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From Left to Right: Mr. Geoff Stapleton, Fiji's Minister for Public Works, Meteorological Services and Transport, Honourable Ro Filipe Tuisawau and USP Pro-Chancellor and Chair of Council, the Right Honourable Siosia Utoikamanu during the opening ceremony of the Sustainable Energy Training Centre in Suva, Fiji.

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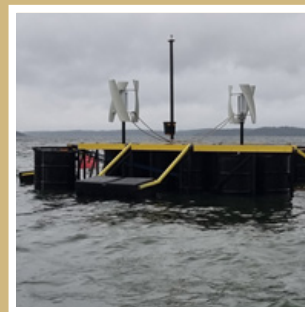
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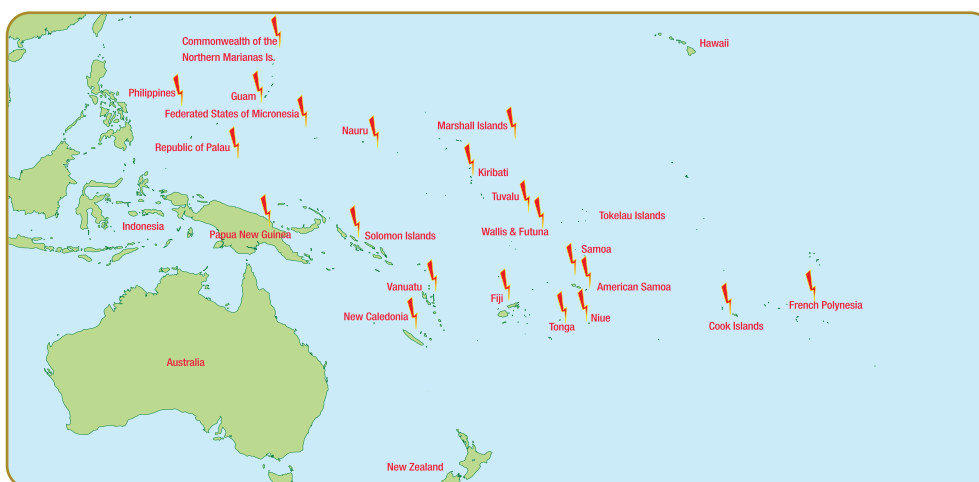
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EDITOR'S NOTE

Gordon Chang
Executive Director

The articles in this issue of our magazine reflect some of the areas of focus in our utilities. The increasing focus on renewable energy as a source of sustainable energy production for the outer islands in addition to remote areas on our main islands is recognition by the utilities of the issues of climate and the delicate environment in which the small islands exist. When it is recognized that the Pacific Islands are providing a greater focus on sustainable energy than the much larger developed countries, particularly in view of our small energy usage and economic situation, it could provide an example for these larger countries to follow.

Notwithstanding this, there remains the ongoing need to reform and to continually improve the performance of our utilities.

It is now "full steam ahead" for our fast approaching 33rd Annual PPA Conference to be held in Nadi, Fiji from 2-5 November 2026. As the PPA Secretariat is the host for this year's conference this will certainly be a Conference conducted in true Pacific Island style.

Our Association has been honored to have Claudia Vasquez, Program Leader for Infrastructure & Lead Energy Specialist, from the World Bank to provide the keynote address at our formal opening on Tuesday. It is not too late for those members that have not registered to make their bookings for this important Conference, which has as its theme "Ensuring fair rates and reliable services while accelerating investment in renewable energy and grids"

Please see below Allied Membership updates for Q3;

New members

1. Sumitomo Electric Industries Ltd
2. ABB Australia Pty Ltd
3. IPS-Energy Australia Pty Ltd
4. SofarSolar Ausco Pty Ltd
5. Infracon Pacific
6. DEIF Australasia Pty Ltd
7. Truepower
8. Australian Power Equipment
9. Dulhunty Poles Pty Ltd

Withdrawn members

1. Essential Energy
2. Generator Rental Services
3. I S Systems
4. Intracor Holdings Ltd
5. Pacific Power Solutions
6. Vergnet Pacific
7. CRISIL Ltd

For those members who have withdrawn their membership, the PPA Secretariat looks forward to welcome those who may want to rejoin the membership in the new future.

See you all at the PPA conference soon.

Enabling Renewable Investment: Lessons from IPPs in the Pacific

David Lloyd and Laure Darcy, Pacific Private Sector Development Initiative,
Asian Development Bank

Summary of an August 2026 Policy Brief published by the Pacific Private Sector Development Initiative of the Asian Development Bank¹

Introduction

Pacific island countries have ambitious renewable energy goals that will require the transformation of their electricity generation infrastructure. Many aim to generate from 70% to 100% of their electricity from renewable sources by the early 2030s. With diesel costs surging while the levelized cost of solar generation continues to decline, the transition has become a commercial imperative. In July 2026, the levelized cost of solar generation with battery storage averaged less than half the marginal cost of diesel generation in the Pacific. To implement this transition, Pacific utilities are increasingly looking to partner with independent power producers (IPPs) under long-term power purchase agreements (PPAs), as has been done successfully in both large and small

economies around the world.

The Pacific's experience with IPPs is limited so far, but it is sufficient to establish that the model works and to identify what determines whether it works well. Over the past decade (2013–2025), 19 PPAs between public utilities and private partners became operational across the 14 Pacific developing member countries of the Asian Development Bank (ADB) (Table 1). The full policy brief² draws on the experience of five of those countries—Fiji, Palau, Papua New Guinea (PNG), Samoa, and Tonga—to examine what has shaped the timing, cost, and quality of IPP investment in the region. Its main finding is that the critical factor determining the success of an IPP is the quality of the enabling environment: the policy commitments, regulatory frameworks, utility governance structures, and project preparation processes that determine whether private investors can assess and price risk with confidence.

Table 1: Private Independent Power Producer Plants Commissioned, 2013–2025

Country	Independent power producer	Capacity (MW)	Fuel source	Commissioning year	Term (years)
Fiji	Nabou Green Energy	12	Biomass	2017	25 ^a
Palau	Solar Pacific	13	Solar	2024	20
Papua New Guinea	PNG Forest Products (Baiune)	21	Hydro	2013	n.a.
	POSCO International Power (Lae)	30	HFO	2016	15
	ExxonMobil (LNG plant)	26	Gas	2016	n.a.
	NiuPower (LNG plant)	58	Gas	2019	15
	Dirio Gas and Power (LNG plant)	45	Gas	2021	15
	PNG Hydro Development (Edevu)	50	Hydro	2023	20
Samoa	Sun Pacific (Faleolo Airport)	2.0	Solar	2015	20
	Sun Pacific (Faleolo expansion)	1.5	Solar	2018	0 additional
	Sun Pacific (Faleolo expansion)	2.0	Solar	2025	10 additional
	Greenpower Samoa / Fuzhou Hao Hui New Energy (Faleolo Airport)	2.0	Solar	2014	20

¹ PSDI is a regional technical assistance facility cofinanced by ADB, the Government of Australia, and the Government of New Zealand

² <https://pacificpsdi.org/publications-2/psdi-publications/read/enabling-renewable-investment-lessons-from-independent-power-producers-in-the-pacific>

	Greenpower Samoa (Upolu racecourse)	2.0	Solar	2014	20
	Greenpower Samoa (buyout of racecourse site from EPC)	2.0	Solar	2024	20
	Solar for Samoa / First Solar (Faleolo Airport)	2.5	Solar	2016	20
	Solar for Samoa (Upolu racecourse)	2.1	Solar	2016	20
	E Energy Group (buyout of Satapuala site from EPC)	1.89	Solar	2024	20
Tonga	Singyes	2	Solar	2017	25
	Sunergise	6	Solar	2022	25

EPC = Electric Power Corporation, HFO = heavy fuel oil, LNG = liquefied natural gas, MW = megawatt, n.a. = not available, PNG = Papua New Guinea.

^a The plant was commissioned in 2017 but closed in 2018 because of inadequate wood pellet fuel supply; it has operated intermittently at a low level since then.

Note: Covers grid-connected installations of at least 1 MW that are privately owned; solar rooftop programs and PPAs between state-owned entities are excluded.

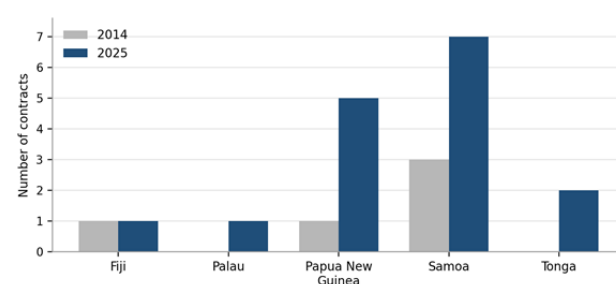
Source: Authors.

IPPs are not merely a convenient financing option—they are an essential mechanism for accelerating the transition to renewable energy. First, IPPs bring private capital and technical expertise that state-owned utilities often lack. Second, contracting out generation transfers project delivery and maintenance risk to the private sector, creating strong incentives to deliver on time and within budget and to maintain the assets over the contract period. Third, IPPs free up scarce public capital for infrastructure that the private sector cannot finance on commercial terms: transmission and distribution networks, grid upgrades, and, in some cases, the battery storage essential for integrating renewable generation. The case for actively pursuing IPPs is therefore not just commercial but strategic—it is the approach most likely to accelerate the renewable transition at least cost.

The pace of uptake across the five countries has been uneven, and slow by comparison with Hawaii, which commissioned its first renewable energy IPP in 2010. Between 2015 and 2025, Hawaiian Electric Company (HECO)—which faces many of the same structural constraints as Pacific utilities, including geographic isolation, multiple island grids, a monopoly utility structure, and historical dependence on imported fuel—added 32 new IPP contracts, 28 of them for solar generation. The five surveyed countries, starting from a similar base, added 11 (Figure 1). Samoa and Tonga account for most of that increase, reflecting strong policy consistency in favor of renewable

energy IPPs and effective commercial incentives for their state-owned utilities.

Figure 1: Operational Independent Power Producer Contracts, 2014 and 2025

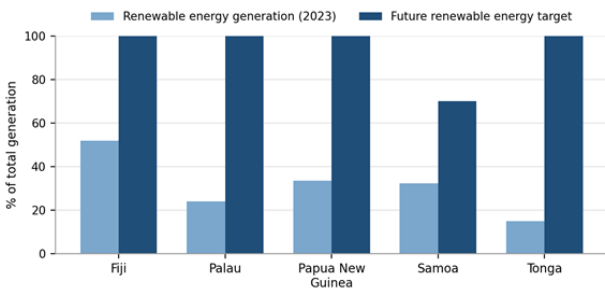


Source: Authors.

1. The Enabling Environment Determines Investment Outcomes

The five countries surveyed all aspire to generate 70%–100% of their electricity from renewable fuels by 2032 (Figure 2). State-owned utilities hold effective monopolies over generation, transmission, and distribution in each country, and have limited capacity to make the investments required to attain these goals. IPPs offer an opportunity to leverage private capital and know-how to help close that gap.

Figure 2: Renewable Energy Generation as a Share of Total Electricity Generation, 2023 Versus Targets



Note: Actual renewable energy generation for Palau may be overstated; the Palau Public Utilities Corporation reports that it was less than 20% in 2023. PNG's target is 78% by 2030 and 100% by 2050.

Source: International Renewable Energy Agency, IRENASTAT Online Data Query Tool.

Private investors carefully assess risk and the opportunity cost of each investment. Higher risk pushes up the cost of financing and shrinks the pool of investors willing to participate. Governments and utilities seeking private investment at the lowest possible cost can act to lower that risk by creating a positive enabling environment. Utilities, in turn, can prepare themselves to ensure that the financial commitments they make through PPAs represent value for money. Where policy, planning, and regulation are aligned and adhered to, competition increases and investment risk falls. The key features of an enabling environment for IPPs are set out in Table 2.

