

CONSTANT RESOURCE CONSTANT CLEAN POWER

Myanmar – March 2023



**ACHELOUS
ENERGY**



WHO ARE WE?

A renewable energy company focused on hydrokinetic power generation

TEAM

Tim and James have worked alongside each other in the marine energy sector for over 13 years, both onshore and offshore.

Between them, they have significant technical and managerial acumen in the delivery of large marine projects, including large-scale EPC contracts (up to £90m GBP) to energy supermajors including Petrobras and Shell.

They have managed complex fabrications in shipyards across Asia (including Singapore, Vietnam, Myanmar, Indonesia), and possess a proven track record of successfully building teams to execute and deliver large projects.

Along with James and Tim, Achelous Energy's core technical development team comprises six people, encompassing structural, mechanical and electrical engineering, naval architecture and CAD expertise.



LIBRA EWT FPSO
TURRET MOORING EPC



THE PROBLEM

Global energy
Poverty

MILLIONS OF PEOPLE HAVE
NO ACCESS TO ELECTRICITY

770
MILLION
PEOPLE

133
MILLION
IN ASIA

50BN
US DOLLARS
REQUIRED
TO SPEND
ANNUALLY

**= USA
x2**



CURRENT RENEWABLE ENERGY

Capacity factors

Renewable Production Capacity

2021

Offshore wind	39%
Onshore wind	39%
Solar PV	17%

What is Hydrokinetic Power ?



Hydrokinetic Power is generated by motion of water in rivers and tidal currents

NO DAMS INVOLVED!



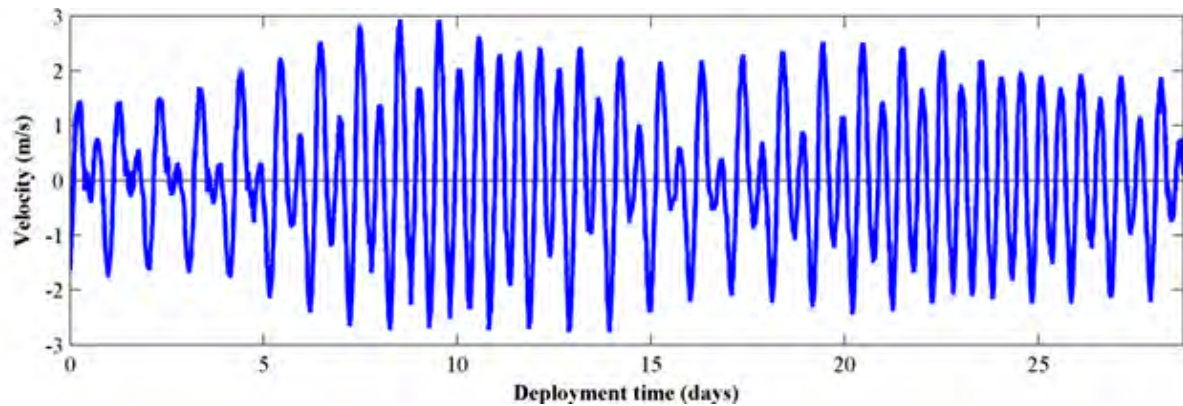
The difference between Tidal Stream and Hydrokinetic



Tidal flow is caused by the gravitational pull of the moon and sun, while hydrokinetic flow is caused by natural currents and movements in bodies of water.

