



PPA

A PACIFIC POWER ASSOCIATION PUBLICATION

VOLUME 26 ISSUE 3 - September 2018



More Power for Your Operations

We help you improve the output of your rotating equipment.

Sulzer supports you on your quest to reach the highest levels of reliability. With our customized solutions, we support you in keeping your operation and maintenance costs at a minimum while bringing your equipment to its best efficiency point. Field service, overhaul and inspection for your generator or motor are just a few of the many services you can expect.

Contact us to discover your best service solution.

www.sulzer.com

SULZER

CONTENTS



2 Members

3 Editor's Notes

5 Welcome Message from the Chairman of Pacific Power Association

7 PPA Conference Opening Speech by The Vice President of the Republic of Palau

9 Keynote Address

- Renewables are our Future

11 Main Articles

- The Potential of Renewable Energy Hybrid Solutions for Islanded Communities; an Exploration of Projects in the Federated States of Micronesia
- Generating Clean Power from Waste Heat Project Integration – Partnership for Success
- Microgrids and Hybrid Power Generation

23 Conference Report

- 27th Annual PPA Conference and Trade Exhibition & the 9th Engineers' Workshop

38 Currents

- Sustainable Energy Technical Guideline Workshop Commences
- PPA Gender Champions
- Guam Power Authority Signs Contract for 60 Mw Renewable Energy Project with Korea Electric Power Corporation (Kepco) and LG CNS Consortium
- Utu Abe Malae (5 December 1949 - 2 October 2018)
- Welcome New Allied Members



September 2018, Volume 26 Issue 3

Head office: Ground Floor,
Naibati House, Goodenough Street,
Suva, Fiji Islands

Mailing Address: Private Mail Bag,
Suva, Fiji Islands.

Telephone: (679) 3306 022

Email: ppa@ppa.org.fj

www.ppa.org.fj

Chairman

Mr. Hasmukh Patel,
Chief Executive Officer
Energy Fiji Limited

Executive Director

Andrew D. Daka

Pacific Power Association, Suva Fiji Islands. The PPA is an inter-governmental agency and member of the Council of Regional Organisations in the Pacific (CROP) established to promote the direct cooperation of the Pacific Island Power Utilities in technical training, exchange of information, sharing of senior management and engineering expertise and other activities of benefit to the members.

PACIFIC POWER magazine is published four times a year.

Advertising

Reena Suliana
Pacific Power Association, Suva, Fiji Islands

Layout & Design

Printhouse Limited

This magazine is read by audience of opinion leaders in governments, development partners, the public service, the academic community, the media, in the Pacific and members of the Pacific Power Association. Subscription to Pacific Power magazine is available at US \$60 a year from the association.

Correspondence should be addressed to:

The Pacific Power Association, Private Mail Bag,
Suva, Fiji Islands.

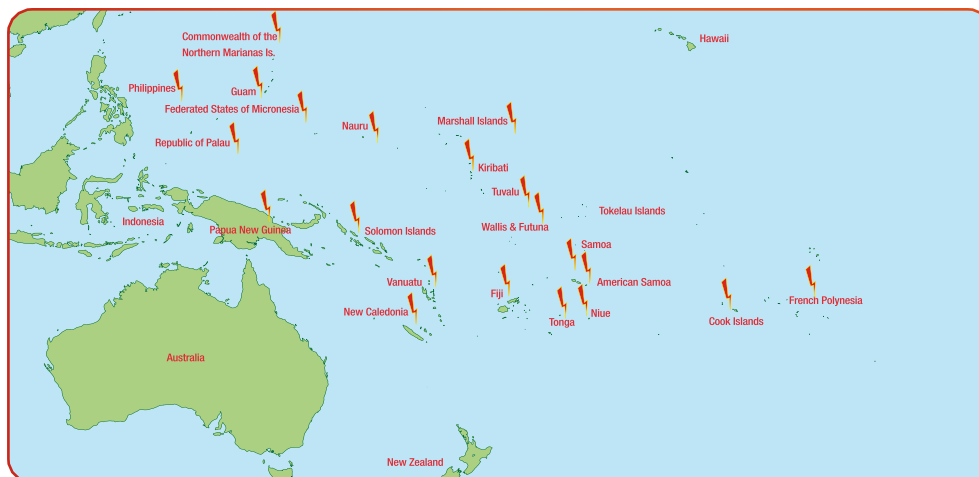
The articles published in this magazine do not necessarily represent the policies of the Board of Pacific Power Association

Cover Page Photograph – The Vice President of the Republic of Palau, Hon. Raynold B. Oilouch, with the PPA Chairman Mr. Hasmukh Patel and the Keynote Speaker Ms. Jennifer De Cesaro of the US Department of Energy.

MEMBERS

ACTIVE MEMBERS

1. AMERICAN SAMOA POWER AUTHORITY, American Samoa
2. CHUUK PUBLIC UTILITY CORPORATION, Chuuk
3. COMMONWEALTH UTILITIES CORPORATION, Saipan
4. ELECTRICITE DE TAHITI, French Polynesia
5. ELECTRICITE ET EAU DE CALEDONIE, New Caledonia
6. ELECTRICITE ET EAU DE WALLIS ET FUTUNA, Wallis & Futuna
7. ELECTRIC POWER CORPORATION, Samoa
8. ENERCAL, New Caledonia
9. FIJI ELECTRICITY AUTHORITY, Fiji
10. GUAM POWER AUTHORITY, Guam
11. KOSRAE UTILITIES AUTHORITY, Kosrae
12. KWAJALEIN ATOLL JOINT UTILITY RESOURCES, Marshall Islands
13. MARSHALLS ENERGY COMPANY, Marshalls Islands
14. NIUE POWER CORPORATION, Niue
15. NAURU UTILITIES CORPORATION, Nauru
16. PALAU PUBLIC UTILITIES CORPORATION, Palau
17. PNG POWER LTD, PNG
18. POHNPEI UTILITIES CORPORATION, Pohnpei
19. PUBLIC UTILITIES BOARD, Kiribati
20. SOLOMON ISLANDS ELECTRICITY AUTHORITY, Solomon Islands
21. TE APONGA UIRA O TUMU-TE-VAROVARO, Cook Islands
22. TUVALU ELECTRICITY CORPORATION, Tuvalu
23. TONGA POWER LIMITED, Tonga
24. UNELCO VANUATU LTD, Vanuatu
25. YAP STATE PUBLIC SERVICE CORPORATION, Yap



ALLIED MEMBERS

1. AB INDUSTRIES, New Zealand
2. ABB AUSTRALIA PTY LIMITED, Australia
3. ABB LIMITED, New Zealand
4. ACCLINKS COMMUNICATION INC, P R China
5. ACO POLYCRETE PTY LTD, Australia
6. AGGREKO (NZ) LIMITED, New Zealand
7. AGILITY CIS LTD, New Zealand
8. AKUO ENERGY PACIFIC, Australia
9. ALFA LAVAL AUSTRALIA PTY LTD, Australia
10. AMERICA'S BEST ELECTRICAL MART, USA
11. AMPCONTROL, Australia
12. ANDRITZ HYDRO, New Zealand
13. AR INDUSTRIAL, Australia
14. ARTHUR D RILEY & CO LTD, New Zealand
15. AVO NZ, New Zealand
16. AUSTRALIAN WINDERS, Australia
17. BALANCE UTILITY SOLUTIONS, Australia
18. BARDOT OCEAN, France
19. BENSON GUAM ENTERPRISES, INC., Guam
20. B&R ENCLOSURES PTY LTD, Australia
21. BUSCK PRESTRESSED CONCRETE LIMITED, New Zealand
22. CANADIAN SOLAR, USA
23. CARPTRAC, Fiji
24. CBS POWER SOLUTIONS, Fiji
25. CLEAN ENERGY TECHNOLOGIES INC., United States of America
26. COMAP PTY LTD, Australia
27. CUMMINS SOUTH PACIFIC, Australia
28. DATELINE EXPORTS INC, USA
29. DELSTAR NEW ZEALAND LIMITED, New Zealand
30. DNV GL, Australia
31. DOMINON WIRE & CABLES LIMITED, Fiji
32. EATON INDUSTRIES PTY LTD, Australia
33. EDM NZ LTD, New Zealand
34. ELECTRATHERM, USA
35. ENERGY POWER SYSTEM AUSTRALIA PTY LIMITED, Australia
36. EPC INTERNATIONAL PTY LTD, Australia
37. ERGON ENERGY, Australia
38. ETEL LIMITED, New Zealand
39. EXACT360TD, Guam
40. FIJI GAS LTD, Fiji
41. FSM PETROLEUM CORPORATION, Pohnpei
42. FUELCHIEF TRUSTEE LTD, New Zealand
43. GENERATOR RENTAL SERVICES LTD, New Zealand
44. GLOBAL SUSTAINABLE ENERGY SOLUTIONS PTY LIMITED, Australia
45. GLOBAL TURBOCHARGER SOLUTIONS, United Kingdom
46. GOUGH CAT POWER SYSTEMS, New Zealand
47. GREENBOX ENERGY PTY LTD, Australia
48. HARELEC SERVICES, Australia
49. HATZ DIESEL AUSTRALIA, Australia
50. HAWKER SIDDELEY SWITCHGEAR PTY LIMITED, Australia
51. HAWTHORNE POWER SYSTEMS, USA
52. HUBBELL POWER SYSTEMS, INC. (ASIA PACIFIC), Philippines
53. HYDRO TASMANIA, Australia
54. IP&E HOLDINGS, LLC, USA
55. I S SYSTEMS, Australia
56. INFRATEC, New Zealand
57. INTERNATIONAL UTILITY POLES, Australia
58. ITRON AUSTRALASIA PTY LTD, Australia
59. JACOBS GROUP (AUSTRALIA) PTY LTD, Australia
60. JEAN MUELLER NZ LTD, New Zealand
61. KOMAI HALTEC INC., Japan
62. KOPPERS WOOD PRODUCTS PTY LTD, Australia
63. MCMAHON LIMITED, New Zealand
64. MACLEAN POWER, Australia
65. MAN DIESEL & TURBO AUSTRALIA PTY LTD, Australia
66. MASKELL PRODUCTIONS LTD, New Zealand
67. MONJE EXPORTS, USA
68. MPOWER GROUP, New Zealand
69. MTQ ENGINE SYSTEMS (AUST) PTY LIMITED, Australia
70. NAN ELECTRICAL CABLE AUSTRALIA PTY LIMITED, Australia
71. NEXANS OLEX, New Zealand
72. NZ MARINE TURBOCHARGERS LIMITED, New Zealand
73. OCEANGAS SERVICES AUSTRALIA PTY LIMITED, Australia
74. OHM INTERNATIONAL CORPORATION, USA
75. OPTIMAL GROUP AUSTRALIA PTY LTD, Australia
76. ORIGIN ENERGY, Australia
77. PACIFIC BULK FUEL LTD, New Zealand
78. PACIFIC ENERGY SWP LIMITED, Vanuatu
79. PACIFIC POWER ENGINEERING (AUST) PTY LIMITED, Australia
80. PAVILION GAS PTE LTD, Singapore
81. PERNIX GROUP, INC, USA
82. PETROLEUM & GAS COMPANY FIJI t/a BLUE GAS, Fiji
83. PLP ELECTROPAR NZ LTD, New Zealand
84. S&C ELECTRIC COMPANY, Australia
85. SELECTRONIC AUSTRALIA PTY LTD, Australia
86. SCHWEITZER ENGINEERING LABORATORIES, New Zealand
87. SIEMENS LTD, Australia
88. SK B&T, South Korea
89. SMA AUSTRALIA PTY LIMITED, Australia
90. STAMFORD AVK, Australia
91. TESLA, USA
92. SOUTH AUSTRAL PTY LIMITED, Australia
93. SULZER DOWDING & MILLS, Australia
94. SUNERGISE INTERNATIONAL LTD, Fiji
95. THE ENERGY NETWORK (AUST) PTY LTD, Australia
96. TOTAL OIL ASIA PACIFIC PTE LIMITED, Singapore
97. TRANDIESEL LIMITED, New Zealand
98. TRANSNET NZ LIMITED, New Zealand
99. TRINA ENERGY STORAGE SOLUTIONS, Australia
100. VERGNET SA, France
101. WARTSILA AUSTRALIA PTY LIMITED, Australia
102. WINSON OIL TRADING PTE LIMITED, Singapore
103. XANT NV, Belgium
104. ZERO-CARBON ISLAND CORPORATION LTD, Fiji



Editor's Notes

Andrew D. Daka
Executive Director

Bula and Greetings from Suva.

The Pacific Power Association, being a member of the Council of Regional Organizations of the Pacific (CROP), is expected to work more closely with other CROP Members and to orient their various programs with their respective members to achieve the objectives the Pacific Island Leaders have set out in the "Framework for Pacific Regionalism". The priorities as determined by the Leaders in the framework are Climate change and Disaster Resilience, Regional fisheries, Sustainable oceans management and conservation, Childhood obesity/Early Childhood Development and non-communicable diseases and West Papua.

This year at the 49th Pacific Islands Forum Leaders' Meeting in Nauru saw the publication of the CROP Report providing a summary of the CROP's joint efforts in addressing the priority areas.

The work of the Pacific Power Association falls under the Climate change and Disaster Resilience thematic area. The work undertaken by utilities, Island governments and private sectors to install renewable energy projects contributes to the displacement of fossil fuels and the reduction in greenhouse gas (GHG) emissions.

The Pacific Island Leaders will be preparing for the upcoming COP24 which will be held in the Polish city of Katowice between 3 and 14 December 2018. This latest Summit will be key when it comes to designing the instruments that enable climate goals to be tackled and achieved effectively and efficiently. COP24 is expected to finalize the rules for implementation of the Paris Agreement on climate change under the Paris Agreement Work Program (PAWP).

