TRINIDAD & TOBAGO ELECTRICITY COMMISSION

T&TEC and Renewable Energy

By

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08/06/2017

Trinidad and Tobago Electricity Commission

- T&TEC is State owned and is the sole Electric Transmission and Distribution Utility in T&T. T&TEC is committed to achieving the National Goal of replacing 10% of its current energy mix with Renewable energy.

- T&TEC has over 455,000 customers and sells in excess of 9,400 GWh of energy per year. T&TEC is responsible for supplying fuel to its three generation suppliers and is given the highest priority for gas supply by the NGC (300MMSCF per day or 7% gas produced).

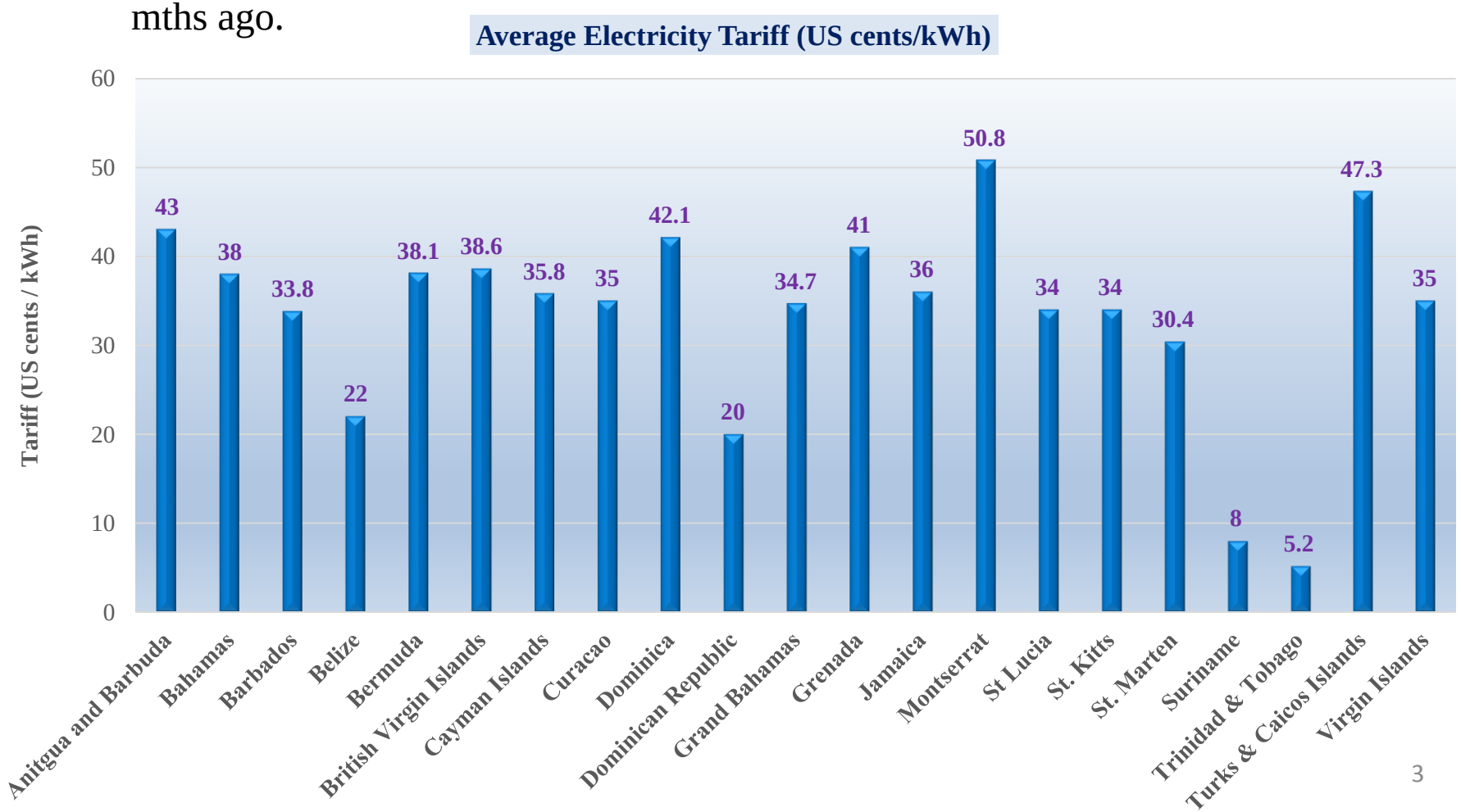
- T&TEC is responsible for national Generation Planning and for the administration of four PPA's. The 2017 YTD peak is 1,290MW. The all-time system peak demand was 1,396 MW in 2015 all of which is generated from Natural Gas

