REGULATED INDUSTRIES COMMISSION

T&TEC's Annual Performance Indicator Report

For The Year

2017

November

2018

Information Document

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EXECUTIVE SUMMARY

This is the eleventh Annual Performance Indicator Report for the Trinidad and Tobago Electricity Commission (T&TEC)[1]. This report focuses on the key performance indicators identified in the "Performance Monitoring Framework (PMR) for the Electricity Transmission and Distribution Sector (2005)" and the "Regulation of Electricity Transmission and Distribution Sector (June 01, 2006 to May 31, 2011) - Final Determination: Rates and Miscellaneous Charges (2006)" (The Determination). It provides an assessment of T&TEC's performance for the year 2017. The Regulated Industries Commission (RIC) assesses T&TEC's performance on those aspects that impact on customers, using targets set by the Determination, as well as against its performance in the previous year, and performance metrics of other jurisdiction in some instances.

For the period under review, T&TEC's performance was mixed, with notable improvements in some key areas and declines in others. T&TEC's customer base expanded by 1.9% over the period, moving from 470,509 in 2016 to 479,632 in 2017. T&TEC maintained an electricity service coverage of 99.3% in 2017; with only a small percentage of the population not connected to the national electricity grid. There was a 1% decline in both the electricity purchased and electricity sold over the period. The electricity purchased decreased from 9415 GWh in 2016 to 9318 GWh in 2017, while the electricity sold fell from 8663 GWh in 2016 to 8565 GWh in 2017.

Total system losses deteriorated over the period, increasing from 7.99% in 2016 to 8.08% in 2017. Thus T&TEC did not meet the system losses target (of 6.75%) set by the RIC. There was some weakening in system reliability, as demonstrated by the performance of the system reliability indicators. The System Average Interruption Frequency Index (SAIFI) decreased from 4.70 interruptions per customer in 2016, to 4.50 interruptions per customer in 2017. Whereas, the System Average Interruption Duration Index (SAIDI) increased from 400 minutes in 2016 to 417 minutes in 2017, and the Customer Average Interruption Duration (CAIDI) increased from 86 minutes in 2016 to 93 minutes in 2017. There was no change to the number of transmission trips and interruptions on the network (32) in 2017; but T&TEC improved the restoration rate for such trips and interruptions from 75% in 2016 to 84.4% in 2017.

[1] T&TEC is responsible for the transmission and distribution of electrical power to customers within Trinidad and Tobago.

In terms of customer care, the number of complaints that T&TEC received declined by 30.3%, from 30,254 in 2016 to 21,804 in 2017. Billing queries accounted for the majority (62.6% or 13,360) of these complaints. In 2017, T&TEC resolved 99.6% of the complaints it received, compared to 96.8% in 2016.

With respect to equipment maintenance, there was a significant decrease in the percentage of transformers inspected/serviced by T&TEC, which fell from 81.1% in 2016 to 38.5% in 2017. Despite this, T&TEC met the target (minimum of 20% per annum) set by the RIC. Also, the number of reported street light failures doubled in 2017, increasing to 44,520 from 22,031 in 2016. T&TEC's 7-day repair rate for such reported failures declined significantly from 29.9% in 2016 to 12.3% in 2017.

T&TEC's financial performance continued to be below par as operating revenue for the period was unable to meet operating expenditure in 2017. The higher debt and worsening cash flow situation suggested an increased reliance on debt for financing both capital projects and operating expenditure. The decline of the receivables collection rate, coupled with constant revenue levels and increasing operating costs have all contributed to deterioration in the liquidity position of T&TEC. This continued to adversely affect the service provider's ability to finance capital projects. Also, profitability worsened as evidenced by T&TEC's negative Funds from Operations (FFO) in 2017. The RIC acknowledges that a strengthening of revenue streams, both new and existing, is necessary for T&TEC to achieve financial sustainability.

SECTION 1.0 INTRODUCTION

1.1 Background

As the economic regulator of the electricity, and the water and wastewater sectors in Trinidad and Tobago, the RIC has a mandate to regulate the service providers under its purview, in a manner which promotes efficiency and economy in their operations. In carrying out its regulatory role, the RIC is guided by the legislative and regulatory framework set out in the RIC Act No. 26 of 1998. Section 6(1) of the Act empowers the RIC to, amongst other things, prescribe and publish standards for service; monitor service providers and conduct checks to determine compliance with the standards; impose such sanctions for non-compliance with standards; and carry out studies of efficiency and economy of operation and of performance by service providers and publish the results thereof.

In keeping with the above, the RIC established the PMR for the Electricity Transmission and Distribution Sector (2005), for the purposes of monitoring the services of the sector.[2] The PMR requires T&TEC to provide data on a core set of financial, operational and service quality measures on a quarterly and annual basis. This dataset includes aggregate data on electricity coverage, number of customers, electricity purchases and electricity sales. T&TEC's network reliability and system losses are also included, as well as other performance criteria, such as customer responsiveness, equipment maintenance, and financial status. Further to the PMR, the RIC published key performance indicators in the Determination (2006) to monitor the performance of T&TEC. The Determination (2006) also outlined specific directives which were to be followed by T&TEC during the regulatory period (2006-2011). Accordingly, the RIC has been carrying out on-going assessments of T&TEC's performance since 2006. These assessments have been published in annual Performance Indicator Reports, and publicly released. This is the eleventh Annual Performance Indicator Report for T&TEC.[3]

[2] Service performance in this context refers to the delivery of an electricity supply to meet customer's load requirements within targeted quality limits and within targeted levels of reliability.

[3] All the data in this document was supplied by T&TEC, except where specified otherwise.

1.2 Purpose of this Document

This document reports on the performance of T&TEC for the year 2017, with respect to the key performance indicators and specific directives outlined in the Determination (2006), and any other metrics of performance that are relevant to the electricity transmission and distribution sector, as decided by the RIC. It provides a comparison of T&TEC's performance against the targets set by the Determination (2006), as well as against its performance in the previous year, and the performance metrics of other utilities, where data is available.

1.3 Structure of Document

This document is divided into three sections. **Section 1.0** highlights the purpose and structure of the report. **Section 2.0** gives a review of T&TEC's performance with respect to some broad performance criteria including: Aggregate Performance, Other Economic Data, Network Reliability, Customer Responsiveness and Service, Equipment Maintenance, and Financial Performance and Efficiency. **Section 3.0** gives a conclusion and recommendations for T&TEC.

An abridged list of key performance indicators for the electricity transmission and distribution sector is contained in the appendix.[4]

[4] The general list of performance indicators for the electricity sector is contained in the Performance Monitoring and Reporting Framework 2005 (PMR)

SECTION 2.0 PERFORMANCE REVIEW

2.1 Aggregate Performance

2.1.1 Electricity Service Coverage

Electricity Service Coverage is an indicator of the level of access to electricity. It may be used to gauge the potential for growth in a country's commercial and industrial sectors. T&TEC's service coverage was estimated at 99.3% in 2017, with only a small percentage of the population not supplied by the national electricity grid.

