REGULATED INDUSTRIES COMMISSION

Review of the Status of the Trinidad & Tobago Electricity Commission 2010-2015

December 2017

This "Review of the Status of the Trinidad and Tobago Electricity Commission (T&TEC) 2010 – 2015", is being published for the information of all stakeholders as part of the recently commenced Second 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 (1 h) of time.
kWh - Kilowatt-hour	1 kWh = 1,000 Wh. It is 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. INTRODUCTION

The Regulated Industries Commission Act, No. 26 of 1998, established the Regulated Industries Commission (RIC) as the economic regulator for the water, wastewater and electricity 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 service providers, publish results and take action, where necessary, to protect the interests of customers and other stakeholders.

1.1 Objective of the Document

This *"Review of the Status of the Trinidad and Tobago Electricity Commission (T&TEC) 2010 – 2015"*, is being published for the information of all stakeholders as part of several documents that accompany the recently commenced Price Review for T&TEC. The purpose of this document is to present information on certain aspects of the technical, operational and financial state of T&TEC over the period 2010-2015, which informs the price review, as it provides an understanding of how T&TEC has performed on an annual basis, as well as allows for a comparison of T&TEC's performance against other utilities, where appropriate[1].

1.2 Structure of the Document

The remainder of this document is arranged into several sections. Section two describes the structure of the electricity sector. Section three contains technical performance metrics of T&TEC across three main categories, namely, system losses, network reliability and standards of service. Sections four and five provide an assessment of T&TEC's operational and financial performance respectively. This is followed by Section six which shows the comparison of prevailing electricity tariffs with that of other jurisdictions. Finally, the document ends with some general conclusions.

[1] Information for this review has been sourced from various documents supplied by T&TEC over the period 2010-2015. 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 and derivations where required, using T&TEC data. Data pertaining to 2016 will be factored into the RIC's calculations in the preparation of its draft determination.

1.3 Responding to this Document

This document is being released for information and the RIC can be contacted at the under-mentioned address:

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2. STRUCTURE OF THE ELECTRICITY SECTOR

The electricity sector in Trinidad & Tobago is made up of a number of stakeholders with various roles and functions including generation, transmission and distribution and consumption. A brief overview of the respective roles of these main stakeholders and key data specific to their operations is 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. The distinctive feature is that T&TEC is a monopsony[2] buyer of electricity from the IPPs and a monopoly seller to customers.

The supply side of the electricity sector involves a combination of private and state-owned generation facilities and state-owned transmission and distribution operations. In addition to some self-generation by T&TEC, the Power Generation Company of Trinidad & Tobago, Trinity Power Limited and Trinidad Generation Unlimited, provide energy to T&TEC for transmission and distribution to all customers. At the end of 2015, the combined generating capacity of the three IPPs was over 2,200 megawatts (MW). T&TEC also has its own generation capacity of 85MW located in Tobago, which is the primary source of electricity on the island. All of the electricity generated in Trinidad and Tobago is from local natural gas. T&TEC sells over 8,000 gigawatt hours (GWh) annually.

Under the First Schedule of the RIC Act, the electricity service providers which fall under the RIC's purview for the purpose of economic regulation are:

- The Trinidad and Tobago Electricity Commission (T&TEC);

[2] Although T&TEC is a single buyer, the existence of take or pay contracts within the sector constrains its market power. Take or pay is a contract provision whereby the buyer has an obligation to pay for a certain amount of power generation whether or not it utilizes that power.

- The Power Generation Company of Trinidad and Tobago (PowerGen); and
- Trinity Power Limited (formerly Inncogen Limited)

Trinidad Generation Unlimited (TGU) was commissioned in 2013 and currently, does not fall under the purview of the RIC.

On the demand side, T&TEC sells electricity to different classes of customers, organized into residential, commercial and industrial customers based largely on their demand characteristics. The number of customer accounts totalled approximately 460,000 at the end of 2015, with residential customers accounting for the majority of the customer base while the industrial and commercial customers accounted for the majority of the total electricity demand.

2.1.1 Generation

As at 2015, PowerGen owned and operated three (3) power plants located in Port of Spain[3], 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 firing. At 2015, the total installed capacity of PowerGen was 1380MW, broken down (by plant) as follows:

- Port of Spain – 300MW
- Point Lisas – 844MW
- Penal – 236MW

The Port of Spain and Point Lisas power plants are configured in a simple cycle arrangement where 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 steam. The steam produced from the waste heat was used to power a 62MW steam turbine thus producing power without the use of any additional natural gas.

[3] In 2015 the GORTT and PowerGen publicized the decision to de-commission the POS plant. The plant was subsequently decommissioned on January 14th, 2016.

At the time that PowerGen was created, T&TEC retained responsibility for a limited amount of generation (21MW) at the diesel powered, Scarborough Power Station in Tobago. In order to reduce transmission losses[4] 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 operated on natural gas with an installed capacity of 64MW. The Scarborough Power Plant was then maintained as a back-up generation supply facility. Both plants have the capacity to generate electricity to meet the current demand on the island. Previously installed submarine cables between both islands are being maintained to supply electricity to Tobago[5], in the event of an emergency.

Trinity Power Limited (Trinity Power) was formed when new management took over operations at Inncogen Limited[6] and is a privately owned, locally incorporated company. 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 is converted to 132kV and interconnects to T&TEC's Brechin Castle electricity substation, which is located obliquely opposite to the Trinity Power plant.

Trinidad Generation Unlimited (TGU) is the newest generator in the electricity sector and its facility in La Brea was officially opened in October 2013. This facility was established mainly to provide electrical power to a proposed Aluminum Smelter Plant[7] and also some amount of generation to T&TEC. 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 machines 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 output of 270MW.

[4] T&TEC previously supplied power to Tobago via submarine cables which resulted in transmission losses.
[5] These submarine cables have been significantly de-rated because of issues with cable-integrity.
[6] Inncogen had been in operation since 1999. In 2003, Trinity Power Ltd officially commenced operations at the former Inncogen facilities.
[7] 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 expanding needs of its customer base. T&TEC's infrastructure network includes high voltage transmission lines which take electricity from the power generation plants and transmit this bulk power to substations located all across the country. Sub-stations receive electricity directly from the generating plants and dispatch to smaller sub-stations for distribution to service areas, over a network of 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 comprises residential, commercial and industrial customers. Assignment to a particular customer category is based on the purpose of use 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. In 2015, T&TEC sold approximately 8,900GWh of electrical energy to roughly 460,000 customers. There were approximately 408,000 residential customer accounts representing 88% of the customer base, 49,000 commercial customer accounts or 11% of the customer base and 3,500 industrial customers, which accounted for less than 1% of total number of customers. While industrial and

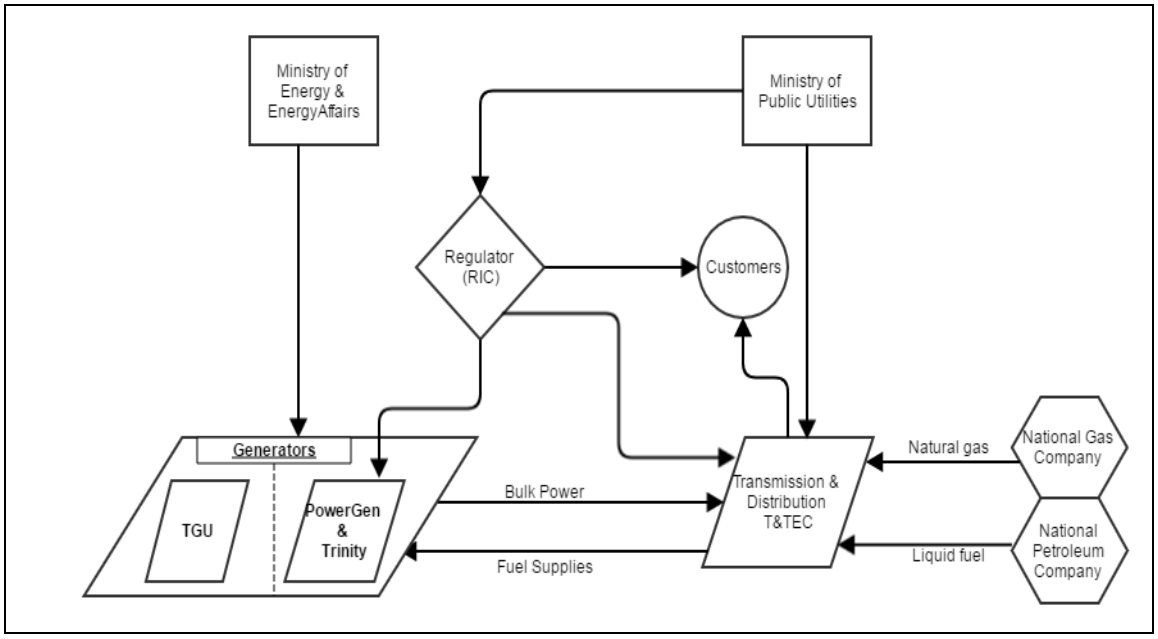
commercial customers comprise a small proportion of the overall customer base, together, these customers account for roughly 70% of total electricity demand. The system peak daily demand was 1396 MW in 2015, which declined to 1339 MW in 2016.