The in-country training workshops on the Renewable Energy Guidelines developed under the World Bank funded Sustainable Energy Industry Development Project (SEIDP) began in Palau

on 6 August 2018 followed by workshops in Yap, Chuuk, and Pohnpei; and Kosrae, Marshall Islands, Kiribati, Tuvalu and Fiji in September 2018. Workshops in the remaining beneficiary countries will be completed in the remaining quarter of 2018.

The Association successfully held its 27th Annual Conference in Koror, Republic of Palau, from 30 July to 3 August 2018 hosted by the Palau Public Utilities Corporation (PPUC). The Association appreciates the work of the PPUC Organizing Committee with the support of the Government of Palau, the Board and Management by providing the resources to the conference. The Association acknowledges the efforts of all the members and delegates who attended the conference.

The 3rd Renewable Energy Investor Forum held on the final day of the conference examined the investment climate in the Pacific for renewable energy projects. The forum noted that there have been an increase in the number of private sector funded projects in the recent years and US\$500 million of potential investment projects in the Pacific for countries to reach their Nationally Determined Contribution.

In this edition we also note the passing away of Utu Abe Malae, CEO of ASPA and the Alternate Chairman of the PPA Board. The late Utu was a member of the group of CEOs who were instrumental in the formation of the Pacific Power Association and had served in various positions on the Executive Committee including as Chairman from 2002 to 2005.

The PPA family and ASPA will miss him.

Vinaka



DOMINION WIRE & CABLES LIMITED

Lighting Fiji and the Pacific

Find us on [facebook](#)

MANUFACTURERS OF:

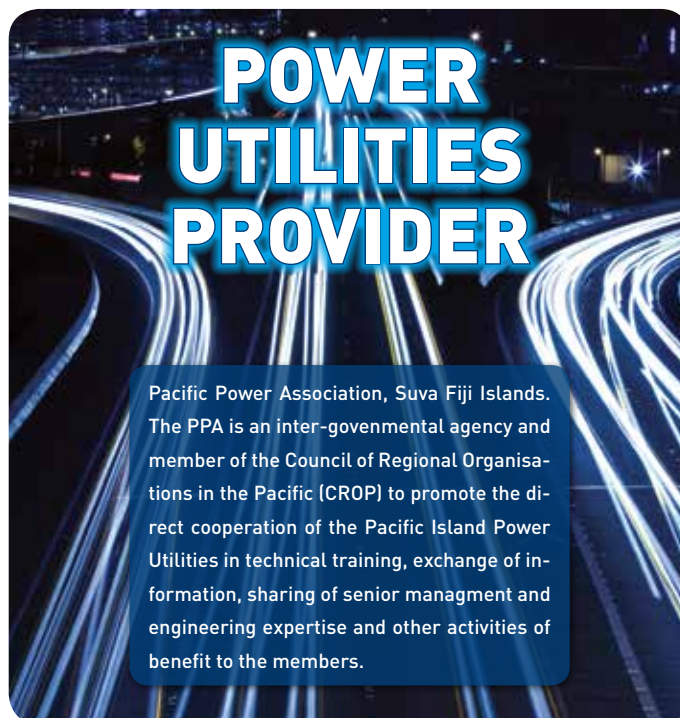
- BARE COPPER CONDUCTOR,
- CIRCULAR PVC CABLES,
- CIRCULAR XLPE/PVC CABLES,
- FLAT TPS CABLES,
- PVC FLEXIBLE CORDS,
- PVC AERIAL CABLES FLAT AND TWISTED,
- PVC CIRCULAR CABLES UP TO FOUR CORE AND EARTH,
- PVC WELDING CABLES,
- AUTO CABLES,
- TELEPHONE CABLES,
- CONTROL CABLES,
- ARMoured CABLES,
- ALUMINIUM OVER HEAD CONDUCTORS,
- XLPE MEDIUM & HIGH VOLTAGE CABLES,
- XLPE AERIAL BUNDLE CABLES,
- RG 59 & RG 6 CABLES,
- CAT 5E & CAT6 CABLES
- AND ALARM CABLES

Cables can be made to: **AS/NZS/BS/STANDARD**

Lot 3, Kings Road, Yalalevu,
P.O. BOX 1562, Ba Fiji.
Website: www.dominioncables.com
Email: sales@dominioncables.com
Phone: (679) 667 5244 / 667 6785
Fax: (679) 6670023

ISO 9001
CERTIFIED
GCS

TÜVRheinland



POWER UTILITIES PROVIDER

Pacific Power Association, Suva Fiji Islands.
The PPA is an inter-governmental agency and member of the Council of Regional Organisations in the Pacific (CROP) to promote the direct cooperation of the Pacific Island Power Utilities in technical training, exchange of information, sharing of senior management and engineering expertise and other activities of benefit to the members.

Contact us today to advertise in the next issue of the New Look PPA Magazine!



Head office: Ground Floor, Naibati House, Goodenough Street, Suva, Fiji Islands
Mailing Address: Private Mail Bag, Suva, Fiji Islands.
Telephone: (679) 3306 022 | Fax: (679) 3302 038
Email: ppa@ppa.org.fj | Website: www.ppa.org.fj

Welcome Message from the Chairman of Pacific Power Association

Hasmukh Patel

CEO - Energy Fiji Limited

Alii and welcome to Pristine Paradise Palau for the Pacific Power Association's 27th Annual Conference and Trade Exhibition.

May I, on behalf of the Pacific Power Association and as Host CEO of this year's conference welcome all delegates to the bountiful shores of Palau; an alluring setting for this year's annual event, hosted by the Palau Public Utilities Corporation (PPUC). We are excited to be back in Palau with PPUC hosting the 27th Annual Conference, having hosted previously in 2003 and 2013.

My warmest welcome goes to the delegates who are attending the conference for the first time, especially colleague CEOs, Allied Members and Government Representatives. For delegates who have attended the previous conferences hosted by PPUC; welcome back.

The utilities are facing major changes at present all brought about by external influences. These are Decarbonization, Decentralization and Digitalization; the 3Ds. Because of these factors, our utilities will have to move from fossil fuel generation to renewable energy, smaller capacity generation locations and the increased use of digital technology to operate, manage and maintain the assets whilst trying to meet the customers' needs. Our owners and governments will be important partners who will bring in the regulatory changes needed to pave the way for the transition.

We will at the conference have our Third Investor Forum supported by ADB through the PRIF Coordinating Office. It is common knowledge that the majority of the renewable energy projects implemented in the PICTs are development partner funded, this is not sufficient in most of the countries, especially the bigger ones, to move the renewable energy contribution towards the targets set by the PICT Governments. Private Sector investment will be required to fund projects to significantly increase our renewable energy generation and achieve the targets our political leaders have set.

Our Government through the esteemed President has committed Palau to achieving its Nationally

Determined Contribution (NDC) to the Paris Agreement, which is reducing greenhouse gas emissions to 22% below 2005 levels by the year 2025. Working closely and under the guidance of the newly formed Palau Energy Administration, the host utility PPUC, is maximizing its efforts to achieve this fervent goal by attaining 45% energy production through renewable sources as well as markedly increasing energy efficiency to 35% by year 2025.

PPUC has taken initiatives to increase the share of renewables in Palau's energy mix and is fostering energy efficiency. To date, total renewable energy efforts have only reached 8% of the needed 22%, principally because two grid-connected solar projects (1.5MW and 3.5MW respectively) never came to fruition.

The Renewable Energy Investor forum is therefore a platform whereby potential projects in the region can be showcased to the private sector to generate interest as an investment opportunity.

PPUC and the PPA Secretariat in their endeavor to cater for all its delegates' interest have a first for this conference; the first Speed Networking to bring Active and Allied Members face to face and the first series of sessions targeting the needs of non-technical delegates at the conference.

I would like to conclude by thanking the Government and people of the Republic of Palau for their support to PPUC in hosting this event; the 27th Annual PPA Conference and Trade Exhibition and side events.

While in Palau, I would like to urge the delegates to take some time off and see the rest of this world renowned island nation for its natural beauty and a leader in environmental conservation

KOHLER
IN POWER. SINCE 1920.



KD SERIES

**Generators powered with advanced KOHLER diesel engines.
Fully customized systems built to meet your specific needs.**

KD Series generators are built with an eye on the future — designed to last for decades. Ranging from 800 kVA/kW to 4200 kVA/4000 KW, this new range of Industrial Generators is perfectly suited for all industrial applications, providing better fuel economy and a smaller footprint than ever before.

- Up to 1800 kVA in 20 FT ISO container
- Choice of fuel or emission optimisation
- Modular design – fewer parts requirements
- 2 year 8,700 hour prime power warranty
- 3 year standby warranty
- World leading power density factor-smaller footprint
- Choice of fuel or emission optimisation

Contact Jim Stewart for more information on:
+64 27 499 8670 or jim.stewart@transdiesel.co.nz

TRANSDIESEL LTD

PPA Conference Opening Speech by The Vice President of the Republic of Palau

Honourable Raynold B. Oilouch

Sus el mora lbedul, Reklai and Rubekul Belau, Minister of State, Speaker, Senators and Delegates, PPUC Chairman Decherong, Board Members and Staff and Rokui el Chad.

Kulengit e bokdu tekinged el tekoi ra merikel el mor tirkal okiak erkid el mlar eroid el mei.

Alii, Ungil Tutau, good morning to all of you, Executive Director, PPA Chairman Patel, members of the Pacific Power Association, Allied members and exhibitors. I hope your arrival in Palau was smooth and that you find your accommodations satisfactory.

With this gathering, let me tell a short story. One of the Elementary Schools here in Palau did a small quiz for their students. The Teacher asked the students; "Beside God who are you most thankful for?" A student said; *"The PPUC. He is the reason I have light to study at night; a fan to keep me cool at night; a fridge to keep our food from getting spoilt; the most importantly for giving my brothers and sisters"*. The Teacher asked how that is. The air-con keeps them in the room.

I will speak on behalf of our President Remengesau and the people of Palau.

It is my honor to welcome all of you to the 27th Annual Pacific Power Association Conference and Trade Exhibition, hosted by our very own Palau Public Utilities Corporation (PPUC). Let me say that you chose the right place to hold your conference. I say that because Palau has made significant stride toward cleaner and greener energy, which I am sure you will be hearing about during the conference.

But please allow me to highlight some important points to start off your conference.

Back in August 2017, Palau held its first annual energy Summit. This was a week-long Conference attended by representatives from both local and international agencies. The goal of the conference was to determine how Palau could best meet its Nationally Determined Contribution (or NDC) to the Paris Agreement – which is, reduce Palau's greenhouse gas emissions to 22% below 2005 levels by the Year 2025. In order to achieve this goal, Palau aims to generate at least 45% of its energy from renewable resources by 2025, while increasing energy efficiency to 35%.

At the conclusion of the Energy Summit, it was determined that in order to meet our NDC target, Palau must pass a legislation that would service to secure and regulate the energy sector for our Republic.

Thus, in April of this year, our Congress working in tandem with our President, passed into law HB 10-76-5, HDI, which created Palau Energy Administration and gave it regulatory authority over PPUC and other energy

producers in Palau. For the first time, the activities of PPUC will be subject to regulation and oversight by separate regulatory agency.

Pursuant to the said law, the Palau Energy Office and PPUC, including any other energy producers, will now work together to ensure sustainable and renewable energy security for Palau.

In addition to the enactment of the said law, Palau has also met with GridMarket, a company that is helping us re-optimize our energy grids. This is opening the door for new energy producers to come into Palau.

We are also meeting other entities, including EarthX and Earthjustice, to seek additional aid in securing renewable energy projects for our Republic

As you all well know, Palau takes its environment seriously and will do what is necessary to protect, preserve and conserve its environment. It has taken many steps, and will continue to do so, to preserve its environment – land, seas and air. Investing in renewable energy is certainly compatible with our long-term goal of conserving our environment

The main objective of PPA is the creation of an environment of 'co-operative partnership' with the private sector, funding institutions and others with interest in the development of power industry and enhancement of the role of power sector in the Pacific Islands Countries. In this light, we look forward to once again bringing together other island nations with circumstances similar to ours, so that we can help and learn from each other. Only by collaborating with each other, can we truly achieve a long-term vision of energy sustainability for the Pacific and the world.

We understand that this Conference will also feature a Trade Exhibition to showcase private sector products and services available to our region. This is a great opportunity for our utility managers to see different products and talk to suppliers, so they can learn how the products actually work and which would best fit into our long-term plans

Palau is privileged to host this Conference once again, and it is an opportunity we do not take lightly. We are honored to bring the Pacific nations together, and to discuss the future of renewable energy. We know that, together, we can make the world a more environmentally friendly place. By the end of this Conference, we hope that you, like us, will become ambassadors of renewable and sustainable energy in the Pacific.

So, Congratulations and I wish you all a successful 27th PPA Conference

On a side note, I understand this Conference will be going on for several days. I hope that you will be able to find some free time of your busy schedule to tour and visit our Island. Oh...and don't forget to spend some time of your per-diems buying gifts for your loved ones. That way, they will know that you truly came to attend an important Conference and not vacationing elsewhere.

Thank you

2 CABLE FAULT LOCATORS, 1 COMMON INTERFACE

Most cable technicians today, work on both LV and HV cable faults . . . with Megger's EZ-Thump and Smart-Thump systems, the transition is now effortless

EZI-THUMP



- Small portable LV Thumper
- 34kg, fits in a car boot
- Full surge energy at 1.5, 3, 4, 12kV
- Carry to the connection point & hook up ... easy!

SMART-THUMP



- Exact same physical interface and operation
- Seamlessly switch between the two units (no great learning curve)
- 'Easy Go' test system
 - Steps user through each step in fault location process
 - Interprets results
- Requires minimal training
- Mains or battery operation
- Sheath fault locating

- 1500J at 8/16kV
- ICE surge pulse
- Vehicle mount options available



+64 3 348 5999 | www.avo.co.nz
dhurley@avo.co.nz

Renewables are our Future

Jennifer DeCesaro

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy

Good morning, I am thrilled to be here for the 27th annual PPA conference

The theme of this year's conference is one that many of us here in this room have been focusing on for some time now and we have seen a lot of progress, but we still have ways to go on this journey and the imperative continues to increase.