2.1.2 Number of Customers by Class and Area

T&TEC categorizes its customers according to specific classes, based primarily on the customer's electrical load and supply voltage. These include the residential, commercial and industrial classes.[5] All customers are billed for energy consumed, measured in kilowatt per hour (kWh). Industrial customers have an additional demand charged, measured in kilovolts-ampere (kVA). A separate classification, street lighting, is used to bill private customers and governmental agencies for electricity that is consumed by private and public outdoor lighting. At the end of 2017, T&TEC had 479,632 customer accounts, which represented a 1.9% increase from the previous year (see table 1). The domestic class accounted for 422,405 or 88.1% of these accounts, while the commercial, industrial and street lighting classes collectively accounted for the remaining 11.9%. The commercial class had the highest growth rate amongst T&TEC's customer classes, increasing by 1,619 accounts or 3.1% in 2017.

Table 1: Number of Active Accounts by Class (2016 - 2017)

Year	Customer Class				Total
	Domestic	Commercial	Industrial	Street Lighting	
2017	422,405	53,250	3,932	45	479,632
2016	415,001	51,631	3,832	45	470,509
% Change	1.8	3.1	2.6	0.0	1.9%

[5] **Residential (Rate A)** supplied at 115/230V at loads less than 50kVA. **Commercial (Rate B)** supplied at 115/230V or 230/400V at loads less than 50kVA. **Commercial (Rate B1)** supplied at 115/230V, 230/400V, 6.6kV, 12kV or 33kV at loads greater than 50kVA but less than 350kVA. **Industrial (Rate D1-5, E1-5)** supplied at 115/230V, 230/400V, 6.6kV, 12kV, 33kV, 66kV or 132kV at loads greater than 50kVA but less than 25,000kVA.

T&TEC serves its customers according to five (5) distribution areas across Trinidad and Tobago, namely North, South, East, Central and Tobago. Table 2 shows the number of active customer accounts by distribution area for the years 2016 and 2017. In 2017, South had the largest number of active accounts (144,835) and it accounted for 30.2% of T&TEC's customer base. Conversely, Tobago had the smallest number of active accounts (28,119 or 5.9%). Among the five distribution areas, Central had the largest growth rate over the period, expanding by 2,142 active accounts (or 2.6%).

Table 2: Number of Active Accounts by Area (2016 - 2017)

Year	Distribution Area					Total
	North	South	East	Central	Tobago	
2017	94,030	144,835	129,213	83,490	28,119	479,687
2016	93,148	142,300	126,390	81,348	27,323	470,509
% Change	0.9	1.8	2.2	2.6	2.9	2.0

2.1.3 Electricity Purchased and Electricity Sales

T&TEC generally purchases electrical energy from three (3) independent power producers (IPPs) in Trinidad and Tobago.[6] This energy is measured in kilowatt-hours (kWh). Table 3 shows the quarterly electricity purchased by T&TEC for the years 2016 and 2017. In 2017, T&TEC purchased 9,318,243,847 kWh of electrical energy from the generators, which represented a 1% decline from 2016 (9,415,044,000 kWh). During 2017, the highest amount of electricity was purchased in the 3rd quarter (2,398,736,000 kWh) and lowest in the 1st quarter (2,213,403,347 kWh).

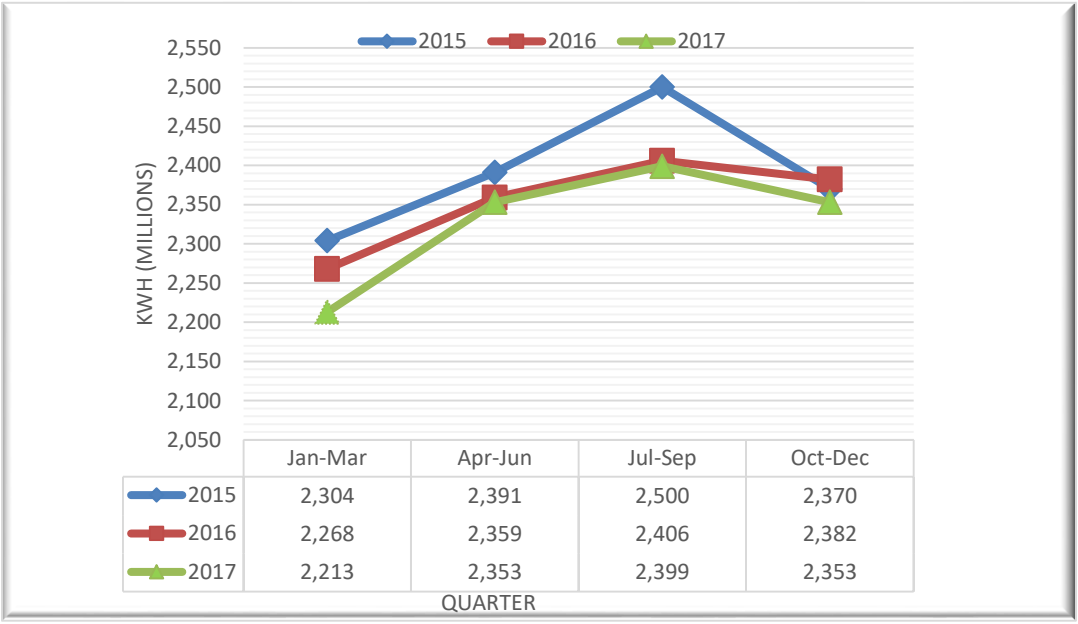
Table 3: Electricity Purchased, kWh (2016 - 2017)

Quarter	kWh	
	2017	2016
Jan-Mar (Q1)	2,213,403,347	2,267,669,000
Apr-Jun (Q2)	2,352,662,500	2,358,975,000
Jul-Sep (Q3)	2,398,736,000	2,406,440,000
Oct-Dec (Q4)	2,353,442,000	2,381,961,000
Total	9,318,243,847	9,415,044,000

[6] These power generators include the Power Generation Company of Trinidad & Tobago Ltd, Trinity Power Ltd, and Trinidad Generation Unlimited. T&TEC also has its own generation capacity of 75MW in Tobago.

A graphical representation of the trends in quarterly electricity purchased by T&TEC over the three-year period 2015-2017 is shown in figure 1. The electricity purchased by T&TEC followed a similar trend over the period. Peak purchases typically occurred in the 3rd quarter, while the lowest purchases occurred during the 1st quarter.

Figure 1: Electricity Purchased: Three-Year Trend (2015 - 2017)