Table 2: Key Features of the Enabling Environment for IPPs

Area	Feature	Risk impact
Policy	Government and utility commitment to renewable energy and IPPs	Clarity and consistency in public sector commitment lowers the risk of engagement for the private sector, and vice versa.
Planning	Coherent sector investment planning framework with reliable supply and demand forecasts	Sector plans that are adhered to and include generation, storage, transmission, and distribution investments based on robust demand forecasts, allow utilities to sequence and size IPP tenders for best value, reducing risk for all parties.
	Grid readiness and storage capacity	Before a tender is launched, the ability of the grid to absorb the proposed energy must be assessed and any required investments (including storage) programmed, including sources of finance. This lowers the risk of curtailment or technical failure that would raise the effective offtake cost for utilities, and the risk of nonpayment for IPPs.
Regulation	Commercially driven, financially viable offtaker, and/or government or development partner backup	Financially viable utilities with commercial incentives and governance structures lower the risk of nonpayment. Where the offtaker is financially weak, a government or development partner guarantee is necessary for IPPs to secure bank financing. Without credit enhancement, IPPs must rely on equity, so fewer will participate and those that do will price in higher financing costs.
	Independent licensing and retail tariff-setting regime	Where generation licensing and tariff setting powers rest with a body independent of the utility and not subject to political directives, a level playing field can be established for generators (lowering participation risk) and the utility has a higher chance of recovering its costs through the tariff (reducing risk of utility insolvency).
Procurement	Suitable and transparent public-private partnership (PPP) procurement process	A documented, transparent procurement process that supports the specific requirements of PPP contracts reduces participation risk for IPPs.

	Standard, bankable PPA terms	Standard, bankable PPA terms lower financing risk and cost for IPPs and streamline the procurement process.
	Project site land secured prior to tendering	Where the land required for the project site is procured by the utility before tendering, rather than left to bidders, a larger number of bidders can participate and the risk and cost of participation fall substantially.

Source: Authors.

Surveyed country experience in brief

Fiji's regulatory environment is broadly supportive of IPPs, but its utility has commissioned only one small IPP plant during the 2013-2025 period. The Electricity Act, 2017 allows competition in generation and transferred regulatory functions—including IPP licensing and tariff setting—to the Fiji Competition and Consumer Commission, which has been critical to maintaining the creditworthiness of Energy Fiji Limited (EFL). EFL is among the best performing state-owned utilities in the Pacific, delivering the region's lowest average tariff (\$0.17/kWh) and the highest measured reliability, and it has been consistently profitable due in part to its legacy hydroelectric plants which generated 52% of its electricity in 2024. Successive annual reports from 2014-2024 announced IPP projects that did not proceed, as EFL struggled to meet the commercial requirements of IPP investors. Concurrently, EFL invested F\$375 million of its own capital to add 211 MW of thermal capacity. A new board and management team installed in 2024–2025 has committed to 90% renewable generation by 2035, a F\$2 billion capital program, and roughly 35 MW of new solar through IPPs and joint ventures.

Palau demonstrates that a small, financially fragile utility can commission a major IPP when policy and regulatory commitment is clear—but also the risks when multiple sources of electricity generation are not fully coordinated. The 13 MW solar plant with a 13 MWh battery commissioned in 2024 is the largest solar IPP in the Pacific and represents about 20% of national generation capacity. The Palau Energy and Water Administration has the authority to set electricity rates to allow full cost recovery and approve IPP contracts entered into by the Palau Public Utility Corporation (PPUC), lending robustness to the process. Under pressure to expedite procurement, PPUC launched a tender before completing a capacity plan, incorporating the potential impact of a solar rooftop program on demand and acquiring a project site. Upon commissioning, the grid could absorb only 53% of

the plant's output in its first year, with curtailment costs driving up the offtake tariff. Curtailment has subsequently dropped through investments to improve grid stability and – in 2026 – expand storage. Palau is now developing an integrated roadmap to guide future IPP and renewable investment.

PNG has the longest IPP history in the region but has struggled to implement a least cost generation plan and competitive IPP tenders. Six IPP plants representing 230 MW—30% of grid-connected capacity—are operating, but only one emerged from a competitive tender. In Q2 2026, PNG Power Limited (PPL) saw its first solar IPP (7MW) commissioned following an unsolicited proposal. PPL's financial condition has steadily deteriorated over the past decade, with a 2013 emergency declaration effectively freezing tariffs while input costs rose. This, combined with high system losses, has contributed to an estimated outstanding debt of K1.3 billion (US\$300m) to existing IPPs as of Q1 2026. While PNG is building a policy and regulatory framework to support IPPs, it has yet to implement a robust procurement framework outlining the steps, requirements, and governance arrangements for preparing and tendering IPP contracts. Ministerial approval of PPL's contractual commitments adds political risk. PNG's first competitively tendered renewable energy PPA – for a 5 MW solar plant on the Gazelle grid which could cut PPL's generation costs by more than 50% - remained unsigned in August 2026, more than four years after tender launch.

Samoa has the strongest commissioning record, built on early regulatory separation, policy consistency and a utility that has used IPPs to lower its cost of supply. During 2014–2024 it commissioned five new solar IPPs, expanded one, and sold two plants to new sponsors; in FY2025 the IPP plants totaled 13.95 MW and supplied an estimated 8.8% of national generation. The Electricity Act, 2010 established an independent Electricity Regulator with licensing and tariff-setting powers, including an IPP tariff policy which instructs tariffs to be calculated from a levelized cost of electricity plus a reasonable investor

return in the context of a standardized PPA. The Electric Power Corporation (EPC) reduced its tariff by 25% while remaining profitable as demand for power grew between 2015 to 2020. A government-imposed 20% tariff reduction in 2021, made without offsetting compensation, drove three consecutive years of losses and weakened EPC as a counterparty, although it returned to profitability in 2025. EPC is currently preparing its largest solar IPP project, for up to 40MW, and using this project to update its IPP procurement process and standard PPA terms.

Tonga's experience shows what coordinated planning and rigorous project preparation delivers. TPL's two solar IPPs supplied an estimated 14% of electricity generated in 2024, and a PPA for a 20 MW solar plant with 55 MWh of storage—one of the largest solar IPPs in the Pacific—is expected to be signed in Q4 2026. Tonga's policy consistency in favor of IPPs has directed development partner financing to assets the private sector will not finance—transmission, distribution, storage, and outer-island systems. Robust sector planning, closely coordinated with Tonga Power Ltd. (TPL) and development partners, has facilitated the integration of renewable energy investments into the grid. In the absence of formal PPP tendering rules, TPL built its own process with transaction adviser support and ensured that projects were market-ready before launch: aligned with the Tonga Energy Road Map and TPL's business plan, with sites identified and lease terms agreed, a draft PPA prepared, and grid studies confirming sizing, storage, and integration requirements. The first tender attracted strong international interest and completed PPA negotiations within 12 months of the expression of interest. The proposed PPAs offered a commercial allocation of risks, allowing the IPPs to secure debt financing. While TPL has remained profitable, tariff caps directed by the government have not allowed TPL to recover the full costs of supplying power since 2020. This effective subsidy to consumers has been largely financed by TPL in the form of a reduced dividend to its government shareholder, and has heightened payment risk for future IPPs.

2. The Hawaii Benchmark

Hawaii shares many of the structural challenges of its Pacific island peers but has managed to integrate renewable IPPs far faster. It is geographically isolated, operates multiple island grids, and has depended historically on imported diesel and fuel oil, leading to very high electricity prices (\$0.39/kWh in mid-2025). Between 2015 and 2024, HECO added 28

solar IPPs and several storage-linked projects, lifting the renewable share of generation from 20% to 36%. Kauai Island Utility Cooperative (KIUC)—serving a population of about 80,000 with peak demand of 80 MW, a scale comparable to several countries in this survey—raised its renewable share from 26% to 51%, having reached 60% in 2022, and expects 100% by 2033 (Table 3).

Table 3: Hawaii Benchmark—Generation and Renewable Share, 2015 and 2024

Item	HECO 2015	HECO 2024	KIUC 2015	KIUC 2024
Total generation (GWh)	10,381	10,311	453	551
IPP generation (GWh)	4,308	3,368	n.a.	n.a.
Utility-scale solar generation (GWh)	51	609	42	134
Utility-scale solar IPP contracts (no.)	4	32	n.a.	6
Client rooftop solar (GWh)	643	1,691	38	77
Thermal generation (GWh)	8,276	6,617	335	273
Share of renewable generation (%)	20	36	26	51

GWh = gigawatt-hour, IPP = independent power producer, n.a. = not available.

Note: KIUC's utility-scale solar and hydro generation is contracted from IPPs but is not reported separately as IPP output.

Sources: Hawaiian Electric Company, Sustainability Reports and Trends and Analysis Reports (2015–2024); Kauai Island Utility Cooperative, compiled by the authors.

Hawaii's comparative success is not explained by grid size or a dollarized economy, but by five reinforcing institutional features.

- (i) Binding statutory targets. Hawaii legislated a 100% renewable portfolio standard by 2045 with interim milestones. These are legally enforceable obligations rather than aspirational statements, giving investors demand certainty and protection from policy reversal.

- (ii) Regulator-approved integrated resource planning. HECO develops long-term capacity plans in consultation with the Hawaii Public Utilities Commission (HPUC), and procurement is permitted only where consistent with an approved plan. This eliminates speculative procurement, effectively bans unsolicited proposals, coordinates storage deployment with solar additions, and has allowed 124 MW of petroleum-fired capacity to be retired in step with renewable additions.
- (iii) Independent regulation and revenue stability. HPUC determinations have never been overridden by the legislature or the executive. Decoupling HECO's revenue from sales volumes, combined with fuel cost adjustment mechanisms, keeps the utility financially viable as rooftop solar and efficiency reduce sales, reduces payment risk to IPPs, and removes any financial disincentive to integrate renewable generation.
- (iv) Commercial utility governance. Professional board and management continuity, transparent reporting, dividend discipline, and decision-making insulated from political direction. Private ownership is not a prerequisite—KIUC is a member-owned cooperative—but commercial governance is.
- (v) Transparent competitive procurement with standardized PPAs. All new generation above 5 MW is procured under an HPUC-approved competitive bidding framework, with published model PPAs, approved evaluation criteria, an independent observer, and regulatory review of final contracts. This has allowed HECO to contract solar and battery IPPs on 25-year PPAs at about \$0.08/kWh.

The contrast with the Pacific is instructive rather than dispiriting. Where Pacific countries have applied similar measures—Tonga's integrated planning and project preparation, Samoa's early regulatory separation, Fiji's independent tariff regulation—IPP uptake and utility financial health have been stronger. Where they are absent or inconsistently applied, the result has been procurement delays, renegotiation, curtailment, and arrears. KIUC's record demonstrates that even small grids can move quickly: it moved from the most expensive cost of generation in Hawaii before 2019 to the least expensive after the COVID-19 pandemic, cut fossil fuel purchases by more than half, and achieved 99.98% reliability in 2022, the

best in the state. The barriers to rapid renewable IPP uptake in small island systems are primarily institutional rather than technical or commercial.

3. Reform Priorities

Each of the five countries faces distinct institutional and political economy constraints, and the priorities in Table 4 reflect the most consequential gaps in each country's enabling environment.

Table 4: Country Reform Priorities

Country	Priority reforms
Fiji	• Adopt and adhere to a formal IPP development process with clear timelines, milestones, and governance arrangements, and hold Energy Fiji Limited (EFL) management accountable for delivering the pipeline. • Adopt and use a standardized, bankable PPA. • Align IPP offtake tariffs with the avoided cost of thermal generation. • Program grid reinforcement and storage investment ahead of IPP commissioning.
Palau	• Protect the independence of the Palau Energy and Water Administration and allow IPP costs to be reflected in the tariff. • Complete the transmission, distribution, and storage investments required to integrate the existing 13 MW plant. • Develop a coordinated renewable energy investment road map integrating net metering, IPPs, and grid planning.
Papua New Guinea	• Implement a credible, time-bound financial recovery plan for PNG Power Limited (PPL), including a pathway to cost-reflective tariffs and clearance of arrears to IPPs. • Introduce a credible payment security mechanism for new IPPs. • Reduce political discretion in PPL contracting decisions. • Standardize PPA terms and publish rules for managing unsolicited proposals.

Samoa	• Preserve the independence of the Regulator and the integrity of tariff determinations; deliver any consumer subsidy on budget. • Consolidate a transparent, competitive IPP procurement process under the revised PPP framework, with explicit rules for unsolicited proposals. • Restore the Electric Power Corporation's financial health and reduce shareholder interference in its commercial operations.
Tonga	• Enact formal PPP procurement guidelines and standard PPA terms. • Restore Tonga Power Limited's (TPL) financial sustainability through a pathway to cost-reflective tariffs. • Ensure timely delivery of grid upgrades and storage to support the 20 MW IPP and future additions. • Strengthen TPL's capacity to manage PPA billing and compliance, and fully implement the institutional framework of the Energy Act, 2021.