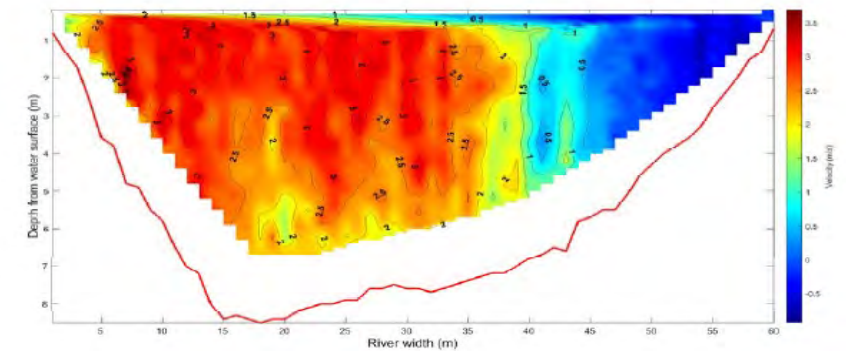
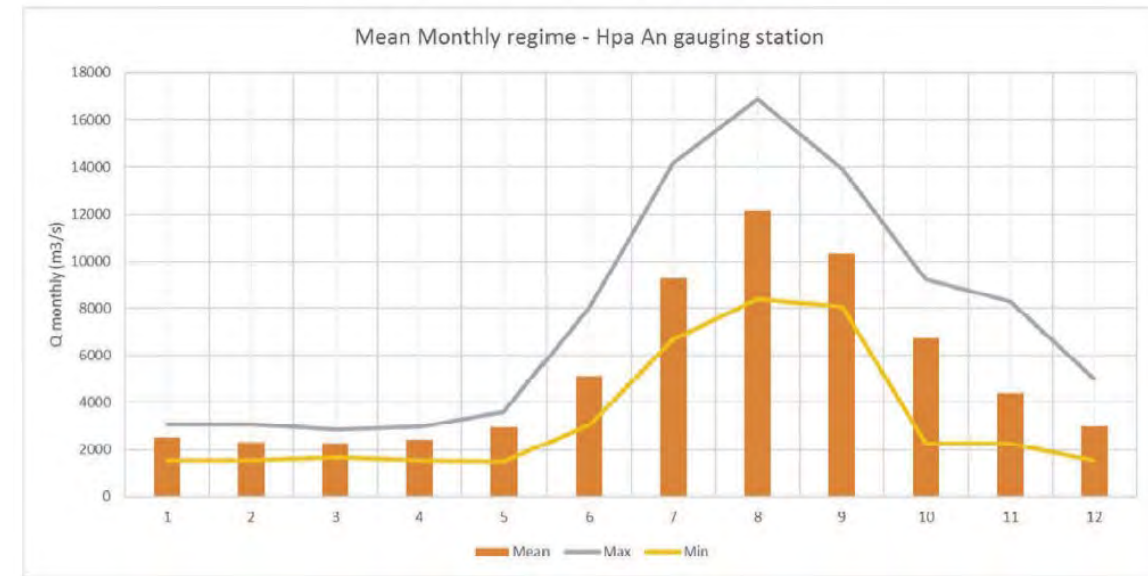
Tidal flow velocity profile

Typical Tidal flow velocity profile characteristics
30 day period



Inter-tidal sites are more complicated due to the nature of the river flow

River flow velocity profile





GLOBAL MARKET

The renewable energy market is estimated to be worth over US\$1.6Trillion globally by 2030

GLOBAL RESOURCE FOR RIVER
HYDROKINETIC POTENTIAL IS OVER

58,000TWh/year

A SCALABLE, ENVIRO-FRIENDLY, RIVER POWER
TECHNOLOGY IS REQUIRED TO ALLOW
EXPLOITATION OF UNTAPPED GLOBAL LOCAL
AND UTILITY SCALE ENERGY MARKETS