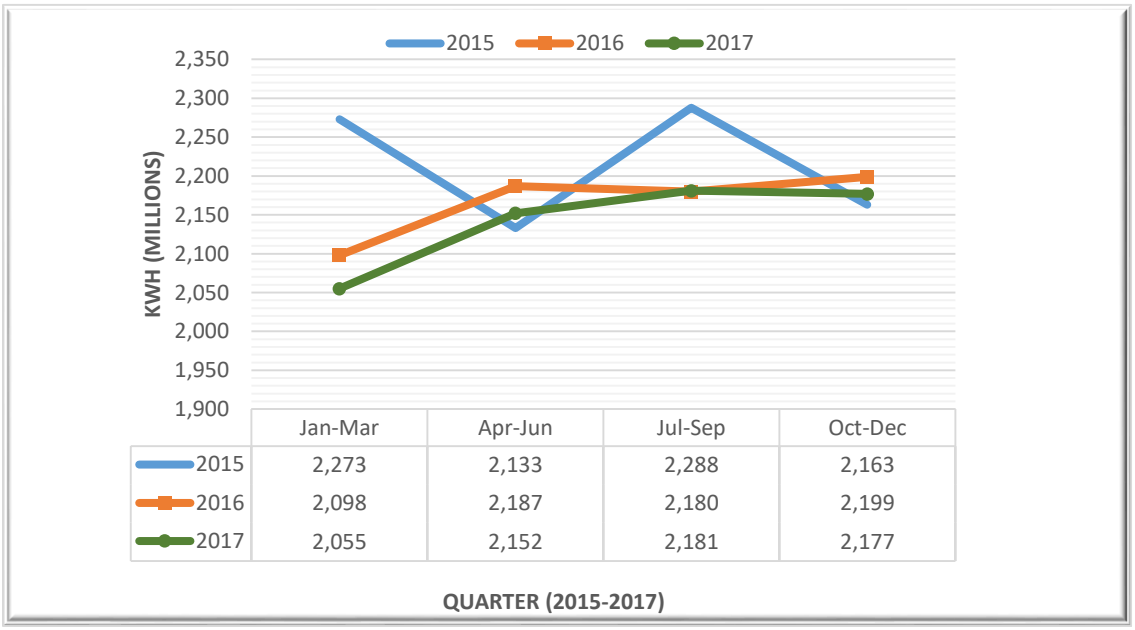
In 2017, T&TEC sold 8,564,536,977 kWh of electricity, which represented a 1.1% decline from 2016 (8,662,919,960) kWh) (see table 4). The closure of T&TEC's largest customer, Arcelor Mittal, in 2016 contributed to this decline in electricity sales (consumption) over the period. The Central distribution area had the highest electricity consumption over the period, with 2,635,152,352 kWh and 2,601,537,087 kWh of electricity, consumed in 2016 and 2017 respectively.

Table 4: Electricity Sales per Distribution Area, kWh (2016 - 2017)

Period	Electricity Sales per Distribution Area (kWh)					Total
	North	South	East	Central	Tobago	
Jan –Mar Q1	391,917,569	474,295,873	456,951,469	656,964,038	74,384,543	2,054,513,492
Apr – Jun Q2	464,812,022	512,519,784	466,612,980	622,198,751	86,166,946	2,152,310,483
Jul – Sep Q3	408,929,079	511,625,703	488,277,569	692,883,105	78,867,469	2,180,582,925
Oct – Dec Q4	464,730,492	522,271,741	472,450,522	629,491,193	88,186,129	2,177,130,077
Total (2017)	1,730,389,162	2,020,713,101	1,884,292,540	2,601,537,087	327,605,087	8,564,536,977
Total (2016)	1,756,076,250	2,058,150,097	1,880,051,395	2,635,152,352	333,489,866	8,662,919,960

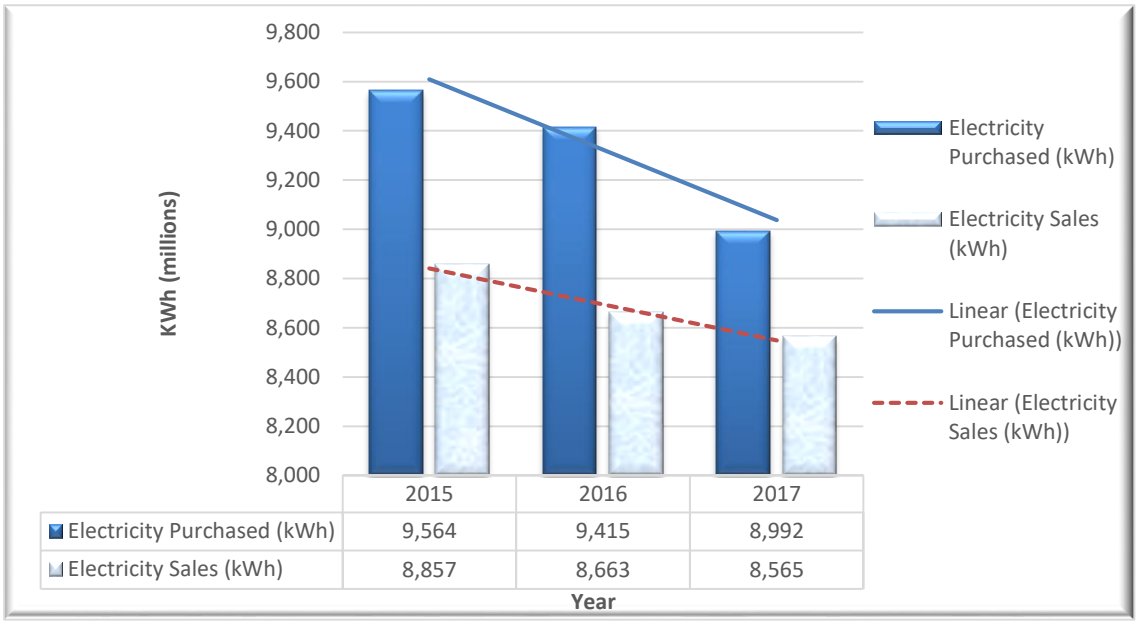
A graphical representation of the trends in quarterly electricity sales over the three-year period 2015-2017 is shown in figure 2. Although no definitive trends were observed over this period, there was a notable change in the direction of quarterly electricity sales from 2016. Electricity sales fluctuated throughout 2016 and 2017. Peak sales occurred in the 4th quarter, while the lowest sales occurred during the 1st quarter.

Figure 2: Electricity Sales - Three Year Trend (2015 - 2017)



The data collected for the electricity purchased by T&TEC from the generators is measured in real-time, whereas the electricity sales data is computed on customers' consumption billed over various cycles. Consequently, the trends of peaks and troughs for these two indicators do not occur simultaneously in each quarter. This discrepancy can be misleading, as the gap between these indicators may not depict the actual difference. A comparison of the amount of electricity purchased versus the amount of electricity sales for the period 2015-2017 is shown in figure 3. There was a downward trend in both indicators over the period. Further, the rate of decrease of the electricity purchased has been aligning itself with the rate of decrease of the electricity sales. This is an indication that the disparity between the indicators has been lessening, compared to the previous years.

Figure 3: Electricity Purchased vs. Electricity Sales: Three -Year Trend (2015 - 2017)



2.1.4 Total System Losses

Not all the electrical energy purchased by T&TEC from the generators is available for sale to customers. The difference between the electricity entering T&TEC's system and that which is supplied to its customers is referred to as 'total system losses'. Total system losses are due to a combination of technical and non-technical losses. Technical losses arise due to physical reasons such as the materials used to construct transmission and distribution lines, the configuration and operation of the networks and the inherent inefficiencies in various pieces of equipment. Non-

technical losses, also called commercial losses, arise when electrical energy is delivered to customers but no revenue is collected by the utility. These losses usually occur as a result of metering errors, recording errors, theft and any other instance where the energy is not billed by the utility.

In the Determination (2006) the RIC set a target of 6.75% for total system losses, which T&TEC was expected to achieve by the end of the regulatory control period June 1, 2006 to May 31, 2011. In 2017, T&TEC reported total system losses of 8.08%, compared to 7.99% in 2016 (see table 5). This increase indicated a weakening in the utility's performance over the period. During 2017, system losses was highest in the 3rd quarter (9.09%), and lowest in the 1st quarter (7.18%). The variation in system losses over the different quarters was likely due to the discrepancy between the real-time purchases data from the generators and the delayed billing information for energy sold to customers, as mentioned previously in section 2.1.3.

