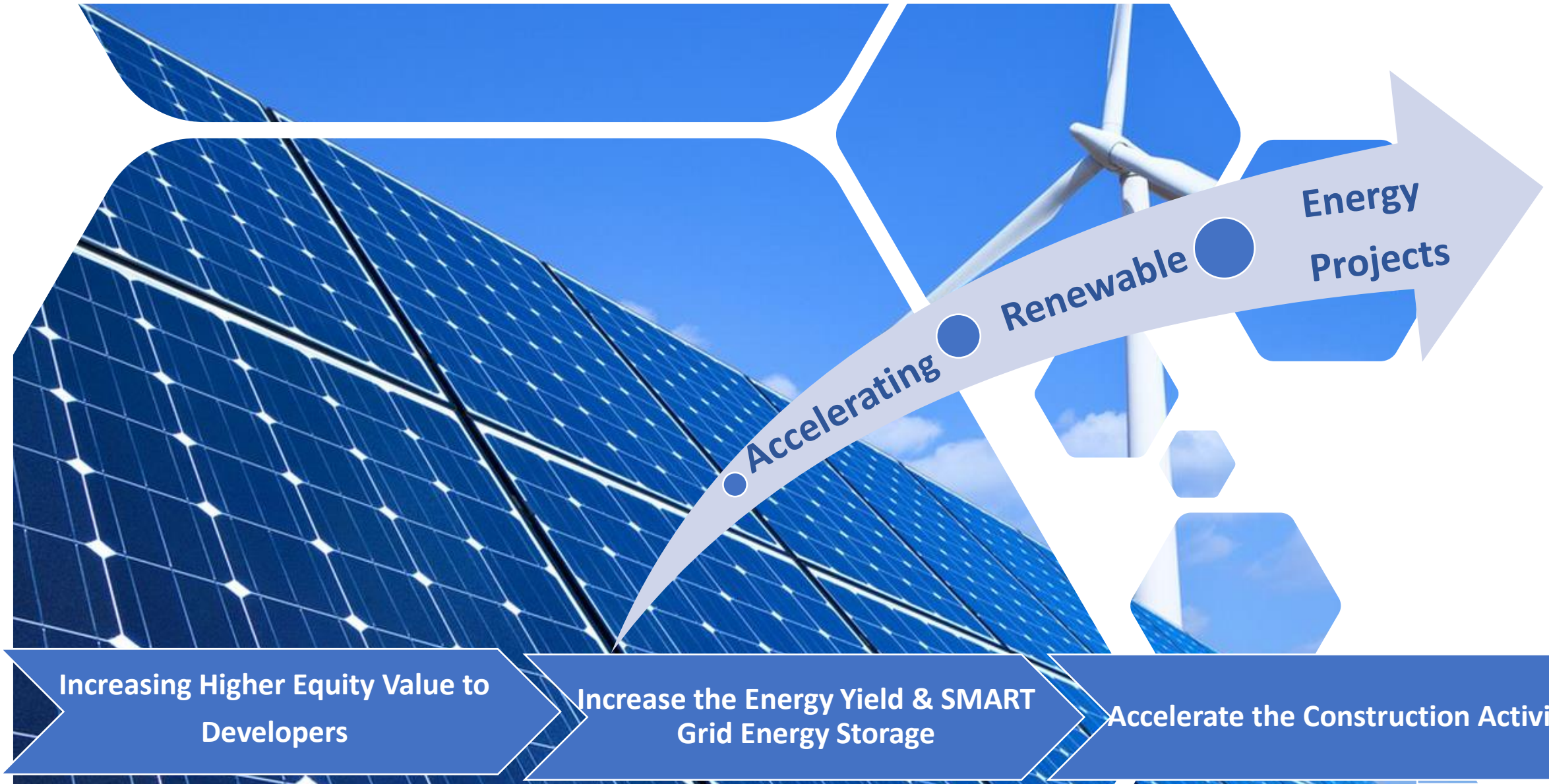
GwSolar Floating Solar PV Technology



Increasing Higher Equity Value to Developers

Increase the Energy Yield & SMART Grid Energy Storage

Accelerate the Construction Activities

GwSolar G8 SUBSEA Company Introduction

- In Depth in Engineering & Technical Innovation Offshore Renewables - G8 is Asia's leading Subsea Engineering & Construction Specialist based in Singapore with strong presence and project development partners worldwide. Our company provides specialized engineering services to leading Contractors, Governments, Utility Companies and Project Developers to install and protect the subsea telecommunications and power infrastructures around the globe.