- T&TEC is required by law to comply with various Service and Overall standards determined by its regulator, the Regulated Industries Commission (RIC)

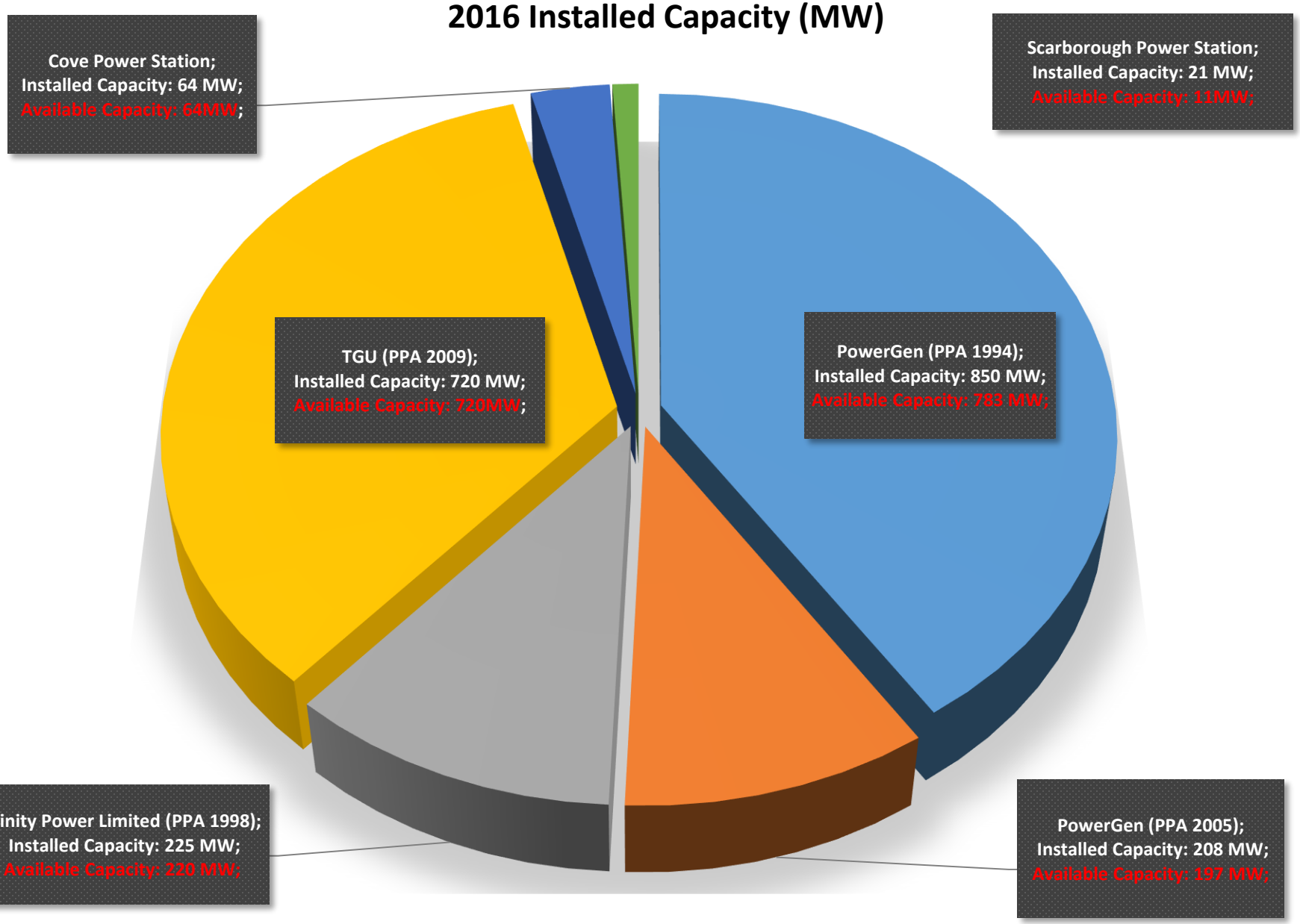
- Our customers are metered through a nation wide real time metering telemetry at

Trinidad and Tobago Electricity Commission

Our customers enjoy some of the lowest tariffs in the region, at an average price of 36 TT cents (5.2 US cents) per kW before tax. Last Carilec tariff survey 18 mths ago.