Table 5: Total System Losses (2016 - 2017)

Quarter	Energy Units Consumed (kWh)	Energy Units Purchased/Generated (kWh)	System Loss[7] (%)
Jan – Mar (Q1)	2,054,513,492	2,213,403,347	7.18
Apr – Jun (Q2)	2,152,310,483	2,352,662,500	8.52
Jul – Sept (Q3)	2,180,582,925	2,398,736,000	9.09
Oct – Dec (Q4)	2,177,130,077	2,353,442,000	7.49
Total 2017	8,564,536,977	9,318,243,847	8.08
Total 2016	8,662,919,960	9,415,044,109	7.99

2.2 Other Economic Data

This section examines T&TEC's performance based on specific economic and consumption indicators which are reported on a "per employee" or "per customer" basis. The main indicators include electricity sales per employee, customers per employee and consumption per capita

[7] Total system loss is calculated by the following T&TEC formula:

$$\text{Total System Losses} = 1 - \left\{ \frac{\text{Energy Units Billed}}{\text{Energy Units Purchased}} \right\}$$

2.2.1 Electricity sales per employee (kWh) and Customers per employee

Electricity sales per employee and customers per employee are two indicators generally used to measure labour productivity and effective use of resources in the electricity distribution sector.[8] In 2017, T&TEC's electricity sales per employee (kWh) was 2,717,764 kWh, which represented a 7.6% decline from 2016 (see table 6). T&TEC's customers per employee increased from 148 in 2016 to 152 in 2017.

Table 6: Other Economic Data (2016-2017)

Indicator	Year		% Change
	2017	2016	
Number of Employees	3,149	3,174	(0.9)%
Electricity Sales (kWh)	8,564,536,977	8,662,919,960	(1.1)%
Electricity Sales per Employee (kWh)	2,717,764	2,940,570	(7.6)%
Electricity Sales per Employee ($)	951,889	940,698	1.2%
Number of Customers	479,632	470,509	1.9%
Customers per Employee	152	148	2.7%

T&TEC's electricity sales per employee (kWh) and customers per employee ratios were compared to the performance of electric utilities in four (4) regional countries, including Dominica, Jamaica, Cayman Islands and Belize.[9] The electricity sales per employee in Trinidad and Tobago was higher than that of the Cayman Islands (2,916,827 kWh), Jamaica (1,870,181 kWh), Belize (1,739,296 kWh) and Dominica (414,100 kWh), as shown in table 7. Additionally, Trinidad and Tobago's customers per employee (148) was significantly lower than all the countries, except the Cayman Islands (138). Statistically, this indicated that T&TEC required more employees to serve their entire customer base than the mentioned countries. Jamaica had the highest customers per employee in 2016 (372).

[8] The World Bank Group (2009). *Benchmarking Data of the Electricity Distribution Sector in the Latin America and Caribbean Region 1995 – 2005*. http://info.worldbank.org/etools/lacelectricity/home.htm

[9] Note: the comparisons were done using data for the year 2016, as data was unavailable for the current year.

Table 7: Other Economic Data: Trinidad and Tobago vs Regional Countries (2016)

Indicator	Country[10]				
	Dominica	Jamaica	Cayman Islands	Belize	Trinidad and Tobago
No. of Customers	36,467	631,568	28,678	90,635	470,509
No. of Employees	240	1,700	208	311	3,174
Electricity Sales (kWh)	99,384,000	3,179,308,000	606,700,000	540,921,000	8,662,919,960
Electricity Sales per Employee (kWh)	414,100	1,870,181	2,916,827	1,739,296	2,940,570
Customers per Employee	152	372	138	291	148

2.2.2 Consumption per capita

Consumption per capita is defined as the total amount of electricity sold, divided by the population. It gives an indication of a country's electricity consumption averaged per individual, not accounting for the specific purpose of use whether residential, commercial or industrial. A comparison of Trinidad and Tobago's electricity consumption per capita for the period 2014-2017 is shown in table 8. Trinidad and Tobago's electricity consumption per capita marginally increased from 2014 (6,516 kWh) to 2015 (6,562 kWh). This was followed by two years of consecutive decline – 6399 kWh in 2016 and 6320 kWh in 2017. The decline in electricity consumption per capita is reflective of the loss of one of T&TEC's largest customer, Arcelor Mittal, as previously mentioned in sections 2.1.3.

[10] These countries were selected based on data availability at time this report was being done. They are presented to give a snapshot of how Trinidad and Tobago's performance compares to other jurisdictions. Data was obtained from the following sources: The Dominica Electricity Services 2016 Annual Report, The Jamaica Public Service Company Limited 2016 Annual Report, The Caribbean Utilities Company, Ltd. 2016 Annual Report, and Belize Electricity Limited Annual Report 2016.

Table 8: Electricity Consumption Per Capita for Trinidad and Tobago (2014-2017)

Year	Electricity Consumption Per Capita (kWh)[11]	Change (%)
2017	6320	(1.2)
2016	6399	(2.5)
2015	6,562	0.70
2014	6,516	-

Trinidad and Tobago's electricity consumption per capita was compared to nine (9) countries using data for the year 2014.[12] These include five (5) Latin American and Caribbean (LAC) countries, and four (4) non-regional countries with comparable GDP per capita to Trinidad and Tobago. Trinidad and Tobago's electricity consumption per capita (6,516 kWh) was substantially higher than the LAC countries, including: Jamaica (1,056 kWh), Cuba (1,434 kWh), Suriname (3,632 kWh), Panama (2,063 kWh) and Venezuela (3,658 kWh) in 2014 (see table 9). However, Trinidad and Tobago's electricity consumption per capita was more comparable to those countries with a similar GDP per capita. For example: Slovak Republic (5,137 kWh), Czech Republic (6,259 kWh), Oman (6,554 kWh) Estonia and (6,732 kWh). The relatively high level of electricity consumption for industrial purposes is one of the reasons for the relatively high per capita consumption in Trinidad and Tobago.

[11] Consumption per capita was calculated using electricity sales data from T&TEC and population mid-year estimates data from the Central Statistical Office of Trinidad and Tobago. Note, population mid-year estimate for 2017 was unavailable at the time. Hence the population mid-year estimate for 2017 was used for the calculation.

[12] Consumption per capita for the year 2014 was the most recent data available at the time this report was being done. Thus, the 2014 is presented to give a mere snapshot of how Trinidad and Tobago's performance compares to other jurisdictions. Also, due to the unavailability of consumption per capita data for most countries in the region, Trinidad and Tobago's consumption per capita was also compared to four countries worldwide with a comparable GDP per capita to Trinidad and Tobago.

Table 9: Consumption Per Capita: Trinidad and Tobago vs Selected Countries (2014)

Country		GDP Per Capita (Current US$)[13]	Electricity Consumption per Capita (kWh)[14]
Latin American and Caribbean (LAC) countries	Trinidad & Tobago	19,325.3	6,516*
	Jamaica	4,855.8	1,056
	Cuba	7,050.5	1,434
	Suriname	9,564.4	3,632
	Panama	12,593.7	2,063
	Venezuela	15,692.4	3,658
Non-regional Countries with Comparable GDP per capita	Slovak Republic	18,629.8	5,137
	Estonia	19,949.6	6,732
	Czech Republic	19,744.6	6,259
	Oman	20,458.5	6,554
World Average		10,850.22	3,125

*The RIC notes the that its calculated value (6,516 kWh) for Trinidad and Tobago's electricity consumption per capita for 2014 varies with the World Bank's calculation (7,134 kWh) at the time the report was being written. This variation may be attributable to a difference in the data reported to the entities.