IPP = independent power producer, MW = megawatt, PPA = power purchase agreement, PPP = public-private partnership.

Conclusion

Affordable, reliable electricity is a foundation for private sector growth and community wellbeing across the Pacific. Accelerating the transition to lower-cost renewable electricity is therefore a high priority for Pacific governments, and a prerequisite for broad-based economic participation and growth. The evidence from the five countries surveyed demonstrates that private investment in renewable generation can deliver cost savings for governments, accelerate the shift away from imported diesel, and bring external capital and technical expertise that state-owned utilities cannot readily replicate on their own.

The main finding of this paper is that the quality of the enabling environment, not market size, is the most important factor determining whether a government can integrate renewable energy IPPs within the time frame its targets require. Where renewable energy commitments have been set out in clear and consistent policy frameworks, regulators have been able to set cost-reflective tariffs

without political interference, utilities have been held accountable for delivering their IPP pipelines, project preparation has been thorough, and procurement has been transparent and competitive, IPP investment has succeeded. Hawaii's experience reinforces the finding. Where these conditions have not been in place, IPPs have experienced extended delays, higher costs, and weakened investor confidence, slowing progress towards renewable energy goals.

Four common priorities emerge as general guidance for all Pacific island countries seeking to increase private participation in renewable energy generation:

- (i) Utilities must be allowed to create and implement renewable energy generation plans on commercial terms, free from political intervention.
- (ii) Tariff frameworks must allow full cost recovery, so that utilities remain creditworthy counterparties for IPPs.
- (iii) Competitive procurement processes must be followed, with standardized PPA terms, transparent processes and criteria, and clear rules for managing unsolicited proposals.
- (iv) Before IPPs are tendered, projects must be fully and properly prepared and sequenced—including grid studies, site procurement, demand forecasting, and storage planning.

This summary draws on the PSDI Policy Brief: Enabling Renewable Investment: Lessons from IPPs in the Pacific. PSDI is a regional technical assistance facility cofinanced by ADB, the Government of Australia, and the Government of New Zealand. The views expressed are those of the authors and do not necessarily reflect the views and policies of ADB, its Board of Governors and the governments they represent, or the governments of Australia and New Zealand. In this summary, "\$" refers to United States dollars unless otherwise stated.

David Lloyd has advised and arranged financing for private sector projects in the Pacific, including renewable energy IPPs in Samoa, Fiji, and Tonga, for over eight years. Transactional work includes Sun Pacific solar/Samoa, Hydro Taveuni/Fiji, Prima Ltd/Vanuatu submarine cable, Vodafone/PNG, and Fiji Airways. After successfully initiating and developing ADB's Pacific Private Sector Financing program from 2018-2025, he now works as an independent advisor to private sector investors. Prior to ADB, he was Head of ANZ Banking Group's Asia-Pacific Project Finance team, based out of Singapore.

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From Digital Twin to Site Acceptance: Leveraging Hardware-in-the-Loop Testing to De-risk Hybrid Microgrid Projects

Tony Delaplagne, Head of Research & Development, Dr. Hassan Issa, Microgrid Development and Simulation Engineer and Dr Jean Dobrowolski, Chief Technology Officer, Energy Pool

Abstract

As microgrids become increasingly sophisticated, traditional Factory Acceptance Tests (FAT) based solely on offline or software simulations are no longer sufficient to validate the complete behavior of integrated control systems. While these approaches can verify control algorithms under predefined operating scenarios, they fail to accurately assess real-time interactions, sequencing logic, communication delays, and dynamic responses between Energy Management Systems (EMS), Power Management Systems (PMS), Battery Energy Storage Systems (BESS), renewable generation assets, and field equipment. As a result, critical integration issues are often only discovered during commissioning or Site Acceptance Tests (SAT). This paper presents a methodology combining Digital Twin modelling and real-time Hardware-in-the-Loop (HIL) testing using the actual microgrid controller to reproduce site operating conditions before deployment. By validating operational sequences and asset coordination in a realistic environment, project teams can identify integration defects at an early stage, significantly reduce commissioning risks, shorten SAT activities, and improve overall project reliability. Practical lessons learned from microgrid deployments are presented to illustrate the benefits of this approach.

Introduction

The increasing deployment of renewable generation and Battery Energy Storage Systems (BESS) is transforming the operation of islanded and weak-grid power systems. Modern microgrids rely on the coordinated operation of EMS, PMS, generator controllers, renewable assets, BESS, and communication networks. As system complexity grows, ensuring proper integration and reliable operation before site deployment becomes a critical challenge.

Traditional Factory Acceptance Tests (FAT) mainly rely on software-based simulations to validate control functions and operating strategies. While effective for functional verification, these environments provide limited confidence regarding communication failures,

controller execution delays, protocol implementation discrepancies, and complex interactions between multiple assets. As a result, many integration issues are only identified during Site Acceptance Tests (SAT), when troubleshooting opportunities are limited and operational risks are significantly higher.

Project background

Enercal is a leading electricity operator in New Caledonia and a key driver of the territory's energy transition. Through its public service mission, the company ensures the continuity and quality of power supply while developing solutions to increase the share of renewable energy.

The Maré Island 100% renewable project illustrates this commitment. It combines solar generation, battery energy storage, advanced automation, and intelligent energy management to reduce the island's reliance on thermal generation and support its long-term energy autonomy.

In this context, the modernization of the Maré Island microgrid represented a critical step toward very high renewable energy penetration. The project involved the integration of a 1.6 MWp solar power plant at Hnagnow, a battery energy storage system at Tadine, and an automated control system designed to coordinate consumers, photovoltaic generation, storage assets, and the existing thermal power plant. Beyond upgrading the microgrid's technical architecture, the objective was to prepare the island for a future 100% renewable electricity supply.

The technical challenges associated with this transition were particularly relevant during the upgrade.

The project involved transitioning from a system where both diesel generators and the BESS could operate in grid-forming mode to an architecture where the BESS became the sole grid-forming asset. The migration also included the replacement of generator controllers and the validation of numerous operational sequences involving generator transitions, BESS startup, photovoltaic integration, and dynamic load management.

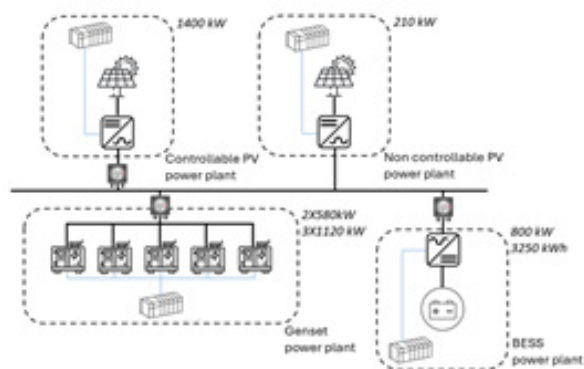


Figure 1 - Maré Island topology

To reduce commissioning risks, Energy Pool implemented a methodology combining Digital Twin modelling and real-time Hardware-in-the-Loop (HiL) testing using the production controller. This approach enabled the validation of real-time interactions, operational sequences, and communication behaviors under realistic conditions before site deployment, while also providing a valuable training environment for operators. The lessons learned demonstrate how Digital Twin and HiL technologies can improve commissioning efficiency, reduce risks, and increase confidence in the deployment of complex microgrids.

Method

Energy Pool's microgrid architecture is based on three complementary layers. The SCADA layer provides monitoring, data acquisition, alarm management, and operator interaction. The EMS optimizes the operation of the microgrid according to energy objectives, asset constraints, and renewable energy availability. The PMS ensures real-time power system stability through frequency regulation, voltage control, power balancing, and asset coordination.

A key feature of the Energy Pool PMS is its ability to support multiple operating modes. Depending on operational requirements, different assets can assume the grid-forming role, such as a diesel generator or a battery energy storage system. The PMS also manages transitions between automatic and manual operation, BESS standby modes, maintenance configurations, and degraded operating states following equipment outages. These transitions require dedicated control loops, synchronization mechanisms, interlocks, protection checks, and sequential operating procedures to ensure a smooth and secure transfer between operating states.

Using the Maré Island microgrid modernization project as an example, the transition toward a

BESS-only grid-forming architecture required the implementation of a new operating mode as well as numerous control sequences and transitions between operating states, involving coordinated interactions between generators, the BESS, and photovoltaic assets.

Mode	Genset	BESS	PV
Hybrid forming	Grid-forming statism	Grid-forming statism	Grid-tie
Manual	Grid-forming isochronous	Standby	Grid-tie curtailed at constant value
BESS forming	Base-load	Grid-forming statism	Grid-tie

As the number of supported operating modes increases, the complexity of the associated control logic grows significantly. Every mode introduces specific control loops, transition sequences, exceptional operating conditions, and failure scenarios that must be thoroughly validated. Consequently, testing activities cannot be limited to individual control functions but must also verify the interactions between multiple controllers, assets, and operating states across the complete microgrid lifecycle.

To accomplish that, the Factory Acceptance Test (FAT) relies on a Hardware-in-the-Loop (HiL) real-time simulation platform that was developed to validate the operation of the islanded microgrid control solution. Figure 2 illustrates the complete FAT setup procedure. As shown, the setup integrates Energy Pool's Power Management System (PMS), deployed on a Programmable Logic Controller (PLC), and the Energy Management System (EMS), hosted in the cloud.



Figure 2 FAT Setup - The Procedure

By coupling the real control hardware and software with a high-fidelity microgrid simulation model, a wide range of operating scenarios can be executed

under realistic conditions. This approach enables comprehensive validation of the PMS and EMS functionalities, including power balancing, optimal asset dispatch, system stability, operational constraints management, and communication performance, all before the on-site deployment.

Another key benefit of Energy Pool's FAT process is that it provides the client with access to the test visualization environment. In other words, the client can early access operational dashboards, visualizations, and performance indicators that will be available once the solution is deployed. Through the HiL simulation platform, the PMS and EMS generate monitoring data under realistic operating conditions, allowing the client to familiarize themselves with the user interfaces and the reporting tools. This not only facilitates user training and operational readiness but also enables validation of data presentation, system observability, and reporting requirements before commissioning.

Since operational sequences and PLC control logic have already been comprehensively validated during the HiL-based FAT, the scope of the Site Acceptance Tests can be significantly streamlined. Rather than repeating the complete functional validation of each sequence, the SAT can focus on verifying communication with assets, confirming the correct execution and monitoring of the validated sequences under real site conditions, and assessing the overall robustness of the control system. This approach reduces on-site troubleshooting and testing time, limits unnecessary operation and stress on the equipment, and enables a faster and more controlled commissioning phase.

Contributions

The combination of a site-specific Digital Twin and real-time HiL testing provides a powerful framework for validating microgrid control systems before deployment. By integrating the actual PMS and EMS with a high-fidelity model of the microgrid, the FAT can reproduce realistic operating conditions, including load variations, renewable intermittency, equipment failures, and operational transitions. This enables the validation of control logic, communication interfaces, protection sequences, and asset coordination in a controlled environment, allowing integration issues to be identified and resolved long before commissioning. As a result, deployment risks are significantly reduced, field interventions are minimized, and Site Acceptance Tests (SAT) can focus on confirming system performance rather than troubleshooting integration defects, leading to faster and more predictable project delivery. Furthermore, the Digital Twin serves as a validated representation

of the site, enabling a more mature and thoroughly tested product to be delivered to the customer. For instance, the SAT for the Maré islanded microgrid was successfully completed within five days, without any significant issues, particularly in control sequences and operational mode transitions.

Beyond reducing project risk, the approach also demonstrates the effectiveness of the PMS/EMS solution in optimizing microgrid operation, even before starting real operations. Through intelligent coordination of renewable generation, battery storage, and gensets, simulations prove that the system minimizes unnecessary genset operation, reducing fuel consumption and operating costs. At the same time, increased utilization of renewable energy and energy storage decreases greenhouse gas emissions, illustrating how advanced microgrid control can deliver both economic and environmental benefits.

