A global distributed utility offering reliable, low-cost and clean electricity as a service

Simon Gamble
Chief Operating Officer
IPS Connect, Maui, October 2018

Independent Power Producers and Microgrid Development
WHO IS ENERNET?

Enernet Global is an independent, technology-neutral renewable microgrid IPP

Mission

+ To develop, finance, build and operate hybrid power systems that benefit customers, communities and investors alike.

Value Proposition

+ Cleaner, lower cost, secure and reliable power with reduced price volatility.
+ Performance guaranteed, supported by experienced delivery and O&M partners.

Core Principles

+ Zero up-front cost: immediate ongoing savings to clients with no cost to their business
+ Technology-neutral: we draw from a wide spectrum of suppliers, integrating the most effective, reliable and cost efficient components to meet clients specific energy needs
+ Technical leadership: we have assembled a world-class team with decades of experience in all facets of hybrid power systems.
Enernet’s global and regional teams have originated, financed, built and operated over 500MW of renewables assets during their careers.

### Global Team

**Steve Hellman**, Chairman  
Serial entrepreneur built 14 successful companies in energy, oil and gas, real estate, software and media. Council on Foreign Relations member and former US State Department Advisor.

**Paul Matthews**, President  
15+ years in strategic business development, building 3 global businesses in consumer and renewable energy fields, including commercial and utility-scale project development.

**Chris Gerlach**, Chief Financial Officer  
20+ years of finance experience, heading SolarReserve’s structured finance effort and as project financier/arranger/adviser at global banking institutions including HSBC and Société Générale.

**Simon Gamble**, Chief Operating Officer  
20+ years in renewable sector, developer of multiple world leading megawatt class micro-grids. Previously Manager of Hybrid Energy Solutions at Hydro Tasmania.

**Brian Gardner**, Chief Development Officer  
10+ years as senior market and energy analyst and consultant focused on global policy and international markets with EIU.

**Dusan Nikolic**, VP of Engineering  
12+ years of renewable engineering expertise and project development, working on world-leading complex microgrids and the integration of renewable energy into islanded power systems.

### Australia and Pacific Islands

**Ashley Rogers**, Regional Director of Development (East)  
12+ years of sales and development within the Australian clean energy sector, commercializing varying PPA structures across multiple industry segments.

**Phil Maker**, Electrical Engineer  
18+ years of design, installation and commissioning of hybrid power systems in Australia, Antarctica, Alaska and the Azores.

**James Murray**, Regional Director of Development (West)  
10+ years of International business development experience in clean technology. Project advisory and strategic consulting experience covering renewable energy and energy efficiency.

**Nic Jacobson**, Senior Development Manager  
15+ years senior renewable energy engineer with a depth of experience in policy, international development, project development and facilitation and renewable energy.
WHY PURSUE MICROGRIDS?

THE PROBLEM
- Remote power generation has relied on expensive, polluting liquid fuels
- High capital costs and gaps in knowledge and finance limit clean-tech investment
- Electricity production not a core competency for many (industry/tourism/mining)
- Exposure to fossil price volatility and logistics and environmental risks

THE SOLUTION
- Distributed renewable generation, storage and more efficient thermal generation
- Secure, reliable 24/7 power, guaranteed performance
- Lower, predictable, stable energy costs
- Fully-funded, offering Energy-as-a-Service with no upfront cost to customer

Microgrids are viable solutions where:

- High Energy Needs
- Good Solar/Wind Profile
- High Electricity Prices
- Remote or off-grid
- Exposure to diesel price volatility
- Poor Energy Reliability
To be successful the IPP must ensure that all stakeholders share in the value created through bankable, stable and profitable projects.

COMMUNITY AND CLIENT BENEFITS

**Community**
Engagement and “ownership” of solution to local energy challenges, reduced cost, local employment

**Customers**
Cheaper and predictable energy cost, no upfront capital, improved operations, improved sustainability

**Partners + Manufacturers**
Expand markets for goods/services, global opportunities

**Investors**
Low technology risk, credit-worthy customers. Global footprint offers diversification benefits

**Governments**
Reduced fuel subsidies for remote power generation; emission targets achieved through free-market mechanisms

**Utilities**
Integration of cheaper, reliable generation enabling an increase in margins without the need to invest.

**Environment**
Lower fossil fuel consumption, carbon emissions and other pollutants
Who is Enernet – What makes up an IPP?