2.3 Network Reliability

A critical part of providing quality service to customers is the delivery of a reliable supply of electricity. An unreliable supply results in economic losses and inconveniences, and increases the likelihood of damage to customers' equipment. Therefore, it is important for a utility to meet some minimum standards of reliability, even as it seeks to pursue and maintain economic and operational efficiencies. One of the roles of the RIC, as the economic regulator, is to ensure that T&TEC supplies electricity to customers at an acceptable level of reliability. Reliability metrics are an indication of the condition of the network system and allow the utility and regulator to assess the system's performance. Since all systems are different and stressed by different factors, it can be very hard to make a legitimate comparison between two systems. This means that reliability indices are situational in nature and will present different baselines depending on the many intrinsic factors affecting the system.[15] The IEEE Guide for Electric Power Distribution Reliability Indices (IEEE 1366-1998) is a standard that has been applied across many jurisdictions with

[13] The GDP per Capita (Current US$) data was obtained on 25.04.2018 from the World Bank: World Development Data at: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2014&start=1960

[14] Electricity consumption per capita for the year 2014 was obtained on the 25.04.2018 from the World Bank: World Development Data at https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC

[15] Evaluation of Data Submitted in APPA's 2013 Distribution System Reliability & Operations Survey http://www.publicpower.org/files/PDFs/2013DSReliabilityAndOperationsReport_FINAL.pdf

respect to monitoring and reporting on reliability. The reliability of T&TEC's supply was assessed using the under-mentioned indices as defined in IEEE 1366-2012.

2.3.1 System Average Interruption Frequency Index (SAIFI)

The System Average Interruption Frequency Index (SAIFI) measures the average number of sustained interruptions per customer. The annual value of SAIFI for 2017 was 4.50 interruptions per customer (see table 10). This represented a minor improvement in performance when compared to 2016 (4.70 interruptions per customer). The value of this index suggested that, statistically a T&TEC customer was likely to experience four to five interruptions in electricity supply per year, as compared to one interruption per customer in selected North American utilities. SAIFI was highest in August, with 0.59 interruptions per customer on average for the month.

2.3.2 System Average Interruption Duration Index (SAIDI)

The System Average Interruption Duration Index (SAIDI) measures the average outage duration per customer. The annual value of SAIDI was 417 minutes in 2017, which was 17 minutes more than in 2016 (see table 10). This indicated a weakening in T&TEC's performance. The median value of SAIDI for the selected North American utilities (based on the IEEE 1366-1998) is 90 minutes, suggesting that the yearly outage duration was about five times longer for a T&TEC customer. SAIDI was highest in June, with outages lasting 76.2 minutes on average for the month.

2.3.3 Customer Average Interruption Duration Index (CAIDI)

The Customer Average Interruption Duration Index (CAIDI) is a ratio of SAIDI to SAIFI. It is a measure of the average outage duration that an individual customer would experience. It can also be viewed as the average restoration time. The annual value of CAIDI for 2017 was 93 minutes, with a high of 161.40 minutes in June, and a low of 61.8 minutes in July (see table 10).

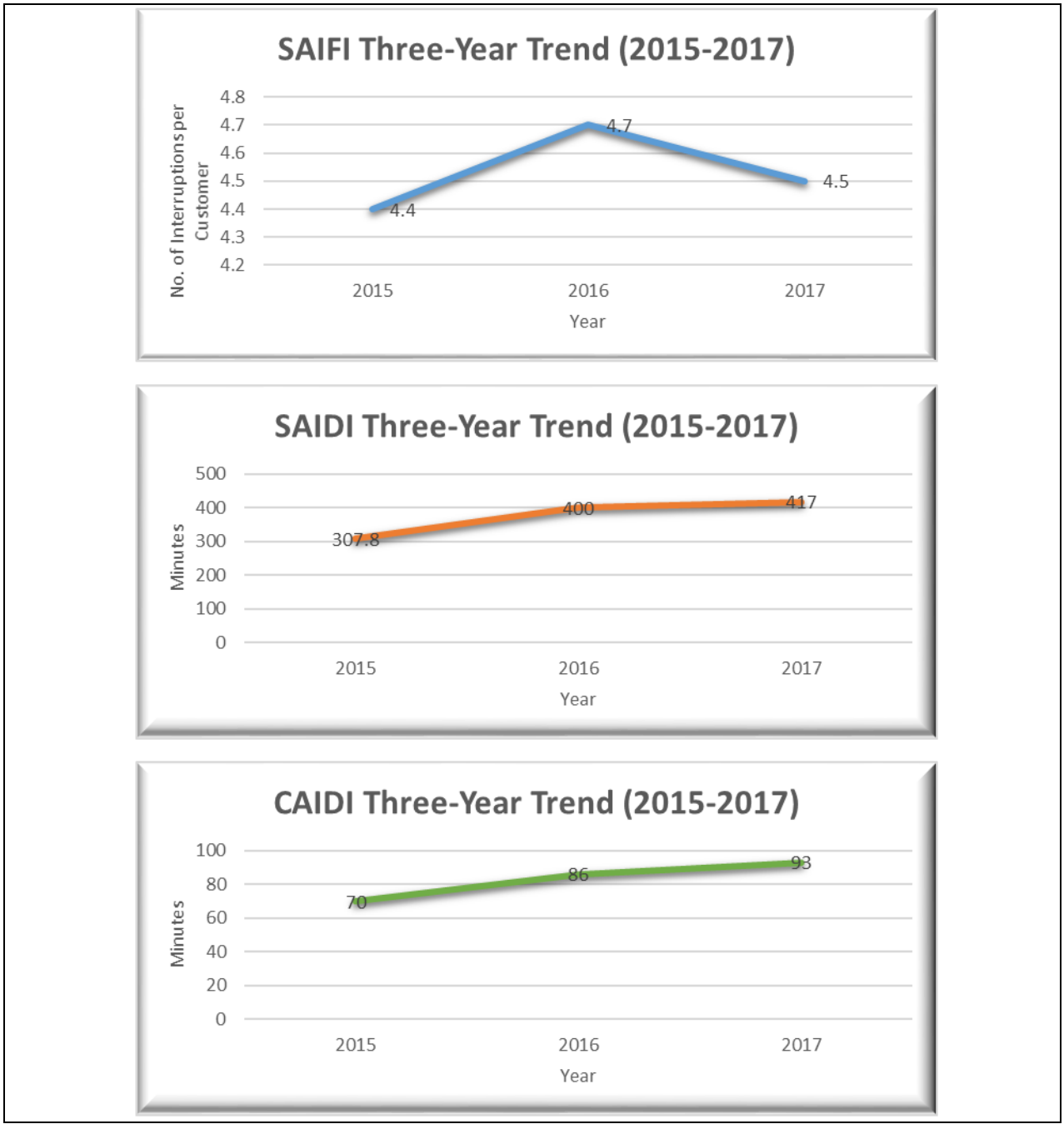
Table 10: SAIFI, SAIDI & CAIDI (2017)

Indicator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	NAU*
SAIFI (No./customer)	0.16	0.22	0.18	0.25	0.26	0.47	0.54	0.56	0.49	0.59	0.37	0.38	4.5	1.1
SAIDI (minutes)	12.00	16.20	13.20	19.20	20.40	76.20	33.6	42	55.8	60.0	27.6	40.8	417	90
CAIDI (minutes)	75.60	75.60	73.20	77.40	79.20	161.40	61.8	75	112.8	102.0	75.0	108.6	93	82

NAU* = values for selected North American utilities according to IEEE Standard 1366-1998

An examination of the trends in SAIFI, SAIDI and CAIDI over the three-year period 2015-2017 is shown in figure 4. The values of SAIFI fluctuated over the period, while the SAIDI and CAIDI values both increased. These trends indicated some weakening in system reliability over the period.