53%

OF THE WORLD'S POPULATION
LIVES WITHIN 3KM OF
A RIVER

£0.5bn+

ACHELOUS ENERGY'S 10-YEAR
REVENUE FORECAST
BASED ON 1000 UNITS
0.2% OF TAM



Myanmar River Resource Potential

125,451 km

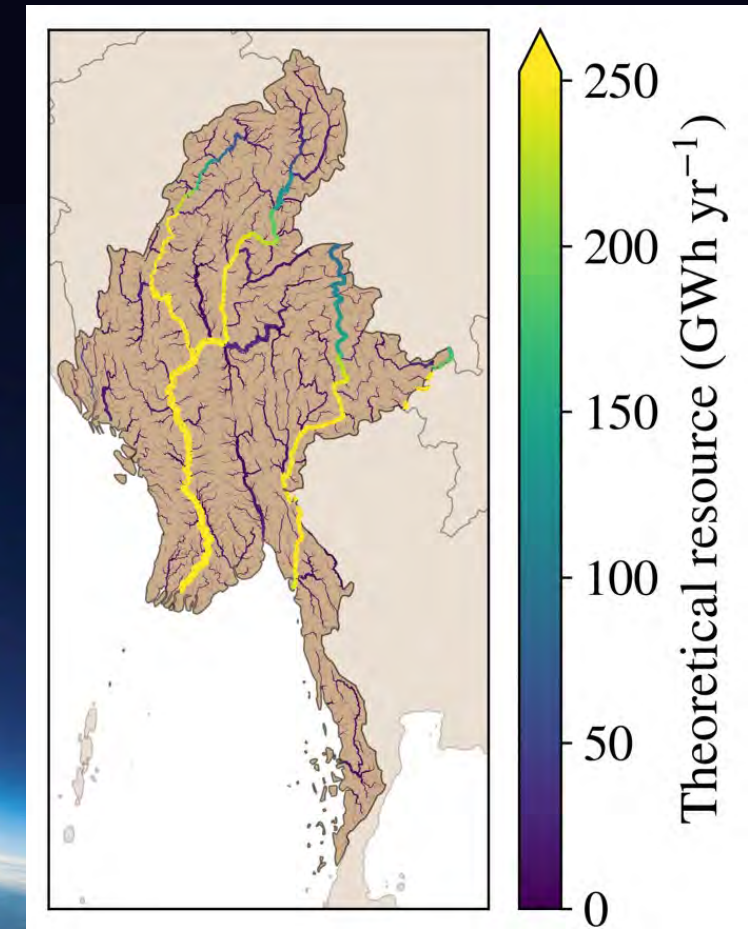
TOTAL LENGTH OF RIVERS IN MYANAMR

10%

OF MYANMAR RIVERS
HAVE RIVER SPEEDS
GREATER THAN 3/S

MYANMAR HAS SIGNIFICANT RESOURCE
THROUGHOUT THE COUNTRY.

RESOURCE POTENTIAL FOR hydrokinetic
STREAM





The Solution

Hydrokinetic river power plant "FITS"