Business Case for a Microgrid IPP

Market Opportunity – Scale and Attributes

Role of the IPP

Planning - Identifying the options and pathway

Risk Mitigation – the name of the game

Summary
Globally, there is over 400 gigawatts of diesel capacity in operation as a result of existing grid limitations. Up to 250 gigawatts could be absorbed into microgrids.*


250 GIGAWATTS -> US$500bn
• The reduction in the cost of solar and the adoption rates are >20% yr on yr.
  • Trend is present across all scales and sectors
  • Risk premiums in off-grid are reducing – facilitating cost reductions in that sector
• The world’s lower per capita GDP regions:
  • lowest access to energy (reliant on off-grid supply)
  • have the highest irradiation levels
  • will achieve significant economic benefits from cheaper more reliable power supply

Sources: NREL, IEA, DOE
• Solar/battery technology is now competitive with traditional supply in regions of high solar irradiation
  • Behind the meter (retail off-set) solutions are attractive and market is growing strongly

• Impact in off-grid has been tempered slightly by depressed diesel/gas pricing
  • Still a “no-brainer” to blend renewables into existing thermal supply
  • Cost effectiveness of high RE systems is improving – largely as a result of battery technology maturing and becoming more cost effective (and risk premiums reducing)
Globally, microgrids offer a significant opportunity for renewable energy investment, financing long term power purchase agreements with bankable off-takers.

Global Microgrid Power Capacity
Market Share by Segment, Jun 2017

- Commercial & Industrial: 16%
- Community: 10%
- Remote: 45%
- Military: 5%
- Institutional: 9%
- Utility Distribution: 15%

Source: Navigant

Total 2017-2026 C&I Microgrid Build
- 18GW
- $60bn

CAPEX = $18.3 Bn

CAPEX = $1.9 Bn

Target Segments
- Total 2017-2026 C&I Microgrid Build

Who holds the opportunities? What strategies are employed for market entry?
CASE STUDY – IPP MARKET ENTRY

King Island, Australia

Solar IPP 100kw dual axis
Local demonstration
Majuro, Republic of Marshall Islands

Waste Heat to Energy IPP 400kW Experimental technology
CASE STUDY
IPP FASTER TO MARKET

Flinders Island, Australia

Wind IPP (mid 2010’s)
Community RE target
300kW
MARKET SECTORS – COMMUNITY / UTILITY

High barriers to entry

Aid has traditionally supported alternate models
Project Summary:

1. 10MW PV across Northern Australia Aboriginal Communities.
2. 9MW used for medium penetration operation resulting in 15% fuel savings. Peak contribution is 87% using Low Load Diesels at Ramingini.
3. 1MW and 800kVA/1.9MWh battery at Daly River resulting in 50% fuel savings.
4. Aim: to make PV/ESS business as usual, i.e. its about cultural change, education not technology.
COMMUNITY CASE STUDY
SETuP & Daly River (NTPW)

Solar Energy Transformation Program

Daly River Solar Array and Energy Storage System
MARKET SECTORS - TOURISM
“Locked” into diesel  
Short mine life
MARKET SECTORS – COMMERCIAL/INDUSTRIAL

High value loads
Interruptible/deferable load
High arbitrage value
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ROLE OF THE IPP

 IPP is at the heart of commercial transactions

- EPC Contractor
- O&M provider
- Equipment Suppliers
- Investors / Bank
- Community

- Distributor *Connection Agreement*
- Utility *Electricity Sales and Purchase*
- Environmental Approvals
- Planning Approvals
- Regulator *Licence to operate*

**Client**

**PPA**

Requires a structured approach to ensure risks are identified, managed by the most appropriate party and contractually covered (for the lifetime of the assets).

PPA is primary commercial agreement: needs to be fair and balanced, performance based, long term.
Microgrids can be confusing

Client is normally the only off-taker

Client represents a credit risk
Automation of existing legacy equipment – more costly than replacement?
Adds perceived complexity and risk to client – education/training required

Split operational responsibilities – consolidate and align where possible
Technology selection can be a show-stopper – in particular where safety is concerned.