Figure 4: SAIFI, SAIDI, & CAIDI: Three-Year Trend (2015-2017)



2.3.4 Number of Transmission Trips & Interruptions Affecting Customers

In 2017, there were 32 transmission trips and interruptions affecting customers on T&TEC's network (see table 11). The majority of these trips occurred on the 33kV network (25), followed by the 66kV network (6) and 132kV network (1) respectively.

Table 11: Transmission Trips & Interruptions Affecting Customers (2017)

Month	Transmission Circuit Trip			Number of Interruptions Restored (<3hrs)			Number of Interruptions Restored (<5hrs)		
	33kV	66k V	132kV	33kV	66kV	132kV	33kV	66k V	132kV
Jan	0	0	0	0	0	0	0	0	0
Feb	2	2	0	2	1	0	0	0	0
Mar	3	0	0	3	0	0	0	0	0
Apr	2	1	0	2	0	0	0	1	0
May	0	0	0	0	0	0	0	0	0
Jun	1	1	0	1	1	0	0	0	0
Jul	2	0	0	1	0	0	0	0	0
Aug	0	1	1	0	1	0	0	0	0
Sep	7	0	0	6	0	0	0	0	0
Oct	3	0	0	3	0	0	0	0	0
Nov	3	1	0	2	1	0	0	0	0
Dec	2	0	0	2	0	0	0	0	0
Total	**25**	**6**	**1**	**22**	**4**	**0**	**0**	**1**	**0**

T&TEC performed the best on the 33kV network, with 88% of the transmission trips and interruptions being restored within 3 hours (see table 12). On the 66 kV, T&TEC restored 83.4% of the trips and interruptions within 5 hours. T&TEC did not restore the trip/interruption on the 132kV network within a 5-hour period.

Table 12: Summary of Transmission Trips & Interruptions Affecting Customers (2017)

	No. of Trips and Interruptions			
	33kV	**66kV**	**132kV**	**Total**
TOTAL	25	6	1	32
Restoration < 3hrs	22	4	0	26
Restoration < 5hrs	0	1	0	1
% < 3hrs	88%	66.7%	0%	81.3%
% < 5hrs[16]	0%	83.3 %	0%	84.4 %

2.4 Customer Responsiveness and Service

This section highlights customer complaints and their resolution, with a focus on certain aspects that are most important to customers. One of the best signals that a utility is improving its service to customers is a reduction in the number of complaints received. In assessing T&TEC's responsiveness and service to customers, the following indicators were examined: the number of complaints received, the number of complaints resolved and the complaints resolution rate.

2.4.1 Complaints Received and Resolved

In 2017, T&TEC received 21,804 customer complaints (see table 13), which represented a 30.3% decline from 2016 (31,266). Billing queries accounted for the majority of these complaints (13,640 or 62.6%), followed by poles/other complaints (6,712), damaged appliances complaints (762) and high/low voltage complaints (690) respectively. In 2017, T&TEC received the largest number of customer complaints during the 3rd quarter (7,040), and the least during the 1st quarter (4,031).

[16] This percentage includes the percentage of transmission trips and interruptions restored in less than 3 hours.

Table 13: Complaints Received by Type (2016 - 2017)

Type of Complaint	No. of Complaints Received									
	2017					2016				
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	**Total**	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	**Total**
Billing Query	2,478	3,906	4,391	2,865	**13,640**	5,496	5,417	6,000	5,683	**22,596**
Damaged Appliances	131	142	286	203	**762**	227	294	304	302	**1,127**
High/Low Voltage	120	179	225	166	**690**	752	933	1,083	903	**3,671**
Poles/Other[17]	1,302	1,755	2,138	1,517	**6,712**	901	963	1,265	743	**3,872**
Total	4,031	5,982	7,040	4,751	**21,804**	7,376	7,607	8,652	7,631	**31,266**

T&TEC resolved 21,716 customer complaints in 2017, compared to 30,254 in 2016 (see table 14). In 2017, T&TEC resolved the largest number of complaints during the 3rd quarter (6,988) and the least during the 1st quarter (4,027).

Table 14: Complaints Resolved by Type (2016-2017)

Type of Complaint	No. of Complaints Resolved									
	2017					2016				
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	**Total**	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	**Total**
Billing Query	2,475	3,905	4,391	2,865	**13,636**	5,496	5,417	6,000	5,683	**22,596**
Damaged Appliances	131	118	279	203	**731**	223	213	245	229	**910**
High/Low Voltage	119	177	222	161	**679**	752	929	1,007	897	**3,585**
Poles/Other	1,302	1,755	2,096	1,517	**6,670**	779	897	946	541	**3,163**
Total	4,027	5,955	6,988	4,746	**21,716**	7,250	7,456	8,198	7,350	**30,254**

[17] "Other" complaints include but are not limited to defective street lights, power outages, delays in the delivery of service and line relocation and removals.

2.4.2 Complaints Resolution Rate

In 2017, T&TEC improved its resolution rate for all complaints (see table 15). As a result, its overall complaints resolution rate increased from 96.8% in 2016 to 99.6% in 2017.

Table 15: Complaints Resolution Rate (2016 - 2017)

Complaints by Type	Resolution Rate[18]	
	2017	2016
Billing Query	100.0%	100.0%
Damaged Appliances	95.9%	80.7%
High/Low Voltage	98.4%	97.7%
Poles/Other	99.4%	81.7%
Total	**99.6%**	**96.8%**

2.4.3 Response to Written Complaints

The timeliness of T&TEC's response to a customer complaint is an important indicator of its service quality. Customers can lodge complaints to T&TEC in several ways, including via telephone or in writing. In 2017, T&TEC received 196 written complaints, a 31% decline from 2016 (283). Of these written complaints, T&TEC was unable to respond to 27 or 13.8% of them within a 2-week period. The highest percentage (43.7%) of written complaints that were not responded to within 2 weeks was recorded in July. T&TEC's best performance, i.e. when 100% of complaints were responded to within 2 weeks, was achieved in the following months: January, February, April, May, August and September.