A future with renewables means the inclusion of an ever expanding set of technologies (power generation, advanced controls, building technologies and appliances) and the associated skills needed to install, operate, and maintain them. This means a greater emphasis on planning and attracting new investment and stimulating private sector led growth. It also means evolving institutional frameworks and business models to accommodate the increasing complexity of the sector.

At the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, we are focused on expanding the portfolio of affordable and reliable energy that enhances economic growth and strengthens energy security. Within our portfolio, we are working to improve the reliability and resilience of renewables to ensure their safe integration with the electric grid. As such, our partnerships with many island communities are critical to this work.

In the aftermath of the 2017 hurricane and cyclone seasons which impacted severely on the Caribbean region, the term resilience has been used very liberally, but its definition varies depending on who you ask. In the simplest terms, resilience is the ability to recover quickly from disruptions.

For many island nations, renewable energy has the potential to enhance resilience in multiple sectors – energy, economic, social – by increasing the use of local resources and expanding the use of those resources to a broader subset of the population.

At various regional and international fora we have all previously discussed the value proposition for renewables and other advanced energy

technologies, but seeing those in practice is critical.



I want to talk about one such example in Wainika, a remote village in Fiji, where villagers depend on fishing for their livelihoods. However, the nearest market to trade fish is a laborious two-hour drive and a 45-minute boat ride away. Keeping their fish fresh, without refrigeration, during this journey used to be impossible for Wainika villagers, until a renewable-powered solution presented itself.

The installation of a standalone hybrid solar photovoltaic (PV) refrigeration system has drastically changed the economic prospects of the village. Installed at the village community hall, the system enables villagers to chill their fish in preparation for the journey to the market, and helps power lighting and phone charging outlets. A backup diesel generator ensures the operation of the freezers during long cloudy periods.

This is just one of many examples of how renewable energy can contribute to the resilience of a community.

Renewable energy has also taken a more prominent role on the global stage as a result of Sustainable Development Goal 7 and the Nationally Determined Contributions submitted by countries in support of the climate agreement, the majority of which include renewable energy targets.

With this increased focus and new national level commitments comes a need for ensuring that all stakeholders are working together to inform and align targets, engage in the planning process (for utilities the integrated resource plan is critical), and

the investment decisions that are the output from the planning process.

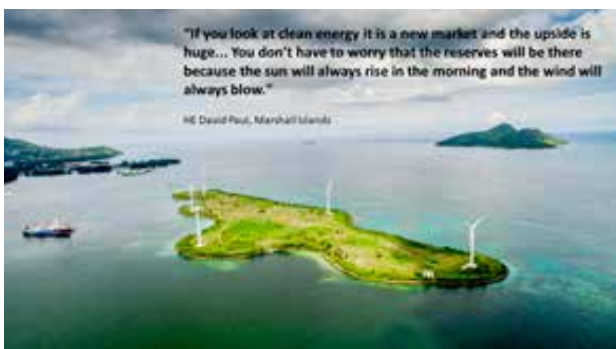
While many commitments are being made at the global level, their implementation is inherently local, as such the development of capacity at the local level to install and maintain these new technologies and to operate a grid with so many more moving parts is critical to success.

What is the role of the utility in all of this?

Alongside government, the utility is central to the successful transition of the energy sector, specifically a utility's ability to successfully integrate new technologies, especially variable technologies, on a 100-year old system designed for baseload generators.

But we are not just talking about the physical system here – generators, substations, transmission and distribution lines – we are also talking about institutional/governance systems, such as regulation, and the revenue/tariff system and structures that contribute to a utility's financial health

With the ever expanding portfolio of technologies and stakeholders in the power sector – including customers as generators – a utility's ability to adapt and maintain flexibility is key. This also includes looking at new ways of using existing assets – diesel generators – to support these new technologies.



While this all can seem rather daunting, the opportunities for countries is exciting. We are seeing innovations in cross-sectoral approaches looking at utilizing renewables for desalination and in the agriculture sector for pumping, alongside vehicle to grid applications for balancing and storage

At the U.S. Department of Energy and many of our

national laboratories, we view our partnerships with islands as key to driving further innovations. One such example, includes the work of the Hawaiian Electric Company (HECO) working directly with the inverter industry to address issues they were experiencing with high penetrations of rooftop PV on many of their distribution feeders. The result was technology modifications that allowed for two-way power flow enabling increasing amounts of distributed PV on their feeders.

We have learned a lot from hurricanes Irma and Maria and the 2017 hurricane season. While the storms impacted a number of renewable energy projects – wind and solar – in the region, we also learned that if those projects are properly sited, installed well, and maintained they can ride through extreme storms with limited impact.

We also learned how communities can increase their resilience through proper planning and asset deployment. For example, in the U.S. Virgin Islands, the island of St. John receives its power through an undersea cable that transmits power from the island of St. Thomas, where all of the generation assets are located. Following hurricanes Irma and Maria, residents of St. John were among the last to have their power restored as they were completing dependent on restoration in St. Thomas happening first. Now, during the recovery efforts, the Virgin Islands Water and Power Authority is pursuing solutions specifically for St. John, including the development of an islandable microgrid that includes the integration of solar and storage.

As we heard earlier this morning from the Vice President, Palau is working to meet a 45% by 2025 renewable energy target and they are in good company throughout the Pacific.

There is an opportunity, now more than ever, to work together across the region, and to learn from and work with colleagues in the Caribbean and AIMS regions as well. While the Pacific islands face significant challenges in their efforts to move forward with renewables, due to their size and logistics, we should also remember that small can also be mighty.

Thank you and wishing all fruitful discussions.

The Potential of Renewable Energy Hybrid Solutions for Islanded Communities; an Exploration of Projects in the Federated States of Micronesia

Rod Hayes

Chairman and CEO - Balance Utility Solutions Pty Ltd

ABSTRACT

The push to achieve autonomous energy supply within Pacific Island countries is incentivized by the instability and cost surges associated with import reliant, diesel-dominant energy models, the increasingly competitive business case for renewable energy, and global prioritization to mitigate greenhouse gas emissions. Renewable energy hybrid solutions have been highlighted as a significant opportunity to provide islanded communities with affordable and clean energy access.

This paper presents two case studies of renewable energy hybrid solutions for islanded communities in the Federated States of Micronesia; ***Pohnpei Terminal's 40 kW Solar Hybrid UPS System with Crude Nut Oil Generator*** and the ***Tonoas Power Plant to support the Coconut for Life (C4Life) project***. Remote communities must transition from fossil fuels to renewables by supporting sustainable, localised energy production and operation. This not only minimises complex logistics systems but creates economic, social and environmental benefits on site. Both projects showcase the potential of modular hybrid energy solutions for sustainable development in the Pacific region. The incorporation of abundant local resources, such as solar and biofuels is a valuable closed loop energy model which can be up-scaled to other remote and regional locations facing similar challenges.

Introduction

Renewable energy solutions are rapidly diffusing into electricity supply worldwide, disrupting traditional governance and energy models. While access to affordable clean energy is on a positive upward trajectory, many of the world's most vulnerable communities have been left in the dark. A large percentage of island communities in the Pacific rely on inefficient and underdeveloped energy infrastructure, powered by costly fossil fuel imports that restrict social and economic progress (Mandelli et al., 2016). Many of these islands however have abundant energy resources such as solar, wind, and biofuel, providing ideal conditions to transition to a renewable energy future. The push to

achieve autonomous energy supply within Pacific Island countries is incentivized by the instability and cost surges associated with import reliant diesel-dominant energy models, the increasingly competitive business case for renewable energy, and global prioritization to mitigate greenhouse gas emissions (Betzold, 2016; Kuang et al., 2016).

Renewable energy hybrid solutions have been highlighted as a significant opportunity to provide remote and islanded communities with affordable and clean energy access (Neves et al., 2014). The advantages of a hybrid solution are its capabilities to combine a mixed bundle of energy resources and storage technologies, providing adaptable applications for a variety of geographical and energy market contexts (Erdinc, and Uzunoglu, 2012). This modular design process is especially useful for applications which require reliable off-grid /stand-alone energy, as a diversified array of resources can account for peak demand and changing weather conditions. In remote and isolated areas with little to no energy infrastructure or services on offer, a photovoltaic/diesel/batteries hybrid configuration is popular. Other combinations include biofuel/photovoltaic/batteries or diesel/wind/photovoltaic depending on an area's energy profile, demand load and resource supply (Neves et al., 2014).

One of the key advantages of hybrid renewable energy systems is the ability to incorporate local bio-energy such as liquid residues from feedstock and coconut oils. An assessment conducted by the International Renewable Energy Agency (IRENA) on the potential of biofuels in South East Asia and the Pacific, suggests that 7.3 exajoules of primary energy per annum could be supplied to the region by 2050 (IRENA, 2017). Bioenergy not only offers a range of sustainable energy approaches but also provides opportunities for economic and social development of small islanded communities by providing conditions to build supplementary markets.

Previous studies have highlighted benefits and challenges associated with the use of biofuels and biomass for energy in Malaysia (Sumathi, et al.,

2008), Thailand (Nakpong, and Wootthikanokkhan, 2010), and India (Puhan et al., 2005). A study conducted by Cloin (2007), in a United Nations of Sustainable Development Journal, investigates the use of biomass and biofuels in the Pacific Islands of Fiji, Samoa, Vanuatu, Solomon Islands, Papua New Guinea, Kiribati and Marshall Islands. The study demonstrates that while Governments and Utilities organisations in the region have experimented with biofuel/ diesel blends no large scale controlled biofuel projects have been launched.

Although the significant potential of renewable energy hybrid solutions are gaining attention for remote developing regions, private investors and publicly owned utility organisations still face several challenges in implementing economically viable projects. A survey conducted by the International Renewable Energy Agency (IRENA) in 2012, gathered data on barriers towards renewable energy in the Pacific Island Countries. The study highlighted several key areas that limit renewable energy deployment in the region, such as;

- A lack of skilled labour and renewable energy training capacity
- Minimal financial support and incentives from government and donors
- A lack of quality data including power utilities current usage and costs, renewable energy resources and optimal sites.
- Institutional and regulatory frameworks are under developed
- Accessibility limitations to sites due to poor land and sea infrastructure, leading to operation and maintenance complexities
- Lack of adequate consultation with community

The above are just some examples which must be overcome to maximise the positive impacts of renewable energy on the Pacific Islands.

Despite these challenges some Pacific islands PV projects have a target to provide 100% fossil fuel free energy supply systems, already evident on Tokelau Islands. Blechinger et al., (2016) suggests a combination of PV, wind power and batteries on many islands should enable the local utility “to switch off the diesel generator”. Their study used GIS analysis to identify approximately 1800 small island energy systems globally with significant renewable energy prospective. This amounts to a global potential of 7.5 GW of solar PV, 14 GW of wind power and 5.8 GWh of battery storage (Blechinger et al., 2016).

Hybrid Renewable Energy Solutions in Federated States of Micronesia

The 607 islands of the Federate States of Micronesia (FSM), located in the middle of the Pacific are pointedly remote. This creates some challenges getting resources, such as fuel and fresh food to the country's some 105,000 residents. The Micronesian people have relied for many decades on a financial compact with the United States, put in place following the Second World War. This compact comes to an end in 2023. Locally FSM rely largely on fishing and a small tourism industry to support their economy. Energy across the islands is supplied mostly from costly diesel generation and many of the islands and areas remain un-electrified. Estimates conclude up to 50% of National Budget is spent on fossil fuel imports (FSM Energy Policy, 2012).

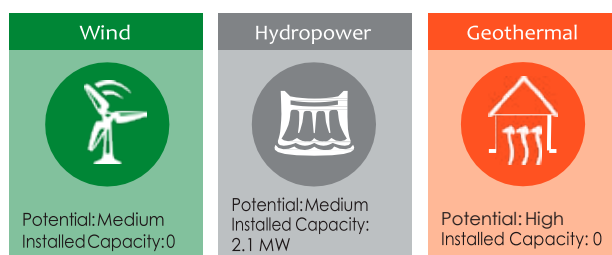
The first National Energy Policy for the Federated States of Micronesia was developed in 1999, with the second and most recent version published in 2012, providing FSM with a national energy roadmap which emphasises Stability and Security—Economic Growth—Improved Education and Health Status—Assured Self-Reliance and Sustainability.

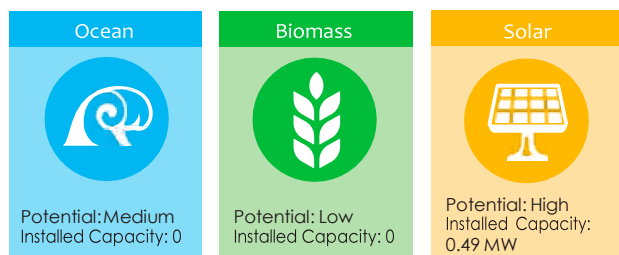
The document also outlines some of FSM's major renewable energy and energy efficiency goals;

- Increase energy efficiency 50% by 2020
- Increase generation of electricity from renewable sources to 30% by 2020.
- Increase the rural electrification rate to 90% by 2020.

In addition, the policy establishes the following guiding principles for energy development in the FSM: (1) the spread of benefits to disadvantaged communities, (2) increased public awareness and local capacity, (3) private sector involvement, and (4) community solutions.

