



27<sup>th</sup> PPA Conference

Palau

Hybrid Case Studies



# The Balance Group

## Better Energy Platforms for Life

Our leadership team share a long term background in remote and regional utility service provision.

We know how fundamental energy is to human welfare and economic development.

**What drives us is a desire to change the world by providing better energy platforms on which people can build their lives and their businesses**

Better energy platforms are *sustainable, affordable, reliable and resilient*



# The Balance Group

## What do we do?

We have built a business to sit in the middle of the market to develop and bring together, deliver, own and operate energy solutions which combine:

- The right technical solution for the specific needs of the situation utilising the lowest cost local energy resource
- The right business model to ensure the solutions are supported by their community, are economically viable and the assets can be maintained, and
- Effective asset management and operating approaches where possible using and building local skills



# The Promise of Hybrids

In our minds the intent and purposes of hybrid systems is simple:

- Optimise the mix of renewable and non-renewable energy generation to achieve the best possible Levelised Cost of Energy whilst delivering significant GHG emissions reductions v business as usual
- The reason hybrids need to exist is that baseload and secure renewable generation is very hard to find

For geographically isolated load centres the cost or practicality of a traditional centralized generation and transmission/distribution system are often prohibitive

The solution historically has been stand alone fossil fuel based power house sitting in the middle of a relatively small and non-meshed distribution system.

Balance has been working since 2012 in the design and delivery of diesel, solar and bio-mass generation, battery energy storage and control systems.



# Case Study 1: FSM Petrocorp (Vital) Pohnpei Fuel Terminal

The fuel terminal in Pohnpei has to date been supplied from the PUC grid which has experienced reliability challenges over quite a few years. Fuel pumping is a critical load and Vital needs a highly reliable supply. Fuel pumps also have a heavy starting draw presenting challenges in starting the pumps from a battery or PV system.

**Table 1. Terminal Average, Maximum and Minimum Energy Consumption.**

	Daily Energy Use			Day			Night		
	Partial	Total	Variance	Partial	Total	Variance	Partial	Total	Variance
Average	195.6	229.7	17%	73.2	86.7	18%	122.4	143.0	15%
Max	221.3	248.4	12%	93.2	115.9	24%	138.6	153.6	10%
Min	167.8	207.5	24%	52.0	60.1	15%	107.5	117.9	10%

Current yearly cost of power is around \$38,000 USD for the terminal

Vital is also producing crude coconut oil as part of its CDU activities and has surplus oil depending on production levels.

Vital wanted an energy solution which gave them a more reliable power supply at a lower net cost of energy (and to demonstrate the viability of hybrid generation)



# What has been built?

A grid tied Hybrid energy solution comprised of:

- 40kW rooftop PV
- 40kWh BESS (Balance PowerCore) – which incorporates the hybrid controller
- A 35 kVA coconut oil and diesel generator including an oil filtration skid

The system has multiple modes of operation:

- Grid connect solar PV system with no export to the grid (excess PV is stored in the BESS)
- Standalone mode – load is supplied by the PV and BESS (the BESS provides both solar smoothing and energy shifting) and generator runs when battery top up is required
- UPS mode – if grid is down and generator is down the BESS will supply the site for 2 hours





# Outcomes

System Cost	\$220,000USD
Annual PV Energy Generated	52,925 kWh
Annual Coconut Oil generation	Varies depending on time of day, grid price and availability of excess crude coconut oil
Additional Maintenance	\$2,500
<b>Net Annual Saving V BAU – assuming zero coconut generation</b>	<b>\$21,290</b>
<b>Simple Payback period</b>	<b>10</b>
Plus: significant improvement in reliability	





# Case Study 2: FSM Petrocorp (Vital) Tonoas Island Hybrid

Vital is currently in the delivery phase of its C4Life project will see through to completion, the construction of a 50,000 per day, coconut processing facility plus power plant on the un-electrified island of Tonoas, producing high value virgin coconut oil plus animal feed.

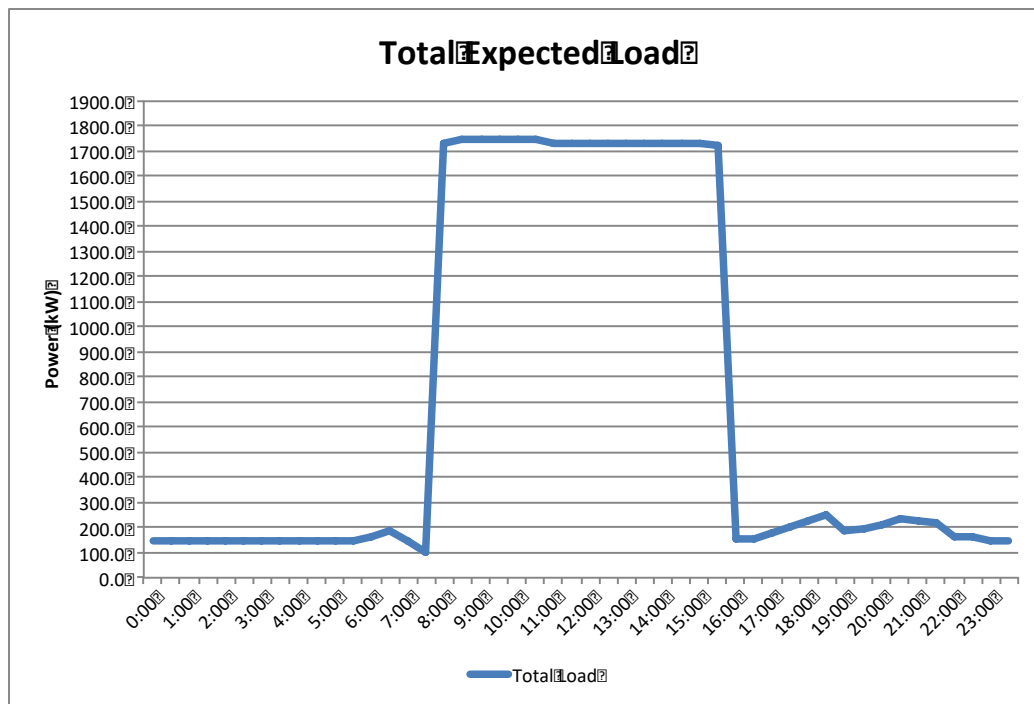
Vital has partnered with Balance Utility Solutions, to design, construct and commission the power solution which in stage 1. comprises a renewable ready diesel power house and in stage 2. 800 kW solar and 640kWh storage and stage 3. potential expansion of storage and PV + biomass generation depending on feedstock