[18] Calculated as (Complaints Resolved/Complaints Received) *100

Table 16: Response to Written complaints (2016-2017)

Month/Year	No. of written complaints received	No. of written complaints not responded to within 2 weeks		% complaints with Response > 2 weeks
		Received in the month	Received in previous months	
Jan-17	25	0	0	0
Feb-17	19	0	0	0
Mar-17	12	2	2	33.3
Apr-17	14	0	2	14.3
May-17	15	0	1	6.7
Jun-17	19	2	2	21.1
Jul-17	16	3	4	43.7
Aug-17	14	0	0	0
Sep-17	16	0	0	0
Oct-17	18	2	0	11.1
Nov-17	17	3	0	17.6
Dec-17	11	2	2	36.4
Total 2017	**196**	**14**	**13**	**13.8**
Total 2016	**283**	**8**	**11**	**6.7**

2.5 Equipment Maintenance

In the Determination (2006), the RIC requires that T&TEC provide information on specific directives related to its operations. This section focuses on two (2) of these specific directives, namely: repair and maintenance of pole-mounted distribution transformers, and repair/replacement of defective street lights.

2.5.1 Repair and Maintenance of Pole-mounted Distribution Transformers

T&TEC was given a directive to repair and maintain pole-mounted distribution transformers at a rate of at least 20% per annum. In 2017, there were 38,558 pole-mounted transformers in service at the end of the year (see table 17), which represented a 2.4% increase from 2016 (36,200). The annual percentage of transformers inspected/serviced by T&TEC was 38.5% in 2017. Notwithstanding a significant decline in performance from 2016 (81.1%), T&TEC surpassed the minimum requirement of 20% per annum set by the RIC.

Table 17: Repairs & Maintenance to Pole-Mounted Transformers (2016-2017)

Indicator	No. of Pole-Mounted Transformers							
	2017				2016			
	Jan-Mar (Q1)	Apr-Jun (Q2)	July-Sep (Q3)	Oct-Dec (Q4)	Jan-Mar (Q1)	Apr-Jun (Q2)	July-Sep (Q3)	Oct-Dec (Q4)
No. of Pole Mounted Distribution Transformers	37,636	37,986	38,304	38,538	35,538	35,752	35,943	36,200
No. of Pole Mounted Distribution Transformers Inspected	3,719	8,599	11,581	11,959	3,976	8,513	18,673	27,237
No. of Transformers Serviced	751	1,511	770	2,867	788	1,526	1,827	2,114
% Inspected/ Serviced	**11.9**	**26.6**	**32.2**	**38.5**	**13.4**	**28.1**	**57.0**	**81.1**

2.5.2 Street lighting Repair

T&TEC is responsible for monitoring the condition and performance of public lighting assets. This includes the development and implementation of plans for the operation, maintenance and replacement of public lighting. The utility is also required to monitor highway lighting and repair non-working lights within 14 days of discovery. Street lighting failures that are reported to T&TEC must be repaired within 7 days. In 2017, T&TEC received 44,520 reports from customers and/or members of the public for repairs to existing street lights (see table 18). Of this, 5,457 (12.3%) repairs were completed within 7 days. T&TEC also completed 6,498 repairs to street light failures as a result of inspections by staff and crews within that period. In total, T&TEC completed 47,111 street light repairs in 2017.

Table 18: Street Light Repairs and Installations (2017)

Indicator	2017				
	Jan-Mar (Q1)	Apr-Jun (Q2)	Jul-Sep (Q3)	Oct-Dec (Q4)	**Total**
No. of Repairs & requests Received (1)	10,921	9,496	8,969	15,134	**44,520**
No. of Repairs Completed within 7 days (2)	986	1,238	1,319	1,911	**5,454**
No. of Repairs without a report (3)	1,616	1,112	1,630	2,140	**6,498**
Total No. of Repairs Completed (4)	8,516	11,063	12,211	15,321	**47,111**

Note:

1) Reports received from customers and/or members of the public for repairs to existing streetlights and for new street lights.
2) Work arising from reports received as in Note 1 and completed in 7 days or less of the date received.
3) Work arising from sources other than customer reports, e.g. inspections by staff and observation by crews.
4) Total work completed within the month, i.e. repairs and installations arising from both customer reports as well as inspections and observation by crews.

A comparison of T&TEC's performance with respect to street light repairs and installations for 2016 and 2017 is shown in table 19. In 2017, T&TEC received approximately twice as many reports of street light failures than in 2016 (22,031). Further, T&TEC's 7-day repair rate for these reported street light failures declined from 29.9% in 2016 to 12.3% in 2017. The number of unreported street light failures that T&TEC detected and repaired increased by 21.9% in 2017 (6,498).

Table 19: Summary of Street Light Repairs and Installations (2016 - 2017)

Indicator	Year		% Change
	2017	**2016**	
No. of Reports Received	44,520	22,031	102.1%
No. of Repairs Completed within 7 days	5,454	6,587	(17.2)%
7-day Repair Rate for reported failures	12.3%	29.9%	(17.6)%
No. of Repairs without a report	6,498	5,332	21.9%
Total No. of Repairs Completed (includes carryover from previous year)	47,111	27,605	70.7%

2.6 Financial Performance and Efficiency

One of the primary goals of economic regulation is to ensure that the utility operates in a way that ensures financial viability and sustainability, while providing an acceptable quality of service to customers at a reasonable price. The RIC has a duty to ensure that T&TEC is able to finance its functions and thus, should enable T&TEC to earn a return on its regulatory asset base that is at least equal to its cost of capital in addition to raising finance on reasonable terms.

Table 20 below shows a selected set of financial ratios which assess the performance of T&TEC from the perspective of debt financing, liquidity, profitability and efficiency.

Table 20: Select Financial Ratios of T&TEC's Performance for 2016 and 2017

RATIOS	YEAR		TARGET
	2016	2017	
Debt Financing			
Gearing (%)	86	84	
Funds Flow Interest Cover	0.73	0.33	Greater than 3
Cash Interest Cover	(3.15)	(3.61)	Greater than 1
Debt Pay Back Period (Years)	(94.31)	(43.13)	Between 5 to 7
Debt as a proportion of RAB (%)	1052%	1062%	Below 65%
Liquidity			
Collection Rate (%)	74%	62%	
Revenue Billed/Operating Cost	0.96	0.92	Greater than 2
Revenue Collected/Operating cost	0.97	0.89	Greater than 1
Internal Financing (%)	(46)%	(83)%	Greater than 40%
Profitability and Efficiency			
Return on RAB (%)	-11%	-25%	≈ 9%
Operating Cost per unit ($/kWh)	0.36	0.38	

2.6.1 Debt Financing

T&TEC showed a slight improvement in the gearing. For the years, 2016 and 2017 both funds flow and cash interest coverage continue to fall outside the respective target ranges, suggesting that T&TEC may have experienced difficulty in meeting its finance costs.

Funds from operations continued the trend from 2016 with continuing negative Funds Flow, which exacerbated the situation of an already poor payback period.

Debt as a portion of Regulatory Asset Base (RAB) remained well above the target of 65% which suggests that borrowed funds are not necessarily being used to fund capital projects only.

2.6.2 Liquidity

According to the indicators presented, T&TEC's liquidity position worsened over the two-year period. The collection rate moved from 74% and 62% over the period, suggesting that T&TEC needs to increase its efforts to decrease receivables. T&TEC's revenue fell slightly over the period and this had a negative effect on the ratios shown. However, receivables increased by $345 million from 2016 to 2017, which also had a negative effect on the ratios. The working coverage ratios, which compare both revenue collected and billed income to operating costs, both decreased from 2016 to 2017, suggesting that T&TEC was unable to meet its full operating costs from either revenue billed or revenue collected. In 2016, the average number of times that collected revenue was able to cover operating costs was 0.96; by 2017, this figure deteriorated to 0.92. For the same period, the average number of times that billed income was able to cover operating costs in 2016 was 0.97, compared to 0.89 in 2017.