FSM Renewable Energy Status and Potential





Source: Energy Transition Initiative – FSM Fact Sheet US Department of Energy (2009)

More recently, under the European Development Fund (EDF-9 REP5 programme), a major PV electrification was implemented in the outer islands of Pohnpei, Chuuk and Yap. PV off-grid systems were installed in 11 outer islands with a total capacity of 120.88 kWp and in Kosrae five grid-connected PV systems were installed, with a total capacity of 52.5kWp. A governance framework has also been erected in order to manage the implementation of FSM energy Policy across the four regions.

In addition there is a slowly growing introduction of Solar on the main islands of FSM including PUC's 600 kW solar farm

Table 1. Installed PV Systems under the EU development fund (2012)

| State | Island | Site | System size |
|---------|----------------|----------------------------------|-------------|
| Yap | Asor | PV mini-grid | 19.5 kWp |
| | Fadrai | PV mini-grid | 28.08 kWp |
| Chuuk | Satawan | High school | 6.6 kWp |
| | Moch | Public facilities - PV mini-grid | 6.7 kWp |
| | Udot | High school | 3.4 kWp |
| | Onoun | Public facilities - PV mini-grid | 10.5 kWp |
| Pohnpei | Kapingamarangi | School | 5.8 kWp |
| | | Dispensary and municipal office | 4 kWp |

| | | | |
|--|------------|-----------------------------|---------|
| | Nukuoro | Dispensary | 3 kWp |
| | | School | 4.6 kWp |
| | Sapwaufik | School and municipal office | 8.4 kWp |
| | | Dispensary | 3 kWp |
| | Mwaokillao | Dispensary | 2.5 kWp |
| | | School | 6.1 kWp |
| | Pingelap | School | 6.2 kWp |
| | | Dispensary | 2.5 kWp |

Model 1. Energy Governance Framework for FSM Energy Policy



The Micronesian islands have an abundant coconut resource, a major untapped resource which is about to be utilised at a national commercial scale for the first time. Vital FSMPC have diversified their revenue streams by owning and operating a Crude Nut oil processing facility in Pohnpei. To better enhance this business division, Vital completed research over the past three years identifying a significant national coconut resource with the highest concentration in Chuuk state. Vital is now in the process of commercialising this underutilised resource for the benefit of the FSM.

As part of this development a new agenda emerged to consider opportunities for hybrid renewable energy solutions, which make use of crude nut oil and coconut biomass for energy production on the FSM islands.

2018 marked the commissioning and completion of Vital's Pohnpei Fuel Terminal 40 kW Solar Hybrid UPS System with Crude Nut Oil Generator. A first of its kind demonstration project in the Pacific providing three critical energy functions:

- Grid integrated supply;
- Base load supply in stand-alone mode when the grid is down; and
- UPS mode from battery when both the generator is off-line and the grid is down

All mode transitions are bumpless; the terminal operators will not see the transitions. The system uses 100% pure crude coconut oil as a substitute for diesel.

The project built on Balance's previous experiences with multi-mode hybrid solutions and is an important precursor to our second case study project which is the staged hybrid development of the Tonoas Power Plant to support the Coconut for Life (C4Life) project. This project will see through to construction a 50,000 per day, coconut processing facility on the currently un-electrified island of some 5,000 people, producing high value virgin coconut oil plus animal feed.

The below two case studies highlight the conditions, drivers, processes, solution design and anticipated outcomes of these two renewable energy hybrid solutions for islanded remote communities in the Federated States of Micronesia and beyond.

CASE STUDY 1: POHNPEI TERMINAL HYBRID Energy Consumption

Table 2. 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 | 17% |
| Max | 221.3 | 248.4 | 12% | 93.2 | 115.9 | 24% | 138.6 | 153.6 | 11% |
| Min | 167.8 | 207.5 | 24% | 52.0 | 60.1 | 15% | 107.5 | 117.9 | 10% |

All energy is currently purchased from the grid at a tariff of \$0.4495 USD/kWh (the tariff is varied from time to time depending on fuel price)

Business as usual cost of energy of Energy Pohnpei = \$37,735 USD

Image 1. Solar PV installation being completed and the PowerCore Energy Storage Solution

Project Description of Pohnpei Terminal Hybrid System



Pohnpei Terminal 30 MW Solar Hybrid UPS System with Crude Fuel Oil Generator
Case Background
Situation:

- 1) PUC's network has been unstable when there is not enough generation to cover loads. This system is to provide the Pohnpei terminal with the capability to rely through power outages in both Grid Preference and CNO Preference mode, essentially providing Uninterrupted Power Supply (UPS).
- 2) Vital wants to fulfil the ability to run their fuel terminal with 100% renewable products, in CNO Preference mode, the system utilizes PV from the sun and CNO to produce energy to run the plant. The battery is utilized as a buffer and also allows to push excess PV generation into the early evening.
- 3) Vital wants to displace the high cost of power from the grid with solar. In just the Grid preference mode, the daily generators should cover majority of the load during the day which in turn reduces their purchase of high cost electricity from the grid.

The engineering design for a solar photovoltaic (PV) and Crude Fuel Oil (CNO) generator hybrid system with a Lithium-Ion (Li-ion) energy storage system (PowerCore) for Vital Pohnpei Terminal (Vital Pohnpei Fuel Terminal).

The system has been designed to satisfy the functional requirements specified below:

- Enable maximal utilization of renewable energy via the sun terminal facility.
- Reduce consumption of energy supplied by the grid.
- Provide stable and reliable uninterrupted power supply (UPS) to sustain critical IT and communication systems through the relatively frequent power outages experienced at the facility.
- Provide backup power generation during times of low PV generation (night time and cloudy weather).

The hybrid system was configured to:

1. Store solar energy generated during the daylight hours in the PowerCore batteries.
2. Offset the consumption of grid-sourced power via utilization of the energy generated in the PV modules or stored in the PowerCore during the day, and via the coconut oil/fuel generator during the night (dependent on "Mode").
3. Export any excess PV energy generated to the grid.
4. Provide an uninterrupted power supply (UPS) to critical systems for a minimum of 2 hours in the event of a power failure from either the main grid or the Crude Fuel Oil (CNO) generator.
5. Provide an uninterrupted power supply (UPS) to critical systems for a minimum of 2 hours in the event of a power failure from either the main grid or the Crude Fuel Oil (CNO) generator.

The system operating philosophy will have two operational modes, which can be toggled within the PowerCore's PLC programs:

1. CNO Mode
2. Grid Mode

To enable operation of the coconut oil generator, the protection relay controls fuel pumping during the day (when the fuel is warmest and least viscous) from the bulk tank to the day tank.

The SoC of PowerCore batteries have pre-determined set points. These set points either allow or prohibit the discharge of the batteries as a power source.



Image 2. The CNO generator and fuel tank

The bulk coconut oil storage tank is required to store approximately one month (2500- 3000L) of coconut oil at the predicted operating point.

The coconut oil day tank is mounted on a skid with a fuel pump and filter system. A pump draws the fuel from the CNO bulk tank outside the building at a nominal 1 litre per minute and pumps the CNO through a series of filters and into the CNO day tank. The feeder board HMI will control the transfer of CNO into the day tank based on level sensors on the tank. The day tank also incorporate a level gauge and manual fill point should there be a failure in the delivery system.

Balance provided training to the staff on site for the plant equipment, operation of the entire solar hybrid UPS system and monitoring procedures. An O&M manual was provided which described further comprehensive checklists and details of maintenance for each component of the solar hybrid UPS system.

Table 3. Summary of Pohnpei Hybrid System 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 |
| Annual Grid Energy Purchased | |

| | |
|---|-----------------|
| Additional Maintenance | \$2,500 |
| Net Annual Saving V BAU – assuming zero coconut generation | \$21,290 |
| Simple Payback period | 10 |
| Plus: significant improvement in reliability | |

Note: the project was part of terminal expansion project and a new custom distribution main board was also required.

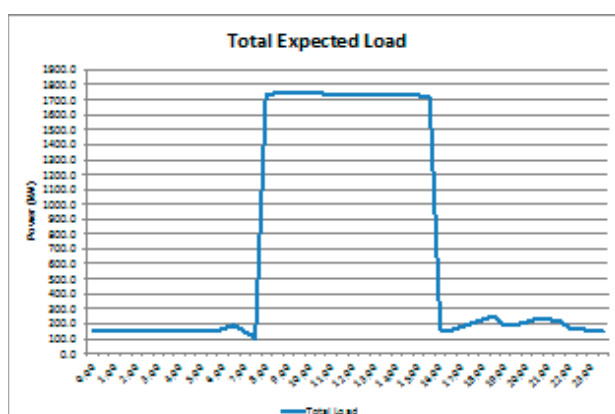
CASE STUDY 2: TONOAS HYBRID POWER PLANT

Vital has partnered with Balance Utility Solutions, to design, construct and commission a 'Renewable Ready' power station to accommodate future Photovoltaic (solar), battery storage and biomass generation to support the Coconut for Life (C4Life) project.

Vital Head of Strategy – Mr Matthias Lawrence stated that: "This project will see through to completion, the construction of a 50,000 per day, coconut processing facility on the un-electrified island of some 5,000 people and produce high value virgin coconut oil plus animal feed."

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.

Expected island Load profile is visualised below.



Project Description of the Tonoas Power Plant

| | |
|--|--|
| Tonoas Power Plant to support the Coconut for Life (C4Life) | |
| Background to Case | |
| Drivers – | |
| With the availability of coconuts on Tonoas and surrounding islands, it was identified that a processing facility can be built and power infrastructure will be required to be installed in parallel. | |
| Vital's Coconut For Life Initiative (C4L) aspires to: | |
| <ul style="list-style-type: none"> • revitalize the nation's Coconut Industry resulting in greater economic benefits, • improved livelihoods for island communities, • boost the Agriculture sector • develop an exports-oriented business, foreign partnerships • Contribute to a 5% increase in the FSM GDP • Build a community of 25,000 registered farmers within 5 years • Assist in achieving development goals for island communities • Generate avenues for clean water & energy and better health through Green Initiatives • Promote geographical and product diversification with positive economic outcomes | |
| System Description | |
| Stage 1 – Power House comprising 7 Volvo gensets, Main Switchboard, Step-up transformers, Plant controller, fuel system – project execution has commenced | |
| Stage 2 – 600-800kW roof-mount solar PV + 640kWh Balance PowerCore BESS and Hybrid Control – project executed is expected to commence before the end of this year | |

Figure 1. BAU outcomes

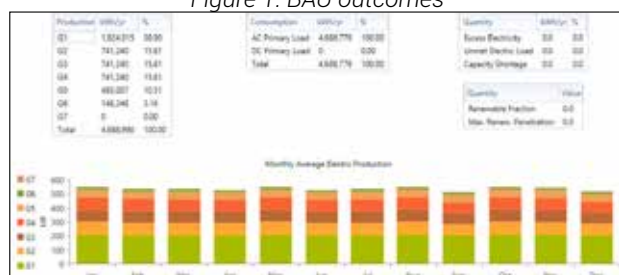


Table 4. Summary of the hybrid solution (per annum)

| | |
|------------------------------------|-------------|
| 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 |

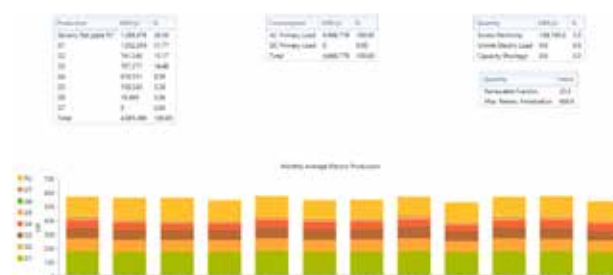


Figure 2. Hybrid Outcomes Summary (per annum)

Table 5. Summary of the Hybrid Solution Outcomes

| | |
|------------------------------------|---------------|
| 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 |

Key Lessons

1. High and medium penetration of Hybrid systems designed for the specific load can produce great paybacks and significantly enhanced reliability versus diesel only systems
2. Hybrid systems are still difficult – the system must interact with multiple forms of generation,



Image 3. The ground breaking ceremony of the C4Life project and the Island of Tonoas

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

3. 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.

References

Betzold, C. (2016). Fuelling the Pacific: Aid for renewable energy across Pacific Island countries. *Renewable and Sustainable Energy Reviews*, 58, 311-318.

Blechinger, P., Cader, C., Bertheau, P., Huyskens, H., Seguin, R., & Breyer, C. (2016). Global analysis of the techno-economic potential of renewable energy hybrid systems on small islands. *Energy Policy*, 98, 674-687.

Erdinc, O., & Uzunoglu, M. (2012). Optimum design of hybrid renewable energy systems: Overview of different approaches. *Renewable and Sustainable Energy Reviews*, 16(3), 1412-1425.

Federated States of Micronesia (2012), Energy Policy. Department of Resources and Development, Division of Energy, Volume 1. <http://www.fsmrd.fm/wp-content/uploads/2015/01/Energy-Policy-volume-I-Updated-SK08232011-Copy.pdf>

IRENA, (2015). International Renewable Energy Agency.

Kuang, Y., Zhang, Y., Zhou, B., Li, C., Cao, Y., Li, L., & Zeng, L. (2016). A review of renewable energy utilization in islands. *Renewable and Sustainable Energy Reviews*, 59, 504-513.

Mandelli, S., Barbieri, J., Mereu, R., & Colombo, E. (2016). Off-grid systems for rural electrification in developing countries: Definitions, classification and a comprehensive literature review. *Renewable and Sustainable Energy Reviews*, 58, 1621-1646.

Nakpong, P., & Wootthikanokkhan, S. (2010). High free fatty acid coconut oil as a potential feedstock for biodiesel production in Thailand. *Renewable Energy*, 35(8), 1682-1687.

Neves, D., Silva, C. A., & Connors, S. (2014). Design and implementation of hybrid renewable energy systems on micro-communities: a review on case studies. *Renewable and Sustainable Energy*

Reviews, 31, 935-946.