After being tested on HIL environment during FAT, the 3 operating modes presented in Figures 3, 4 and 5 were successfully delivered on Maré site, confirming simulation results and illustrating the operational flexibility offered by Energy Pool integrated microgrid solution.

The 3 modes tested and delivered in Maré project

Manual Mode: In this mode (Figure 3), the BESS remains in standby while the diesel generators operate in isochronous grid-forming mode. To prevent the generators from being driven below their minimum recommended loading level, the PV production is curtailed to a fixed 150 kW limit. This operating mode provides a simple and robust fallback configuration suitable for maintenance or degraded operation.

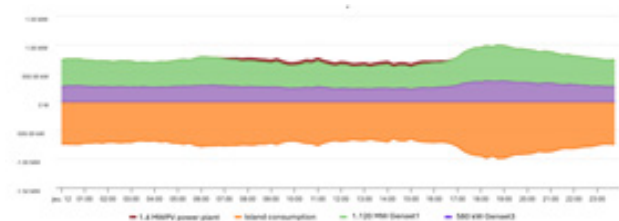


Figure 3 Typical day in Manual mode

Hybrid-Forming mode: in this configuration (Figure 4), both the diesel generators and the BESS operate in grid-forming droop control. In this configuration, power balancing is dynamically shared between the different grid-forming assets. Therefore, generator output continuously varies throughout the day in response to load fluctuations and photovoltaic production variability. This mode maximizes operational flexibility while maintaining stable

microgrid operation under changing conditions.

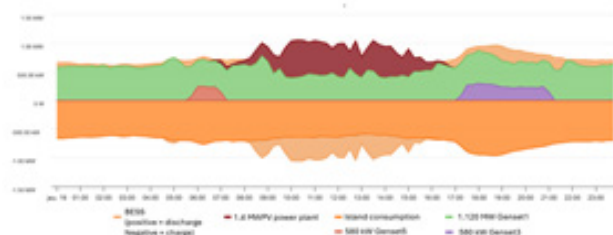


Figure 4 Typical day in Hybrid-Forming mode

BESS-Forming mode: Finally, in this mode (Figure 5), the BESS acts as the sole grid-forming asset while the diesel generators operate in base-load mode. Since the generators are no longer required to participate in fast power balancing, their output remains highly stable, reducing mechanical stress, thermal cycling, and overall engine wear. Under the operating conditions represented in Figure 5, the combination of photovoltaic generation and battery storage was sufficient to maintain system operation for approximately eight hours without running any diesel generator, demonstrating the potential for significant fuel savings and increased renewable energy penetration.

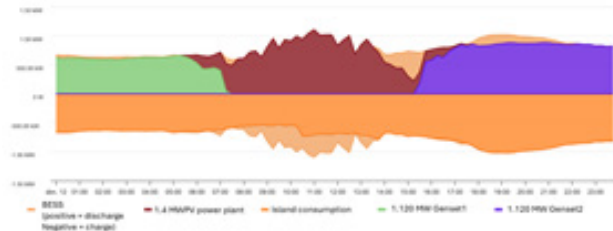


Figure 5 Typical day in BESS-Forming mode

Conclusion

The HiL simulation, being part of Energy Pool's FAT process, represents a significant step forward in the validation of islanded microgrid control solutions. By enabling the testing of control sequences and operational mode transitions in a real-time simulation environment, many issues that would traditionally be discovered during the SAT can now be identified and resolved much earlier in the project lifecycle. This approach minimizes commissioning risks, limits unnecessary stress and operational impacts on field assets, as well as reduces the uncertainty associated with on-site testing.

Following recent microgrid deployments, the gained experience demonstrates that transferring sequence validation from the site to a high-fidelity real-time simulation environment contributes to a smoother and more efficient commissioning phase. Consequently, this leads to fewer incidents and accelerated deployments.

Ultimately, HiL-based FAT not only improves the quality and reliability of control solutions but also enables a more efficient and predictable path towards successful project delivery.

About the Authors

Energy Pool Microgrid is a specialized business unit of Energy Pool dedicated to the design, development, and deployment of advanced microgrid control solutions. Leveraging expertise in Energy Management Systems (EMS), Power Management Systems (PMS), SCADA platforms, renewable energy integration, and battery energy storage systems (BESS), the team delivers innovative solutions for remote communities, islands, industrial sites, and critical infrastructures worldwide. Through a combination of advanced control algorithms, digital twin technologies, and field-proven operational experience, Energy Pool Microgrid supports customers in improving reliability, reducing fuel consumption, and accelerating the transition toward sustainable energy systems.

Dr. Jean Dobrowolski is Chief Technology Officer of Energy Pool Microgrid. He holds a PhD and has more than 10 years of experience in power systems, renewable energy integration, battery energy storage systems, and microgrid control. He leads the development and deployment of advanced EMS and PMS solutions and oversees product strategy, R&D activities, and technical project delivery for microgrid projects across the world.

Tony Delaplagne is Head of Microgrid Research & Development at Energy Pool Microgrid. He leads the engineering and innovation activities related to microgrid control systems, digitalization, and advanced energy management solutions. His work focuses on the development of robust and scalable technologies enabling the integration of renewable energy sources and battery storage systems into complex power networks.

Dr. Hassan Issa is a Microgrid Development and Simulation Engineer at Energy Pool Microgrid. He holds a PhD and joined the company in 2024. His expertise includes microgrid modelling, simulation, and control system validation. He contributes to the development and testing of advanced EMS/PMS applications, with a particular focus on digital twin environments, performance assessment, and system verification methodologies.

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Selecting the right Current - Limiting dropout Fuses is critical to networks

Goran Stojadinovic, MCE, MEE, Product and Innovation Manager, Transnet NZ Limited

Background

Traditional DDO rewirable expulsion fuses have served the electricity industry for decades as a cheap protection from fault currents. However, they are becoming obsolete for most applications because they handle only high fault currents, respond slowly, produce heavy arcing, vent hot gases and sparks, and pose a high bushfire risk. [Fig.1] They are also not suited to distribution networks with high renewables content.



Fig. 1: A night photo of a rewirable DDO fuse in operation

As climate change increases bushfire risk from electrical power lines, utilities are swapping traditional DDO expulsion fuses for current-limiting alternatives. Some distribution companies are replacing old-type rewirable DDO fuses with the basic level of current-limiting fuses – the Back-Up fuses, while others use Full-Range current-limiting dropout fuses (CLF). General-purpose current-limiting fuses are not widely used for this application.

1. Purpose of the current-limiting dropout fuse (CLF)

A current-limiting dropout fuse (CLF) must limit the current magnitude and energy to the protected

equipment by reliable operation in case of:

- High fault currents (short circuits on feeders on OH spur lines, and UG sections).
- Low overload currents (for transformers).

Also, for safety reasons (public & personnel) and to prevent potential bushfires, they must be arc-free, without explosions, hot gas expulsion, or noise.

Moreover, internal arcing must be limited to a very short duration, within half a cycle for high fault currents and several cycles for low overload currents. [1] This prevents fuse overheating and fire ignition due to extreme thermal and electromechanical stresses.

2. Types of current-limiting dropout fuses (CLF)

For medium-voltage fuses, there are three normalised classes of CLF fuses specified in IEC 60282-1 and shown in Fig. 2: [1]

Full-Range: CLF capable of breaking, under specified conditions of use & behaviour, all currents that cause the melting of the fuse elements up to its rated max. breaking current.

General-Purpose: CLF capable of breaking all currents from the rated max. breaking current down to the current that causes the melting of the fuse element in 1 hour or more.

Back-Up: CLF capable of breaking all currents from the rated maximum breaking current down to the rated minimum breaking current.

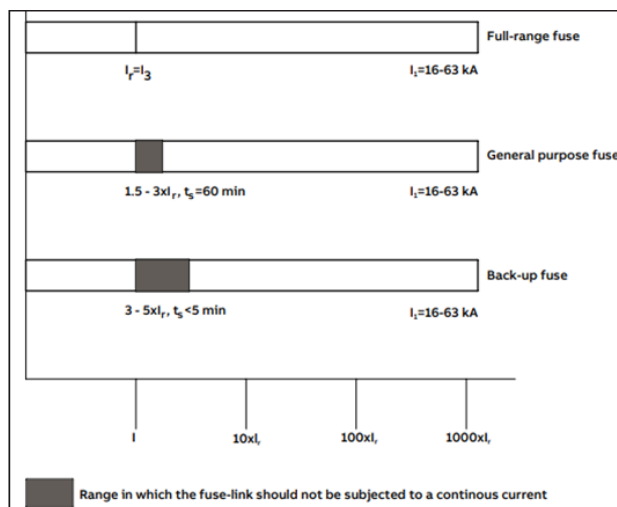


Fig. 2: Range in which the fuse should not be subjected to a continuous current [1]

3. Selecting the right CLF drop-out fuses is critical to Pacific nations' distribution networks with high renewables content

Traditional distribution networks are passive; e.g., they contain only loads. However, high uptake of renewables (solar and wind) in the Pacific introduces bi-directional power flow; e.g. the networks are now active.

Bidirectional power flow from inverter-based resources lowers available short-circuit currents and introduces highly varying load/generation profiles. It also directly affects the protection coordination between reclosers, protection OC relays, and fuses.

In this context, Full-Range CLF fuses significantly outperform Back-Up fuses (and General-Purpose fuses as well), as follows.

3.1 Operating at lower and varying fault currents

Inverter-based renewables severely limit the fault currents.

- A backup fuse on its own cannot efficiently and safely interrupt low-level faults or low overload currents below 3 to 5 times its nominal rating (refer to Fig. 2). [1]
At a low-current fault below the minimum breaking current, a backup fuse may melt but fail to clear the arc, leading to catastrophic fuse explosion or fire.
- Full-range fuses are designed to safely operate at any current level, from minimal sustained overloads up to their maximum interrupting capacity. [1]

3.2 Operating in bidirectional power flow conditions

On sunny days, high solar generation causes power to flow backward to the substation.

- Backup fuses require another device paired in series (like an expulsion fuse for low faults and overloads) to clear low currents. Coordinating these two components is extremely complex when power flow directions and fault currents change during the day due to changing weather conditions (sunny/cloudy, wind speed changes).
- Full-range fuses are standalone devices that operate independently by covering the full range of fault currents, from low overloads to high fault currents. They are not affected by fluctuating currents from renewable generation. [Tab. 1]

Feature	Full-Range Fuses	Backup Fuses
Minimum Breaking Current	No. Breaks any current that melts the fusing element	3-5 times the rated current; only breaks high-level fault currents
Standalone device	Yes. Completely standalone protection	No. Requires another device in series (e.g. an expulsion fuse for low faults and overloads)
Suits networks with renewables	Yes. Clears low fault and overload currents	No. Cannot safely clear low-level faults and overloads
Coordination requirements	Low. Operates independently under bidirectional flow	High. Difficult to coordinate with other devices in ever-changing power flow and lowered fault currents
Bushfire risk mitigation	Yes. Fully sealed and captures all arc energy.	No. Not sealed; can cause a bushfire or pole-top fire as any other rewirable fuse
Recommended use	Overhead power lines and transformers	Inside enclosures of pad-mounted transformers

Table 1: Comparison between Full-Range and Back-Up CLF fuses

3.3 Bushfire risk mitigation

Bushfire risk across the broader Pacific region is increasing due to climate change.

Drop-out fuses on MV overhead lines are the only electrical equipment designed to produce a visible flash, stream of hot gas and sparks, and an open flame during operation (Refer to Fig.1). They are not sealed; therefore, they are most likely to cause a bushfire.

Back-up fuses are not universally fully sealed either, so they do not contain arc energy within the enclosure; arc energy can escape and cause a bushfire, like any DDO. Furthermore, most back-up

fuses have a polyurethane fibre-reinforced body that can melt and burn due to overheating under low faults or overloads, causing bushfires.

Full-range current-limiting fuses are fully sealed and capture all arc energy within their sand-filled enclosure. The best full-range CLF fuses have a porcelain body, with superior thermal properties, and cannot burn. [3]

3.4 In summary

Full-Range current-limiting fuses (CLF) are much better suited for distribution networks with high uptake of renewable energy resources than Back-Up CLF fuses (or general-purpose fuses). They provide complete, standalone protection across all expected electrical fault scenarios, for both lines and transformers, including bushfire risk mitigation.