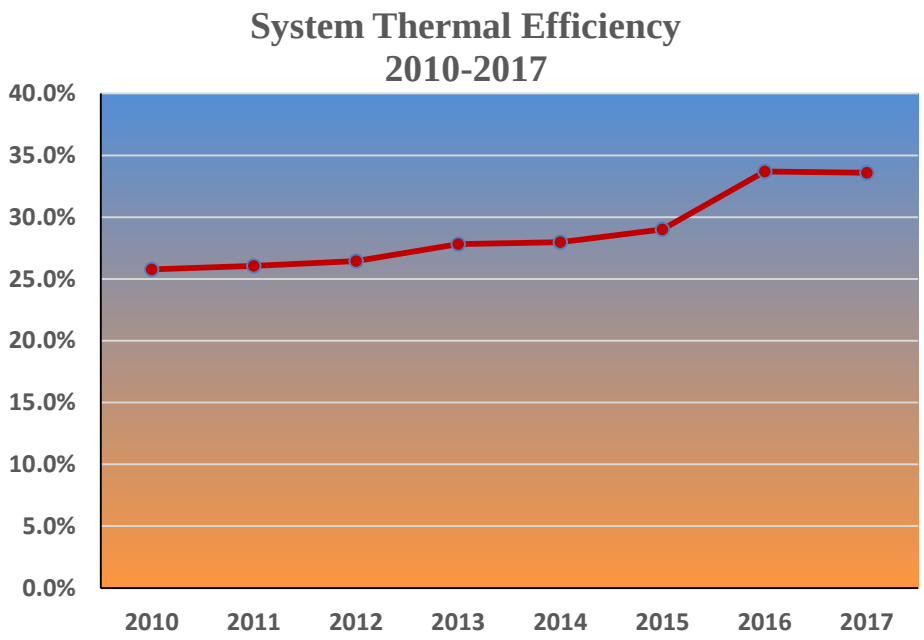


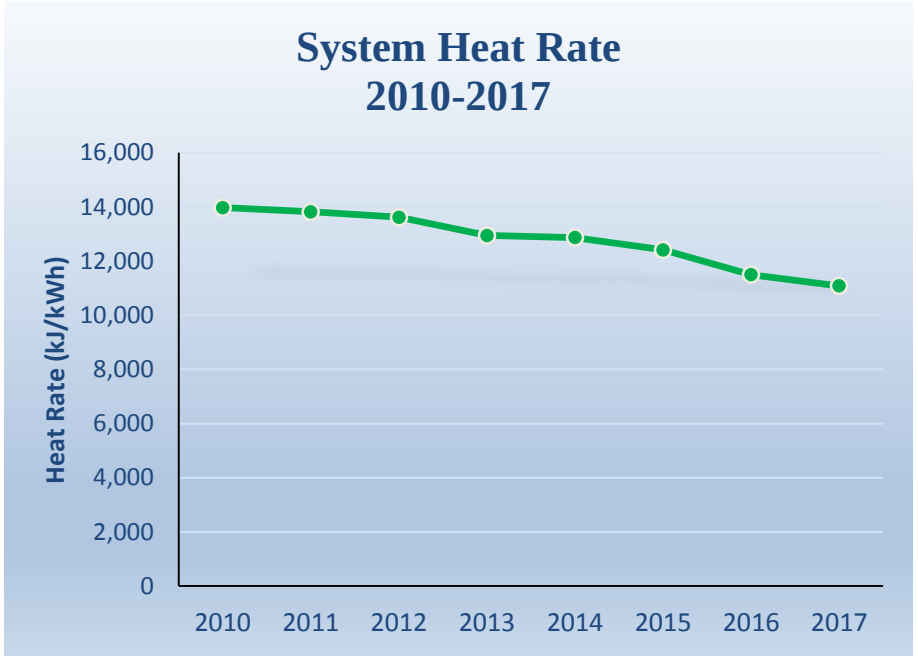
2016 Installed Capacity (MW)