T&TEC's service areas are grouped by geographical division; North, South, East, Central and Tobago. In 2015, approximately 31% of T&TEC's customer base was located in the South, 27% was located in the East, 20% in the North, 18% in Central and 6% in Tobago.

2.2 Institutional Arrangements

In addition to the commercial arrangements between the electricity generators and the transmission and distribution utility, other institutions play a significant role in the operation of the electricity sector. Figure 1 below highlights some of the key stakeholders and relationships that have an impact on the electricity sector in Trinidad and Tobago.

Figure 1 : Key Stakeholders in the Electricity Sector[8]



[8] Figure 1 summarizes the main inter-relationships among the key players and is not intended to capture all the intricacies of the sector. Trinidad Generation Unlimited (TGU) was commissioned in 2013 and currently, does not fall under the purview of the RIC.

3. TECHNICAL PERFORMANCE

Electricity is essential to modern life and growth in economic activity, therefore, it is important for the electric utility to meet minimum standards of service in the provision of electricity to customers. Disruption in 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 losses (and costs) to the utility.

Overall, T&TEC has maintained a sound electricity transmission and distribution network over the period 2010 to 2015. System losses have been kept within levels that are comparable on a global scale. Network reliability metrics from 2010 to 2015, all indicate that the frequency and duration of outages have been decreasing. T&TEC's performance with respect to the QSS scheme has also been consistently good throughout the period, with some areas still requiring improvement.

A closer look at certain electricity supply indicators for systems losses, reliability and quality of service over the period 2010 to 2015 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 a utility because they represent losses in revenues. The same is true for T&TEC, when all of the energy it pays for and receives from the generators is not 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. The total system losses of any electricity supply system consist of a combination of technical and non-technical losses[9]. The system losses

[9] Technical losses occur naturally and consist mainly of energy loss in electricity system components such as transmission and distribution lines, transformers, 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.

on T&TEC's network are calculated as the difference between power sold to customers and purchased from the generators, expressed as a percentage.

Table 1 shows the Total System Losses (percentage) across T&TEC's network from 2010 to 2015. This has varied between 6.46% and 7.08% over the period. These figures are comparable to the 6% value for system losses reported by the United States Energy Information Administration (EIA) for a group of selected utilities in the United States[10].

Table 1: Total System Losses for T&TEC

Year	2010	2011	2012	2013	2014	2015
Total System Loss	6.46%	6.50%	6.67%	7.08%	6.93%	6.57%

Source : TTEC

3.2 Network Reliability

Network reliability can be assessed by measurements of the frequency and duration of interruptions in the electricity supply to customers. Network reliability metrics can also serve as a guide to determining problematic areas in the electricity delivery system. An unreliable supply of electricity may incur economic losses to T&TEC and its customers, either through loss of business or through inconvenience caused to residential customers. The RIC has assessed the reliability of T&TEC's supply according to the indicators listed in Table 2.

Table 2: Network Reliability Indictors[11]

	2010	2011	2012	2013	2014	2015
SAIFI (Interruptions per customer)	6.61	5.68	5.71	5.21	4.42	4.40
SAIDI (minutes)	563	486	464	398	326	308
CAIDI (minutes)	85	86	81	76	74	70

Source: TTEC

[10] The U.S. Energy Information Administration (EIA) estimated that state-wide electricity transmission and distribution losses averaged about 6% from 2004-2013.

[11] 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 over the entire electricity network, for the period of a year. During the six year period, 2010-2015, SAIFI on T&TEC's network ranged between 4.40 and 6.61 "interruptions per customer". In 2015, there was a statistical average of 4.40 interruptions per T&TEC customer, which represents a higher level of reliability than the other years in the period. For a group of selected North American Utilities (NAU) [12] the average value for SAIFI was 1.52 interruptions per customer, therefore, the likelihood of T&TEC's customers experiencing an outage was greater than the customers within this group of NAU.

The System Average Interruption Duration Index (SAIDI) statistically represents the average length of time that a customer is without electricity in a year. SAIDI on T&TEC's network ranged between 5-9 hours during 2010-2015. In 2015, T&TEC customers on average would have experienced interruptions totaling 5.1 hours in duration, which is the lowest for the period. When compared with the group of NAU, the average value for the total duration of interruptions experienced by customers was 2.2 hours.

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. It can also be viewed as the average restoration time. In 2015, T&TEC customers would have experienced interruptions averaging 70 minutes in duration, showing improvement from the 85 minutes observed at the start of the period. For the selected group of NAU, the median value for the average duration of interruptions experienced by customers was 137 minutes, therefore, T&TEC's customers were more likely to have their electricity supply restored quicker than the customers of over half of the NAU in the group.

Overall, the trends in the values of the reliability metrics from 2010 to 2015, suggest that T&TEC has been successful in reducing not only the number of outages, but also the duration of the outages and the time taken to restore power to its customers across its entire network.

[12] Institute of Electronic and Electrical Engineers (IEEE) United States, Distribution Reliability Working Group, Benchmarking 2015 Results

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 the QSS scheme solely applies to T&TEC. These standards were subsequently revised in 2009[13]. The QSS is comprised of both Guaranteed Electrical Standards (GES) and Overall Electrical Standards (OES) which seek to ensure that consumer expectations of consistency, reliability and accountability from the service provider have been addressed by the performance requirements placed on T&TEC. 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. Compliance with these Standards forms part of an effective incentive regulation framework[14]. Over the period, 2010 to 2015, the quality of the electricity supply was assessed across 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 2010-2015

Area of Concern	Standard's Performance Measure (QSS Code)	Performance Assessment (2010-2015)
Reliability	Response and restoration time after unplanned (forced) outages on the distribution system. (**GES1**)	Very good with compliance rates ranging from 99.5% to 99.9%. However, breaches under this standard affect the largest number of customers relative to the other standards. Implementation of the Outage Management System is required.
Service Quality	Investigation of Voltage Complaints. (**GES5**)	Very good with compliance rates ranging from 98.0% to 100%.
	New Connection of supply (Specifies service drop and meter installation only). (**GES7**)	Very good with compliance rates ranging from 92.9% to 99.9%.

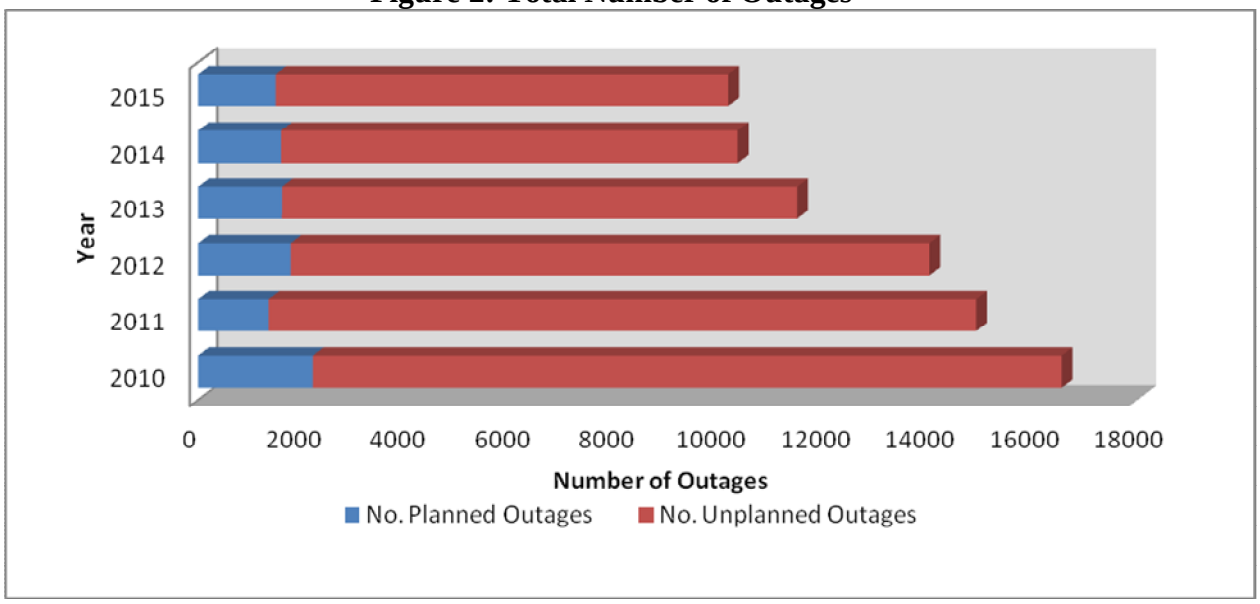
[13] The QSS for T&TEC were recently reviewed and revised in 2017.