Affordable

Baseload

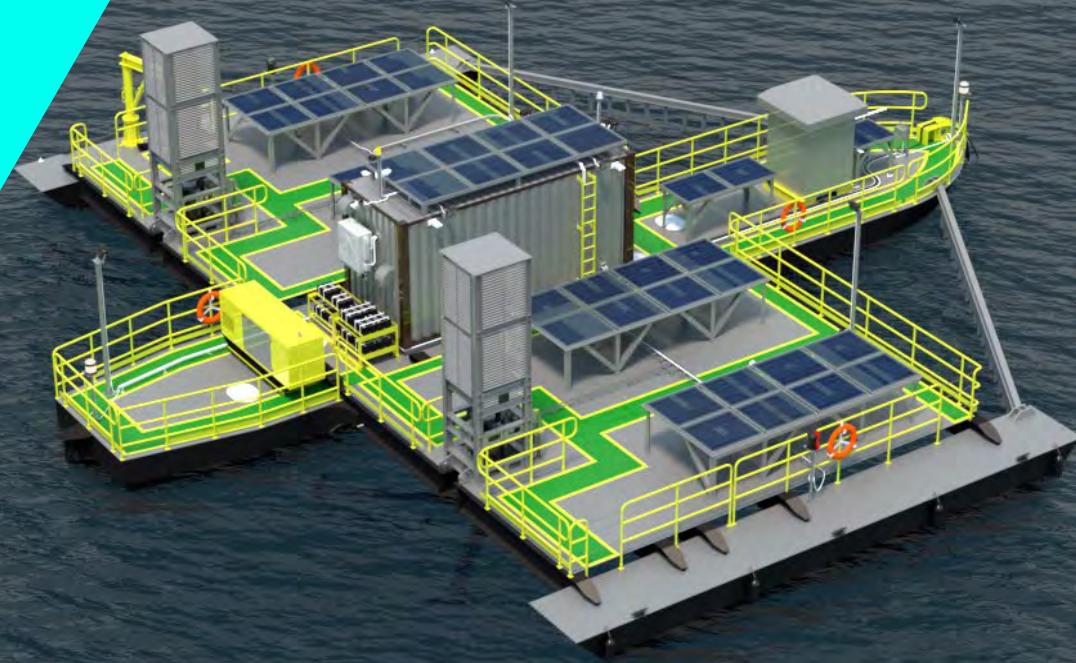
Clean Power



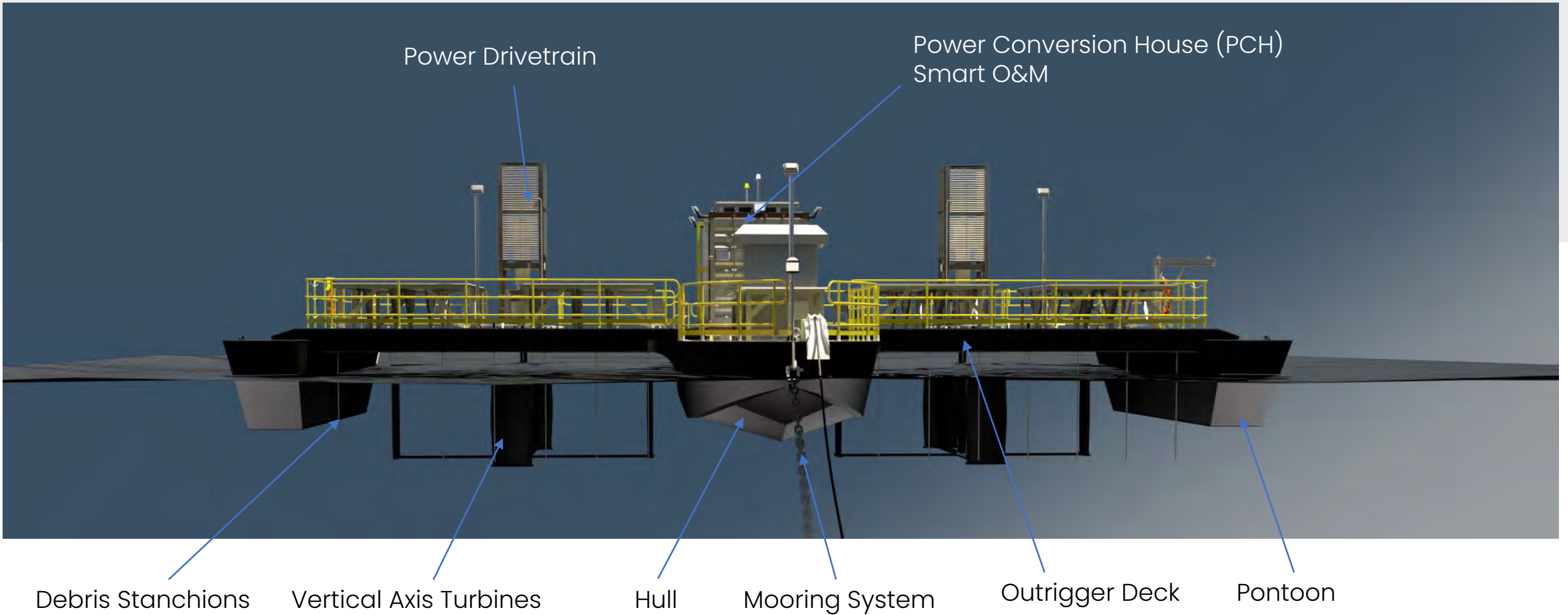
TECHNOLOGY

The Floating Instream Tidal and Solar (FITS) hydrokinetic generation unit uses vertical axis turbine technology.

- Underwater turbines capture the energy of running river water
- 200kW-500kW rated output
- A single 200kW FITS unit produces up to 1,500 MWh/year - enough energy to power over 1000 households in developing nations, or 140 households (UK / USA)
- Optimised for cost and durability
- Utility scale LCOE < US\$ 0.05/kWh
- IP protected: UK Patent Pending (GB2106494.4)



A SINGLE 200KW FITS UNIT PRODUCES UP TO 1,500 MWH/YEAR - ENOUGH ENERGY TO POWER OVER 1000 HOUSEHOLDS IN DEVELOPING NATIONS, OR 140 HOUSEHOLDS (UK / USA)



TECHNOLOGY

Design advantages

Designed for Energy Access



- Easy construction
 - Steel / Concrete hulls, simple on-site construction
 - Off-the-shelf equipment (drivetrain, electrical generators etc)
 - Simple assembly: maximum lift 1 tonne (can be assembled using JCB)
- Low Operations & Maintenance (O&M)
 - All electrical equipment above water
 - Remote monitoring and control of equipment
 - Predictive maintenance schedules
 - Automated safety systems
 - Equipment rated at 7-year+ service life
- Fast installation
 - Contract – installation: 6-12 months
- Resilient
 - Storm / flood-proof
 - Earthquake resistant (floating, chain-moored)
 - Debris boom to deflect river debris



BENEFITS

Hydrokinetic energy

24/7

Constant,
sustainable
power

SPEED

Quick local
fabrication
Easy transport
Fast install

SCALE

Single units
1kW – 500kW
Up to 20MW
arrays

O&M

Low O&M cost
Negligible
intervention



IMPACT



CLIMATE

Step towards climate targets

- >15.4 TWh lifetime renewable energy generation (100MW installed)