Puhan, S., Vedaraman, N., Rambrahamam, B. V., & Nagarajan, G. (2005). Mahua (*Madhuca indica*) seed oil: A source of renewable energy in India.

Sumathi, S., Chai, S. P., & Mohamed, A. R. (2008). Utilization of oil palm as a source of renewable energy in Malaysia. *Renewable and Sustainable Energy Reviews*, 12(9), 2404-2421.

US Department of Energy (2012) 'Energy Transition Initiative: Island Energy Snapshot - Federated States of Micronesia Fact Sheet'

Generating Clean Power from Waste Heat Project Integration – Partnership for Success

David Knight

Business Development Oceania - ElectraTherm

The need to take action on climate change was recognized at the Paris Climate Convention with the Paris Agreement coming into force on the 4th November 2016. The Paris Agreement central aim is to bring countries together for a global response to the threat of climate change by keeping global temperature rise this century below 2 degrees Celsius.

Many of the Pacific Island Community have already submitted their Intended Nationally Determined Contributions (INDC) in accordance with the accord with targeted emphasis on achieving high levels of electricity generation from renewable energy. The ElectraTherm Power+Generator can assist in the achievement of renewable energy goals through the generation of base load renewable energy using waste heat from diesel generating assets and other sources of heat such as geothermal, biomass, biogas and waste to energy.

Successful renewable energy projects are all built on a solid foundation of knowledge, experience and world class proven technology. Without a solid foundation projects will either fail to meet expectations of the power authority, not achieve expected outputs or fail completely. Projects involving low temperature Organic Rankine Cycle machines are no exception with only a limited number of companies achieving success in the application of this technology. ElectraTherm has achieved, where others have failed, in developing and proving a low temperature ORC capable of delivering base load renewable energy. The Power+Generator commercial fleet exceeds 68 machines in operation with combined operating fleet hours approaching 1,000,000 hours.

Part of the foundation of a successful project is the Project Team and their ability to work in partnership. The Project Team should include members from the client, the technology provider and the system integrator. To achieve "success in partnership" requires a level of trust and disclosure between each member and the ability to meet a common goal without being tempted to take financial advantage of other members of the team. Most "partnership" projects fail through lack of

disclosure, breakdown in trust and unfavorable commercial results.

As a technology provider, ElectraTherm have built their success through dedication and credibility. Credibility is achieved by delivering results in line with promised outcomes. The Engineering Team behind the Power+Generator are genuinely committed to make a positive impact on the world's energy requirement through the generation of base load renewable energy and as a result, ElectraTherm are the leader in the Low Temperature Waste Heat Market.

Our partner, B Power, the system integrator, is a European based engineering company delivering turnkey solutions for the generation of renewable energy using ORC technology. The company is a leading integrator of ORC technology, particularly in association with diesel/gas engines whilst also providing maintenance and support to a fleet exceeding 100 machines. A key to the success of B Power is both their passion and innovation to achieve results and their ability to work closely with all participants in a project.

There are five key elements that determine the success for a project. These common elements are:

- **Project Understanding** – success is only achieved through a thorough understanding of the projects requirements with this understanding extending to all project partners. The technology partner and integrator need to understand the client's goals and aspirations and the client needs to be advised of both the outcomes and limitations of the technology for the specific application. ElectraTherm's approach is to ensure that all information provided to the client is both credible and achievable. This is particularly important for ORC based projects where changes in heat input and condensing water temperatures influence outputs.
- **Experience** – the practical experience of both the technology provider and system integrator are crucial for the successful implementation of

the project. This experience should be verifiable and applicable for the type of installation proposed. Both ElectraTherm and B Power have significant experience in the joint supply and installation of the Power+Generator with the Power+Generator being the largest operational fleet of low temperature ORC's in the world.

- **Technology** – the right technology is imperative for the successful outcome of the project. Projects based on experimental technology and/or application in a non-standard configuration can lead to missed outcomes, disappointing results or total project failure. The Power+Generator is a commercially proven technology supplied in a standard package specifically designed to convert low temperature heat sources into renewable energy. The standardization of the Power+Generator technology provides both a known predictability of outcomes and a low risk approach to achieving the client's goals.
- **System Integration.** The very best technology will only provide positive outcomes if the integration of this technology is correctly designed and implemented. Not fully understanding the project specific integration requirements or incorrect design of ancillary equipment will contribute to project failure. The experience and knowledge of the system integrator is paramount. Our partners, B Power have the proven experience and knowledge to seamlessly integrate the Power+Generator with diesel generators having completed more than 40 similar installations
- **Support and Maintenance** – once equipment has been installed and commissioned there always remains a requirement to undertake maintenance and support. Both ElectraTherm and B Power are fully committed to provide continuing support for all installations of Power+Generators.

For the initial stage of a project, ElectraTherm/ B Power prepare a preliminary proposal based on information provided by the client taking into account the required project outcomes. The preliminary proposal includes an assessment of potential outputs based on estimated heat resource, preparation of a basic layout and a budget estimate for a full turnkey installation. A financial assessment for simple capital payback, internal rate of return and lifetime cost per kWh is also prepared. The purpose of the Preliminary Proposal is to establish the viability of the project and to provide the basis for the client to review potential

outcomes before proceeding to the development of a fully costed technical and commercial proposal.

Following the client's acceptance of the preliminary proposal and commitment to proceed the preparation of a formal proposal is undertaken over two stages. The first of these stages involves a site visit of an experienced technician to measure the available waste heat energy. This is achieved by undertaking mass flow measurements under normal operating conditions.

Onsite mass flow measurements are an important component as each engine operates differently with actual heat available often differing from manufacturer's technical data.

Without an actual knowledge of the available heat source it is impossible to design accurately ancillary equipment such as exhaust gas heat exchangers or calculate the electricity output from the Power+Generator. The most common cause of disputes between clients and technology providers occurs when performance does not meet promised outputs which can often be attributed to a failure to accurately measure and understand the resource.

During the site visit the technician, in discussion with the client operations staff, will also assess site conditions, proposed location of equipment and the provision of condensing water options. Outputs from ORC's are dependent on the temperature difference between the heat input and the condensing circuit and whilst air cooled radiators are typically used to supply cooled water other options such as process water, ground water and sea water can provide a better alternative.

Following the site visit the waste heat measurements and site information will be used to prepare the formal technical and commercial quotation. The experience of B Power is paramount in the development of a successful integration design and program. The process includes the selection of appropriate technology, basic engineering design incorporating design for ease of maintenance and safety, sizing of equipment and the preparation of concept layout and estimate of costs.

Upon award of a formal contract ElectraTherm/ B Power will proceed to bring the project to a successful completion. Actions will include finalisation of detail design, manufacture of the Power+Generator and ancillary equipment,

factory acceptance testing of all components, export packing and shipment, onsite installation, commissioning and training. All activities are subject to vigorous documented quality assurance and occupational safety procedures with onsite installation undertaken by experienced technicians in coordination with the client's operation staff to ensure minimum disruption to the operation of the Power Station.

The commissioning team will include representatives from ElectraTherm, B Power and the clients operating personnel. During commissioning and acceptance testing the clients operating personnel will be trained in all aspects of operation and maintenance of the equipment including PLC control and procedures for alarm response.

As previously indicated the successful installation and commissioning of the Power+Generator is only part of a successful partnership. Without the provision of maintenance and long term support the potential for disappointing performance or complete failure is greatly increased. To assist in achieving ongoing optimum performance of the Power+Generator a remote monitoring facility is provided which enables online troubleshooting support and performance monitoring by ElectraTherm Engineering Team. B Power also offer long term service contracts for ORC installations with a fleet of more than 100 ORC's serviced by B Power personnel.

To conclude the elements of a successful project are knowledge, experience and world class technology as well as an ability for the project team to work together in a "Partnership for Success". For ElectraTherm and B Power a successful project would be the Power+Generator operating quietly in the corner of your facility without any fuss delivering the promised base load renewable energy. We look forward to the opportunity to demonstrate our commitment to the Pacific Island Nations and to bring success to your renewable energy aspirations.

PRODUCTS & SYSTEMS FOR THE ELECTRICITY INDUSTRY



**VERTICAL FUSE
DISCONNECTS**



**HORIZONTAL FUSE
DISCONNECTS**



FUSES + FUSE BASES



CABINETS



BUSBAR SYSTEMS



METERING SOLUTIONS



**SHEAR HEAD BOLT
CONNECTORS +
LUGS**



**CURRENT TRANSFORMERS
AND STANDOFF INSULATORS**



**POWER DISTRIBUTION
BLOCKS**

Jean Müller NZ Ltd.
Unit 2, 37 Hurlstone Drive
PO Box 907
New Plymouth 4340
NEW ZEALAND

Phone +64 67699694
Fax +64 67699696
Email sales@jeanmueller.co.nz
Website www.jeanmueller.co.nz

Microgrids and Hybrid Power Generation

Christopher Pye

Renewable Energy Divisional Manager – ComAp Ltd

What Is A Microgrid?

A microgrid is a small scale power grid that is able to operate independently of the mains (or macrogrid) know as islanded mode, as well as in conjunction with the grid to supply backup or additional power. Any small-scale, localized power station that has its own generation and storage resources and definable boundaries can be considered a microgrid – such as any power station on any island throughout the Pacific Islands.

Why It Becomes Such A Hot Topic?

Microgrids are becoming increasingly popular because of the rapid rise in power demand due to population and industrial growth. In many locations, the current mains grid system is unable to cope with the increase in power demands, so business, governments and even some individuals have begun to resort to generating their own power, to ensure reliability, but also to gain more control over rapidly rising electricity prices.

Islands, such as the Pacific Islands are also becoming increasingly interesting in microgrids because of the above increasing demands, but also because the difficulty of obtaining electricity from the main island, (or mainland) electricity grid system.

The increase in the price of diesel, and the associated costs of diesel transportation to isolated island communities, has also led to the development of local microgrids into Hybrid PV/ Diesel Microgrid Systems.

What Is A Hybrid System?

Remote places such as islands or mines are often located outside of the national electricity grid reach and therefore, have to use their own microgrids to generate electricity. Usually these microgrids rely heavily on diesel gensets. When the diesel system is combined with a renewable source of energy (such as solar panels, wind turbines or hydro power) it's a hybrid system, bringing the reliability of diesel power generation along with the environmental benefits and the cost savings of the renewable source.

Why The Pv-Diesel Combination Is So Popular?

The PV-Diesel Hybrid combination is popular because of the ease of integration between the two, and the relatively low cost of the photovoltaic panels and ancillary equipment. The weather in the Pacific, with its high levels of sunny days, also contributes to the efficiency and reliability of the PV/Diesel Hybrid system. Integration with Wind Turbines is also possible within a Hybrid system, but the initial costs (and therefore return on investment times), on a cluster of wind turbines is much, much higher.

What Are The Benefits?

The main benefits of a Hybrid system are the reduction in power generation costs, and the increase in system reliability, as well as the environmental benefits found from using a renewable source of energy.

Why Use The Comap Hybrid System?

With hybrid systems two goals are always crucial – save fuel and keep the system reliability. Thanks to its advanced functions designed specifically for hybrid systems ComAp controllers can maximize the amount of energy from renewables while not endangering the system stability.

ComAp system continuously monitors data from all sources of energy, including solar, wind, hydro, batteries and gen-sets. ComAp controllers can control multiple gen-sets and can also command PV inverters.

ComAp also has a cloud forecasting system which increases the efficiency of the Hybrid power generation installation. The forecasting system uses a camera to continuously monitor the cloud cover over any photovoltaic installation. The cloud forecasting system uses an algorithm to predict overall solar irradiation that is above the PV cells. The algorithm uses overhead cloud cover, background radiation, weather patterns, radiometric measurements from ground stations, the size and location of the sun in the sky, wind patterns, cloud sizes, and cloud density to predict the solar output and ensure the maximum utilization of the PV system before the gen-set starts.

The system allows for the maximum input from the PV system, whilst also reducing the use of the diesel gen-set – resulting in a reduction of wear on the engine, and saving in diesel consumption.

Conference



27th Annual PPA Conference 9th Engineering

Group Photo

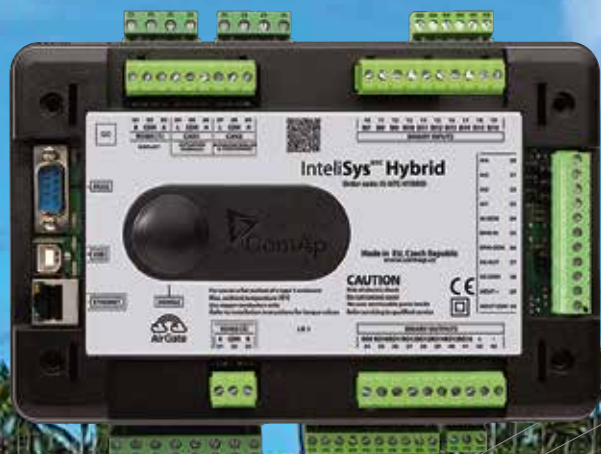


Conference and Trade Exhibition & Leaders' Workshop

**Make your
power generation
more reliable, and
more efficient.
That's smart
control.**

ComAp designs and manufactures control products for power generation and diesel/gas engines, along with associated accessories and software. Our focus on renewable energy and environmentally responsible power generation has made us market leaders in retrofitting power stations, design and system integration of hybrid diesel/renewable microgrids, and converting diesel generators to run primarily on gas, as well as other power generation solutions perfect for the Pacific Islands.

We have completed many installations throughout the Pacific Islands including The Cook Islands, (Rarotonga, Mangaia, and Atiu), Tahiti, (Bora Bora), New Caledonia, Vanuatu, Micronesia and Kiribati.