[14] Lewis and Garmon (1997) define incentive regulation as "the use of rewards and penalties to induce the utility to achieve desired goals where the utility is afforded some discretion of the manner of achieving goals".

Area of Concern	Standard's Performance Measure (QSS Code)	Performance Assessment (2010-2015)
	Street lights maintenance. (**OES5**) • Street lights – within 7 days • Highway lights – within 14 days	Inconsistent with the compliance rate in first performance measure declining to its lowest in 2015 at 40.5%. The compliance rate for the second performance measure varied from 76.1% to 95.4% over the period.
Customer Service	Billing Punctuality (new customers). (**GES2**)	Significant improvement over the period with compliance rates that started as low as 29% in 2010 now at 96.9% in 2015.
	Making and keeping appointments. (**GES4**)	Excellent with a compliance rate of 100% over the period.
	Responding to billing and payment queries. (**GES6**)	Sustained improvement in compliance rate which was 72.7% in 2010 and has been maintained at 99.9% and greater between 2011 and 2015.
	Payments owed under guaranteed standards. (**GES8**)	Unsatisfactory in terms of the number of claims made and payments made.
	Frequency of meter reading. (**OES1**)	Excellent with a compliance rate of 100% over the period.
	Billing punctuality. (**OES2**)	Excellent with a compliance rate of 100% over the period.
	Response to customer queries/requests (written). (**OES6**) • Initial response within 10 days • Final position within 30 days	Inconsistent; compliance rates ranging from 84.2% to 91.9% for the initial action and 34.8% to 95.7% when further action is required.
	Notifying customers of receipt of claim under guaranteed standard GES1. (**OES7**)	Excellent with a compliance rate of 100% from 2011 to 2015.
Service Quality / Customer Service	Reconnection after payment of overdue amounts or agreement on payment schedule. (**GES3**)	Very good with compliance rates ranging from 92.9% to 99.9%.
	Responding to meter problems. (**OES3**)	Good to very good with compliance rates ranging from 72.6% to 96.8%.
	Prior Notice of planned outages. (**OES4**)	Very good with compliance rates ranging from 91.2% to 98.5%.

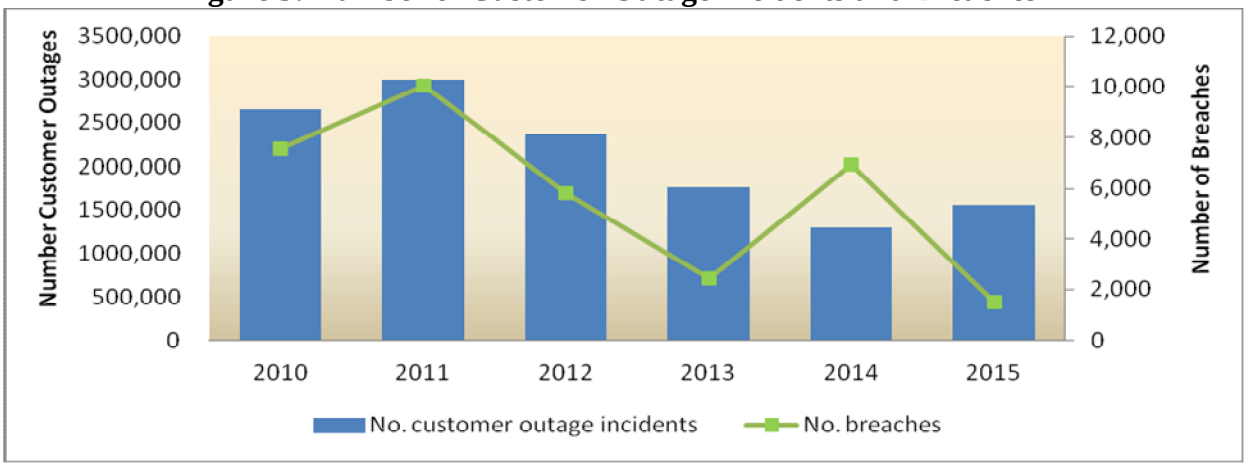
The consistent availability of an electricity supply is an important consideration for customers. Figure 2 shows the total number of electricity outages experienced annually from 2010 to 2015 separated as planned and unplanned outages. Planned outages are scheduled outages by T&TEC to facilitate work that T&TEC deems necessary to improve the reliability of supply. The number of planned outages fluctuated between 2010 and 2015, with the highest number of 2,198 outages occurring in 2010. In 2015 there were 1,482 planned outages, representing a 33% improvement from the number of planned outages recorded at the start of the period. Unplanned outages can be caused by several factors however, the most cited causes of unplanned outages by T&TEC include blown transformer fuses and vegetation management (tree contact resulting in burst wires). Figure 2 shows that unplanned outages were highest in 2010 at 14,358, and decreased by 40% in 2015.

Figure 2: Total Number of Outages



Unplanned outages usually affect multiple customers at the same time however, an unplanned outage experienced by an individual customer is referred to as an outage incident. The number of outage incidents fluctuated over the 2010-2015 period, however, there was an overall decline in outage incidents from about 2.6 million in 2010 to roughly 1.5 million outage incidents in 2015, as shown in Figure 3.

Figure 3: Number of Customer Outage Incidents and Breaches



Where there is an outage incident and the electricity supply to an individual customer is not restored within a specified time of the outage report being received by the utility, this is considered a breach of established standards. In the case of T&TEC, unplanned outages that exceed ten hours represent non-compliance[15] under GES1. Figure 3 also shows that the number of breaches under GES1 has shown significant decline from 10,049 in 2011 to 1,524 in 2015. T&TEC typically cites inclement weather and service crew delays as the main reasons for their failure to restore service within ten hours.

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. Under GES5, for instances 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 2010-2015 was 3,582. Although the most number of voltage complaints (4,159) were received in 2013, T&TEC had only one breach in that year where the complaint was not responded to within 24 hours.

T&TEC is responsible for monitoring the condition and performance of public lighting assets. This includes the development and implementation of plans for the installation, operation, maintenance and replacement of public lighting which is a critical public service that enhances

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

the welfare of citizens. Over the period 2010-2015, approximately 2,100 streetlights were installed annually. Table 4 shows the number of failed street light reports that are made annually by members of the public which has more than doubled since 2010. Under OES5, T&TEC is required to monitor highway lighting and repair defective lights within 14 days of discovery and repairs to failed street-lights that are reported to T&TEC are to be completed within 7 days. The high number of failed street lights not repaired within 7 days is an indication that a comprehensive course of action has to be developed to both minimize the rate at which street lights become defective and increase the rate at which repairs are completed within the stipulated timeframe.

Table 4: Street Light Repairs

	2010	2011	2012	2013	2014	2015
No. of failed street light reports received	11,244	17,654	21,222	24,773	26,461	28,531
No. repairs completed within 7 days	2,559	3,692	6,401	7,389	13,193	16,972

Source: TTEC

4. OPERATIONAL PERFORMANCE

Operational performance management measures how efficiently a utility's targets are achieved given its current assets and procedures. It is important to measure the efficiency of operations because it can contribute significantly to the utility's financial performance. While technical performance indicators provide information on standards of service and reliability of supply, monitoring operational performance is concerned with how well the utility is managing its resources to meet objectives and minimize cost.