ACCESS

A 200kW FITS unit can provide clean, secure energy to:

- Developing world: Up to 1000+ households (population >5,000 people), two local commercial businesses

SKILLSETS

Diversification of a country's skillset:

- Fabrication of FITS Power Plants
- Operations & Maintenance
- Equipment supply

EMPLOYMENT

Increase in local economic growth:

- Direct employment: Project employees
- Training to local workforce
- Indirect employment: Supply chain

EDUCATION

Enablement of education / skills

- Lighting in schools and houses
- Street lighting to allow safe transit to/from schools after dark

HEALTH

Improvement in healthcare:

- Cold storage for medicines
- Lighting for buildings

FORESTATION

No deforestation to install

- 1 x 200kW FITS Power Plant allows between 4-40 mTCO₂e sequestered saved per hectare of forest

CO₂

Greenhouse gas emissions avoided:

CARBON EQUIVALENT OFFSET	200kW UNIT	10MW ARRAY
PER YEAR [mTCO ₂ e]	406	20,311
50y LIFETIME [mTCO ₂ e]	20,300	1,015,550



IUK Pilot Project Details – Mid Stage EC Project

Scope

- Design build & test a full scale prototype river hydrokinetic power plant for Myanmar energy access stakeholders
 - 2 x 100KW Vertical Axis Turbines
 - 10kW Solar PV Plant

Stakeholders

- Innovate UK – Energy Catalyst Grant donor
- Achelous Energy (Industrial Lead) & Private Investors (match funding grant)
- Myanmar Local Companies – Project partners
 - Royal Marine Engineering
 - Spectrum SDKN
 - Sanda Hotels
 - British Chamber of Commerce Myanmar
 - Lotus Green (sub-contract)