4. Comparing different designs of Full-Range CLF fuses

Not all Full-Range CLF fuses are equal either. There are two distinct design concepts.

Major manufacturers worldwide have adopted a common design concept. However, that design failed to perform as claimed and expected. Independent testing in the HV Test Lab at one of New Zealand's major universities proved serious design flaws in some of these fuses that compromise reliability and safety when clearing low-overload currents. [4]

Reformtech in South Korea invented and developed a new, much better design concept, which KEPCO (South Korea) has adopted. [3] As confirmed in the HV Test Lab, the Reformtech CLF fuse is the only one that works as expected, clearing both high-fault and low-overload currents. [4]

The following technical considerations should be factored in when selecting full-range current-limiting fuses as a replacement for the ordinary drop-out fuses.

4.1 Performance of Full-Range CLF at high fault currents and low overload currents

Generally, the higher the fault current, the faster the fuse melts, resulting in a shorter voltage-dip duration. Most CLF fuses work very well at high fault currents. However, low overload currents pose one of the most complex problems for CLF fuses. The main reason for CLFs' weak overload-current interruption capacity is their excessively long pre-arcing time. [5]

4.2 A common type of CLF design concept uses the M-effect; Reformtech doesn't

To address the problem of overvoltage and long pre-arcing time, most manufacturers use a perforated silver ribbon as a main fusing element, divided into two sections – a high-current clearing section and a low-current clearing section, thereby causing them to blow gradually. [8] They then introduced the so-called M-effect between these two sections, offering a potentially efficient way to shorten pre-arcing time under low overload currents. (Refer to Fig. 5).

The M-effect uses a small drop of low-melting alloy, such as tin (called a "thermal dot"), soldered to the fuse element (a perforated silver ribbon) near the neck point (a hole) [5]

In theory, under a low overload current, tin should heat quickly, melt, and diffuse into the silver ribbon, creating a local high-resistance alloy. The increased resistance of the fuse element should shorten the time it takes to blow. The ribbon should melt at several neck points until it breaks the current.

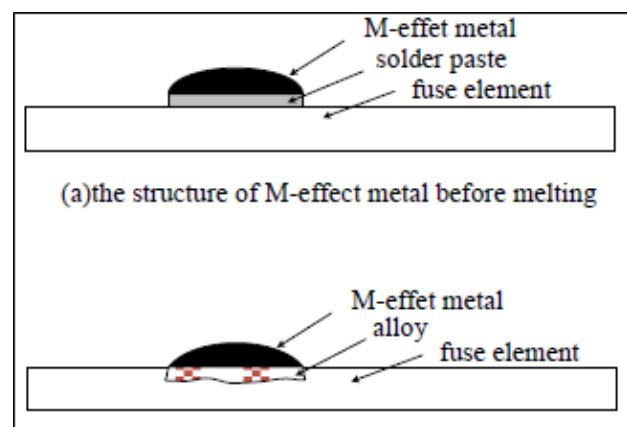


Fig. 3: Basic concept of M-effect [9]

However, in practice, this process is highly unpredictable and unreliable. [9] Experimental results and studies have concluded that under high overload conditions, above 2x the rated nominal current, the M-effect does not work. [5] The fuse element heats quickly, and the neck points melt faster, so there is no time for tin to diffuse into silver; e.g. it is too late for the M-effect to take place. For that reason, the M-effect is used mainly in LV and DC applications.

In contrast, Reformtech CLF has only one section. It does not use the M-effect. It is designed to handle both high fault currents and low overload currents with a single section of perfectly notched silver fusing wire, combined with a high-resistance triggering

tungsten wire in parallel. (Refer to Fig. 5) [3] [4]



Fig. 4: Reformtech CLF fuse broken open to reveal a single fuse element [4]

4.3 Typical failure mechanism of common CLF fuse tested at low overload currents

At low overload current, the fuse operated but did not drop out. [4] The fault current remained for around 45 cycles before clearing. Further current spikes were noted for the remainder of the test. A closer inspection revealed that, although the circuit was open:

- The main silver fuse element (ribbon) was still intact
- The M-effect did not take place either
- Instead, the bonding wires between the fuse element and the bottom end cap had melted (like in ordinary rewirable fuses)
- Video footage showed evidence of heavy internal arcing

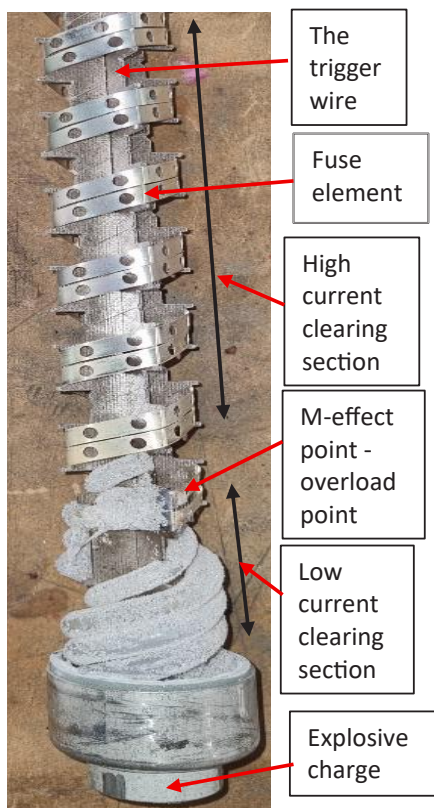


Fig. 5: Internal components (bottom half) of a common CLF that failed under low overload test currents. [4]



Fig. 6: Instead of the main fusing element, the bonding wires inside silicone tubes melted and broke the circuit after prolonged heavy arcing

In contrast, under the same low-overload test conditions, the Reformtech CLF fuse performed flawlessly. Its fusing element, the notched silver wire, burnt at several neck points and safely and efficiently cleared the fault in 4 cycles (11 times faster). [4]

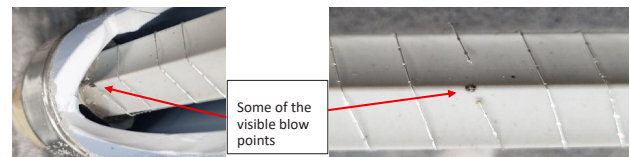


Fig. 7: The main fusing element of the Reformtech CLF blew at multiple points [4]

4.4 Triggering mechanism

Some common full-range CLF fuses use a small explosive charge to initiate the drop-out function. This defeats the purpose of making an explosion- and arc-free CLF fuse. It also produces a bullet-like bang when it operates. Unfortunately, some manufacturers omit this important detail in their fuse documentation.

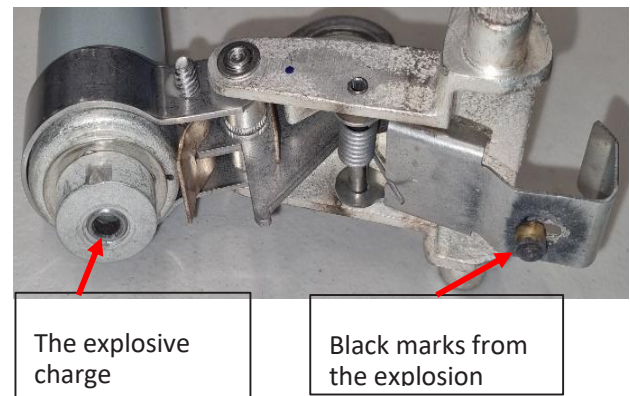


Fig. 9: The triggering mechanism in some common full-range CLFs [4]

In contrast, the full-range Reformtech CLF fuse triggering mechanism uses a loaded spring and

contains no explosive charge. Operation is smooth and silent, with no expelled hot gases or particles.



Fig. 10: Components of Reformtech full-range CLF triggering mechanism [4]

4.5 The CLF fuse enclosure and thermal properties

Most common design full-range CLF fuses have a polyurethane fibre-reinforced body that can melt and burn under high fault current or low overloads, causing bushfires.



Fig. 8: A common full-range drop-out fuse with a polyurethane fibreglass enclosure. It burnt out under the fault and caused a local bushfire. The only remaining part was fibreglass (Note: photo courtesy of an NZ distribution company)

In contrast, the full-range Reformtech CLF fuse has a porcelain body with superior thermal properties and cannot burn. [3] [4]

Summary and Discussion

The detailed study and HV Lab tests compared two completely different concepts and designs of the Full-Range Current-Limiting Fuses: [4] [6]

The common design of Full-Range CLF fuses uses a perforated silver ribbon as a fuse element, with two separate sections for clearing fault and overload currents, and the M-effect for the initiating clearing of low overload currents:

- While the ribbon is easy to make, it isn't easy to perfectly punch holes. This can cause undesirable electrical effects, including erratic arcing in parallel necks. [7]
- The M-effect is a metallurgical process that occurs at the molecular level and is extremely difficult to control due to many factors
- The explosive charge in the triggering mechanism defeats the purpose of making an explosion-free and arc-free CLF fuse
- The dropout function mostly malfunctions and is unreliable
- The polyurethane fibreglass body can burn and sustain fire, causing bushfires

Reformtech CLF design is the only one that uses a notched silver wire and a single section for reliable and safe clearing of both high and low currents (without M-effect):

- The fuse element is made of a perfectly notched silver round wire, which doesn't produce any undesirable electrical side effects
- Reliable drop-out is initiated by a mechanically loaded spring (e.g. there is no explosive charge in the trigger mechanism)
- Porcelain body and the former have superior thermal properties and resistance to thermal shocks; it does not burn

Conclusions

Comparing two different Full-Range CLF dropout fuses revealed significant differences in construction and operation between these two concepts and designs.

Reformtech's full-range CLF fuse has key advantages over other concepts:

- 1) Superior electrical properties:
 - It protects the lines and transformers from high fault currents
 - It protects transformers from low overload currents (from "slow cooking")
- 2) Superior thermal and mechanical properties:
 - It will not burn because its body and internal 'former' (the core that holds the main fusing element) are made of ceramic
- 3) Safety and environment:
 - It is guaranteed to operate, e.g. it drops out every time
 - When it operates, the Reformtech fuse does not produce any noise; it is quiet
 - It doesn't produce any arcing, flame, molten metal particles, or expulsion of any gases or particles outside the fuse body, reducing the risk of bushfires

- Its triggering mechanism doesn't contain any explosive charge

Reformtech is currently the only independently tested and proven Full-Range Current-Limiting drop-out Fuse in New Zealand that can safely and reliably handle both high fault currents for lines and low overload currents for transformers and mitigate bushfire risk.

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Power Engineering and product support from Hiko

Geoffrey Sullivan, General Manager, Hiko Engineering Ltd

When the company known today as Hiko Power Engineering began supplying electrical equipment, components and tools to electricity utilities 88 years ago, designing and manufacturing its own product solutions for power distribution networks was not part of the plan.

But today it is a major driving force of the company having developed advanced assemblies that make connecting assets to networks safer, easier, more reliable and longer lasting, says Hiko Power Engineering general manager Geoffrey Sullivan.

These Hiko innovations include underground distribution pillars (UDPs), underground service connections for branching networks (U-Pillars), network link boxes, link pillars and distribution cabinets and modular LV frames for transformers.

Sullivan says Hiko Power Engineering has come a long way since Harry Hamer left Gough, Gough and Hamer, along with the company's electricity product agencies. The company began manufacturing in 1959 in partnership with Bowthorpe and today Hiko manufactures the Bowthorpe HD series of line taps as its own brand and supplies product locally and to countries around the world who use British standards in their networks.



Whether it is components, accessories or complete assemblies, Hiko Power Engineering provides a range of solutions for connecting assets to networks

While the company continues to supply products from its exclusive international agencies such as EFEN, NKT, Lucy Electric, Pfisterer, Insulect, Sieyuan, Langmatz and Polaris, Hiko Power Engineering is now both a supplier of high-quality products and an engineering company designing and manufacturing LV assemblies for electricity distribution systems.

Sullivan says there is a lot more science and engineering that goes into the solutions the company makes today, and it was their customers that drove them down that path.

"About 20 years ago network operators were happy with the products and components we were supplying through our agencies. They were using some of them to construct distribution pillars, low voltage frames for transformers and other subassemblies but were not satisfied with the consistency of the results they were achieving in the field.