Total Installed Capacity: 2,088 MW
Total Available Capacity: 1,995 MW

Thermal Efficiency & Heat Rate



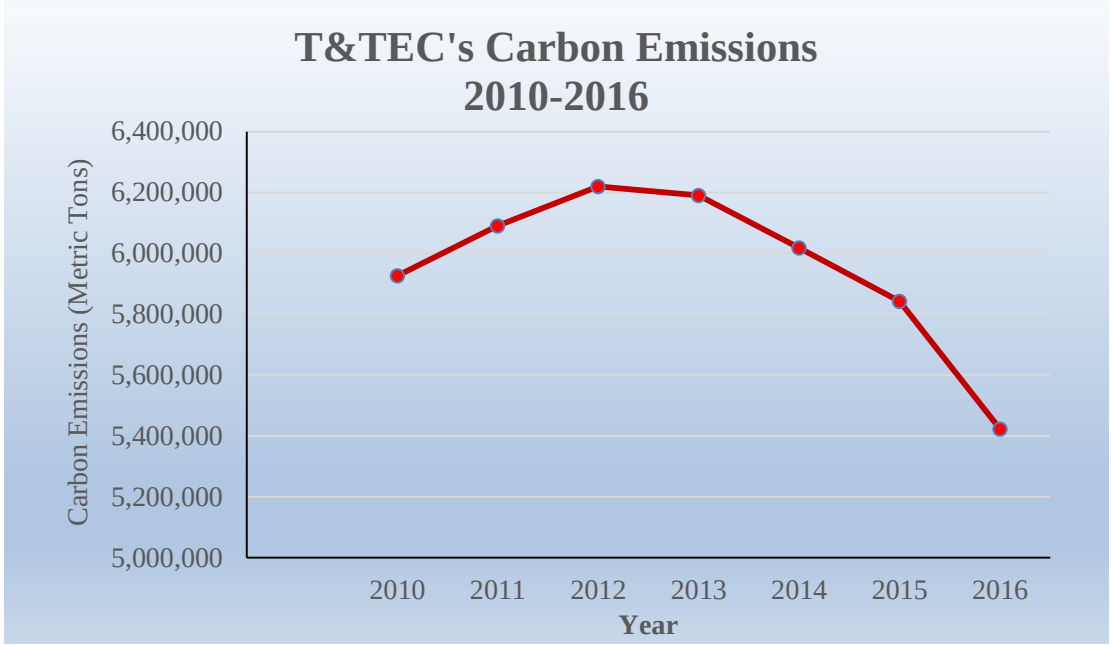


Prior to 2012, a large sector of power generation was produced using simple cycle plant. The resultant system efficiency was **26.4% or system heat rate – 13,617 kJ/kWh**).

On 12th December 2012, 2x135 MW of the steam component of the Combined Cycle plant was commissioned at the TGU Plant.
This new Combined Cycle efficiency resulted in a present system efficiency of **41.9% or system heat rate – 8,590 kJ/kWh**

Reduction in CO_2 Emissions

Year	CO_2 Emissions (Metric Tonne)
2010	5,926,000
2011	6,091,000
2012	6,220,000
2013	6,190,000
2014	6,018,000
2015	5,842,000
2016	5,423,000



With the introduction of the total 720 MW Combined Cycle Plant in December 2012, there was a noticeable decline in CO_2 emissions.

T&TEC and Renewable Energy

How does Renewable Energy fit in ?

- Less CO_2 (Paris Agreement, Caricom/ United Nations Framework Convention on Climate Change (UNFCCC))
- Improved gas security
- Increased economic opportunity for value added gas products
- Creation of new industries, markets and jobs

ENABLING RENEWABLE ENERGY

- T&TEC has completed a pilot Solar project and a small scale wind resource survey in Tobago towards the implementation of RE locally.