ComAp Renewable Energy

Brisbane, Australia. T: +61 8 8177 0333, E: info@comap.com.au

www.comap-control.com

27th Annual PPA Conference and Trade Exhibition & the 9th Engineers' Workshop

held at Ngarachamayong Cultural Centre, Koror, Republic of Palau

July 30 - August 3, 2018

Introduction

This year's conference attracted a total of 209 delegates with 74 delegates representing 21 Active Utility members, 79 delegates from the 49 Allied Members, 10 observers, 16 spouses, and 30 speakers from development partners, government representatives and multilateral aid agencies¹.

Such was the interest in attending the conference that the Secretariat was still registering delegates and new Allied Members in the week leading up to the conference. Delegates wanted to be part of this great networking platform which the PPA conference had to offer and also to take part in the trade exhibition showcasing their services and products.

The PPA Secretariat welcomes the following new Allied Members who joined prior to the conference:

1. FuelChief Trustee Limited
2. Monje Exports
3. Canadian Solar
4. Vergnet SA
5. Bardot Ocean Group
6. Benson Guam
7. Pavilion Gas
8. Trina Energy Storage Solutions
9. Jean Mueller New Zealand Limited
10. Zero-Carbon Island Corporation Limited
11. Exact360TD
12. Koppers Wood Products Pty Ltd
13. Selectronic Australia Pty Ltd

We take this opportunity to welcome them into the PPA family and trust that the conference was of benefit to their companies and that they will continue to be members of the PPA.

Initially forty five (45) trade booths were available but only 36 booths were confirmed and taken up by the trade exhibitors.

The conference activities started with the Executive Committee meeting at 10:10AM and followed with the conference registration at 2:00PM on Sunday, July 29 at the Ngarachamayong Cultural Centre. The PPA Secretariat acknowledges the huge effort put into the pre-conference preparation by Tmetuchl Baules, Marcie Okeriil, Lola Reklai, Punssen Imetengel, Hasinta Idechong, Lucia Santos and the team at Palau Public Utilities Corporation (PPUC) who also assisted in the registration and distribution of the conference packages to the delegates.



Figure 1: Conference Registration in Progress

Day 1 - Monday July 30 Engineers' Workshop

The Engineers' workshop was conducted at the Ngarachamayong Cultural Centre and the opening was attended by all Engineers' from the twenty one (21) Utilities who attended the conference. Mr. Krishnan Nair, the Electrical Engineer Consultant of World Bank welcomed and addressed the participating attendees and opened the workshop.



Figure 2: Engineers Workshop in Progress

¹ Registered financial PPA members can access the full delegates listing from the PPA website.

Utility Board Directors' Workshop

The one-day workshop on Monday for the Utility Board of Directors was conducted at the Palau International Coral Reef Centre where fifteen (15) Board members from the different PPA Utilities participated in an all-day event. This gave all the Board members an uninterrupted opportunity to discuss and learn about the following topics; the significant difference between a Megawatt of Diesel, a Megawatt of Solar and a Megawatt of Wind Capacity and how that affects the utility, An overview of renewable energy in general, Energy Storage and how its uses in Pacific grids, Metering on-grid solar, Private on-grid solar and its integration into the grid, IPPS and PPAs for renewable energy, Challenges for renewable energy integration into Pacific grids, Grid stability issues and ownership and finance for utility solar installations.



Figure 3: Utility Board Directors' Workshop in progress

CEOs' Retreat

The half day retreat on Monday for the Utility CEOs' was conducted at the Palau International Coral Reef Centre where twenty-one (21) CEO's and representatives from the different PPA Utilities participated. The morning session was the development partners and utility representatives' dialogue followed by an update on the Sustainable Energy Industry Development Project (SEIDP) and discussions on the review of the PPA's 2011-2016 Strategic plan and the preparation of concept note for follow up funding. More discussions were based on the presentation of PPA's 2019 draft budget.



Figure 4: CEO's meeting in progress

PPA acknowledges the kind sponsorship of Sulzer for the morning tea and afternoon tea and PPUC for the lunch.

Allied Members Meeting

The formal Allied Members' meeting was held after the afternoon tea. The Allied Members' Chairman, Scott Coles, together with the Alternate Chairman and Executive Director of PPA conducted the meeting at the Ngarachamayong Cultural Centre.



Figure 5: Allied Members' formal meeting in progress

Delegates were treated to dinner and entertainment at a welcome dinner in the evening at the Palau Royal Resort kindly sponsored by the host, PPUC.



Figure 6: Entertainment during the Welcome Reception at the Palau Royal Resort

Day 2 Tuesday July 31

The conference was officially opened by the Honorable Raynold B. Oilouch, the Vice President of the Republic of Palau with the keynote address delivered by Ms. Jennifer DeCesaro, Director-Technology-to-Market of the US Department of Energy.



Figure 7: Official Opening of the 27th Annual PPA Conference



Figure 8: PPA Alternate Chairman Hasmukh Patel with the Vice President of the Republic of Palau, Honorable Raynold B. Oilouch



Figure 9: PPA Alternate Chairman Hasmukh Patel with the Keynote Speaker, Jennifer DeCesaro, Director-Technology-to-Market of the US Department of Energy

The Official Opening Ceremony was followed by the official group photograph session and morning tea.

Morning tea was followed by a panel discussion on the theme: "Renewables are our future" which was moderated by Mr. Tereapii Timoti, CEO, of Te Aponga Uira (TAU). The following were the panelists; Ms. Jennifer DeCesaro, Dr. Mike Allen, Mr. Hasmukh Patel and Mr. Scott Coles.



Figure 10: Mr. Tereapii Timoti, Ms. Jennifer DeCesaro, Dr. Mike Allen, Mr. Hasmukh Patel & Mr. Scott Coles

The afternoon session kicked-off with the first ever Speed Networking introduced at the conference. The speed networking provided an opportunity for the Allied members time to have face to face discussion with the active members.



Figure 11: Clean Energy Technologies with TAU



Figure 12: Hatz Diesel with TEC



Figure 13: Itron Australasia with SP



Figure 17: Tesla with UNELCO



Figure 14: Vergnet SA with ASPA



Figure 18: Transnet with MEC



Figure 15: Komaihaltec with KAJUR



Figure 16: B&R Enclosures with PPL

PPA acknowledges the kind sponsorship of Sulzer for the morning tea and afternoon tea and PPUC for the lunch.

PPA Board Meeting

The PPA Board meeting which is open to all members began at 3:40PM and concluded at 5:01PM.



Figure 19: Board Members' meeting in progress at the Ngarachamayong Cultural Centre

Opening of the Trade Exhibition

The evening saw the opening of the Trade Exhibition with the cocktail kindly sponsored by Itron Australasia Pty Limited.

The Trade Exhibition was officially opened by Mr. Gregory Decherong, Acting CEO and Board Chairman of PPUC. In his remarks Mr. Decherong reiterated that the importance of the Trade Exhibition and the opportunity for us to continue with our on-going dialogue and partnership with suppliers and the allied members.

The following thirty six (36) Allied members participated in the Trade Exhibition:

1. Exact360TD, Guam
2. NZMT Ltd, New Zealand
3. AR Industrial, Australia
4. OHM International, USA
5. Aggreko (NZ) Ltd, New Zealand
6. CBS Power Solutions, Fiji
7. Hawthorne Power Systems, USA
8. International Utility Poles, Australia
9. America's Best Electric Mart, USA
10. ElectraTherm, USA
11. Global Turbocharger Solutions, Australia
12. Cummins South Pacific, Australia
13. Nexans, New Zealand
14. B&R Enclosures, Australia
15. ComAp Pty Ltd, Australia
16. Delstar NZ Ltd, New Zealand
17. Itron Australasia Pty Ltd, Australia
18. Komaihaltec Inc., Japan
19. Selectronic Australia Pty Ltd, Australia
20. Australian Winders, Australia
21. Hatz Diesel, Australia
22. ABB Ltd, Australia
23. ABB NZ Ltd, New Zealand
24. Greenbox Energy Pty Ltd, Australia
25. Nan Electrical Cables, Australia
26. Hydro Tasmania, Australia
27. Balance Utility Solutions, Australia
28. Transnet NZ Ltd, New Zealand
29. Global Sustainable Energy Solutions Pty Ltd, Australia
30. Dateline Exports, USA
31. Clean Energy Technologies, USA
32. PPA SEIDP Gender
33. S&C Electric Company, Australia
34. Arthur D. Riley, New Zealand
35. Sulzer Australia Pty Ltd, Australia
36. Bardot Ocean, France



Figure 20: Ajay Prasad of CBS Power Solutions



Figure 21: David Chute of Aggreko NZ Ltd & Jonathan Perez of FSM Petroleum



Figure 21: Mitsuaki Hirano & Paul Gandolfo of OHM International



Figure 22: Branko Stojakovic and Marvin Bolanos of AR Industrial

CONFERENCE REPORT



Figure 23: Sam Sneddon of NZMT



Figure 27: Darren Hoffman of SMA International with Kieran O'Neill of Nexans

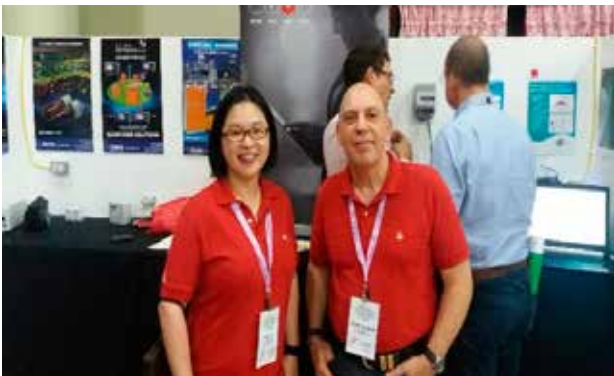


Figure 24: Tina Lin & Mark Atkinson of Itron Australasia



Figure 28: Apii Timoti and Tei Nia of Tau with Scott Lomate of Cummins



Figure 25: Thomas Hellmich of Wartsila with Radek Mrkvica & Chri Pye of ComAp Ltd



Figure 29: Wilhelm of Wartsila with Geoff Stapleton & Cathy Stapleton of GSES



Figure 26: Mark Gosper & Ben Bridges of B&R Enclosures



Figure 30: Evan Schmidt of Dateline with Vincent Bouet of Yap State Public Service Corporation



Figure 31: Kel Saul of Transnet



Figure 35: Wallon Young of ASPA with Scott Coles of International Utility Poles



Figure 32: Ray Massie & David Butler of Hydro Tasmania



Figure 36: Tony O'Brien of Australian Winders with Mala Knight & Ellen Emrich of ElectraTherm



Figure 33: Karun & David McNamara of Nan Electrical Cables



Figure 37: Darren Hoffman of SMA International With Zhengye Zhang & Hoi Lun Ng of Greenbox Technologies



Figure 34: Rod Scott of Selectronic Australia with Mau Simanu of EPC, Samoa



Figure 38: Rod Hayes of Balance Utility Solutions with Treyvane Esiel of Pohnpei Utilities Corporation



Figure 39: Mau Simanu & Jovesa of EPC, Andrea Tora of TPL & Edna Noga of ASPA



Figure 40: Rod Iliff of Global Turbochargers Solution with Mala Knight of ElectraTherm

Day 3: Networking Day Wednesday August 1

The host utility, PPUC sponsored Wednesday's Networking Day which was held in the Peleliu State and included of site visits to the Peleliu Power Plant and solar PV Diesel & Hybrid System and a tour around the island to the historic sites .



Figure 41: Peleliu Power Plant and Solar PV Diesel and Hybrid System

Day 4 Thursday August 2

There were three morning sessions of presentations. Session three was based on PPA Utility Projects and this was chaired by Hasmukh Patel, CEO of EFL. The first presentation was presented by Itron Australasia Pty Ltd based on Key

benefits of implementing DRRI (Demand Response for Renewable Integration) in Pacific Island countries. This was followed by a presentation by Hydro Tasmania on Yap Renewable Energy Development Project. While Balance Utility Solutions presented on the potential of Renewable Energy Hybrid Solutions for Islanded Communities; A Case Study of Coconut for Life (C4LIFE) project in Chuuk State and Tonga Power Limited presented on Tonga Power Limited's Progression under the theme "Renewables are our future".



Figure 42: Paul Nelsen of Itron Australasia Pty Ltd & Dean Haley Of Hydro Tasmania



Figure 43: Rod Hayes of Balance Utility Solutions & Setitaia Chen of TPL

After morning tea presentations continued from the Allied Members for session four which were based on Energy Storage and Addressing Stability chaired by Mr. Tereapii Timoti, CEO of TAU. The first presentation was presented by Tesla on Tesla Powerpack enable cost effective microgrids to accelerate the world's transition to sustainable energy followed by Hydro Tasmania on operational learning and considerations for hybrid energy systems. While Australian Winders presented on Ord river generator refurbishment case study abstract and Wartsila presented on intelligent battery storage applications in the South Pacific region.



Figure 44: Shane Bannister of Tesla & David Butler & Ray Massie of Hydro Tasmania



Figure 45: Tony O'Brien of Australian Winders & Wilhem van Butselaar of Wartsila

After afternoon tea presentations continued for session five which was based on renewable energy generation chaired by Pradip Verma, CEO of SP. Komaihaltec presented on Non-tilted type Typhoon resistant model of 300kW wind turbine and ElectraTherm had two presentations which were Waste heat to power – The Baseload renewable you already have and Steps for successful implementation of an ORC Project for Diesel generators. While ComAp Limited presented on The Energy mix for Micro-Grids – Diesel power and Renewables and Vergnet SA presented on Experience on Renewable Energy Integration in islands and remote locations worldwide. Canadian Solar concluded the session and presented on Global Utility trends in Hybrid Solar PV + Energy Storage.



Figure 46: Leiko Toyoda of Komaihaltec & Rob Emrich and David Knight of ElectraTherm



Figure 47: Chris Pye of ComAp Ltd, Istvan Ponsot of Vergnet SA & Chet Lyons of Canadian Solar

PPA acknowledges the kind sponsorship of Marshalls Electric Company for the morning and afternoon tea and PPUC for the lunch.