"To improve this, they asked us to go the next step and make up assemblies for them in a controlled work-shop environment, then ship each assembly as a complete plug-and-play unit they could rely on and simply install it.

"So, while we were established as an importer and distributor of electrical products for the electricity supply industry, the design and manufacture of our own assemblies and products to recognised standards has also become a major focus."

Sullivan says all their engineered solutions are quicker to install and reduce cost at time-critical sites.

Innovation

The company's most recent innovation is the U-Pillar which utilised the expertise in underground switchgear developed by the Hiko engineering team in its development of its UDP distribution system.

The Hiko UDP (underground distribution pillar) now patented in both New Zealand and Australia, combines industry-standard fusegear including EFEN DIN-type disconnects with Langmatz modular pits for distribution, reticulation and service supplies up to 1000 amps. Engineered to last, the underground pillar protects the fusegear by housing it under a composite 'bell' cover which creates a permanent air pocket for the fuses to safely operate in.

While the principle of using an upside-down air cavity to protect underground switchgear in flood conditions has been long established overseas, Hiko introduced it to New Zealand 15 years ago in its UDP family of underground link boxes. Today many electricity networks benefit from the technology developed by Hiko Engineering and utilise the UDP range with

up to six circuits and a mix of bus couplers, vertical fuses and switches.

Hiko production & design manager, John Spence, says their successful adaption of the air pocket technique in the UDP range, enabled Hiko to extend it further in the development of its U-Pillar.

Now up to 100 amp fuses and 160 amp horizontal disconnects can be designed into customisable U-Pillars covered by Class B and D lids for high traffic areas and roadways, says Spence.

"We designed the U-Pillar as a complete pre-wired unit that keeps the fusegear dry under a transparent bell. While you have to pump out any water to carry out maintenance on UDP switchgear, we designed the smaller U-Pillar to allow the whole fuse stand to be lifted out of the water and worked on securely above the ground without having to use a pump."

Spence says products like the U-Pillar have been developed in close collaboration with customers to ensure the final solutions take away the risks they face with potential installation and maintenance errors using traditional methods.

"The high engineering values we design into each product provide a lot more certainty that our U-Pillars, UDPs and LV frames will deliver consistency and reliability by design to meet both the safety and lifetime expectations of network operators," says Spence.

"They might not open a cabinet for years, but they can rely on our solutions to deliver safe, predictable and easy access for maintenance work at any time of the night and day and under any conditions."

To ensure this safety and performance by design, Hiko mechanical and electrical engineers worked with network contractors on site, sometimes in the middle of the night, to understand the issues they faced.



The U-Pillar has been designed to be as easy to maintain as it is to install

"We addressed these problems through risk analysis and applied a range of mitigating solutions such as touch reduction, arc initiation protection, lowering the weight of designs and making them modular so products like LV frames are easier to work with," says Spence.

"While our focus is on ensuring the safety of everyone installing and maintaining the equipment, we also ensure the safety and performance of the network architecture through precision engineering, material selection and comprehensive testing.

"We stress-test risk elements in our designs like thermal testing of busbars and underground products to ensure they remain within tolerable limits under full load. We also test insulator strength and stress-test busbar mounts to ensure they will not fail under extreme conditions."

Further engineering and high voltage testing are carried out in the EPE Centre at the University of Canterbury.

Customised solutions

Geoffrey Sullivan says Hiko Power Engineering continues to develop its asset solutions with more than half the company's production today being customised to meet the standards and requirements unique to each network, regardless of the age and type of transformer.

"We have developed an extensive library of CAD designs to enable us to provide any design variation for a lines company based on the pre-engineered combinations we have already established. This enables us to minimise downtime for our customers where an emergency replacement is required.

"We also supply CAD drawings to customers with quotes so they know what they are getting before the product turns up so they can verify beforehand, for example, that every frame fits the intended transformer."

Hiko's South Island key account manager, Mike Scott, says while Hiko engages with its customers very effectively and collaboratively at an engineering and design level, the company also continues to supply a large portfolio of globally sourced, high quality, products and equipment designed to connect assets to networks.



Hiko Power Engineering supplies components and equipment from a range of international manufacturers including EFEN, NKT, Lucy Electric, Pfisterer, Insulect, Sieyuan, Langmatz and Polaris

"We supply everything from Bowthorpe line taps, Pfisterer IPCs and fuse holders for overhead line connections, through to Insulect substation disconnectors, electronic sectionalisers, and airbrake switches. We also supply underground NKT and Pfisterer LV, MV and HV cable accessories to connect the network to transformers, LV frames and substation switchgear."

While these products take care of connectivity between network assets all the way to the end-consumer, Hiko is also supporting network planners, engineers and operators with remote monitoring of LV loads using the Gridkey system.

Scott says by installing a Gridkey low voltage monitoring device on an LV-frame, actionable real-time data can be gathered to detect phase imbalances, warn of potential voltage and temperature problems, monitor total harmonic distortion (THD) and assist in fault location.

He says Gridkey also provides network companies with tracking data over time so that they can more effectively plan for network upgrades. This type of monitoring can help networks future-proof against the impact of PV and EV installations.

"Hiko Power Engineering is the ideal partner to help manage changing LV loads with the latest technology. This includes frames with fused switchgear or with remotely controlled MCCBs – all designed to protect networks and communities."

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Opening of the Pacific Sustainable Energy Training Centre

Geoff Stapleton, Executive Officer, Sustainable Energy Industry Association of the Pacific Islands

The Pacific Sustainable Energy Training Centre (PSETC) at the University of the South Pacific (USP) Pacific Technical and Further Education (TAFE) campus in Statham Road, Suva was officially opened on 27th August by Fiji's Minister for Public Works, Meteorological Services and Transport, Honourable Ro Filipe Tuisawau, who is also responsible for Fiji's Department of Energy

Over 100 people from industry, development partners, government representative academic staff, students and regional stakeholders were at the ceremony.

In addition to the Minister's opening address, speeches were also given by the :

- USP Pro-Chancellor and Chair of Council, the Right Honourable Siosua Utoikamanu,
- Executive Officer of the Sustainable Energy Industry Association of the Pacific Islands (SEIAPI) Mr Geoff Stapleton AO representing the philanthropic donor from the USA; and
- Director of USP Pacific TAFE, Ms Rosalia Fatiaki

After the ribbon was cut, Mr Stapleton gave the Minister and USP Pro-chancellor a tour of the centre.

In his speech Mr Stapleton said that Dr Herb Wade, a former Fiji Director of Energy, who developed the initial solar training in the Pacific region in the 1980's, sowed the seed for this centre and should be known as the "father" of the PSETC. In 2005 Dr Wade and Mr Stapleton co-authored the document, Pacific Renewable Energy Training Initiative (PRETI) which proposed a Pacific training centre based in Fiji that would develop sustainable energy training resources for the PICTs. However, the initiative was never funded.

SEIAPI has been promoting the need for solar training for system designers, installers and maintainers since its establishment in 2010. The private solar industry companies and the electrical power utilities in the region require a well-trained technical workforce to

meet the needs of their customers and to support national energy objectives.

Over the years SEIAPI has been very active in developing the necessary components of a quality framework for the solar energy industry including:

- Developing 19 sustainable energy training unit standards (micro-credentials) which were approved by the Educational Quality and Assessment Programme (EQAP) for inclusion in the Pacific Register of Qualifications and Standards (PRQS).
- Developing 16 technical standards to be used to support the industry.
- Arranging for German aid organisation Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), to purchase a one-off license-agreement between Global Sustainable Energy Solutions (GSES) and the Pacific Power Association. The agreement provides access for Pacific based training institutes to training resource materials on the design and installation of solar PV systems
- Developing the SEIAPI/PPA program that accredits designers and installers of solar systems and other technology applications.
- Supporting USP Pacific TAFE in obtaining a license from GSES to offer online training courses from June 2022.

Due to travel restrictions during the covid pandemic in 2022 the long-term objective of in-person solar training readily available in the PICTs was delayed. A USA based philanthropic foundation (which wishes to be anonymous) approached SEIAPI in July 2022. Through facilitation by SEIAPI, USP Pacific TAFE signed a funding agreement for US\$800,000 in December 2023 for:

- the construction of a new sustainable energy training centre at its Statham Campus in Suva with furniture and IT equipment
- two new trainers with salaries covered for a minimum of 2 years;
- a PV and battery energy storage system suitable for the new building;
- equipment to be used for practical training; and
- testing and measurement equipment required for training.

The construction of the building was managed by USP's Estates and Infrastructure section. SEIAPI provided advice on the design, managed and oversaw the equipping of the training centre and represented the foundation during construction.

In May 2026, SEIAPI and USP Pacific TAFE signed a partnership agreement to facilitate SEIAPI/USP Pacific TAFE arrangements for ongoing PSETC operations. The PSETC will operate under the academic, financial, and governance oversight of USP. SEIAPI shall serve as an industry and technical partner.

PSETC will initially offer micro-credential courses similar to those in Australia, New Zealand and North America to allow technicians/engineers to design, install, operate and maintain, and inspect grid connected solar systems, off-grid systems (solar and solar/diesel hybrids) and battery energy storage systems. The centre will continually liaise with SEIAPI and PPA members to develop the courses identified to meet their needs in this quickly changing industry. These could include system control for multiple generation sources, solar water pumping, EV charging and energy efficiency.

PSETC will also investigate with the industry different training delivery models. This could include flexible delivery such as 15-day courses, 1 day per week over 15 weeks and providing on the job training and assessment.

Training resources developed through SEIAPI and PSETC will be made available to other training centres. SEIAPI has been working with existing training institutes in the Solomon Islands, Federated States of Micronesia, Vanuatu, Kiribati and Tonga.

SEIAPI would like to thank:

- The USA philanthropic foundation for its support;
- USP Pacific TAFE for providing the land;
- The following companies for donating equipment for the centre: Sungow with Solar Juice, TCL Sunpower, Victron Energy, Goodwe, Tindo Solar, ComAp, Clenergy and CBS Power Solutions; and
- The following companies for providing equipment at very reduced prices: Selectronics and Enphase with AC solar warehouse.



Figure 1 starting of opening ceremony



Figure 5 Geoff Stapleton, Minister and Pro-Chancellor



Figure 2 Training Centre



Figure 6 Geoff Stapleton's Speech



Figure 3 Training Centre



Figure 7 Opening of Training Centre



Figure 4 Training Centre and Simulated Roof



Figure 8 Inverters and Battery System for building



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Bridging the Grid: The Enercal & PNG Power Partnership is Pioneering Regional Technical Exchange

PNG Power Limited

Across the Pacific, electricity utilities have a common pressing mandate: transition to renewable energy at pace, while maintaining grid stability on isolated island systems. While the targets are clear, the operational realities of managing variable renewable energy (VRE) like solar and wind present a formidable technical bottleneck.

To solve these complex integration challenges, Pacific utilities are increasingly looking to one another. The collaboration agreement between Enercal (New Caledonia's public power generation, transmission, and distribution utility) and PNG Power Limited (PPL) stands as a blueprint for how peer-to-peer technical integration can accelerate the Blue Pacific's green transition.

Facilitated and funded by the French Agency for Development (AFD) through its FEXTE (Fund for Technical Cooperation and Experience Transfer) mechanism, this partnership bypasses top-down consulting in favor of deep, utility-to-utility operational exchange. Mr Benoit, Country Representative of Agence Française de Développement (AFD) in Papua New Guinea explained "This is a great example of regional expertise mobilized in the long term by donors working closely with PNG Power Ltd to address capacity issues."

The Genesis of the Alliance

This unique agreement was signed during French President Emmanuel Macron's historic visit to Papua New Guinea in July 2023, signalling a dramatic scaling up of French commitment to climate resilience and energy transition in the region

Recognizing that PNG Power is tasked with managing massive infrastructure development across a highly fragmented, topographically challenging island grid network, AFD stepped in to fund a €800,000 (approx. PGK 3.5 million) technical framework. Rather than bringing in external agencies unfamiliar with the unique conditions of Oceania, the program explicitly tapped into the localized genius of Enercal.

As an active fellow member of the Pacific Power Association, Enercal has spent years practising the

delicate balance of injecting high percentages of solar and hydro power into small, isolated multi-grid networks across New Caledonia.