- T&TEC has completed a manual entitled “Wiring for Renewables” in anticipation of an expanded RE implementation at the domestic level. Publication hinges on amendments to the T&TEC Act

- T&TEC has worked closely with the TTBS and the GEI in establishing standards for certifying equipment and building wiring

- T&TEC has contributed significantly by assisting the Ministry of Energy in the development of:
  - A National Renewable Energy Policy.
  - A Draft Renewable PPA template for use in T&T
  - A FIT Policy for Trinidad and Tobago

T&TEC's Technical Considerations

Renewable Generation Systems

- The Commission shall only approve the interconnection and parallel operation of distributed renewable generating sources (DRGSs) to its Distribution System (up to 12kV) when the system comprises Certified Equipment with a maximum aggregate capacity per facility of:
  - 5 kW, for single phase, 3 wire, 115/230 volt installations serviced under the Domestic and General tariff (Rate A),
  - 50 kW, for single and three phase, 4 wire, 115/230 volt installations serviced under the Commercial Tariff (Rate B), and
  - 200 kW, for three phase, 4 wire 115/230 volt installations serviced under the Industrial D1 Tariff.

- The installed DRGS may be single phase or three phase as indicated above, however, its output capacity may be limited by the size of the ac and dc disconnects servicing the installation and the current rating of the interconnecting cables.

- Generally, single DRGS with output greater than 200 kW shall be installed for self-generation as stand-alone equipment which does not export to the Grid. Such DRGS should be for internal use ONLY and must not be synchronized onto the Commission's Distribution system save and except a RE Power Purchase Agreement (PPA) is entered into.

FEED-IN TARIFF Policy
(Incentive for Renewable Energy Developers)

•The Feed-In Tariff (FIT) policy will encourage interested groups to develop renewable energy projects.

•The policy should guarantee grid access and mandate T&TEC to purchase all available renewable energy to a predetermined upper limit.

•Tariffs will take into account location, cost of project and a reasonable return on investment and consequently Tariffs will not be fixed but will be determined on a case by case basis.

•Guaranteed long term power purchase agreement

T&TEC's Renewable Energy Projects

- As part of the country's drive for renewable energy, T&TEC and the Electrical Inspectorate initiated and completed two small-scale PV projects (for training purposes). The two locations are:
  - T&TEC, Mt. Hope
  - UTT, O'Meara Campus
- The eventual goal is to encourage residential and commercial customers to have permanently-connected renewable energy systems installed at their premises.

T&TEC's Grid Interconnected Photovoltaic (PV) Project

- The grid-connected PV System was commissioned on 27th March, 2012 by T&TEC (1st of its kind)
- The **first** PV System is located on the rooftop of T&TEC's Mt. Hope Office Building. (Grid-connected PV systems without batteries are comparatively easy to install)
- 10 polycrystalline silicon PV panels with a total area of 15 square meters
- Each panel is rated at 220 Watts and the Total Installed Capacity is 2.2kW

