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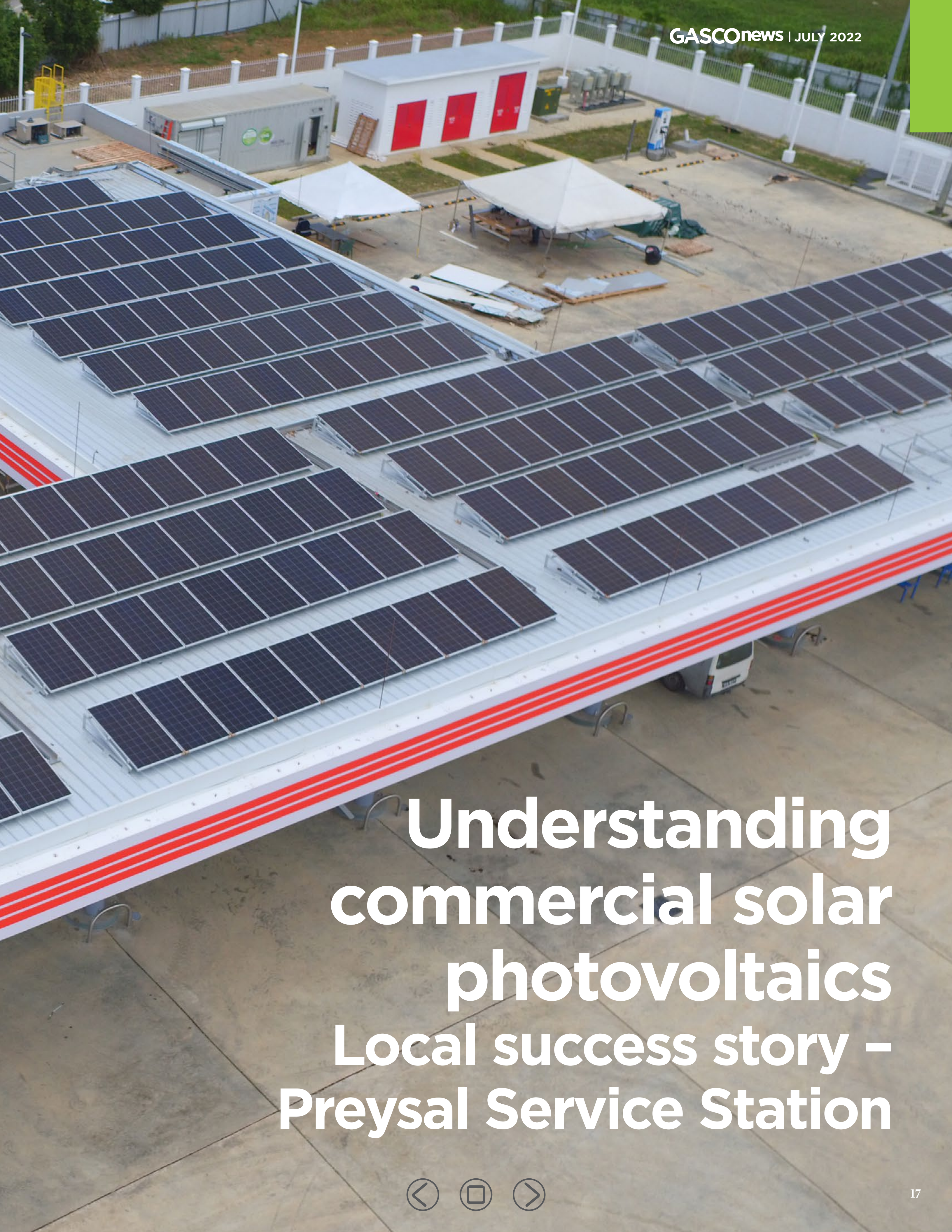

Understanding commercial solar photovoltaics

Local success story – Preysal Service Station

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FIGURE 1: 320 SOUTH FACING SOLAR PANELS AT THE PREYSAL SERVICE STATION WHICH FORM PART OF THE PV SYSTEM.

> Indeed, National Energy is currently working with the Government towards the future installation of rooftop solar photovoltaic (PV) systems at schools and community centres that are used as emergency shelters.

In 2021, National Energy successfully oversaw the installation of a 100 kW rooftop commercial solar photovoltaic (PV) system at the new Preysal Service Station.

This project showcases the Government of Trinidad and Tobago's commitment to incorporating renewable energy technologies into the national mix. Indeed, National Energy is currently working with the Government towards the future installation of rooftop solar photovoltaic (PV) systems at schools and community centres that are used as emergency shelters.

As such projects unfold, the Preysal Service Station is a model that allows for the collection and analysis of critical solar data. Some of this data is profiled below.

PROJECT DATA - CONSIDERATIONS FOR MAXIMUM PERFORMANCE OF A SOLAR PV INSTALLATION

Prior to installation of the solar array at Preysal, several factors needed to be assessed. These factors should inform any project seeking to harness maximum solar energy.

Shading
In conducting the technical assessment of using a commercial solar PV system, issues of shading, roof orientation and the structural and space requirements must be analysed and optimised. Conducting a shading analysis refers to looking at the effects of sunlight blockage on the solar array cell. Any form of blockage/shading reduces the power out of the solar PV system. Objects such as trees, other buildings and fixtures can cause shading issues on the solar array cell at different times during daylight hours.

Roof orientation
Roof orientation deals with the slope of the roof on which the solar PV system will be mounted and how this will impact the configuration of the system. Roofs are classified as either low-sloped or sloped, where the incline of a low-sloped roof ranges from 0 to 24 degrees.