A decrease in funds from operations for the period 2016-2017 caused negative changes in the internal financing ratio, which posed a challenge for T&TEC to find cash to finance capital expenditure.

2.6.3 Profitability and Efficiency

T&TEC is a state-owned utility and analysing profitability may not be as useful as in the case of an investor-owned utility. Instead of assessing the traditional return on capital, measuring the return on RAB is better suited to this type of governance structure. This approach is similar to the return on capital except the net cash flow return will be compared to the regulatory asset base. In 2016, the net cash flow return on the RAB was negative 11%. In 2017, with an increasing negative operating loss the return was a negative 25% return on the RAB for that year.

The above approach is often supplemented by financial metrics on costs such as the operating cost per kWh, which may be more suited in determining the efficiency of operations in a state owned public utility. The operating cost per kWh increased by two cents, between 2016 and 2017, hinting at a fall in efficiency.

SECTION 3.0 CONCLUSION AND RECOMMENDATIONS

3.1 Conclusion

The RIC assessed T&TEC's performance in 2017, with respect to selected performance indicators, specific directives contained in the Determination (2006), and any other metric of performance which was relevant to the electricity transmission and distribution sector, as decided by the Commission.

T&TEC maintained its level of performance and/or showed improvement for some of the performance metrics assessed in 2017. These included: service coverage (99.3%), electricity sales per employee ratio (2,717,764 kWh), customers per employee ratio (152), System Average Interruption Frequency Index (4.50 interruptions per customer), total transmission trips and interruptions (32), complaints resolution rate (99.6%), and percentage of transformers inspected/serviced (35.8%). Notwithstanding this, there is still a need for significant improvement in other critical areas, such as total system losses (8.08%), System Average Interruption Duration Index (417 minutes), Customer Average Interruption Duration Index (93 minutes), and 7-day Repair Rate for reported street light failures (12.3%).

T&TEC's financial indicators revealed that operating expenditure continues to increase and contributed to a decline in T&TEC's ability to meet its financial obligations for 2017. T&TEC's liquidity position has also weakened, with a decrease in the collections ratio. The period of the first rate review ended at May 31, 2011 and the RIC will be considering further efficiency incentives for T&TEC in the second regulatory control period.

3.2 Recommendations

In light of T&TEC's performance for the period under review, the RIC recommends the following:

- T&TEC should investigate the reason for the increased system losses, and identify/review strategies to manage these losses;
- T&TEC should reconcile the real-time data captured for electricity purchased from the generators to the delayed billing information for electricity sold to customers. This would allow for a more reliable estimate of total system losses (both technical and commercial);

- T&TEC should develop strategies for reducing the duration of service interruptions, in order to improve the SAIDI indicator;
- T&TEC should develop strategies to improve the repair rate for reported street lighting failures;
- T&TEC should continue to develop strategies to improve its labour productivity and use of resources, relative to other utilities;
- T&TEC should continue its efforts to collect outstanding funds, including accounts receivables from government Ministries and local government authorities.
- To offset increases in operating expenditure, T&TEC should explore opportunities to increase sources of income other than electricity sales.

APPENDIX: PERFORMANCE INDICATORS FOR T&TEC

Item	Category	Indicator	Definition	Units	Reporting Period
1.0	**Aggregate Data**				
1.1		Number of electricity customers by class and area	T&TEC's customer data		Yearly
1.2		KWh sales by area	T&TEC's customer data		Semi Annually
1.3		KWh purchased	The basic unit of electric demand, equal to 1,000 watt-hours.	KWh	Monthly
1.4		Total System Losses	Difference between MWh purchased and sold	MWh	Semi Annually
1.5		Electricity coverage (i.e. Access to electricity)	$\frac{[\text{No. of customers (T\&TEC stats)}]}{[\text{No. of households in T\&T}]}$		Quarterly & Yearly
2.0	**Financial**				
2.1		Gearing	$\frac{[\text{Interest bearing debt}]}{[\text{Interest bearing debt + equity}]}$		Yearly
2.2		Funds From Operations ($)	Operating Revenue – Operating Expenses	$	Yearly
2.3		Funds Flow Interest Cover (Times)	$\frac{\text{(FFO + Interest)}}{\text{Interest}}$		Yearly
2.4		Cash Interest Cover (Times)	$\frac{\text{Opening Cash Flow}}{\text{Interest Expense}}$		Yearly
2.5		Debt Pay Back Period (Years)	$\frac{\text{Net Debt}}{\text{FFO}}$	Years	Yearly
2.6		Debt as a proportion of RAB (%)	$\frac{\text{Net Debt}}{\text{RAB}}$		
2.7		Collection Rate	$\frac{\text{Operating Revenue – Receivables}}{\text{Operating Revenue}} \text{ X } 100\ \%$	%	Yearly
2.8		Revenue Billed/Operating Cost	$\frac{\text{Operating Revenue Billed}}{\text{Operating Cost}}$		Yearly
2.9		Revenue Collected/Operating cost	$\frac{\text{Revenue Collected}}{\text{Operating Cost}}$		Yearly

Item	Category	Indicator	Definition	Units	Reporting Period
2.10		Internal Financing (%)	$\frac{\text{(FFO – Dividends)}}{\text{Net CAPEX}} \times 100\%$	%	Yearly
2.11		Return on RAB (%)	Net operating income / RAB x 100%	%	Yearly
2.12		Operating cost per unit	$\frac{\text{Total Operating costs}}{\text{Total no. of kWh sold}}$	$	Yearly
3.0	**Network Reliability**				
3.1		System average interruption frequency index (SAIFI) (Average number of sustained interruptions per customer)	Total number of reported customer interruptions greater than 1 minute duration / total number of customers served	Interruptions per year	Yearly
3.2		System average interruption duration index (SAIDI) (Average minutes off supply per customer)	Sum of each outage duration in minutes times the number of customers / total number of customers served	Minutes	Yearly
3.3		Customer average interruption duration index (CAIDI) (Average interruption duration)	$\frac{[\text{SAIDI}]}{[\text{SAIFI}]}$	Minutes	Yearly
3.4		Number of transmission and distribution circuit trip outs by voltage level			Yearly
3.5		Interruptions restored within 3 hours and 5 hours			Yearly
4.0	**Affordability and other Economic Data**				
4.1		Sales per employee (KWh)	$\frac{[\text{Total KWh sales}]}{[\text{Number of employees}]}$	(KWh)	Yearly
4.2		Sales per employee ($)	$\frac{[\text{Total revenue form sales}]}{[\text{Number of employees}]}$	($)	Yearly

Item	Category	Indicator	Definition	Units	Reporting Period
4.3		Customers per employee	$\frac{[\text{Total no of customers}]}{[\text{Total number of employees}]}$	Number	Yearly
4.4		Consumption per capita (kWh)	$\frac{[\text{Total Kwh sales}]}{[\text{Total population}]}$	KWh	Yearly