Objectives

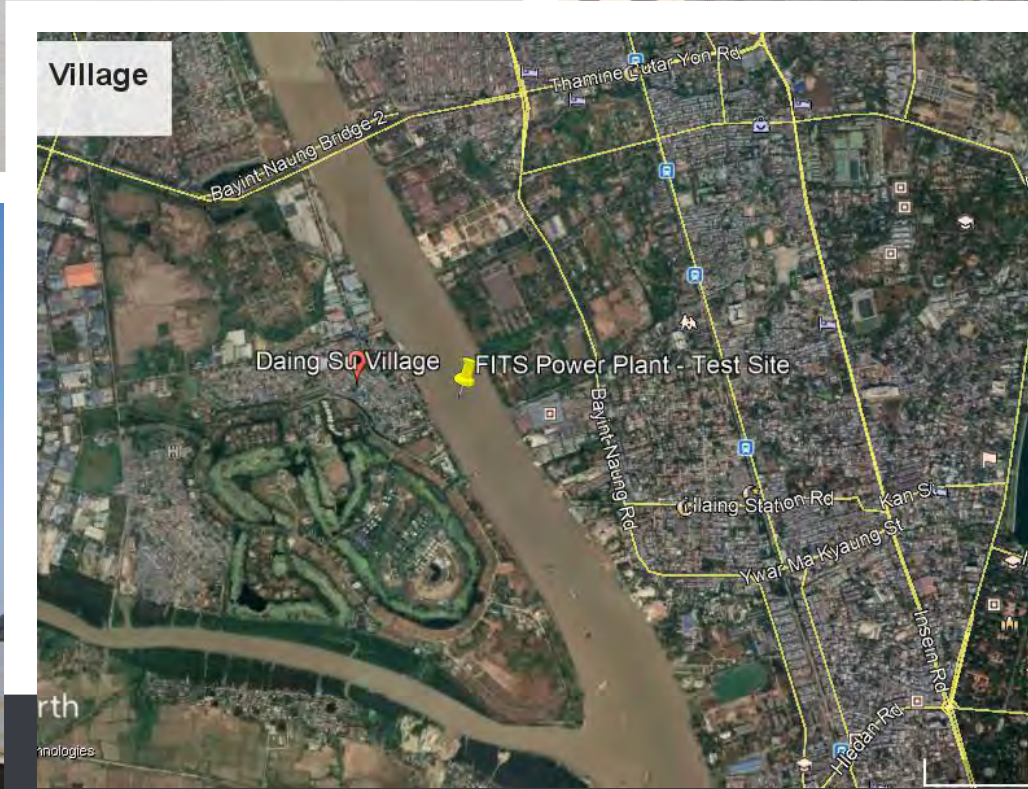


- Design & Engineering of a low cost RE power plant
 - Hydrokinetic turbines (3 or 4 Blade system)
 - Hybrid solution (solar & hydrokinetic)
 - Digitalisation
- River Resource Assessment
 - Insitu & desktop assessment
 - Hlaing River
 - Yangon River
 - Salween
 - Tidal Areas
- Social Engagement & Economic growth
 - Understand the landscape on energy access poverty
 - Engage with villages / townships
 - Build supply chain network
- Fabrication
 - Engage with local fabricator to build and assembly the FITS
- Test and demonstrate the FITS
 - Verify and validate turbine power curves

MYANMAR – EC7 PILOT PROJECT SITE (Daing Su Village Yangon)



Site Measurements



Engagement



Fabrication



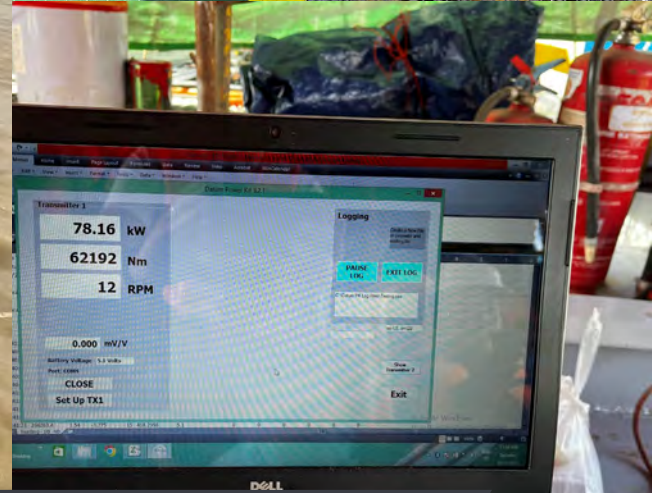
Fabrication



Fabrication









Project Outcomes

The technology was proven over a series of successful test rounds on the Hlaing River, Myanmar during 2021-2022



AEL activities in 2022

- FITS manufacturing, assembly, tow and installation proven for frontier markets
- Technology Readiness Level (TRL) achieved: TRL 7

Validation & Verification of systems

- Power Curve validated against analytical modelling
 - Turbine Cut-in speed – **0.5m/s** (12% lower than predicted, meaning FITS can produce power at very low river speeds).
 - Turbine Rated Power – 100kW at 3m/s river speed
- Power Production: Over 1000 hours of Energy produced during tests
- Prototype CAPEX and OPEX models verified – **LCOE \$0.10/kWh**
- Verification of the remote monitoring & control system through Internet of Things (IOT) of key components; Parameters measured:
 - Turbine vibration
 - Bearing temperatures
 - Slow & fast speed drivetrain rotations
 - Turbine power production





Project Outcomes Summary

- The FITS design demonstrated it can produce secure energy access at an affordable cost LCOE \$0.10/kWh
- Demonstrated the FITS can be used as baseload power generation source
- The FITS can be fabricated and assembled in-country
- The project was an enablement of skills boosting
- Created positive social and equality impact
- Created local employment, through fabrication and created local operational and maintenance jobs



Myanmar Hydrokinetic Opportunity

River Resource

Total Length of Rivers

125,451 km

Mean Flow speeds of 3m/s

12,164 km

Myanmar Opportunity

FITS Tidal Stream

Power Small Islands!





CUSTOMERS

Key segments



200KW
20MW+

ENERGY ACCESS:

NGOs and Governments

ENERGY AUTONOMY:

Private companies

E.g. Rice Mills, Fisheries, Plantations, Cold storage, Factories, Hotels, Ports etc.

GRID / UTILITY POWER:

Utility energy companies

BUSINESS MODEL

Revenue channels

1

TECHNOLOGY SALE

Stand-alone units +
Operations and Maintenance

2

BUILD, OWN, OPERATE

Sale of energy under
Power Purchase Agreement

3

TECHNOLOGY LICENCING

Sale to energy project
developers



LETS HAVE A DRINK

Let me buy you a drink

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CONSTANT RESOURCE, CONSTANT CLEAN POWER

Thank you!

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