Azimuth & Tilt Angle
Two additional factors to be considered in the configuration of the solar array are the azimuth and tilt angle of the array. The azimuth refers to the angle at which the array is positioned. The azimuth angle is the clockwise angle from true north that describes the array's orientation. A south-facing array has an azimuth angle of 180 degrees, whereas a north-facing array has an azimuth angle of zero (0) degrees.

The default azimuth angle for locations in the northern hemisphere is 180° (south-facing) and 0° (north-facing) for locations in the southern hemisphere. However, the specific azimuth used at the location must be determined based on the orientation of the roof, to optimise spacing and layout.

The tilt angle refers to the angle of the PV modules in the array which is measured in degrees from the horizontal. The tilt angle of a fixed array is its angle from horizontal, where 0° equals horizontal and 90° equals vertical. Figure 3 shows the relationship between azimuth and tilt angle. To optimize the system's total electricity production across the year, a popular rule of thumb for fixed arrays is to adjust the tilt angle to the latitude of the system's position. However, on flat roofs the system may employ a tilt angle that is less than ideal for the given latitude. Flat or zero-tilt arrays are sometimes utilised on low-slope roofs because they provide a significant amount of energy per square foot of roof area and reduce wind loads.

The solar PV system at the Preysal Service Station was installed well in line with industry standards for Trinidad's location (see Figure 2).

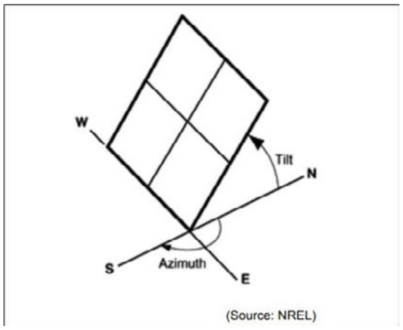


FIGURE 2: PREYSAL SERVICE STATION PV SYSTEM CONFIGURATION

Preysal Service Station PV System Configuration

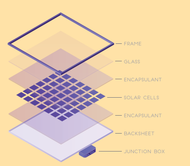
PV System: Medium size commercial
Azimuth of PV panels: 186°
Tilt of PV panels: 11°
Installed capacity: 100kW

Structural and Spacing Requirements

The structural integrity of the commercial facility must be evaluated before the solar PV system is placed on the rooftop. The roof must be able to support the weight of the solar PV system while still dealing with environmental conditions such as rain and debris as well as the weight of service personnel who will have to conduct routine maintenance and checks on the solar PV system. Understanding the pressures applied to the racking system and roof from static and dynamic loads is critical.

Depending on the type of solar PV module utilised and the system's architecture, the array's footprint will vary significantly. When evaluating potential roof space for a solar PV system, it is important to consider the placement and size of current or future rooftop equipment such as heating, ventilation, and air conditioning (HVAC) systems.

FIGURE 3: CONSIDERATIONS FOR SOLAR PV INSTALLATIONS



PV System Components

- Major components: mounting system, PV array, inverter, switches, circuit breaker and meters
- Mounting systems attach the PV modules to the roof
- Mounting system must securely support the PV array and its attached components under conditions such as strong wind and heavy rainfall
- PV arrays are composed of PV modules and their material impacts operating characteristics and efficiency

Meteorological Data

- The amount of solar radiation and time of sunshine hours
- Wind velocity and wind direction of the location
- The wind direction and wind velocity of the location must be accounted for to minimise damage during adverse weather conditions
- Geographical latitude and longitude positioning determines the amount of solar radiation available

Other Factors

- Energy load/demand
- Regulations
- Transmission and interconnection requirements
- Accessibility

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OPERATIONAL DATA FROM THE PREYSAL SERVICE STATION

Emissions Savings

During the period January – April 2022, the solar PV system dispatched 31,484.2 kW of power, resulting in 5,788.99 kg of CO_2 emissions savings. This makes it clear that distributive, rooftop or commercial solar PV installations can open an avenue for Trinidad and Tobago to achieve its Paris Agreement targets.

February Blackout vs Preysal Solar Panels

Security of supply and resilience of infrastructure were critical in the design of the Preysal Service Station. The use of a solar PV system as the primary source of power was part of a strategic effort to improve business continuity for the station's operations, during such events as the nationwide power disruption which occurred on February 16th, 2022.

There are 320 solar PV panels installed on a purpose-built canopy and a battery bank with a total voltage of 729.6 VdC which provides 510.72 kWh. During the power outage on February 16th, the battery bank provided power for the:

- liquid fuel pumps
- internal and external lighting in the convenience store
- in-store cashier booths.

Combined, the abovementioned factors facilitated increased customer purchases at the pumps and traffic through the convenience store. The station was able to remain online and continue providing full service to its customers. At the time of power restoration, the state of charge of the battery was 78%.

National Energy continues to work with stakeholders to expand the use of solar energy as a power source in Trinidad and Tobago. As the solar PV installation atop the Preysal Service Station continues to support operations, more data and learnings will be collected to help guide future projects. ■

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The recommendations are generally feasible, though not without disruption to the existing organisation of the economy. The reality remains: for Caribbean countries, the shift to a circular economy, though necessary for long-term sustainability and viability, represents a significant disruption for a series of economies that have been historically built to benefit from the linear economy, not to mention the influence of entrenched economic and other interests in the status quo. Smaller islands may be closer to implementing these recommendations since, being in a much more parlous economic state post-COVID, any overall shift may be less jarring.

For Trinidad and Tobago, the economic pain point which would make a general transition to a circular economy feasible is much further away. Though elements that would facilitate the transition exist in the SDGs and country commitments under the Paris Accord, they are not present as a series of overall policies. What is lacking is an explicit circular economy framework, and a means to evaluate and monitor the progress to the circular economy. ■

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