Demonstration can be best and only way to prove system will work when called on.

Testing ability of inverter to provide fault current to blow fuses.
Technology selection can be a show-stopper – in particular where safety is concerned.

Testing ability of inverter to ride through faults

What does a fault look like AND what is the appropriate test for a battery system?

Protection relays required new settings

Alternative – use test facilities (see ACEP)
Regulators of isolated power systems can play an important role in supporting the success of hybrid microgrids:

- Prescriptive requirements – e.g. spinning reserve, plant redundancy
- Historical bias – favouring traditional approaches that prevent renewable deployment – e.g. minimum load requirements, diesel subsidies
- Technology bias – Picking winners vs system quality and reliability standards
- Connection regulations – preventing or restricting feed in, gross metering
- Land zoning – supporting land availability for solar generation, WTGs
CONTRACTOR ENGAGEMENT

CUSTOMER
(Power off-taker)

Large Mine Example

BOOM/PPA

EPC + O&M

Head EPC Contractor
Suitable scale, experience, warranties

Equity Finance
Enernet Global

DEBT FINANCE
Banks/Debt Financiers

IPP
Enernet Global

EPC / O&M

Technology suppliers

Controls
Capability
Scalability
Tailorable

eBoP
HV/LV
System dynamics

BESS
Application
Redundancy
Life

Diesel Gen-sets
Response
Efficiency
LLD operation

Wind Turbines
Low maintenance
Constructability
Survivability

Enernet Global

Low maintenance
Constructability
Survivability
Enernet works with leading vendor partners to design, implement, operate and maintain our solutions over the tenure of a power purchase agreement. Examples include:

**GENERATION**
- First Solar
- Canadian Solar
- Cummins
- CAT
- Wärtsilä
- Siemens Gamesa

**STORAGE / CONTROL**
- Qinious: smart energy storage
- Samsung
- Samsung SDI
- ABB
- Greensmith
- Tesla

**EPC/INTEGRATION/O&M**
- Infratec
- RCR
- Juwi
- Harelec: solar power specialists
- Siemens

**Questions**
- Fitness for purpose?
- Detailed knowledge!
- Collaborative engagement?
ASSET MANAGEMENT AND OPERATION

An IPP must manage all maintenance and operation processes – normally via a network of service providers.

System uptime and performance is wrapped.
Back-up generation core to the solution.

Remote monitoring with automated alarms.
Clear workflow and associated actions.

Local or onsite teams for active maintenance and system operation.
Scheduled component maintenance and replacement.

Remote monitoring with automated alarms.
Clear workflow and associated actions.

Systems are operated and maintained by local teams and closely monitored to ensure maximum up-time and minimum customer interruption.
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Summary
RENEWABLE ENERGY JOURNEY - PHASE 1

Diesel selection (size/number/type)

Automation
Load (kW) vs. Time

- Running diesel capacity
- Minimal diesel Loading

LOAD

Running Diesels

RENEWABLE ENERGY JOURNEY - PHASE 2
Wind / diesel integration in the absence of energy storage – use of low load diesel

Source: Synergy

4xEnercon WTG, 7x Diesel generators, inc 3xLLD
PHASE 3 CASE STUDY
MARBLE BAR – HORIZON POWER

Source: ABB

4x 320kW diesel generators, 300kW solar PV, 500kW flywheel
PHASE 4 CASE STUDY
FLINDERS ISLAND – HYDRO TASMANIA

Source: Hydro Tasmania – Flinders Island Hybrid Energy Hub
Source: Tesla
• Enernet has built a proprietary software platform providing fast, accurate and consistent sizing and pricing for microgrids, tailored to customer needs.