Closing of the Trade Exhibition

The Trade Exhibition was formally closed by Board Vice Chairperson, Mr. Ngiratmetcuchel R. Belech. In his closing remarks he thanked the Allied Members who have put a lot of effort in participating in the exhibition.



Figure 48: Scott Coles & PPUC Board of Directors Vice Chairperson Mr. Ngiratmetcuchel

PPA acknowledges the kind sponsorship of all the Allied Members who participated in the trade exhibition for the closing of the trade exhibition, Nexans Olex for the conference lanyards, MTQ Engine Systems (Aust) Pty Ltd for the conference satchels, CBS Power Solutions (Fiji) Ltd for the

conference shirt and blouse and Balance Utility Solutions for partial sponsor of the conference programmes.

Conference Dinner

The conference dinner was held at the Palau Pacific Resort. Delegates were treated to the wonderful local cuisine and entertainment.



Figure 49: Closing Dinner at the Palau Pacific Resort

Day 5 Friday August 3

The day began with session six which was the 3rd Private Sector Investor Forum. This session was facilitated by Pacific Region Infrastructure Facility which started with the highlights of the Third Pacific Energy Investors Forum Report: Exploring the Private Sector Opportunities in the Pacific Energy Markets. The first panel was a utility view of the electricity market.



Figure 50: Pradip Verma of SP, Hasmukh Patel of EFL & Tologata Tile of EPC

After morning tea, the second panel was based on a market view of opportunities.



Figure 51: Anthony Maxwell, Terrence Lui, Peter McGill, Isabel Neto and Steve Anderson

After lunch the third panel was based on market influences and support mechanisms.



Figure 52: Martin Garrood, Peter Storey, Solomon Fifita & Manuel Cox

The fourth and final panel was based on maximizing the collective benefits of experience to date.



Figure 53: Mike Allen, Andrew Daka, Brian Clayton, Hasmukh Patel & Anthony Maxwell

Annual General Meeting

The Annual General Meeting was held at the Ngarachamayong Cultural Centre.

At the meeting the Executive Director provided a summary of the resolutions from the Board meeting held on Tuesday. The results of the elections for the Chairman, Alternate Chairman, Treasurer, Alternate Treasurer, Secretary and Alternate Secretary was also announced.

The meeting also approved the theme for the 2019 conference which will be "Sustainable, reliable and affordable Renewable Energy" as voted by majority of the members that attended the Annual General Meeting.

The PPA acknowledges the contribution of the following sponsors whose assistance has ensured a successful conference.

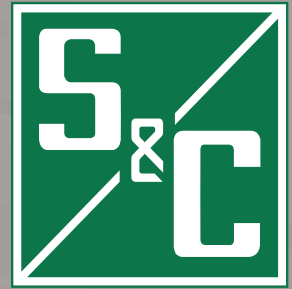
| Sponsorships | Sponsors |
|--------------------------------------|--|
| Monday Morning & Afternoon Tea | Sulzer |
| Monday Lunch | PPUC |
| Welcome Reception | PPUC |
| Tuesday Morning & Afternoon Tea | Sulzer |
| Tuesday Lunch | PPUC |
| Opening of Trade Exhibition Cocktail | Itron Australasia Pty Ltd |
| Wednesday Networking Day | PPUC |
| Thursday Morning & Afternoon Tea | Balance Utility Solutions |
| Thursday Lunch | PPUC |
| Closing of Trade Exhibition Cocktail | Contribution from each trade exhibitors |
| Thursday Conference Closing Dinner | PPUC & Blue Ray |
| Friday Morning & Afternoon Tea | Marshalls Energy Company |
| Friday Lunch | PPUC |
| Accessories | |
| Conference Program | Partially sponsored by Balance Utility Solutions |
| Conference Shirt & Blouse | CBS Power Solutions |
| Conference Satchels | MTQ Engine Systems (Aust) Pty Limited |
| Lanyards | Nexans |

The PPA Secretariat would like to commend and acknowledge this year's host utility, Palau Public Utilities Corporation, for their tremendous effort and hard work in hosting a hugely successful conference. We also thank all the delegates who made all the effort to attend the conference, trade exhibition and also the presenters who had taken the time to prepare and present the presentations. Without you all, the Conference would not be the same. Thank you all so very much for all the support, hard work and effort put in.

We invite you all to come and join the PPA for the 28th Annual Conference and Trade Exhibition in Rarotonga, Cook Islands, 2019.



TripSaver® II Cutout-Mounted Recloser



SAVE MONEY
INCREASE RELIABILITY



S&C ELECTRIC COMPANY
Excellence Through Innovation



ELECTROPAR NEW ZEALAND
The connection you can count on.

www.sandc.com

www.electropar.co.nz

Sustainable Energy Technical Guideline Workshop Commences

Pacific Power Association

The first in-country workshop on the sustainable energy technical guidelines developed under the Sustainable Energy Industry Development Project (SEIDP) is underway this week in Koror, Palau, on 6 August 2018. The SEIDP is being implemented by the Pacific Power Association (PPA) with funding from the World Bank. The objective of the workshop is to give an overview of the various technical guidelines on renewable energy systems developed so far for the Pacific Islands countries by the PPA in collaboration with the Sustainable Energy Industry Association of the Pacific Islands. The workshop focuses on topics such as design, installation, operation and maintenance of solar photovoltaic systems as well as energy storage systems.



Figure 1: Palau Workshop participants



Figure 2: Kosrae participants



Figure 3: Chuuk participants



Figure 4: Pohnpei participants

The workshops were also held in Yap, Chuuk and in the same month followed by Kosrae, Tuvalu, Kiribati, Marshall Islands, Tuvalu and Fiji in the month of September.



Figure 5: Fiji participants with trainer.



Figure 6: Tuvalu participants

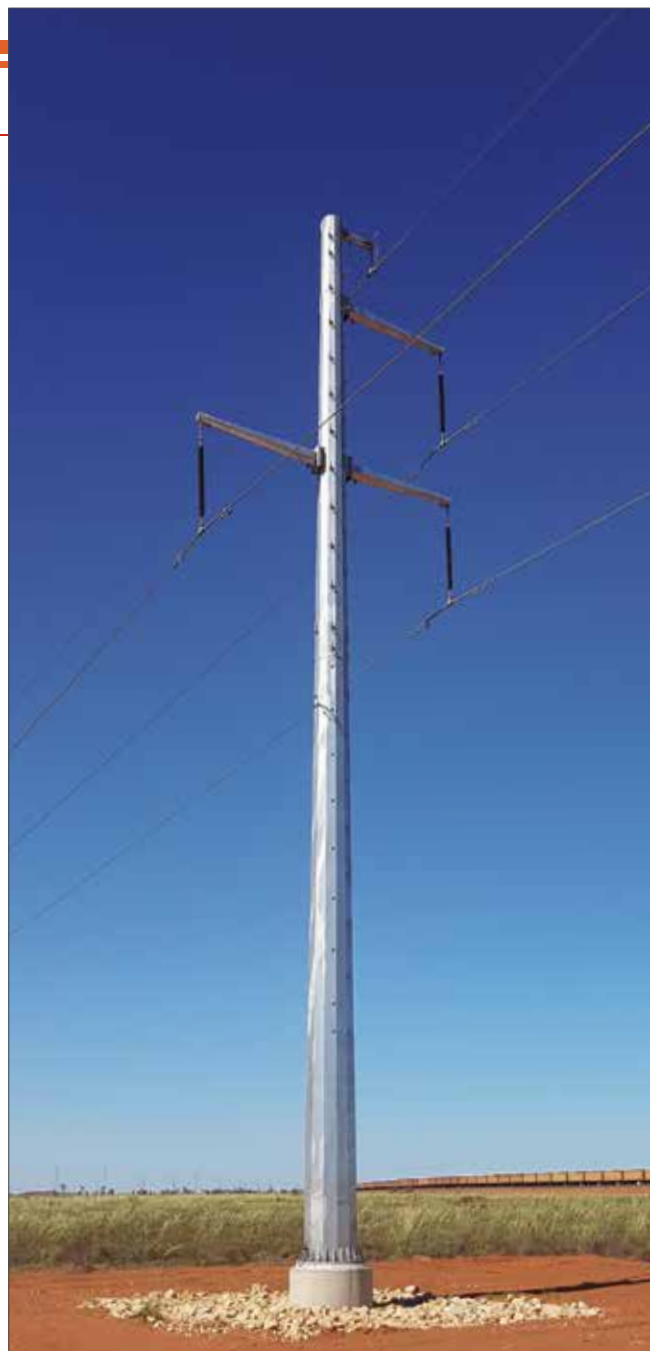


Figure 7: Kiribati participants



Figure 8: Marshall Islands participants at the workshop

Representatives from the power utilities, relevant government ministries and the private sector attended the workshops. Similar in-country workshops will be held out over the next months to the rest of the beneficiary countries; Samoa, Tonga, Vanuatu, Nauru, Solomon Islands and Papua New Guinea. The 4-day workshops are being facilitated by sustainable energy training provider GSES Pty Ltd.

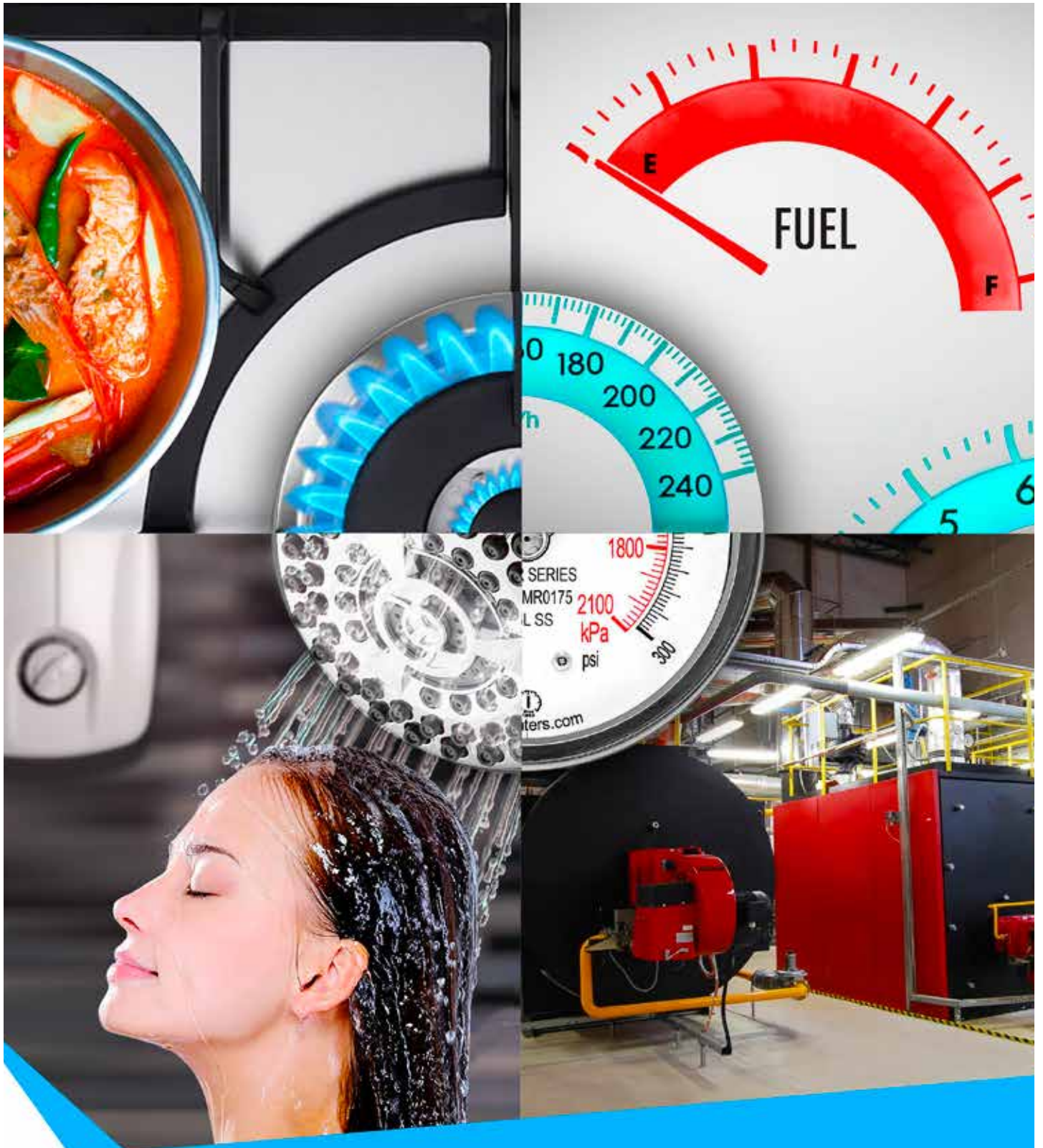


We love poles!

At **IUP** we have a passion for the electricity industry, we're local, and we understand the relationships are long term. Have us work with you on your next project and you'll understand the benefit of the experienced local support that **IUP** provides.

 **INTERNATIONAL
UTILITY POLES**

☎ +61 2 9603 1562 📠 +61 488 088 377
✉ scoles@iupoles.com



Your Complete Energy Solutions Provider

Contact Us Today on 336 1694 or visit fijigas.com.fj



PPA Gender Champions

Pacific Power Association

The Pacific Power Association, with support from the World Bank, has turned its lens on tackling gender equality in the power sector. Revealing that the proportion of women employed in technical roles throughout the region's power utilities stands at just 4%, PPA has recognized the need for a fresh approach. "Our member utilities in the Pacific Islands are struggling with two big shared challenges" said PPA Executive Director, Andrew Daka. "One is aging infrastructure. The second is an aging workforce.". In the context of recruitment challenges, women are an under-tapped labor pool that "we can no longer afford to ignore", explained Daka.