The Mission: Taming Intermittency

The core objective of the FEXTE-funded arrangement is to help PNG Power build institutional and operational capacity to manage the "intermittent" nature of renewable assets. When cloud cover suddenly drops solar output, or wind speeds shift, a small grid can destabilize in seconds.

The Enercal-PNG Power partnership targets these exact system vulnerabilities through three core pillars:

- **Dynamic Grid Modelling:** Shared engineering workflows to simulate VRE penetration and map how PNG's regional grids handle sudden load shifts.
- **Operational Best Practices:** Transferring Enercal's proprietary methods for storage integration (such as large-scale battery storage installations) and real-time network stability controls.
- **Field-Level Engineering Exchange:** Moving past theoretical reports by embedding technical staff and engineers into peer operating environments to study active grid management systems.

Proving the Concept: Capacity building and studies for solar, hydro and network stability

Since 2024, a number of mission trips from Enercal's experts to PNG and a study tour in New Caledonia dedicated to visits of solar plants and control room for network stability took place.

The regional cooperation has been instrumental in identifying an investment plan of urgent actions easy to implement for PPL through a financing from AFD: replacement of turbines for Rouna3 hydro power plant and automation of the entire complex, solar plants on two sites for which land belongs to PPL, improvement of network stability and protection of the POM grid.

A practical training took place in 2026 aiming to learn how to design a solar plant on the basis of case studies for the sites identified in the investment plan. With similar climate and topographic conditions and similar power capacity to generate, New Caledonia and PNG benefit a lot from sharing experience and expertise. Before end of 2026, a training on network protection and a study on network stability of the POM grid will take place.

A Model for PPA Regional Integration

For the wider Pacific Power Association community, this arrangement highlights a vital truth: the solutions to the Pacific's energy crisis already exist within the Pacific.

By pairing the deep localized infrastructure experience of PNG Power with the advanced VRE integration toolkits developed by Enercal, and backing it with targeted bilateral development financing from the AFD, this partnership bypasses traditional development friction. It exemplifies the exact spirit of regional integration and resource pooling that the PPA has championed since 1992.

As utilities gather to deliberate the future of our grids, the Enercal-PNG Power collaboration stands as concrete proof that when Pacific neighbours share electricity expertise, the entire region moves closer to a self-reliant, sustainable, and illuminated future.

Paul Bayly, CEO of PNG Power Limited reflects "there is deep technical and local experience in the Pacific region. The challenge is to harness what we are good at and combine it with the right partner to bring about a local solution with a regional impact. Ultimately we are strong working together."

About the Facilitator: *The Agence Française de Développement (AFD) Group funds and supports the transition to a fairer, more sustainable world. With a renewed focus on Oceania through its Pacific Ocean Regional Office, AFD's energy portfolio focuses on climate adaptation, grid modernization, and fostering regional integration among French territories and neighbouring Pacific Island States.*

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Turning the Pacific's Ocean into Power

Jan G. Skjoldhammer, Founder and CEO, NoviOcean



At NoviOcean, we believe the ocean can add another important resource to the Pacific's move towards cleaner, more secure energy systems.

Pacific Island countries are surrounded by vast ocean areas with strong wave, wind and solar resources. In many locations, wave energy can complement wind and solar, helping to provide a more balanced renewable generation mix.

For island grids, this can mean less dependence on diesel and less reliance on costly battery storage to manage variable renewable generation. A more balanced supply can also make it easier to integrate renewables while maintaining grid stability and, importantly, strengthen energy security by reducing the amount of imported fuel needed for power generation.

Our work at NoviOcean is focused on bringing these resources together – wave, wind and solar on one offshore platform – as part of the generation mix.

NoviOcean is a Swedish renewable energy company developing an offshore hybrid platform that combines wave, wind and solar power on one floating structure.

We are now progressing towards full-scale demonstration and, as we look ahead to commercial deployment, we see the Pacific as a region where this type of technology could have a particularly good fit.

Why We Combine Wave, Wind and Solar

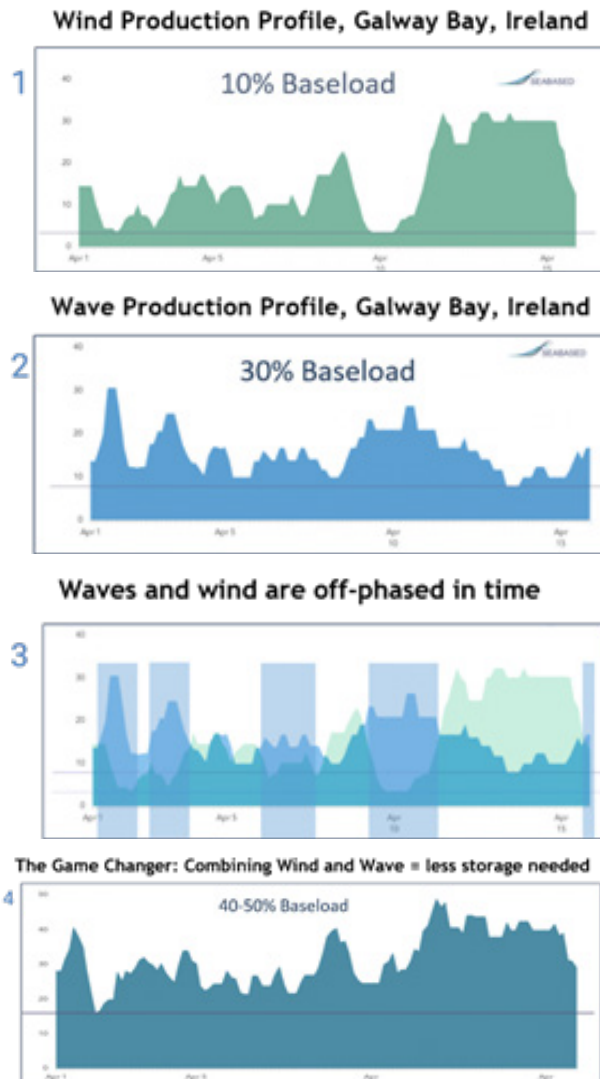
Our current system under development, the Medi Wave 850H, is designed with a rated capacity of approximately 850 kW, combining: Wave: 300 kW, Wind: 350 kW, and Solar: 200 kW.

Wave power forms the base of the system, with vertical-axis wind turbines and solar PV installed on the same offshore platform.

The reason for combining the three is practical.

Wave, wind and solar have different production patterns. Solar produces during daylight hours, while wind and waves continue producing at other times. Because ocean waves store and transport energy, swells can continue for hours or even days after the local wind weakens or moves away. This time lag allows wave energy to complement wind and solar particularly well.

By bringing these resources together, our aim is to achieve a more balanced renewable generation profile than would normally be available from a single resource alone.



This is especially relevant for smaller or isolated grids, where integrating increasing amounts of variable renewable generation needs to be carefully managed.

A more complementary generation profile can also help reduce the amount of battery storage required and reduce the operating hours of diesel generation.

As our founder and CEO Jan Skjoldhammer often puts it, the goal is not simply to produce renewable electricity when the resource is available. It is to make renewable energy more stable, more useful to the grid and more competitive with the diesel generation it needs to replace.



Making Better Use of Available Space

Another reason we believe the technology could be relevant to Pacific islands is land.

Finding suitable land for renewable energy development is not always easy. The same land may already be needed for homes, agriculture, tourism, infrastructure, community use or environmental protection.

Offshore energy gives us another option.

Our platform is approximately 60 metres by 30 metres and combines three renewable resources on the same structure. This allows us to produce renewable electricity without requiring a large area of land.

For us, this is one of the most interesting aspects of working in the Pacific.

An island may have limited land, but it is not limited in the same way when we look at the ocean surrounding it.

We believe that ocean space can become part of the renewable energy solution, alongside the solar, storage, hydro, wind and other technologies already being developed across the region.

From the Ocean to the Grid

NoviOcean has secured three patent families protecting key elements of its wave energy technology and power take-off system.

At the heart of the technology is the interaction between the floats, cylinders and water turbine. As waves pass along the platform, the floats move independently with the local wave motion, acting on vertically mounted power take-off cylinders. Rather than requiring the floats to move in synchronisation, their individual movements contribute to a common pressurised water flow. This water is then directed through a Pelton turbine connected to a generator, converting the irregular movement of the waves into electricity.

The principle has similarities to conventional hydropower, but instead of using water falling from a height, NoviOcean uses the lifting force of ocean waves to create the pressure and flow needed to drive the turbine. The system has been developed around proven engineering principles and components, adapted for continuous operation in the offshore environment.

The technology is also being developed with future add-ons in mind, including desalination and green hydrogen production, which could be integrated depending on the needs and scale of each project.

For the Pacific, we see particularly strong potential for desalination. Many island communities face freshwater constraints alongside the need for secure and affordable energy. In the future, renewable energy produced by the platform could support reverse-osmosis desalination and freshwater production, allowing the same offshore system to contribute to both energy and water security. Green hydrogen production could provide another future application where there is a suitable local or commercial need.

Where We Are Today

NoviOcean was founded in 2016 with the ambition of making ocean energy clean, commercially viable and practical, using proven engineering principles and readily available components.

Our journey began with the Alta Wave 1000H, developed for larger wave conditions. The technology went through several stages of testing, from 1:7 and 1:5 scale prototypes and 24 months on a test rig, to wave-tank campaigns in the UK and France. We then took the technology offshore, where the prototype operated for approximately 14 months in real sea conditions, powering a small island and operating under full remote control.



What we learned from Alta Wave became the foundation for our next generation, the Medi Wave 850H. While Alta was developed for larger waves, Medi is designed to work effectively in medium and smaller wave conditions, opening up a much wider range of potential locations.

Our latest N03 prototype is another step in that journey. It is being used to further develop and validate the Medi Wave concept as we prepare for the next major milestone: a full-scale hybrid pilot combining wave, wind and solar.



Importantly, NoviOcean is not developing every part of the platform from scratch. Wind Harvest's

wind technology and Midsummer's flexible solar technology are at approximately TRL 8 and TRL 9. Together, wind and solar represent about 65% of the platform's rated capacity and an estimated 55% of annual production.

The floating structure uses established shipyard construction, while NoviOcean's TRL 6 wave system is progressing towards TRL 7 and is built around proven hydropower components. More than 500 days of offshore operation, wave-tank campaigns and long-duration rig testing further reduce the overall technology and execution risk.

Along the way, NoviOcean and its technology have received five national and international awards and recognitions, as well as the European Commission Seal of Excellence. Our development has also been supported through Swedish and European public funding programmes.



Next steps:

As NoviOcean moves towards full-scale demonstration and commercialisation, we are looking to build the right partnerships in the Pacific and explore where hybrid ocean energy can bring the most value to the region.

We believe future projects should create value within the Pacific, not only deliver energy to it. By working together from an early stage, projects can benefit from local knowledge and regional capabilities, while creating opportunities to build skills, strengthen supply chains and keep more long-term project value within the region.

Depending on the needs of each project, a consortium or project-specific SPV could be one way of bringing these strengths together. This could allow responsibilities and risks to be shared appropriately, while creating a structure that can bring together the right mix of funding and investment as the project develops.

There is also strong potential to build on existing capabilities across Australia, New Zealand and

the Pacific, with regional fabrication, engineering, installation and long-term maintenance becoming part of future deployment.

Rather than starting with a fixed model, we are open to exploring the right approach together—one that works for the local energy system, makes technical and commercial sense, and creates lasting value for the Pacific.

Please contact us using the details below for further information or discussion, or book a meeting directly with our CEO: <https://calendly.com/jan-skjoldhammer-noviocean-ocean-energy>



Visit our Website
<https://noviocean.energy/>

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Variya K: Business Development Director
variya.kietprungvej@noviocean.energy

The Idea Behind NoviOcean

After a career as an airline captain, display pilot and instructor, I had seen first-hand aviation's enormous fossil-fuel use. As an inventor, I had also watched earlier ideas become successful products in others' hands. One idea was still waiting in my drawer – NoviOcean. I decided to bring it to life myself and help create a cleaner energy future.



