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Project Case Study

Project:	PicoGrid Active Power Limitation
Location:	Espiritu Santo, Vanuatu
Commissioned:	October 25th, 2013
Clients:	MPower Pacific
Stakeholders:	Government of Vanuatu, Vanuatu Utilities Inc. (VUI), The Asian Development Bank, Energy4All

ADB

VUI A PERNIX GROUP COMPANY

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Overview

Three sites were chosen in the Sanma district on the island of Espiritu Santo to demonstrate the efficacy of grid-connected solar PV systems by the Government of Vanuatu and the Asian Development Bank (ADB). MPower and its local partner Energy4All designed and implemented the solar systems below:

Site	General Capacity	Inverters
Sanma District Council Building	10kW	1 x SMA Tripower STP-10000
Hospital	20kW	2 x SMA Tripower STP-10000
College	10kW	1 x SMA Tripower STP-10000

Context

The setting for these systems would be in a very hot climate, with limited bandwidth for internet connectivity and an electrical network that is not accustomed to directional AC loads, nor has policy yet for feed-in tariffs or crediting of solar-generated kilowatt-hours. Electricity prices in Santo are relatively expensive – approximately 44 vatu (equivalent to approximately $0.44 NZD) so judicious use of solar resources was desired.

Requirements

The system requirements for distributed generation asset and energy management are listed below:

Top Performance

With power prices being linked to diesel prices in the Pacific, it was important that these systems extracted the most value out of the sun's energy for the long term.

Reliability

With salt winds, cyclone conditions, high temperatures and the resulting intermittent network power quality, these systems needed to be highly reliable with a long life expectancy.

High-resolution, zero-data-loss, responsive monitoring and visualization

VUI needed a monitoring and visualization package that gave them high visibility to the state of the equipment and the performance. Being able to log performance with the internet up or down was important

Resilient 3G connectivity

As with many Pacific applications, internet connectivity is often wireless and can suffer from low speeds and patchy signal strength. Due to potential dropouts, the monitoring system must pro-actively re-establish communications in the event of signal loss.

Affordability

The system must be priced in a fashion to show solid ROI for the people of Vanuatu.This is not only up-front costs but ongoing costs.

Highly-available secure Remote Control

The systems needed to be fit into a generation portfolio that included both diesel gensets as well as a 1.2MW hydro station. In certain instances, the solar PV systems would need to be shut down with full security and non-repudiation of the shutdown request.

Future-proofed as possible

As the first set of large-scale solar PV systems in Espiritu Santo, there was a need to make sure that information and communication systems were not going to be limited to one set of hardware or software, and that communication protocols did not become obsolete..

Technical Solution

Greenstage provided 3 Active Power Limitation Solarnodes to both monitor and control 4 SMA Tripower STP-10000 inverters. The Solarnodes collect information from the SMA inverters as well as control the inverters output, using an SMA Power Control Module that slots into each inverter (see diagram below). In the case of the Hospital, there were two inverters in parallel, which presented no problem. PV modules chosen by MPower were CNPV 250W, complete with IEC 61215, 51730 certificates as well as salt-mist protection IEC 61701. Ironridge framing was used to secure the modules flush to the roof.

In order to make sure that the 3G connection is up, the Solarnodes actively monitor the connection to the internet, and physically power down and power up the 3G modems if necessary. The 3G modems used were modern Huawei E3131, which are both high quality units, and common in NZ and around the world. They come with an optional CRC9 external antenna port, which we outfitted with a 3dB booster antenna for better signal strength.

In addition, the multi-threaded Solarnode software still collect data from the SMA inverters whether or not the Solarnode is connected to the internet. It caches that data and when internet connectivity returns, will shuttle that info up to the SolarNet server based in Wellington, where it is visualized on the Console. All communication involved is secured using either 128-bit SSL certificates or X.509 encryption in conjunction with a Certificate Authority acting as a non-partisan independent 3rd-party authorization authority. This means that any commands issued by VUI administrators are vetted and guaranteed with non-repudiation by the system.

VUI administrators have access to a branded Console which shows the live status and generation performance of the inverters. As well, VUI administrators can securely turn off the inverters using the same console. Unlike other solutions where either monitoring or control is available only by the web server on the monitoring device, the Greenstage platform is highly customizable and extremely responsive as an HTML5 application utilizing secure web services. This means mobile platforms such as smart phones and/or tablets can be easily integrated into the full solution.