In the absence of competitive pressure, it is imperative that T&TEC operates in a manner that allows it to deliver good quality service to its customers, while also efficiently managing its costs. Labour costs contribute significantly to the total operating costs of the utility. Staff productivity indexes represent a measure of staff efficiency and by extension; an evaluation of T&TEC's human resources practices and policies. Operational performance monitoring by the regulator helps incentivize the utility to more efficiently use resources such as capital and labor.

Monitoring both for efficiency improvements contributes to the utility incurring only prudent and necessary costs.

4.1 Labor Productivity Indicators

The operation and maintenance of a reliable transmission and distribution network requires significant labour resources. T&TEC employed approximately 2,689 persons in 2010, which increased to 3,210 persons by 2015, an increase of 19%. The most significant annual increase during that period took place from 2011 to 2012 when number of employees increased from 2,706 to 3,137.

Productivity of T&TEC's labour can be examined using the following well-established indicators[16]:

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

The Sales per employee ratio gives an indication of how efficiently T&TEC uses it staff to generate revenue from electricity sales. Higher values for this metric indicate that more electricity sales have been achieved with the given workforce, suggesting a higher level of productivity. Figure 4 is a combination graph showing both the trends in electricity sales per employee[17] and kWh sold per employee[18] over the period 2010-2015. Although the highest recorded sales and largest workforce occurred in 2015, sales per employee peaked at approximately $1 million dollars in 2011, suggesting that efficiencies during that year helped T&TEC achieve more sales with fewer employees. The same premise can be applied to the fact that kWh sold per employee was the highest in 2011 although the most kWh were sold in 2015.

[16] These are partial productivity indicators and should be used in conjunction with other factors.
[17] The sales per employee ratio is calculated by dividing annual electricity sales by the total number of employees.
[18] The kWh sold per employee ratio is calculated by dividing the total number of kilowatt-hours sold by the total number of employees.

Figure 4: Sales and kWh Sold Per Employee

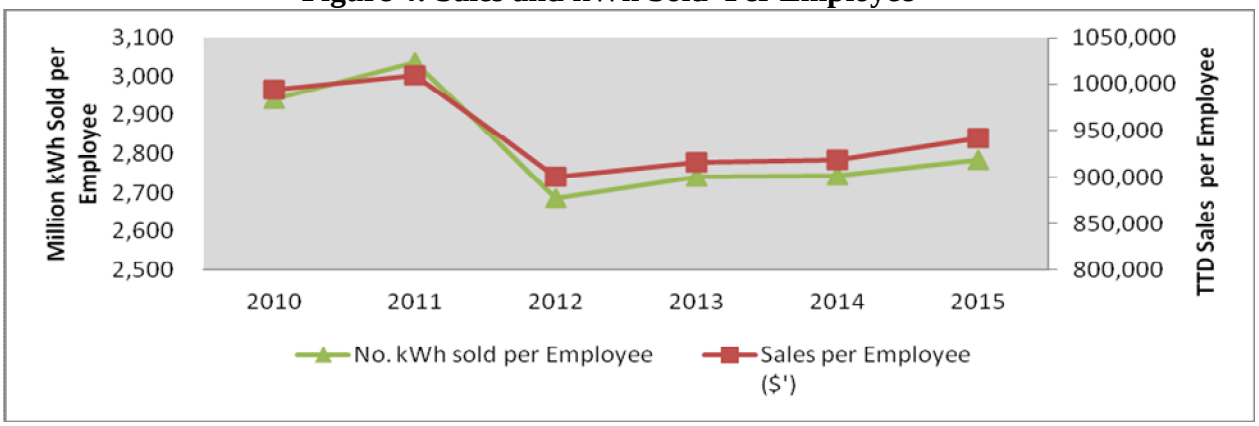
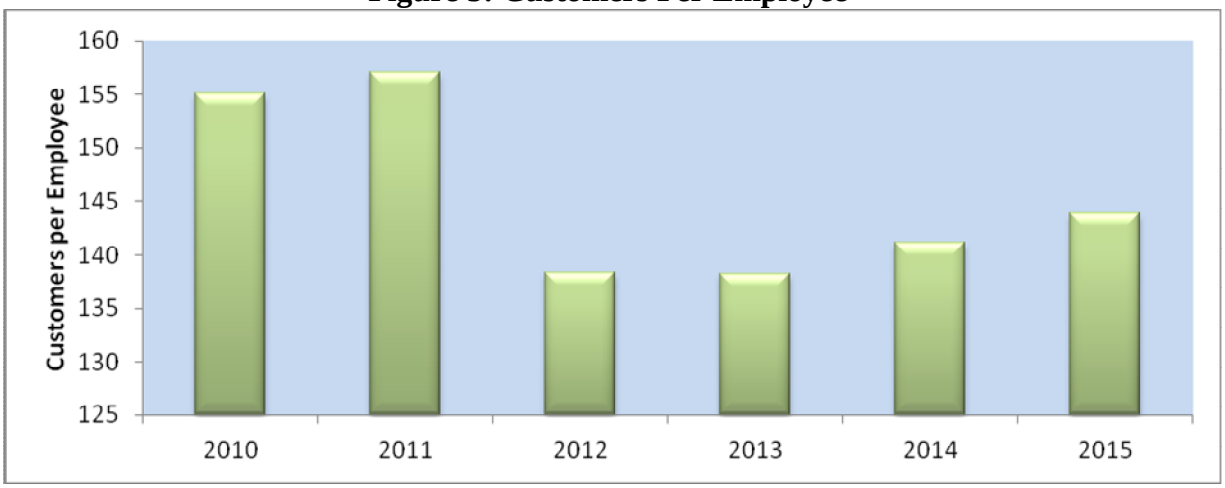


Figure 5 highlights changes in the number of customers serviced per employee. This indicator measures labour efficiency of the utility and tends to be higher in well-managed, efficient utilities. There was a 19% increase in persons employed at T&TEC over the five year period while the number of customers increased by 11% from roughly 417,000 in 2010 to roughly 462,000 in 2015. In 2011, the customer per employee ratio was 157, which was the highest over the period under consideration.

Figure 5: Customers Per Employee



The productivity ratios mentioned above can be considered along with the number of T&TEC Customers per employee[19], to address issues related to efficiency of human resources, including the need for training, the frequency and quantum of overtime work and other such concerns.

4.2 Other Productivity Indicators

In addition to labour productivity, other productivity indicators can be used to observe whether there has been improvement in the performance of the utility over time, and perhaps allow for measurement of the rate of productivity gains. This is useful when establishing the expected rate of productivity gains that can be achieved over a subsequent regulatory period.

Table 5 shows the growth in customer base, electricity sales and the corresponding unit operational costs over the 2010-2015 period. Overall the number of kWh sold increased by 13% and the customer base grew by 11%. Operating cost per kWh[20] increased by an average of $0.02 each year. In comparison, there was no overall increase in operating revenue per kWh sold over the period, which remained at $0.34. This steady trend in operating revenue per unit of electricity may be largely attributed to stable electricity rates over the time period.

The table also shows an increasing trend in the number of customers for T&TEC. Between 2010-2015, the customer base grew by about 44,000 customers. Over the five year period an average of 89% of T&TEC's customer base were residential customers. An average of 10% of the base was commercial customers and industrial customers remained at 1% of the total customer base.

In contrast the industrial customers contributed an average of 54% of T&TECs operating revenue despite being the smallest customer class. Residential customers contributed an average of 29% of T&TECs operating revenue and commercial customers contributed an average of 13% of operating revenue. Operating costs per customer on average, increased by $357 each year, for an overall increase of 38%.

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

[20] Per kWh metrics such as operating costs and operating revenue refer to factors specifically related to producing one unit of electricity or one kWh.

Table 5: Other Productivity Indicators

	2010	2011	2012	2013	2014	2015
kWh sold (Million kWh)	7,910	8,211	8,428	8,769	8,766	8,935
Operating Cost per unit ($/ kWh)	0.25	0.23	0.34	0.31	0.33	0.33
Operating Revenue per unit ($/ kWh)	0.34	0.33	0.34	0.33	0.33	0.34
Number of Customers	417,108	425,161	433,962	442,182	450,733	461,701
Operating Cost per customer ($)	4,663	4,514	6,625	6,101	6,370	6,448

5. FINANCIAL PERFORMANCE

This section presents an analysis of T&TEC's financial position and performance. Assessing financial performance is key to assessing the impact of pricing decisions on the sustainability of the utility.