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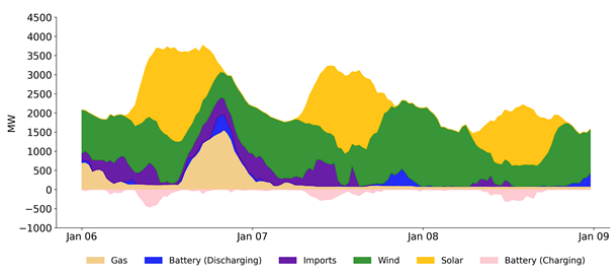
Barker Inlet's evolving role in one of the world's leading renewable power systems

Javier Savolainen & Vedansh Bihani, Wartsila Energy

Six years into operation, the flexible engine power plant at the heart of AGL's South Australian portfolio is being called on more often, in more seasons, and during more hours of the day than ever before.

South Australia's renewable share has climbed to around 78 per cent of generation, placing the state among the power systems with the highest shares of renewable energy in the world. Barker Inlet Power Station, delivered to AGL Energy at the end of 2019, was designed to operate in a power system with growing shares of renewable energy. The 211 MW plant, featuring dual-fuel reciprocating engines, was built to provide firming capacity for renewable generation rather than operating constantly in baseload mode. Six years later, the way the plant is being used continues to evolve.

Electricity demand in South Australia has continued to grow while renewable generation has expanded further. Although renewables now provide most of the grid's generation, Barker Inlet continues to record substantial running hours, shaped by weather and demand variability.



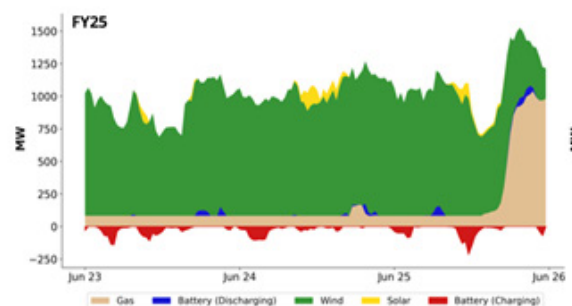
Equally notable is when the plant is running. The plant has traditionally been busiest during autumn and winter demand peaks, though its operating profile can vary significantly from one year to the next, depending on rainfall, wind conditions and solar generation. Variable weather patterns are making seasonal demand and renewable output more difficult to predict. Barker Inlet's running hours are increasingly extending into summer and spring as well. This points to a broader role for firming capacity across all seasons, rather than only during a limited number of predictable peak periods. Barker Inlet appears to be called on more often to help support system balance across a wider range of operating conditions.

Why the evening peak is not the whole story

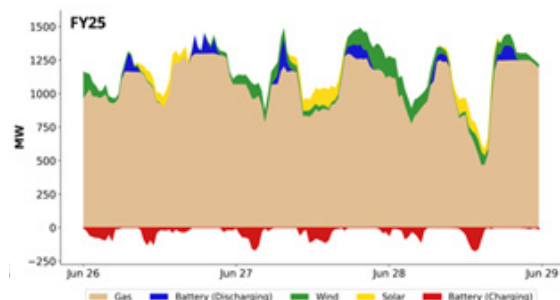
The evening peak remains one of the most visible challenges in renewable rich power systems. As solar generation falls towards the end of the day and electricity demand remains elevated, dispatchable resources are needed to fill the gap.

Battery energy storage systems play an important role in this period and are particularly effective at providing fast response over short durations. South Australia's experience, however, demonstrates that the evening peak is only part of the balancing challenge. A more demanding test comes during extended renewable drought periods when both wind and solar generation remain low for longer than a single evening. In these conditions, battery duration becomes a binding constraint. No matter how much battery capacity is installed, batteries still need sufficient stored energy and opportunities to recharge. When low wind and solar output persist, those opportunities may be limited. Firm, flexible capacity like Barker Inlet can help fill that gap, with the plant's running hours extending well beyond the traditional evening peak.

High renewable energy day



Low renewable energy day



This operating pattern reflects the plant's modular design. Its individual engines can be started or stopped independently, allowing the plant's output to be adjusted to changing system requirements throughout the day and night. Instead of following a fixed operating profile, the plant can respond flexibly to system needs as they evolve.

A pattern set to spread

Barker Inlet's changing utilisation profile is relevant beyond South Australia. The state is often viewed as an early example of how power systems operate as renewable penetration increases, providing insights that may become relevant elsewhere as energy transitions progress.

Significant changes are already underway across Australia's National Electricity Market. Around 14 GW of coal-fired generation is expected to retire by 2035, increasing the need for new ways to maintain reliability as the share of renewable generation grows.

While every market will follow its own transition path, South Australia's experience indicates that the need for flexible balancing capacity does not disappear as renewable penetration rises. Instead, the nature of that need evolves. Year-to-year variations in weather, and therefore in wind and solar output, add another layer of uncertainty for system planners. Flexible assets may be called on across more seasons, during more hours of the day and under a wider range of operating conditions than originally anticipated.

Barker Inlet's latest operating data offers a glimpse of what the future could look like. Six years after entering service, the plant is more relevant than ever, running more frequently and supporting the power system across a wider range of conditions than during its early years. As renewable generation continues to expand, similar operating patterns may become increasingly familiar across other parts of Australia's electricity system.



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I Just Saw the Future and its Electric

Judy Yuen, Accountant, Pacific Power Association

In June 2026 I joined the Smart Energy Council (SEC) delegation to China which was delivered by the Renewable Energy Council Asia Pacific (RECAP).

What I saw blew my mind.

In the Pacific we tend to be at the end of global supply chains, and we certainly don't get to see large-scale manufacturing operations.

My visit began in Beijing, where I attended the Fourth China International Supply Chain Expo where Australia was the "Country of Honor".

We certainly do not see exhibitions like this in the Pacific - hall after hall of bright lights, rolling videos and shiny gadgets - a big step up from the pull-up banners and printed literature of the usual Pacific exhibition.



The delegation at the 4th China International Supply Chain Expo. Photo credit: RECAP

The site visits that followed really changed my view of the world's future energy system.

While we are seeing a trickle of electric cars and minibuses in the Pacific, we visited XCMG which is producing all-electric haul packs at scale for global mining companies like Australia's Fortescue as well as agricultural, roadmaking and other industrial machinery.



The delegation at XCMG. Photo credit: Tim Buckley, Climate Energy Finance

During the visit I had the opportunity to speak to the other delegates. It was fascinating to hear from Daniel Bleakley how he is rolling out an electric truck delivery service in Australia.

I knew BYD made cars, but I did not know that they made light and rigid trucks like the ones we use in the Pacific. Perhaps we can power our transport fleet with sunshine.



The delegation at BYD. Photo credit: RECAP

Existing diesel trucks can be retrofitted so don't have to wait for the entire vehicle fleet to be replaced. Charging networks and grid management are an important element of this transition. This is where I also met another delegate, Lisa Marsh from eLumina, which helps utilities overcome these challenges.

China is even rolling out electric container ships. How good would it be if we could electrify our maritime transport in the Pacific? From ferries to cargo vessels, we could slash the cost of transit and transport.

I was joined on the visit by Jaydol Jacob from Alternate Energy, a solar and battery installation company in the Solomon Islands.

As a member of the Sustainable Energy Industry Association of the Pacific Islands (SEIAPI), Alternate Technology was recognised as the first locally owned company in the Solomon Islands to promote, market, and engage in the electric vehicle sector. Jaydol said this recognition has highlighted the country's potential to advance its e-mobility transition and has positioned our company as a pioneer in this emerging industry

A visit to Sigenenergy, well known for its stackable batteries, got us thinking about how we could quickly add renewable energy to households around the region.

Sigenenergy also manufactures plug-in solar PV kits and batteries, sometimes referred to as balcony solar, and batteries—two-to-four solar panels with microinverters and a battery that can be plugged into an existing electrical socket. These modular systems can be rolled out quickly across households & islands which are currently experiencing diesel fuel shortages.

We heard that energy retailers and grid managers in Europe and America have different rules for plug-in kits because most of the electricity generated is used within the house with very little ever flowing back into the grid, bypassing concerns some grid operators have about safety and minimum demand levels during the middle of the day - the so-called solar "duck curve".

How good would it be if we could deploy these technologies now in the middle of a fuel price crisis? Households could have access to free electricity while the cost of transport could be slashed, along with air and climate pollution.

I also had the opportunity at the end of the visit to see my extended family in China's south. I don't get to travel back often, and I was a bit apprehensive ahead of the visit. I didn't need to be though. My family arranged for me to be picked up from the airport and whisked to their hometown. All around us were electric buses, cars and trucks - the road trip was so quiet!

I really look forward to the time when we can electrify our transport fleets in the Pacific, allowing passengers to travel in quiet comfort and breathe cleaner air.

These delegations give you the chance to see the technologies firsthand, make connections with original equipment manufacturers, project developers and make lasting friendships.

Big thank you to Zoey Xiao, Professor Scott Hamilton and Richard Neumann for including me in the program and for all your assistance with the visit arrangements.

Welcome!

TO THE NEW ALLIED MEMBERS

There have been nine (9) new Companies who have joined the PPA as Allied Members since our last PPA Magazine.

ABB AUSTRALIA PTY LTD: ABB Australia Pty Ltd is based in Notting Hill, Australia. Their primary activity is OEM of synchronous condenser and associated equipment/services. Their secondary activity is synchronous condenser turnkey package supplier.

AUSTRALIAN POWER EQUIPMENT: Australian Power Equipment is based in East Maitland, Australia. Their primary activity is Med-High voltage power solutions and equipment. Their secondary activity is refurbished and secondhand power equipment.

DEIF AUSTRALASIA PTY LTD.: DEIF Australasia Pty Ltd is based in Nottinghill, Australia. Their primary activity is renewable energy systems. Their secondary activity is protective devices.

IPS – ENERGY AUSTRALIA PACIFIC PTY LTD: IPS- Energy Australia Pacific Pty Ltd is based in Preston, Australia. Their primary activity is sales and implementation of power utility software. Their secondary activity is grid operations and asset management.

SOFARSOLAR AUSCO PTY LTD: SOFARSolar Ausco Pty Ltd is based in Sydney, Australia.

TRUEPOWER: Truepower is based in Auckland, New Zealand. Their primary activity is providing electrical engineering products. Their secondary activity is providing engineering services.

INFRACON PACIFIC: Infracon Pacific is based in Mooloolah valley, Australia. Their primary activity is designing and constructing microgrids and microgrid control systems. Their secondary activity is substation automation and protection schemes including arc flash.

SUMITOMO ELECTRIC: Sumitomo Electric is based in Kyoto, Japan. Their primary activity is equipment supplier. Their secondary activity is services supplier.

DULHUNTY POLES PTY LTD: Dulhunty Poles Pty Ltd is Moolap, Australia. Their primary activity is poles. Their secondary activity is poles hardware.

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- UPS systems to 1000kVA
- Batteries & load banks
- Generators, fuel tank systems

EV CHARGERS

- Wallbox & pedestal chargers
- AC charging: 3.5kW-43kW
- DC fast charging: 12kW-400kW
- RFID, Wi-Fi, 4G & Bluetooth
- Dynamic load management
- User management & billing
- Solar canopy for EV chargers

MV / HV EQUIPMENT

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- MV switchgear & transformers
- HV & MV capacitors
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- HV lightning protection design
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- Exothermic welding equipment
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LIGHTNING & SURGE PROTECTION

- Active lightning protection
- Conventional lightning protection
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- Design & consultancy
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- Lightning warning systems
- On-site inspections

EARTHING & EXOTHERMIC WELDING

- Copper tape & bars
- Copper, galvanised & stainless rods
- Earth bars & earth pits
- Rebar clamps & connectors
- Ground enhancement materials
- Chemical earth rods
- Rebarcons
- Exothermic welding systems

STREET LIGHTNING

- Main powered LED street lights
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NiuPower is an independent power producer headquartered in Papua New Guinea.

We mobilise capital to deliver, operate and maintain energy generation or storage technologies as hybrid solutions or as part of a grid or microgrid. We adopt a practical, flexible and modularised approach to meeting the specific needs of a customer.



One of our core capabilities is the ability to partner with Government at all levels, indigenous owners of land and State-Owned Enterprises to deliver business outcomes.

NiuPower currently owns a 60MW gas fired power station near Port Moresby operated by its O&M and OEM partner, Wartsila.

Given there is gas in excess of our requirements, we are seeking to set up domestic and regional markets for LNG throughout our neighbours in Micronesia, Polynesia and Melanesia.

Michael Uiari

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