Advantages and Strategy

The advantages of the Solarnodes are that they provide a rich set of robust energy management services along with the flexibility going forward. While SMA Tripower was the solid choice of inverter in these installations, there are increasing options for solar hardware in the marketplace. Greenstage is aware of this, and have designed the Solarnode to speak simultaneously to multiple devices concurrently. For the solar installer, this is a very practical solution as the technology in this industry is changing rapidly. From a n energy management perspective, the potential for Solarnodes is great especially in the Pacific region. Using the Power Control Module on the Tripower series in conjunction with a IEC 61036 class 1 kWh meter, Solarnode is also able to regulate output to match dynamic load on a building in a "Zero-export" configuration. This is important on diesel grids, as too much backfeeding on a smalller network can cause issues with voltage and frequency, while self-consumption of solar PV power remains a very desirable goal for these nations with plenty of solar resources.

Cost Benefits

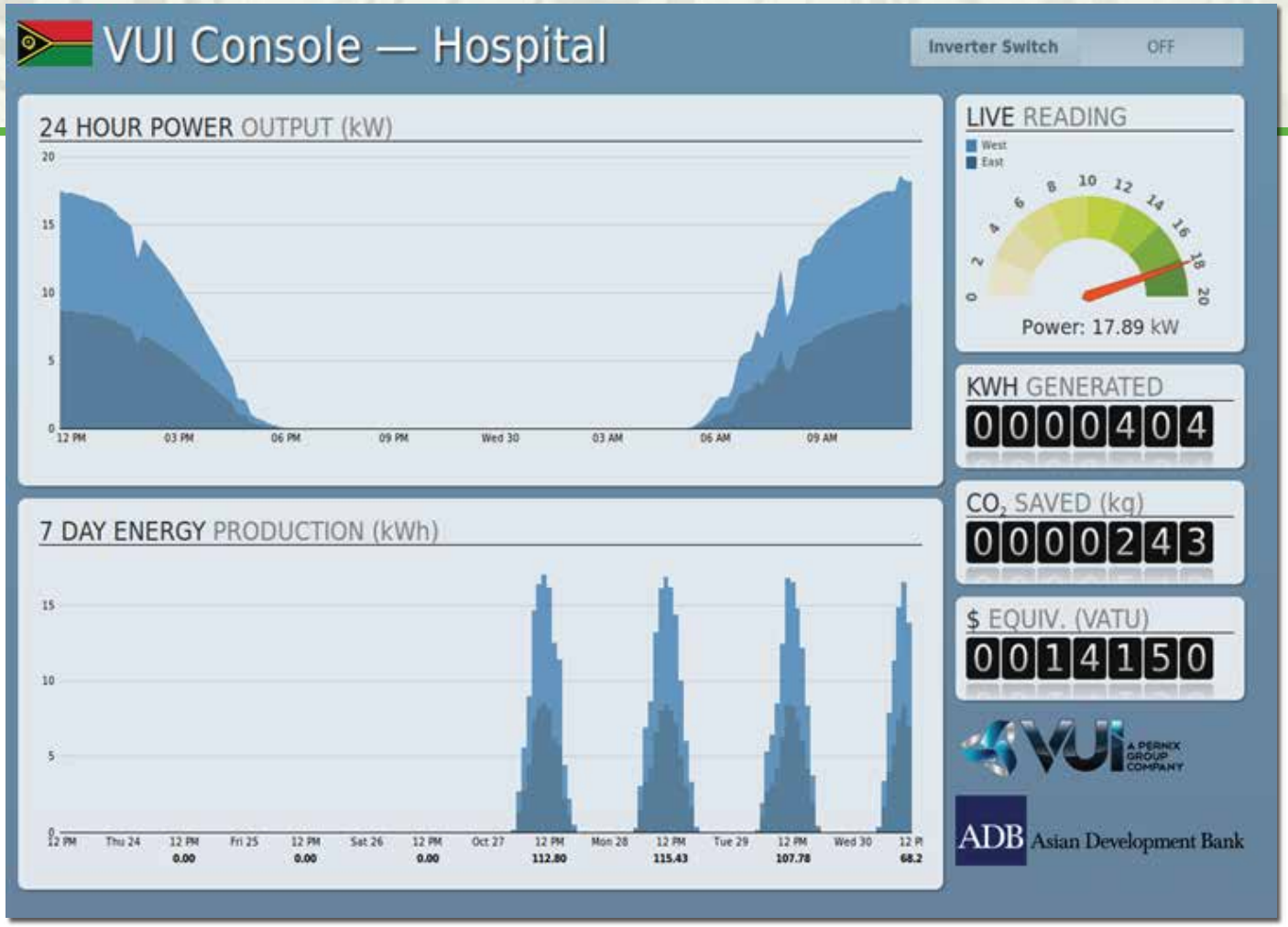
The ROI on grid-connected solar PV systems in the Pacific is very high, but comes with technical challenges. With the addition of a managed system, grid operators can have assurance that the output of these inverters remains within the tolerance of their network limits. Also, usage of different brands of equipment – a heterogeneous environment in IT terminology – is now very likely and possible. Greenstage creates solutions from the most robust industrial-quality commodity gear that survies testing in the field. Nothing exotic or proprietary is used, and international standards are adhered to wherever possible. This results in highly maintainable solutions going forward, with costs can be kept low while compatibility with new devices and integration other software systems such as Building Management Systems can be achieved. Greenstage takes a holistic view of energy management and realizes that true cost savings comes from a working solution that accommodates your business, not the other way around.