Overall, T&TEC's ability to meet its financial obligations has weakened from 2010 to 2015. T&TEC achieved its best liquidity position in 2011 after which its ability to meet present and future obligations from current and other resources declined. On a year to year basis, funds from operations (FFO)[21] varied greatly and sometimes, were insufficient to match the increase in operating expenditure. The following sections present more details on T&TEC's financial statements, specifically, items related to their income statement and balance sheet.

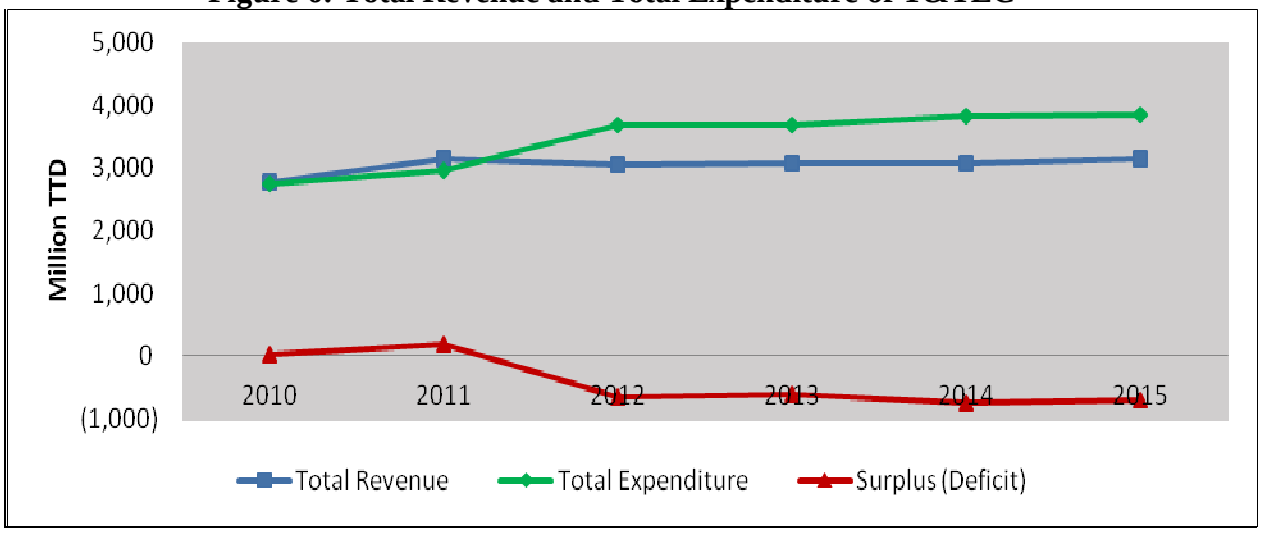
5.1 Revenue and Expenditure

Figure 6 shows the changes in T&TEC's total revenue[22] and total expenditure[23] between 2010 and 2015. Over the same period, T&TEC's total revenue increased by 13% or grew by $374 million dollars while total expenditure increased by 40% or $1.1 billion dollars, which will be

[21] Funds from operations are broadly the equivalent of net cash flow from operation less non recurrent sources of revenue such as capital contributions, proceeds from disposals and other investment activity.
[22] 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.
[23] 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, GTD costs, administrative and general costs, depreciation and foreign exchange costs.

examined further below. A surplus was achieved in 2010 and 2011 before decreasing sharply to a deficit of $649 million dollars in 2012. Between 2012 -2015, a relatively stable deficit was experienced, suggesting stability in total expenditure and total revenue over the final three years of the review period. Although the deficit may have been stable, continuously operating at a deficit highlights the fact that T&TEC's revenue was not adequate to meet the expenses in the latter period.

Figure 6: Total Revenue and Total Expenditure of T&TEC



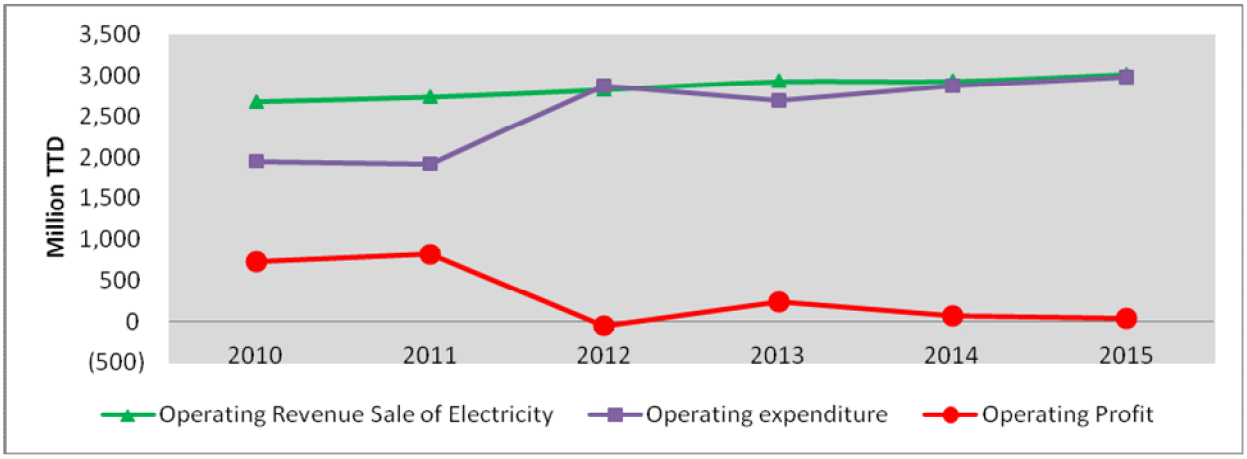
5.1.1 Operating Profit

Operating revenue is considered to be the proceeds from the sale of electricity to T&TEC's customers and is only one component of total revenue. Operating expenditure encompasses the costs related to the production, transmission and distribution of electricity. Operating profit is thus achieved when operating revenue exceeds operating expenditure in a particular year.

Figure 7 shows that operating revenue has generally exceeded the operating expenditure, except in 2012, when operating expenditure exceeded sales by almost $48 million dollars. Operating revenue increased by about $347 million dollars overall between 2010-2015, while operating expenditure increased by a little over $1 billion dollars over the same period. As a result, operating profit decreased from $729 million dollars in 2010 to $43 million dollars in 2015, an overall decline of about $685 million dollars. The significant increase in operating expenditure from 2012 was attributable to an increase in generation costs associated with operations at

Trinidad Generation Unlimited (TGU). Compared to the first two years of the period, operating profit had decreased significantly after 2011, suggesting that operating costs per unit had increased at a faster rate than sales per unit during the remaining years.

Figure 7: Operating Revenue vs Operating Expenditure



5.1.2 Collections

Assessing the outstanding debt owed to T&TEC by its customers may reveal certain trends which can be used to develop a more effective collections process. The amount owed by debtors over the period 2010 to 2015 is shown in Table 6 below. T&TEC's debtors balance was highest in 2010 in the amount of $654 million, fluctuated over the next four years around a lower value and then climbed back to $625 million in 2015. T&TEC also made provision for bad and doubtful debts[24] which generally remained between 2% to 3% when expressed as a percentage of sales for the corresponding period. Table 6 also shows the movement in the provision for bad debt between 2010 and 2015, and it is noteworthy that this provision decreased from $85 million at the start to $65 million in 2015. This decline suggests that T&TEC has been collecting enough of its billings to avoid any significant increases in bad or doubtful debts.