• Generates an optimized financial model and microgrid bill of materials using machine learning algorithms
• Incorporates weather and load forecasts to produce a dispatch schedule that minimizes operational cost
• Multi dimensional solution landscape is created
• Allows solution space to be explored and performance/pricing trade offs made with client
• Projects offered to clients come directly from these frontiers
### Diesel Only

- **PV Size (kWp)**: 
- **Battery Size (kW)**: 
- **Battery Size (kWh)**: 1050
- **Genset Size (kWh)**: 
- **% RE**: 0.0%
- **LCOE (Php/kWh)**: 23.10

### PV-Diesel

- **PV Size (kWp)**: 200
- **Battery Size (kW)**: 1050
- **Battery Size (kWh)**: 
- **Genset Size (kWh)**: 
- **% RE**: 5.7%
- **LCOE (Php/kWh)**: 22.70

### PV-Diesel

- **PV Size (kWp)**: 700
- **Battery Size (kW)**: 1050
- **Battery Size (kWh)**: 
- **Genset Size (kWh)**: 
- **% RE**: 18.0%
- **LCOE (Php/kWh)**: 21.70

### PV-Diesel

- **PV Size (kWp)**: 900
- **Battery Size (kW)**: 100
- **Battery Size (kWh)**: 420
- **Genset Size (kWh)**: 1050
- **% RE**: 22.9%
- **LCOE (Php/kWh)**: 21.60

### PV-Diesel

- **PV Size (kWp)**: 1400
- **Battery Size (kW)**: 500
- **Battery Size (kWh)**: 2100
- **Genset Size (kWh)**: 1050
- **% RE**: 37.1%
- **LCOE (Php/kWh)**: 20.10

### PV-Diesel

- **PV Size (kWp)**: 1800
- **Battery Size (kW)**: 600
- **Battery Size (kWh)**: 2520
- **Genset Size (kWh)**: 1050
- **% RE**: 44.3%
- **LCOE (Php/kWh)**: 20.20

### PV-Diesel

- **PV Size (kWp)**: 2000
- **Battery Size (kW)**: 650
- **Battery Size (kWh)**: 2730
- **Genset Size (kWh)**: 1050
- **% RE**: 47.9%
- **LCOE (Php/kWh)**: 20.30

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### RAPID PROTOTYPING - GRIDSCAPE
CONTINUOUS RISK MITIGATION

- Cummins LLD X must run at load Y every 6.5 hours in order to ...
- Battery X must ...

- Will the customer commit to load growth?
- Is there enough land? What is the slope?
- Is there consensus among models?
- Will the customer commit to load growth?

Feasibility | Verification | Contract | Detailed Requirements | Site Acceptance | Operations
## COMMON IPP RISKS AND MITIGATIONS

<table>
<thead>
<tr>
<th>Risk</th>
<th>Description</th>
<th>Mitigations</th>
</tr>
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<tbody>
<tr>
<td>Permitting</td>
<td>• Achieving all environment, development and building permits in time for scheduled construction</td>
<td>• Early issue identification, development experience, outsourcing to experts, <strong>CPs in construction contract</strong></td>
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<tr>
<td>Construction</td>
<td>• Completion on time and budget</td>
<td>• Lump-sum turn-key EPC arrangement with <strong>robust performance and delay liquidated damages</strong></td>
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<td></td>
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<td>• An independent engineer reviews and comment technical aspects</td>
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<td>Technical Performance</td>
<td>• Inability to achieve reliability standards, production estimates</td>
<td>• <strong>System level performance specifications</strong></td>
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<td></td>
<td></td>
<td>• Proven vendors and technology</td>
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<td></td>
<td></td>
<td>• System modelling – HIL / Bench tests</td>
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<td></td>
<td></td>
<td>• <strong>FAT / SAT / Ongoing performance test</strong></td>
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<tr>
<td>Natural Resource</td>
<td>• Wind and solar components rely on natural resources that are available intermittently</td>
<td>• Natural resource assessments are based on satellite data combined with ground data.</td>
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<td></td>
<td></td>
<td>• Investor and lender base case numbers are based on <strong>P50 and P90 output</strong>, respectively</td>
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<tr>
<td>Political</td>
<td>• Political risks include expropriation, political violence and inconvertibility</td>
<td>• <strong>Carefully selects markets</strong> that are less likely to be affected by political risk events;</td>
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<tr>
<td></td>
<td></td>
<td>• <strong>Use PRG and insurance products</strong> on a case by case basis</td>
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SUMMARY – MICROGRID IPPs ARE EMERGING

Requires excellence in:

- ORIGINATION
- FINANCE
- EXECUTION
- OPERATION

Enernet Global’s key differentiators are:

- Team expertise
- Technology agnostic
- Microgrid optimization platform
- Fully financed and warrantied via OEM/EPC partners