Photographs and Visualizations

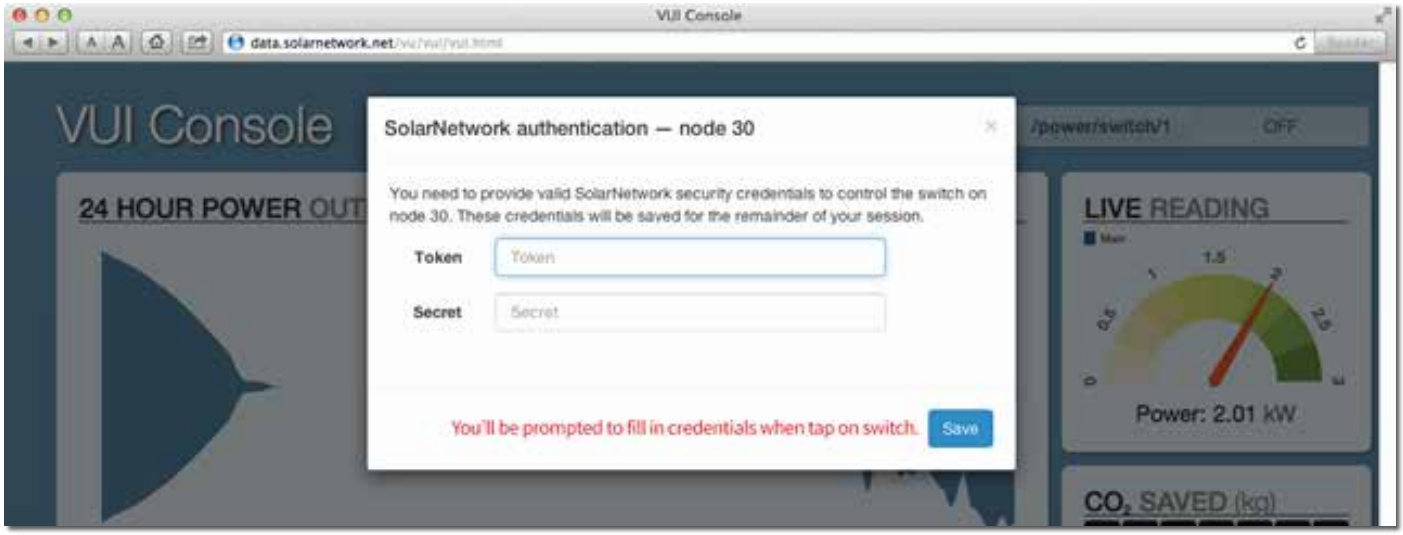
The 20kW array on the Hospital in Sanma Province, Espiritu Santo, Vanuatu