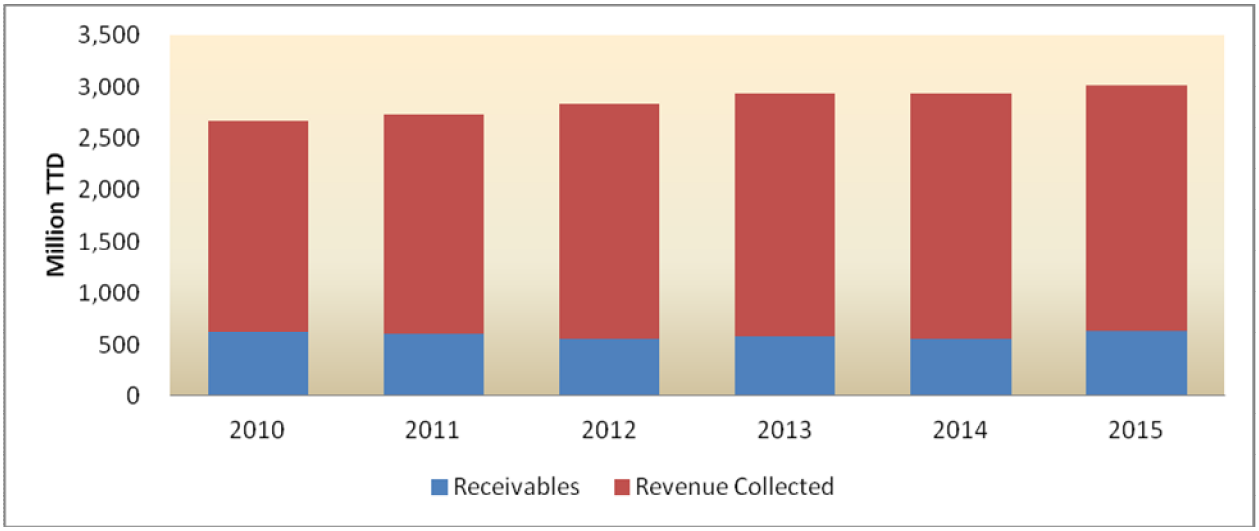
[24] According to International Accounting Standards 37, either a provision for doubtful debts or write off of irrecoverable debts must be made where it is expected that a portion of the receivables will not be recovered.

Table 6: T&TEC Debtors & Provision for Bad Debts

	2010	2011	2012	2013	2014	2015
Total Debtors (Million TTD)	654	534	564	577	517	625
Provision for bad & doubtful debts (Million TTD)	85	76	66	60	60	65
Sales (Million TTD)	2,674	2,733	2,827	2,930	2,933	3,021
Provision for bad debt as a % of Sales	3%	3%	2%	2%	2%	2%

While operating revenue accounts for all sales of electricity, there is usually a delay in collecting the revenue from these sales after bills have been sent to customers. Figure 8 shows that revenue collected based on billed income[25] has steadily increased on an annual basis between 2010 and 2015. While there was an overall increase of 16% in revenue collected, receivables have fluctuated throughout the period, with a total increase of 2% over the years 2010-2015. Added to this, the overall collection rate remained relatively stable between 77% and 81% over the period. These metrics suggest that complementary to the increase in revenue collected every year, there were consistent efforts to at least maintain the level of receivables from year to year.

Figure 8: Breakdown of Billed Income



[25] Billed income refers to revenue that has been collected based on bills sent to customers as well as outstanding receivables not yet collected by T&TEC.

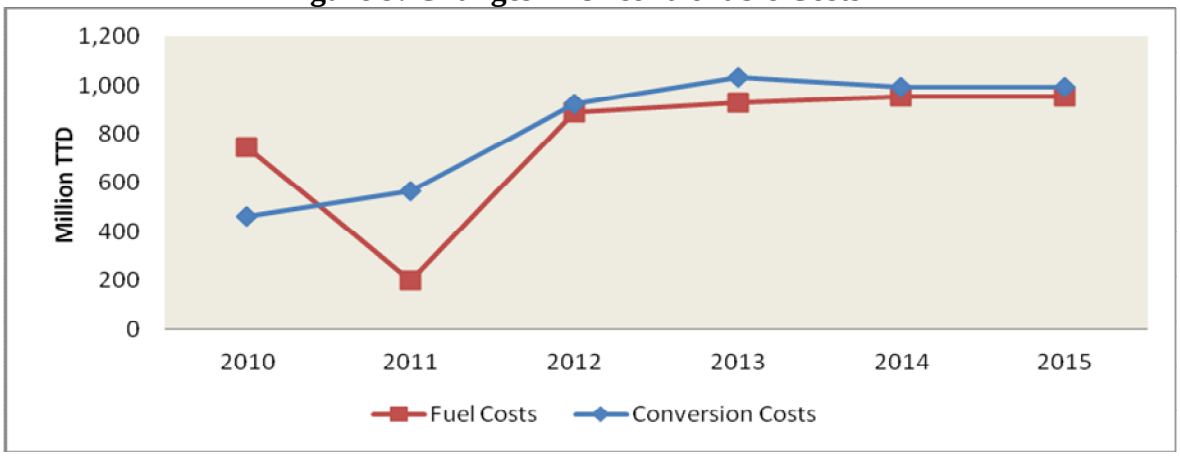
While there are acceptable levels of receivables, the cost to T&TEC of maintaining a high receivables figure would be reflected by an increase in the cost of working capital which would compound the increasing operating cost. Working capital is the cost of capital used for day to day running of an organisation and is calculated by deducting current liabilities from current assets (which includes receivables).

5.1.3 Expenditure

T&TEC's costs can be categorized broadly into controllable and uncontrollable costs, depending on the degree to which the utility's actions can determine or influence expenditure on same. Over the period 2010-2015, the main factors contributing to a significant increase in expenditure were conversion and fuel costs. Conversion costs and fuel costs are considered uncontrollable costs, which T&TEC has very little or no control over, and are generally treated as pass-through costs. These costs items are included in PPAs and are subject to long-term contractual agreements.

Figure 9 shows that conversion costs more than doubled, increasing from $462 million in 2010 to $992 million in 2015. Fuel costs rose from $748 million in 2010 to $953 million in 2015 an increase of 27%. Notably, $198 million were spent on fuel costs in 2011, the lowest expenditure on fuel during the period. The reason behind this significant drop was as a result of an accounting adjustment, where a credit note was applied based on overbilling of fuel for a number of years prior.

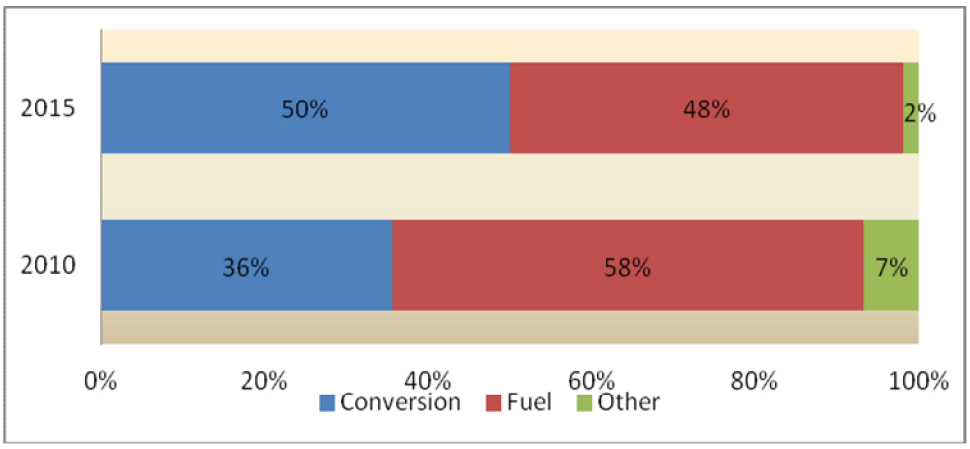
Figure 9: Changes in Uncontrollable Costs



According to T&TEC, overall generation costs include conversion, fuel and other generation costs[26]. Figure 10 highlights changes for the years 2010 and 2015 in the percentage of overall generation costs that are attributable to conversion, fuel and other generation.

Conversion costs represented 36% of T&TEC's overall generation costs in 2010 and by 2015, accounted for 50%, for a total increase of $530 million over the five-year period. Fuel costs, which represented 58% of the overall generation costs in 2010, had in fact increased by $206 million dollars over the time period and was 48% of total costs by 2015. The main reason behind these increases was the commencement of operations at TGU, where, on a phased basis, generated power was introduced onto the grid starting in late 2011, thereby having a full impact in 2012 and thereafter.

Figure 10:Percentage Change in Components of Overall Cost



Costs which are directly controlled by T&TEC include generation costs (other than fuel and conversion costs), transmission, distribution, engineering, administration and general costs. Figure 11 below shows fairly stable expenditure in controllable costs between 2010-2015, with the exception of generation and administrative and general (A/G) costs.

[26] Other generation costs refer to costs related to internal generation and other power generation expenses.