T&TEC's RENEWABLE ENERGY PROJECTS

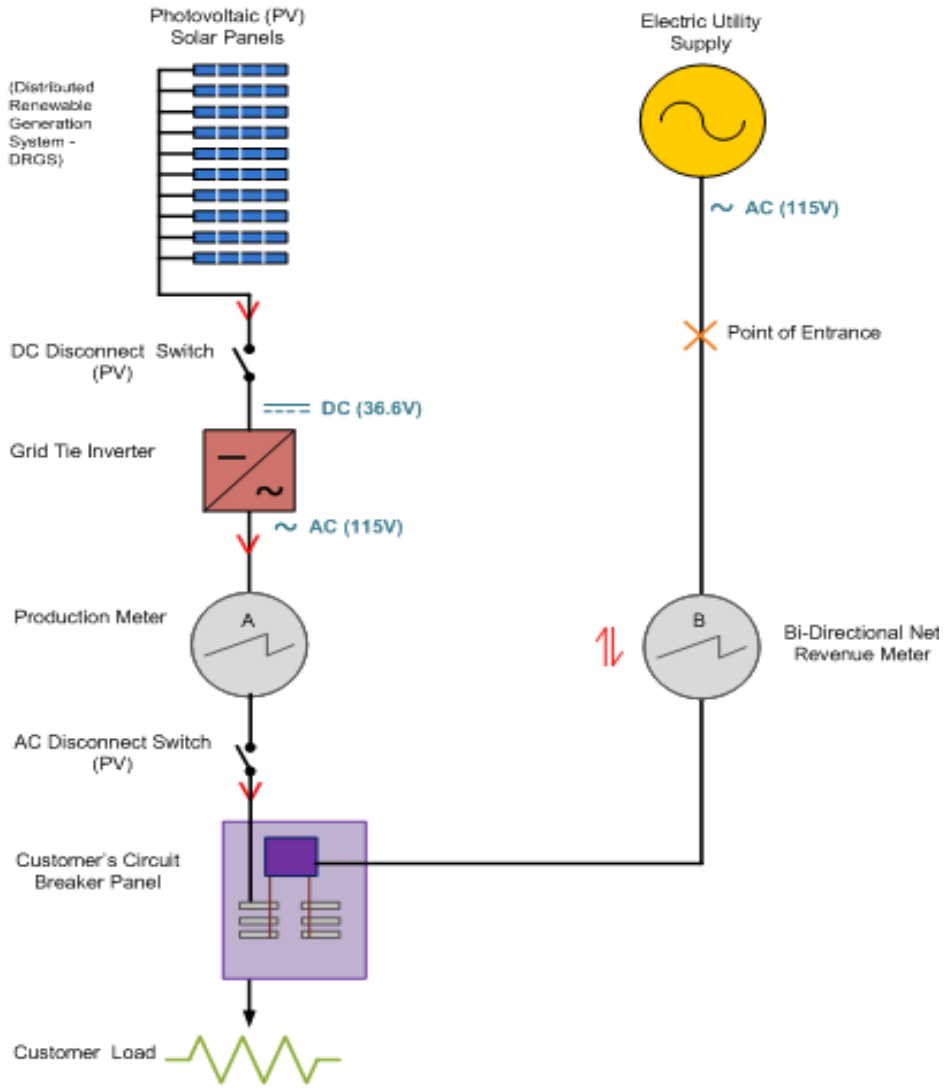
PV Projects

University of Trinidad and Tobago
O'Meara Campus (2 kW)

Trinidad and Tobago Electricity Commission
Mt. Hope Compound (2 kW)

T&TEC's Grid Interconnected Photovoltaic (PV) Project

Net Metering Arrangement



Net Metering

• Allows customers who generate energy from a renewable source to offset their own consumption over a billing period. It even allows meters to run backwards when the consumer generates electricity in excess of their demand

• By netting-off, the consumer, in a sense, is guaranteed the utility's retail price for their excess energy

• Consumer may negotiate price for excess energy

• The utility may cap net energy import to regulate grid conditions

Net Billing -“Buy All, Sell All”

