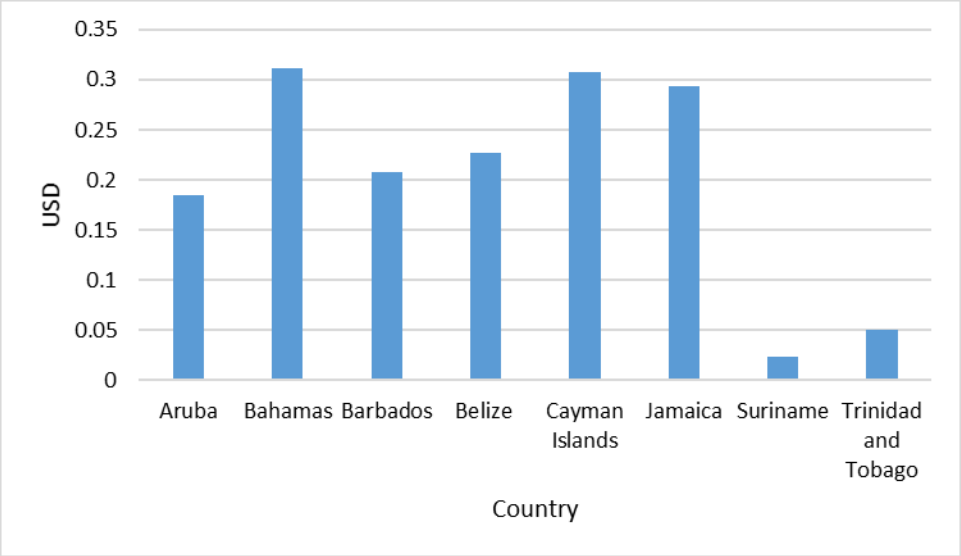
Table 7: Current T&TEC Tariff Schedule

Rate Class	Customer Charge ($)	Energy Charge ($/kWh)	Demand Charge ($/kVA)
Residential (Bi-monthly):			
Up to 400 kWh	6.00	0.26	-
401 - 1000 kWh	6.00	0.32	-
Over 1000 kWh	6.00	0.37	-
Commercial (Bi-monthly):			
Rate B	25.00	0.415	-
Rate B1		0.610	-
Industrial (Monthly):			
Rate D1	-	0.199	50.00
Rate D2	-	0.218	50.00
Rate D3	-	0.183	42.50
Rate D4	-	0.167	40.00
Rate D5	-	0.16	37.00
Rate E1	-	0.145	44.50
Rate E2	-	0.145	44.00
Rate E3	-	0.145	43.00
Rate E4	-	0.145	42.00
Rate E5	-	0.145	41.00
Street Lighting (Annually):			
S1 – 1	848.72	-	-
S1 – 2	565.81	-	-
S1 – 3	411.50	-	-
S1 – 4	372.92	-	-
S2 – 2	450.08	-	-
S2 – 3	347.20	-	-
S2 - 4	282.91	-	-

6.2 Comparison of Electricity Tariffs

Figure 16 shows the average tariff per kWh for selected countries in the Caribbean region[51]. These average tariffs were derived using kWh sold and revenue from electricity sales across the various countries and therefore do not make any distinction by customer class. Based on this data, Trinidad & Tobago has one of the lowest average electricity tariffs in the region at US$0.05/kWh.

Figure 16: Regional Average Electricity Tariffs (USD)



While average electricity tariffs are useful for high-level comparisons, it is important to also compare the average rates by customer class. Utility tariff schemes across countries often include usage (quantity of kWh consumed) and non-usage charges for the different class of customers, which contribute to the overall electricity bill. Table 8 below shows the average residential tariff by specified consumption bands, which was computed based on what residential customers typically pay on their bill when consumption charges and non-consumption charges like taxes and fuel are factored in. When non-consumption charges are included, Trinidad & Tobago is amongst the countries with the lowest tariffs in the region.

[51] It should be noted that comparison of electricity prices across countries is sensitive to the different tariff schemes applied in each country and there can be significant variances (sometimes obscured) depending on fuel charges, width of rate blocks and other factors.

Table 8: Average Residential Tariffs, 2019 (in USD)

COUNTRY	Total average cost per kWh for 100kWh	Total average cost per kWh for 400 kWh	Total average cost per kWh for 800 kWh
Belize	0.19	0.23	0.24
British Virgin Islands	0.35	0.33	0.32
Curacao	0.32	0.34	0.40
Dominica	0.35	0.40	0.41
Grand Cayman	0.36	0.30	0.30
Grenada	0.33	0.34	0.34
Martinique	0.15	0.15	0.15
Trinidad and Tobago	0.05	0.04	0.05

Source: Computations from Carilec Electricity Tariff Report, December 2019

7.0 CONCLUSION

This review of the technical, operational and financial state of T&TEC over the period shows that there was deterioration in certain aspects of T&TEC's technical performance, there were positive movements in some of the operational performance indicators, while financial indicators highlight the difficulties that T&TEC continues to experience in meeting its financial obligations.

When the results of this report are combined with its predecessor, there seems to be a strong correlation between the decline in T&TEC's financial position and stagnation in its rates since the last price review. T&TEC's revenue remained has remained fairly flat over the period, caused mainly by relatively low retail rates. Despite a notable decrease in total expenditure over the period, T&TEC remained in a sizable deficit position at the end of 2019. In this context, the price review for T&TEC that is currently being undertaken is in keeping with the RIC's regulatory mandate to ensure sustainability of the service provider.