Other generation costs decreased by about $48 million dollars between 2010 and 2015. Fuel costs aside, this decrease in generation costs corresponded to an increase of 1024 GWh sold over the five-year period. Transmission costs had the smallest increase during this time of almost $10 million dollars with distribution costs experiencing a 53% increase over the time period. A/G costs experienced a 75% increase during the time period, despite a decline in A&G costs for 2013.[27]

Figure 11: Trends in Controllable Costs

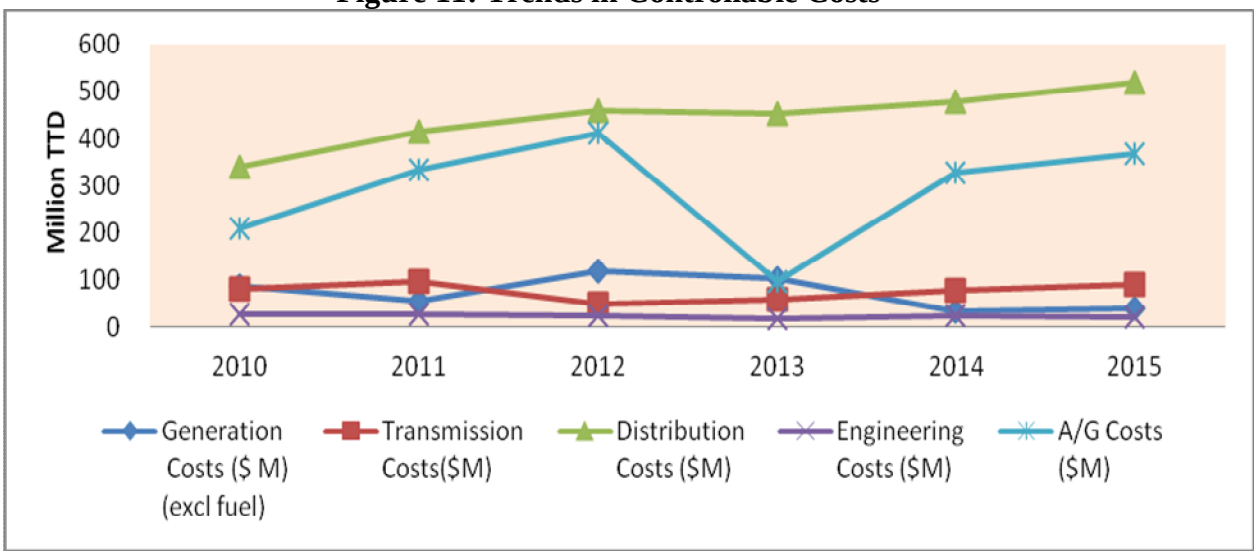
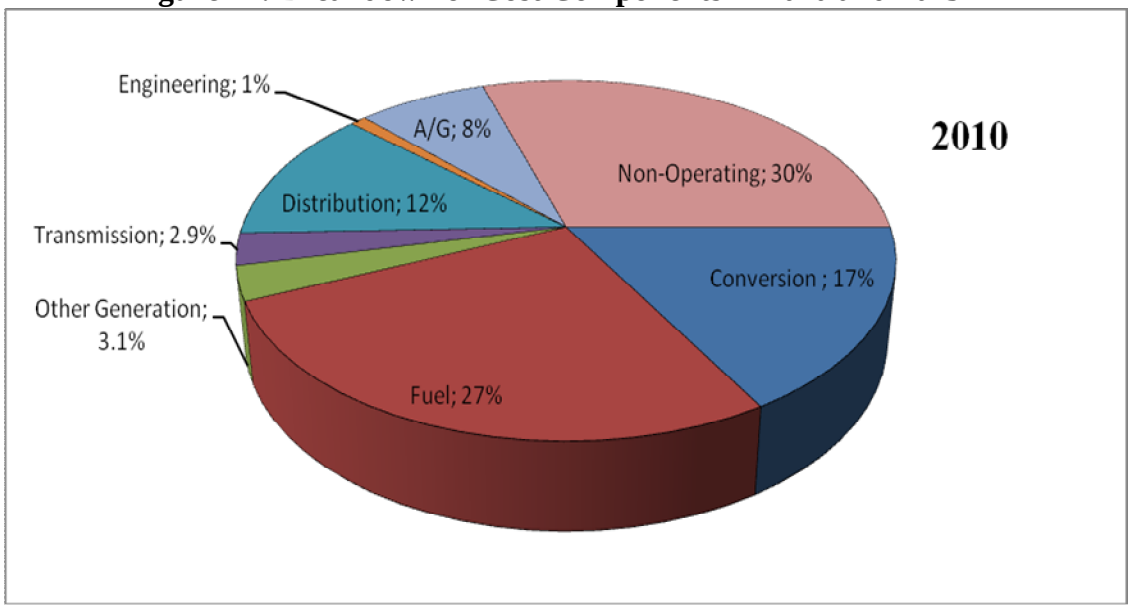
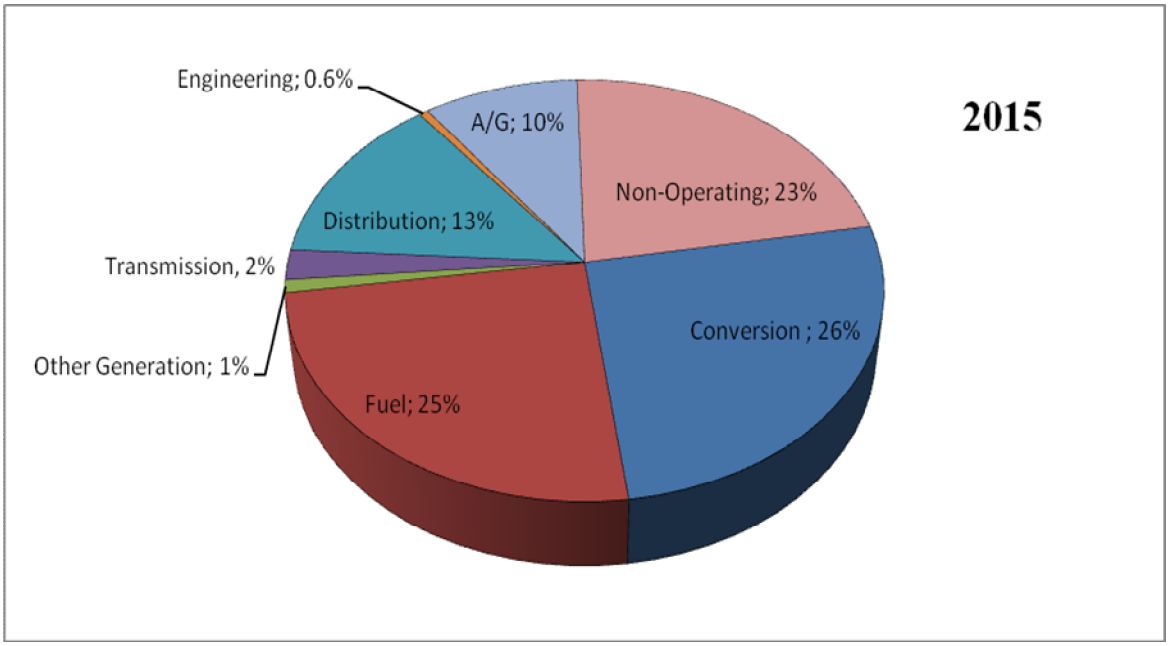


Figure 12 illustrates the components of T&TEC's total expenditure between 2010 and 2015. Conversion and fuel costs represented a total of 44% of total costs in 2010 and 50% of total costs, in 2015. Non-operating costs which includes depreciation, interest & finance costs and interest on gas, increased by $43 million dollars over the period. Other generation costs, decreased by 56% to $38 million dollars in 2015. Engineering costs decreased by about $4 million dollars.

[27] Mostly attributable to adjustments in T&TEC's pension plan administration.