C4Life also has plans to become Zero Waste. Using the entire coconut (including husk and shell) to produce export quality virgin coconut oil, animal feed, energy and fertiliser.





# Load Profile of the Island Loads



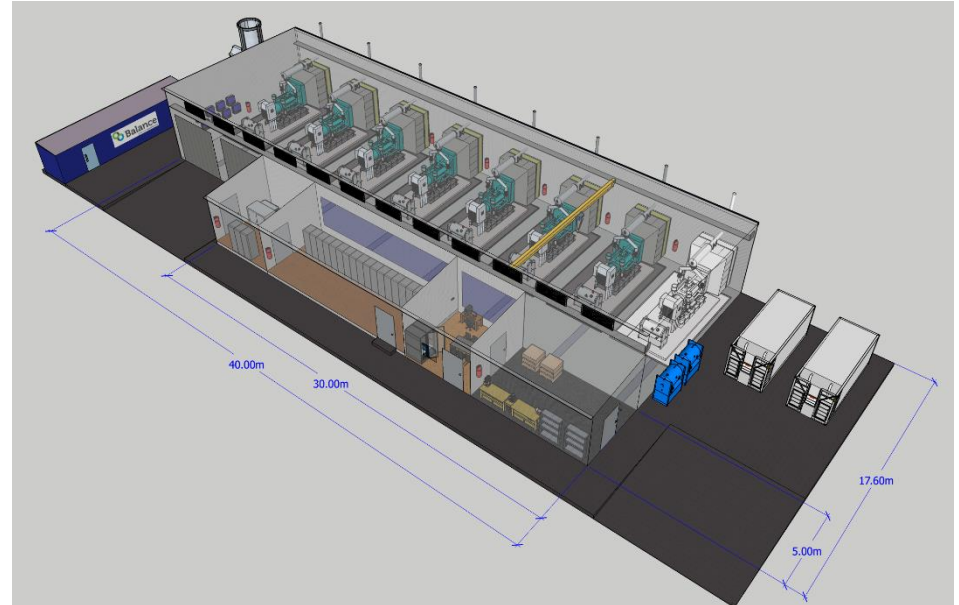


# What are we building?

- 3 MW diesel generation + fuel system – 7 diesel Volvo high speeds with room for expansion
- 600- 800 kW of rooftop solar
- 640kWh of battery energy storage – Balance PowerCore

A key constraint is available land area for a larger solar array.

The intent of the system is to maximise the total hours where the island is running diesel off whilst optimizing the best benefit from the solar.



The BESS will solar smooth during daylight hours and be charged by PV or diesel by the end of the day.

Overnight or weekends the island will be supplied for up to 20 hours from the solar and BESS and a single generator will be run when required to top up the load.



# Business As Usual (Diesel) Outcomes

## Summary (per annum)

AC Energy (MWh)	4,688
Diesel Fuel (kL)	1,373
Ave Heat Rate (kWh/L)	3.415
Gen run hours (hr)	19,200
Fuel Cost	\$1,670,000
Variable Maintenance Cost	\$384,000
Annual Variable Cost of operations	\$2,054,000



# Expected Outcomes Hybrid

## Summary (per annum)

Capital cost of stage 2 hybrid	\$1.9M USD
AC Energy (MWh)	4,688
Diesel Energy (MWh)	3,784
Solar Energy (MWh)	1,289
Renewable Fraction (%)	19.3
Diesel Fuel (kL)	1,065
Diesel Cost	\$1,296,000M
Gen run hours (hr)	10,819
Diesel Off (hr)	4,093
Variable Maintenance	\$270,475
Annual Variable Cost of operations	\$1,566,475 M
Annual Operational Saving V BAU	\$487,525
Simple Payback	4 years



# Lessons

- High and medium penetration Hybrid systems designed for the specific load can produce great paybacks and significantly enhanced reliability versus diesel only systems
- Hybrid systems are still difficult – the system must interact with multiple forms of generation, the grid and the load. A large part of the art is in this integration and tuning of the control systems to achieve predictable and reliable operation
- Modern Battery systems are complex – the build and integration of battery energy systems is still very much in the development phase. Your battery integrator and your hybrid integrator need technical depth.