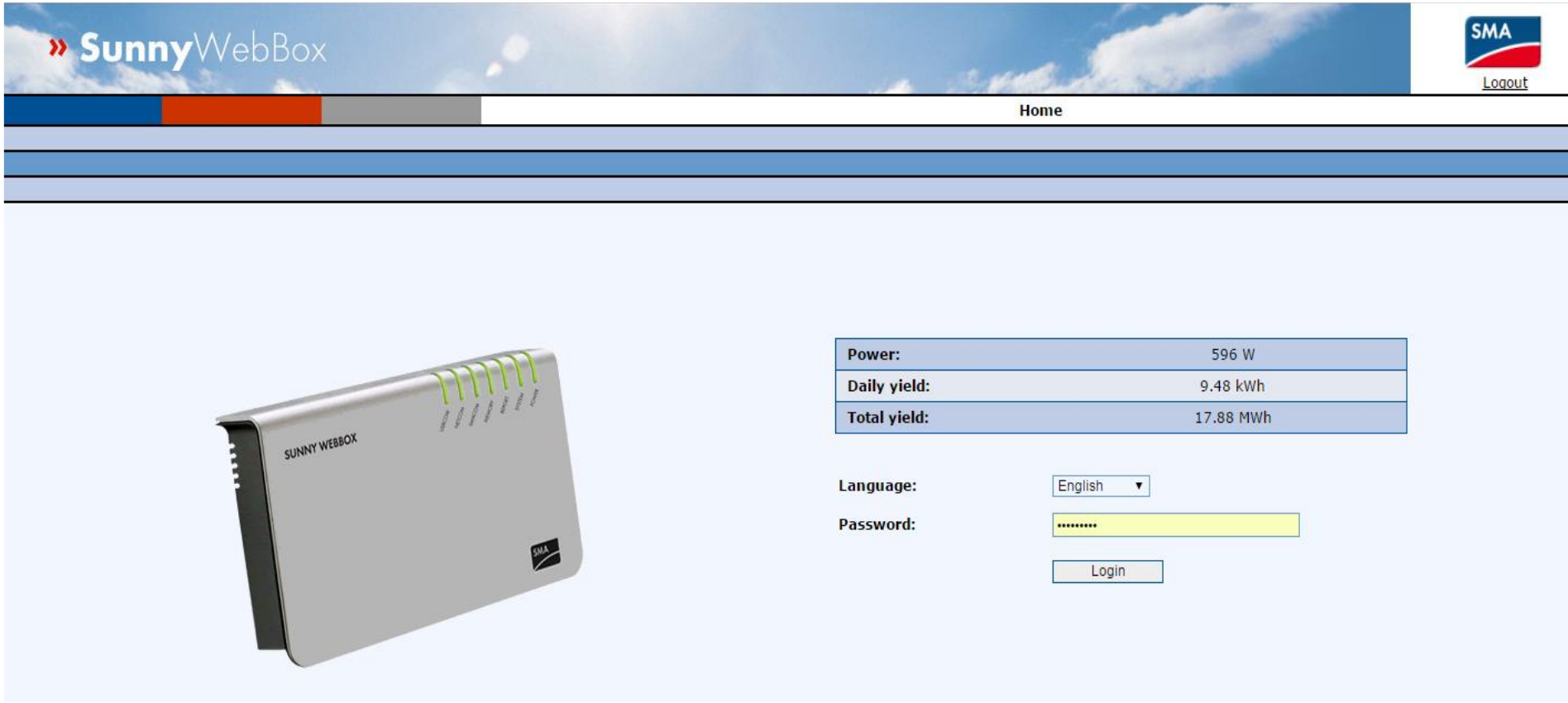
• A billing arrangement in which the customer operates a small IPP. The customer’s bill reflects the difference between the consumption billed in the rate schedule in the applicable tariff to the amount paid to the customer for all the energy produced and exported to the utility (FIT).

•All the energy produced by the DRGS is purchased by the utility at a rate typically higher than the energy the customer purchases.