Figure 12: Breakdown of Cost Components in 2010 and 2015

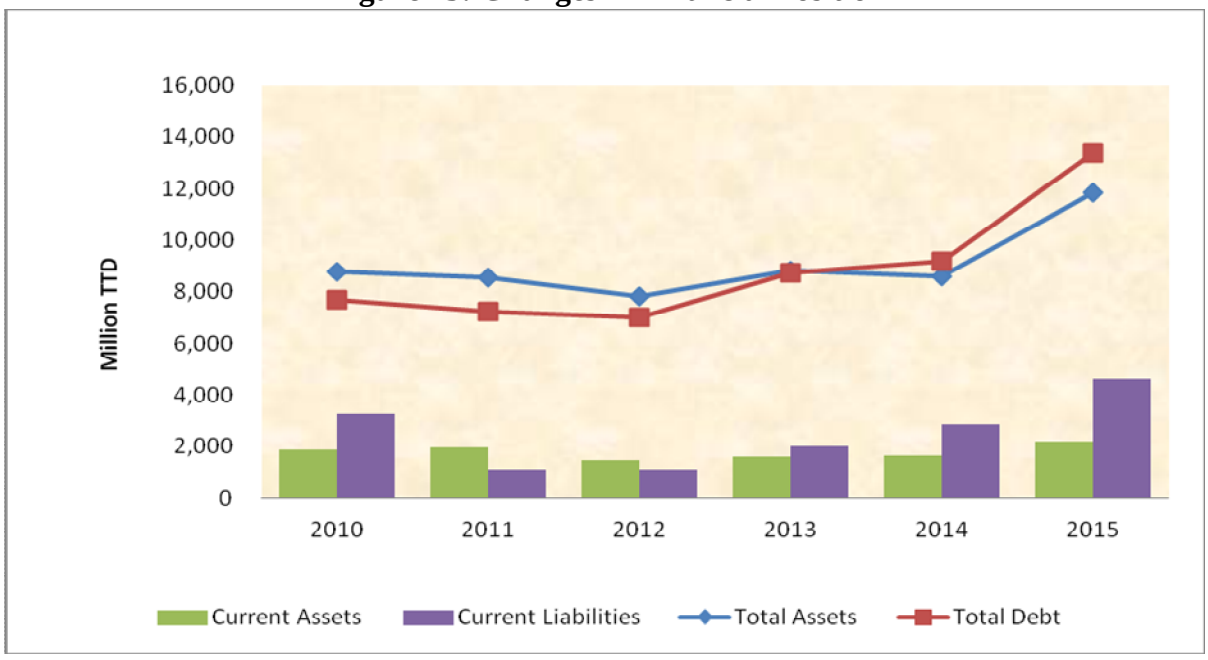




5.2 Assets and Debt

Over the period T&TEC's net assets showed an overall increase of approximately $1.5 billion dollars. Figure 14 shows movements in the assets, liabilities and total debt throughout the period.

Figure 13: Changes in Financial Position



For the period 2010 – 2015, there was an increase in T&TEC's property, plant and equipment of $2.7 billion. These assets were utilised to carry out the transmission and distribution aspects of its business and also support the core operations such as billing, administration, etc. Current Assets increased overall by a value of $305 million where the main increases were to debtors while Current Liabilities increased over the period by $1.3 billion, with the main driver of this increase being payments for natural gas.

Total debt (short and long term) increased by approximately $5.7 billion dollars while total assets increased by about $3 billion between 2010-2015 as shown in Figure 13 above. Over the period, working capital decreased by approximately $1 billion dollars and maintained a negative position for several years during the period, indicating that T&TEC's current liabilities exceeded its current assets during those years.

6. RATES & TARIFFS

6.1 T&TEC Tariff Schedule

Tariffs are charges levied by utilities for services. 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). While an assessment of each of the 'building blocks' is central to rate determination, consideration must be given to the implications of the pricing structure on consumers and efficiency improvements. The last rate adjustment for T&TEC[28] occurred before the period covered under this document and as such there have been no changes to the tariff schedule since that time.

There are four main classes of customers: residential, commercial, industrial and street-lighting The prevailing tariff structure that applies to these customers is shown in Table 7. The residential class operates on an inclining block structure consisting of three blocks[29].

The commercial customers are grouped into two rate classes and each class carries a flat energy charge per bill. Both residential and commercial B customers are billed bi-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.

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	-

[28] Within the 2006-2011 rate determination period, the last rate increase occurred in 2009.

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

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	-	-

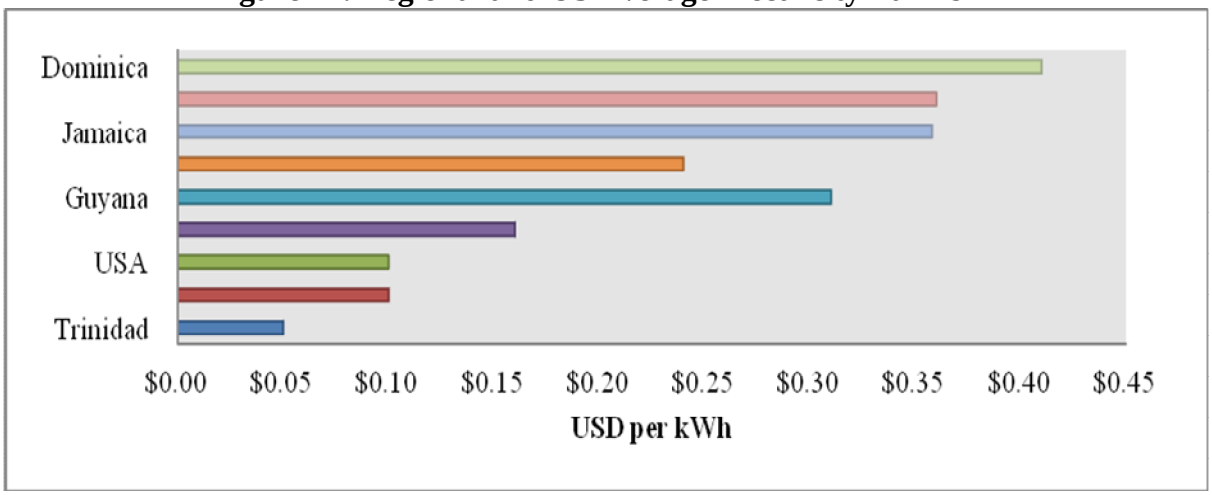
Source:TTEC

6.2 Comparison of Electricity Tariffs

Figure 14 shows the average tariff per kWh for selected countries in the Caribbean region and the United States in 2013[30]. 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 the lowest average electricity tariffs in the region at US$0.05/kWh.

[30] 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.

Figure 14: Regional and US Average Electricity Tariffs



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. For instance, 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 pay when consumption charges and non-consumption charges like taxes and fuel are factored in. When non-consumption charges are included, both Suriname and Trinidad & Tobago have the lowest tariffs in the region arguably because of the relatively low base rates and minimal or non-existent fuel surcharges attached to the customer bill.

Table 8: Average Residential Tariffs for 100, 400 & 800 kWh Consumption levels

Country	Total average cost per kWh in US$ (for 100 kWh)	Total average cost per kWh in US$ (for 400 kWh)	Total average cost per kWh in US$ (for 800 kWh)
Bahamas	0.30	0.30	0.32
Belize	0.17	0.19	0.22
British Virgin Islands	0.33	0.30	0.30
Curacao	0.28	0.30	0.33
Grand Cayman	0.32	0.28	0.27
Grenada	0.29	0.30	0.30
Guyana	0.22	0.25	0.25

Jamaica	0.25	0.33	0.35
St Lucia	0.26	0.27	0.27
St. Vincent	0.29	0.30	0.31
Suriname	0.03	0.04	0.06
Trinidad and Tobago	0.05	0.05	0.05
Turks and Caicos	0.37	0.37	0.37
US Virgin Islands	0.37	0.35	0.35

Source: Computations from Carilec Tariff Study, March 2017

Based on information from Section 5 above for 2015, with operating costs at TT$0.33/kWh and an average tariff of TT$0.34/ kWh, this suggests that T&TEC had barely enough billed revenue to cover its day to day operations in 2015. This position worsens when total expenditure per kWh of TT$0.43 is considered. At a minimum, these metrics suggest that T&TEC did not have enough funds to cover its costs. On a micro scale, it is evident that T&TEC's revenue based on the average tariff at that point in time, was inadequate to cover the utility's costs.

7. CONCLUSION

This review of the operational and financial state of T&TEC reveals two different perspectives in terms of performance of T&TEC. Technical performance steadily improved over the period of review, with some areas still requiring attention, while financial indicators suggested difficulties for T&TEC in meeting its financial obligations. There appears to be a direct correlation between the decline in T&TEC's financial position and the end of the last price control period, however, attention must be also be paid to the rate at which T&TEC's expenditure has increased, vastly outstripping the rate of increase of units of electricity sold.

The RIC has recently commenced the second price review for T&TEC and will address some of the observations coming out of this review of the status of T&TEC, during this process.