The 10kW array on the Sanma Council offices, Espiritu Santo, Vanuatu

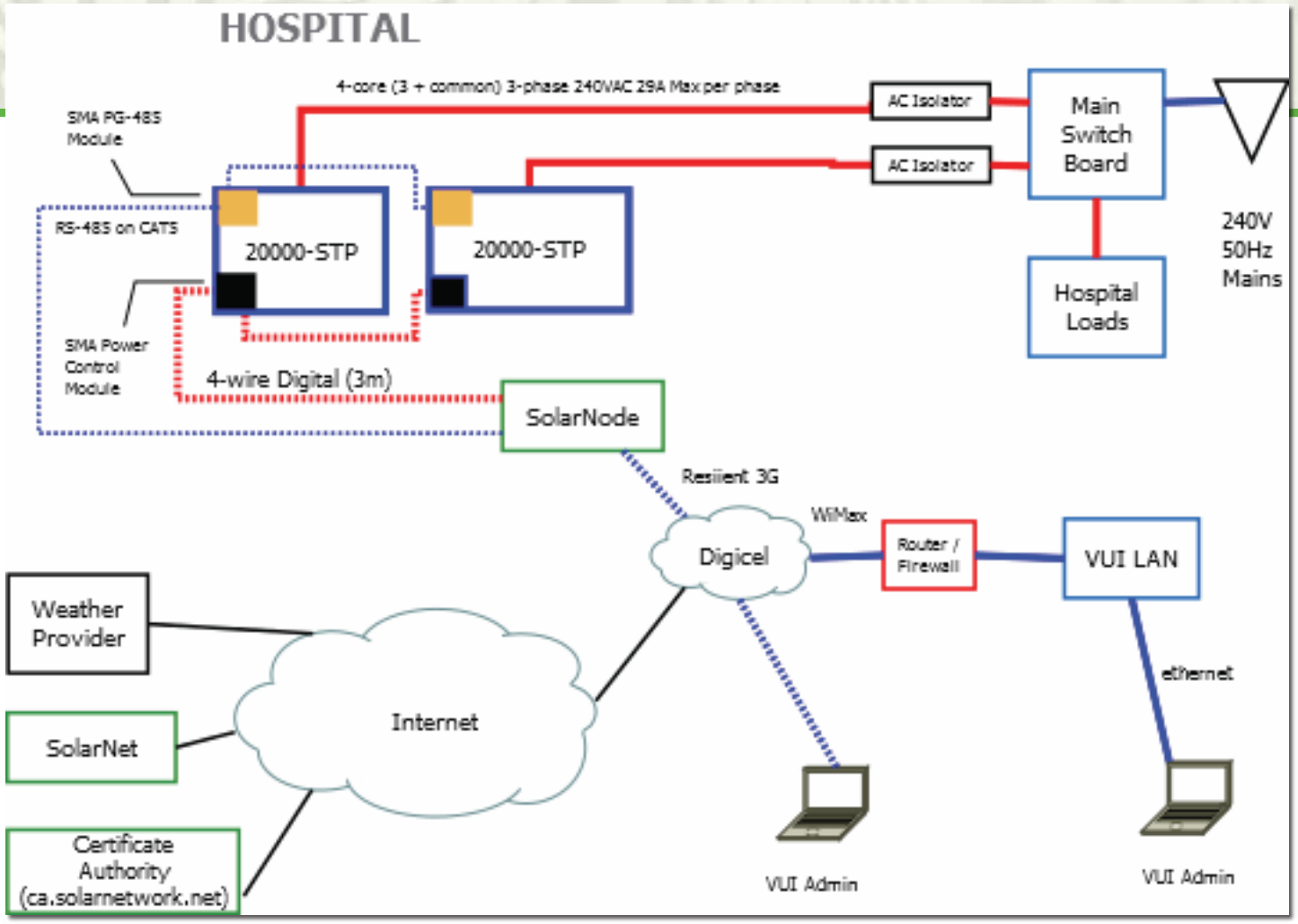
The 10kW array on the Lycee de Luganville in Sanma Provice, Espiritu Santo, Vanuatu



The VUI Console displaying live generation, historical performance metrics and control of the inverter



Logging into the secure Console via SolarNetwork



The network diagram for both solar power and communications on the Hospital in Sanma Provice, Espiritu Santo, Vanuatu

VUI administrators Rusiate Cavalevu and Charles Riso operating the Console in Sanma Provice, Espiritu Santo, Vanuatu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