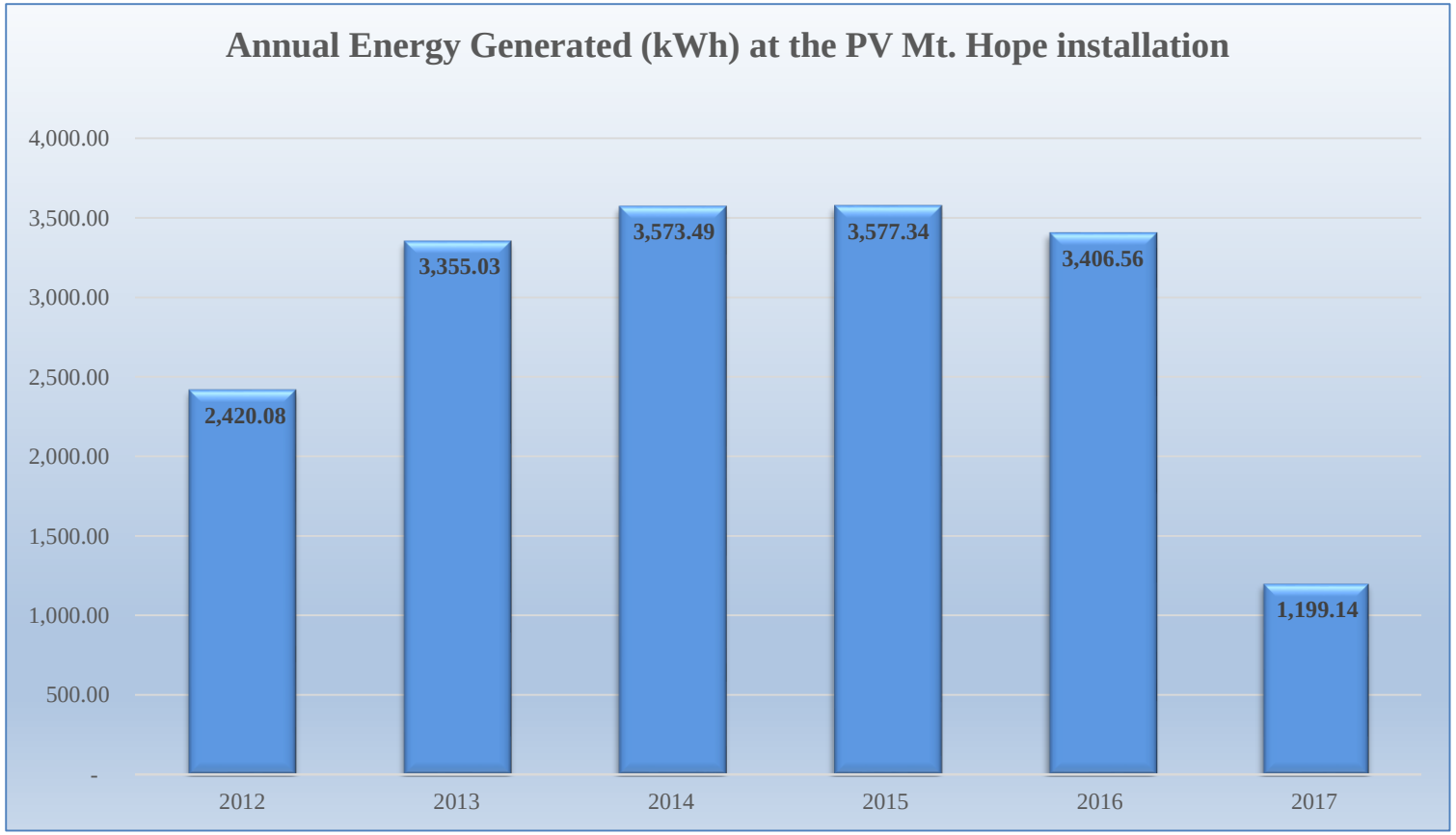
Put differently, the customer buys all its energy from the Utility at prevailing rates, and sells all the Renewable Energy produced at a Feed–In-Tariff (FIT) rate.

T&TEC's Grid Interconnected Photovoltaic (PV) Project

The Sunny WebBox can be connected via the following link
http://172.20.18.26/



Sustainability of PV System



2017 YTD figures (April 2017)

Benefits of T&TEC's PV Project

- To serve as a live demonstration project and also provide hands-on experience for Electrical Inspectorate officials
- Lessons learnt during installation provided the practical input into the development of T&TEC's "Wiring for Renewables" manual
- Provided real time data to calculate actual avoided CO_2 emissions from conventional fossil-fuelled generation
- University students were able to use data from the PV Project for their theses on the development of a road map for renewables in T&TEC and the country
- We have hosted other Government Ministries to raise consciousness and allow for increased knowledge building

Other T&TEC RE Initiatives

T&TEC has expanded its research into wind energy. Tobago's winds made the island an ideal location for the research.

- **Two anemometers** installed in January 2015
- Two locations – **Minister's Bay and Flag Staff Hill**
- Preliminary average wind speed readings – **5.5m/s**

Other RE Initiatives

Additional actions taken to better prepare T&TEC and Trinidad and Tobago for energy sustainability:

- An RFP has been developed for an ocean current renewable energy project in Tobago
- The analysis of a possible 5MW PV Project at the Piarco International Airport
- T&TEC ideally prefers ‘dispatchable’ energy sources such as Waste to Energy with Hydro Electricity being a remote possibility

Challenges facing RE connectivity

- The T&TEC Act, Chapter 54:70 and Regulated Industries Commission (RIC) Act, Chapter 54:73 makes no provision for grid connected renewable power generation by Independent Power Producers (IPPs)

- Due to prevailing tariffs, net billing would not make grid connected RE cost effective

- The existing regulatory environment has no incentive for a Feed In Tariff (FIT).

- How does conservation feature as a strategic priority?

Thank You