This week the PPA welcomed four 'Gender Champions' to Suva for a lively week of collaboration, discussion, learning and planning. The four individuals - two men and two women, and representing Samoa, American Samoa, and Cook Islands - were selected by PPA and its membership as outstanding examples of leadership in contributing to promoting women and creating a workplace and culture within utilities that is welcoming and inclusive to all employees, regardless of gender. As part of their appointments, each of the Gender Champions participated in film interviews during which they shared their experiences and gave their views on how and why gender equality is a strategic priority for the future of the sector. The videos will be part of a new section of the PPA website, dedicated to gender and workforce development. PPA plans to launch the revamped site with a program of special events at its annual conference, which will take place this year from 30th July to 3th August in Palau.

Mr Mau Simanu, Chief Engineer from Samoa's Electric Power Corporation and a gender champion, said "The public perception of engineering is that it's a 'dirty' job full of manual labor, and unsuitable for women. In fact, this is not the case - engineering in the power sector is exciting, well-paid, and fundamentally about problem solving, creativity and making a contribution to society. It is a job for anyone who enjoys these things and shows an aptitude for mathematics and science".

Ms. Edna Noga, Staff Engineer at ASPA, American Samoa, added: "there's no reason, in this day and age, that women cannot work in all roles in the power sector. From meter techs to engineers to administrative personnel - all jobs should be open to strong candidates regardless of whether they are male or female. We as utilities need to get more skilled at creating workplace environments where everyone feels welcomed and empowered to contribute."



Pacific Power Association "Gender Champions" L-R Apii Timoti - CEO (Te Aponga Te Uira, Cook Islands); Teiiti Paio - Electrical Engineer (Te Aponga Te Uira); Edna Noga - Staff Engineer (American Samoa Power Authority); Mau Simanu - Chief Engineer (Electric Power Corporation - Samoa)

Guam Power Authority Signs Contract for 60 MW Renewable Energy Project with Korea Electric Power Corporation (Kepco) and LG CNS Consortium

Guam Power Authority

On Friday, August 24, 2018, the Guam Power Authority (GPA) entered into a renewable energy contract as part of its Phase II Renewable Acquisition of a 60 MW project with Korean Electric Power Corporation (KEPCO) and LG CNS Consortium.

"GPA ratepayers are the beneficiaries of this utility scale renewable project to include the benefits of solar energy available at rates that are affordable, stable and not subject to world oil price fluctuations," stated GPA General Manager John M. Benavente, P.E. The substantial savings in the first five-years of operations is estimated to exceed \$20 Million, passed on to ratepayers through their monthly energy statement as part of the GPA's Levelized Energy Adjustment Clause

rate. At completion, the project will contribute 9 percent of Guam's energy needs.

In total for August 2018, GPA inked two contracts for two renewable energy companies for a total of 120 megawatts of utility scale solar photovoltaics (PV), to meet a Renewable Portfolio Standard mandated by Guam public law wherein GPA must have 25 percent of its energy supplied by renewable technologies by 2035. GPA earlier signed a 60 megawatt Power Purchase Agreement (PPA) with Hanwha Energy Corporation to construct a facility in the Dandan area of Inarajan, Guam on August 22, 2018. Both projects are expected to be online within three years.



Shown above at the August 24, 2018 GPA-KEPCO LG-CNS PPA contract signing at the Guam Power Authority Gloria B. Nelson Multi-Purpose Facility, Consolidated Commission (CCU) on Utilities 3rd Floor Board Conference Room were seated (L-R): John J. Cruz, Jr., P.E., Assistant General Manager of Engineering & Technical Services, Alan Ungacta, Mangilao Village Mayor, Joseph "Joey" T. Duenas, Guam CCU Board Chairman, GPA General Manager John M. Benavente, P.E., Bongsu Ha, KEPCO Executive Vice President & Chief Global Officer, Chungkook Choi, General Manager & President of Mangilao Solar SPC, and Taeseok Ha, LG-CNS Vice President and Mr. Kisung Hwang with KEPCO. Standing (L-R): Joven Acosta, P.E., GPA Manager of Engineering, Josephina F. Naputi, GPA Buyer II, Jaime C. Pangelinan, GPA Supply Management Administrator, Jennifer G. Sablan, P.E., GPA Manager of Strategic Planning & Operations Research, Francisco C. Santos, GPA Power Systems Control Superintendent, Tricee P. Limtiaco, GPA Assistant General Manager of Administration, Melinda C. Mafnas, GPA Assistant General Manager of Operations, Cora R. Montellano, GPA Assistant Chief Financial Officer, D. Graham Botha, GPA Staff Attorney, John J.E. Kim, CPA Chief Financial Officer, Peter Kim (LG CNS), Yesol Han (LG CNS), Yeseul Park (LG CNS), Hyunie Hwang (KEPCO) and Seungha Lee (KEPCO).

Trinabess



TrinaSolar

Power beyond solar

A subsidiary of Trina Solar

EMPLOYEE: 15000+

MODULE: 32+ GW

GRID-TIED: 2 GW

CLIENT: 100+ COUNTRIES

TrinaCommercial 50-500 Power



**Customized Commercial Solution
according to Application**

50 - 500 kW with Three-phase

100 kWh - 1 MWh Modular Design

TrinaMega

Energy Storage Solutions for Commercial & Microgrid

Capacity Scalability: **500 kWh - 3 MWh**

System Efficiency (AC / AC): **≥ 90%**

Duration: **15 Minutes - 4 Hours**

Response Time: **≤ 100 ms**



Oceania

Trina Energy Storage Solutions (Australia) Pty Ltd.
Add: Suite 60, 20 Maddox Street, Alexandria,
NSW 2015, Australia
Tel: +61 2 8034 6313
E-Mail: australiasales@trinabess.com

Europe

Trina Energie Storage Vertrieb und Service GmbH
Add: Otto-Schott-Str.4, 60438,
Frankfurt am Main, Germany
Tel: +49 (0) 69 75844 361
E-Mail: eusales@trinabess.com

Japan

トリナ・エナジー・ストレージ・ジャパン株式会社
〒105-6133 東京都港区浜松町二丁目4番1号
世界貿易センタービル21階
Tel: +81 (0) 3 6432 0581
E-Mail: jp.sales@trinabess.com

United States

Add: 100 Century Center,
Suite 501 San Jose CA 95112
Tel: (+1) 408 459-6700
E-Mail: ussales@trinabess.com
Web: www.trinaenergystorage.com

Utu Abe Malae (5 December 1949 - 2 October 2018)

American Samoa Power Authority (ASPA) Executive Director, Utu Abe Malae, who is also chairman of the Territorial Bank of American Samoa (TBAS) board of directors, passed away peacefully early Tuesday morning, 2 October 2018, at LBJ Medical Center, Pago Pago, American Samoa.

Utu, who had been in Washington State for health reasons, seeking medical treatment for an undisclosed illness, returned to the territory last Thursday night. He was among a handful of cabinet members who attended last Saturday's memorial service at Lions Park for the 34 victims of the September 2009 tsunami.



Late Utu Abe Malae

News of Utu's passing quickly spread on island yesterday morning as mourners gathered around 6.00AM for a prayer service at the LBJ chapel, attended by Lt. Gov. Lemanu Sialega Palepoi Mauga, who is also the acting governor, several ASPA employees, some lawmakers as well as family and friends. Utu's body was in the chapel during the service, and afterwards, many of the attendees stopped to say their goodbyes.

"Our Board and staff are all shocked and saddened by the passing of Utu," said ASPA Board Chairman Fonoti Perelini Perelini through a statement in response to media inquiries. "We were all looking forward to his return this week to attend our board meeting this Friday and be with the staff before he returns to Seattle for continuation of his treatment," he said.

Responding to local media request for comments, TBAS president Drew Roberts said that it's "with heavy heart" that the TBAS "family acknowledges the passing" of the bank's board chairman. "I know I speak for the entire staff when I say just what a pleasure and privilege it was to work with such a giant of a man. His influence and direction for the bank cannot be overstated. He served with vigor and purpose,"

BACKGROUND

Utu, who is also the current chairman of the ASG Educational Reform Task Force, took over the ASPA leadership post about five years ago, around the same time the Lolo Administration took the helm of government. In June 2012, he resigned as executive director of the Commonwealth Utility Corporation (CUC), the government owned utility provider in the Commonwealth of the Northern Mariana Islands.

He took over the CUC post in the latter part of 2009, after he stepped down as Saole senator that same year. He was a candidate for governor in the 2008 gubernatorial race, with running mate, current Sen. Nuanuaolefeagaiga Saoluaga T. Nua, but lost in the run-off election to the incumbent at that time, the Togiola and Faoa Administration. Utu had also served as president of the Development Bank of American Samoa up to September 2004 and prior to that, he was executive director for ASPA for many years and during his ASPA tenure, he was asked by previous governors to oversee Port Administration and LBJ Hospital for a certain period of time.

Between 1985 and 1986 he served as both the ASPA boss and director of Public Works. Utu also served as Operations/Assistance Manager for PRI-South Pacific Resources from 1983-1985 and Assistant Manager for Marlex Petroleum from 1981-1983. In April 2001, Utu was named one of the "Top Ten Public Works Leaders of the Year" by the American Public Works Association. In the same year, he was named Vice Chair of the Pacific Power Association (PPA). He later became the chairman of the PPA in 2002 where he was chosen for a full three-year term as chairman of the PPA while still the ASPA boss.

Utu, representing ASPA, is a board member of the PPA, whose office is based in Fiji. Utu earned a Bachelor's degree with a double major in chemistry and English from Morningside College in Sioux City, Iowa in 1970. In 1973 he received a master's degree in physical chemistry from Iowa State University of Science & Technology in Ames, Iowa. In 1976 he received two separate master's degrees from the University of Pittsburgh in Civil Engineering and Public Works Administration.

In March 2017, NOAA Ship Okeanos Explorer 'America's Ship for Ocean Exploration' mission scientists, in recognition of unprecedented leadership in advancing science and engineering in the US Pacific Territories, named a newly discovered submarine geologic feature — "Utu Seamount" — after the ASPA executive director.

The Pacific Power Association, on behalf of its members, expresses its condolences to the Utu, Malae family and ASPA staff in their time of grief.

Welcome! *New Allied Members*

Seven (7) new companies who have joined PPA as Allied Members since our last PPA Magazine. The new members are:

KOPPERS WOOD PRODUCTS PTY LTD: Koppers Wood Products Pty Ltd is based in NSW, Australia. Their primary activity is treated timber poles.

EXACT360TD: Exact360TD is based in Hagatna, Guam. Their primary activity is transmission and distribution predictive based maintenance.

BENSON GUAM ENTERPRISES, INC.: Benson Guam Enterprises, Inc. is based in Tamuning, Guam. Their primary activity is wholesale and retail of construction and electrical materials and equipment.

PAVILION GAS PTE LTD: Pavilion Gas Pte Ltd is

based in Marina Bay, Singapore. Their primary activity is supply of liquefied natural gas and natural gas fuels.

SELECTRONIC AUSTRALIA PTY LTD: Selectronic Australia Pty Ltd is based in Victoria, Australia. Their primary activity is manufacturer of SP PRO multi-inverters, certified PV inverters & supporting products.

STAMFORD-AvK: STAMFORD-AvK is based in South Australia, Australia. Their primary activity is design, manufacture and supply of STAMFORD & AvK AC alternators.

BARDOT GROUP: Bardot Group is based in La Ciotat, France. Their primary activity is integrated energy solutions.

BUILT FOR IT.™



1 Carpenter Street, Raiwai, Fiji Islands.
Private Mail Bag, Suva, Fiji Islands
Phone: +679 337 1125 Fax: +679 337 0095
✉: sales@carptrac.com.fj 🌐: www.carptrac.com.fj 📘: <https://www.facebook.com/Carptrac>

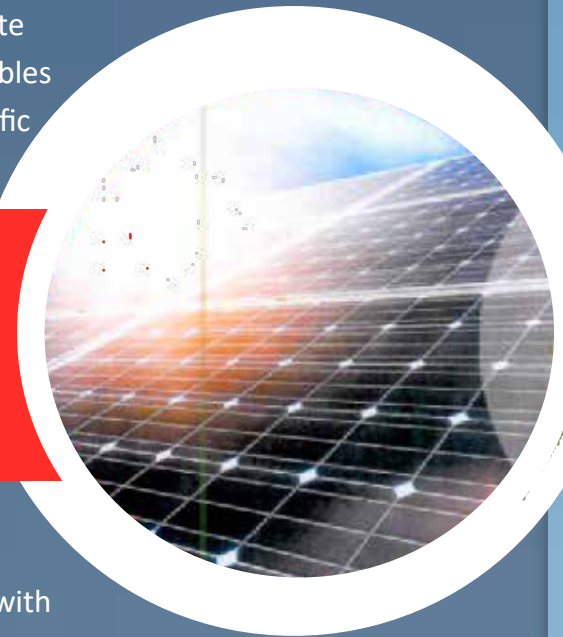
Carptrac



Do it once, do it right. Use NAN cables to ensure renewable technologies built today are operating strong tomorrow—your legacy to future generations.

We have a complete range of quality cables to solve your specific application.

NAN Cables powering the future of renewable technologies



Our cables are the product of choice with numerous power utilities, electrical wholesalers and contractors.

See for yourself we do not compromise on quality, and be confident our cable not only complies with Australian standards, but will stand the test of time.

CONTACT US FOR OUR PRODUCT BROCHURES AND ASK FOR THE NEW NAN CABLES DATA HANDBOOK.

**CABLE DATA
HANDBOOK
NOW AVAILABLE**

NAN Electrical Cable Australia Pty Ltd
28-30 Permas Way
Truganina, Victoria 3029
T: +613 8368 2688
F: +613 8368 2489
M: +614 12105100
E: david.mcnamara@nancable.com.au
Skype: david.mcnamara1407