- With unsurpassed capabilities to design and construct renewable energy systems offshore, floating solar and wind energy plants worldwide. Patent in MTB & STM system for Floating Solar PV Energy System

World's First Floating Solar Farm with 20MW Substation

Gw Solar – Utility Scale Floating Solar

Service Introduction

WIND Pro®

Accelerating offshore renewable projects by ensuring returns of Investments and protecting long term operations.

CABLE Pro®

Technical Consultation, Transport, Delivery, Lay and Protection of Power and Telecommunication cables.

GwSolar®

Implementation of large scale industrial scale solar with developers and utility partners.

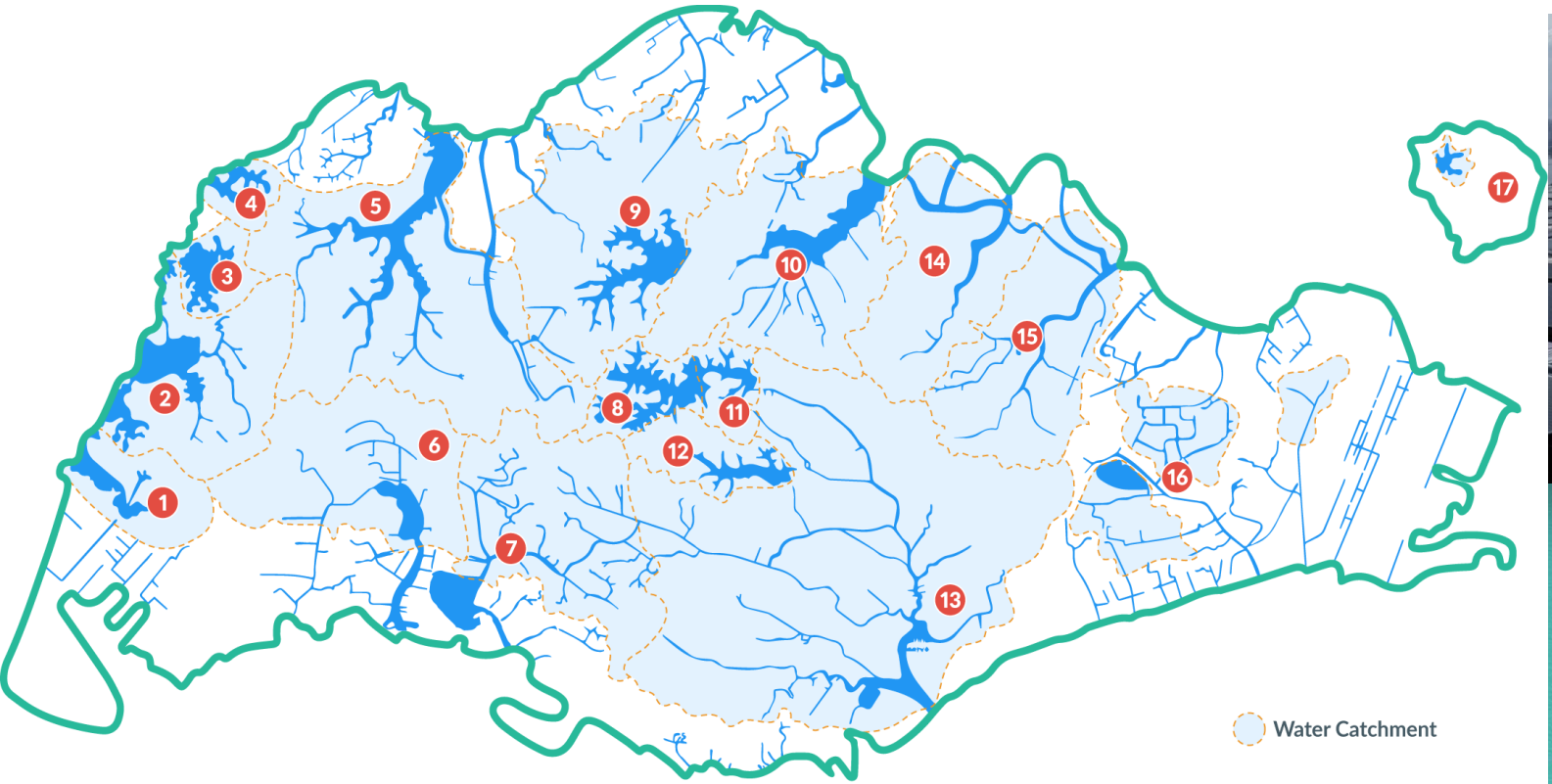
- Government
- Developers
- EPIC
- Utility Company

RE - Expertise & Track Record

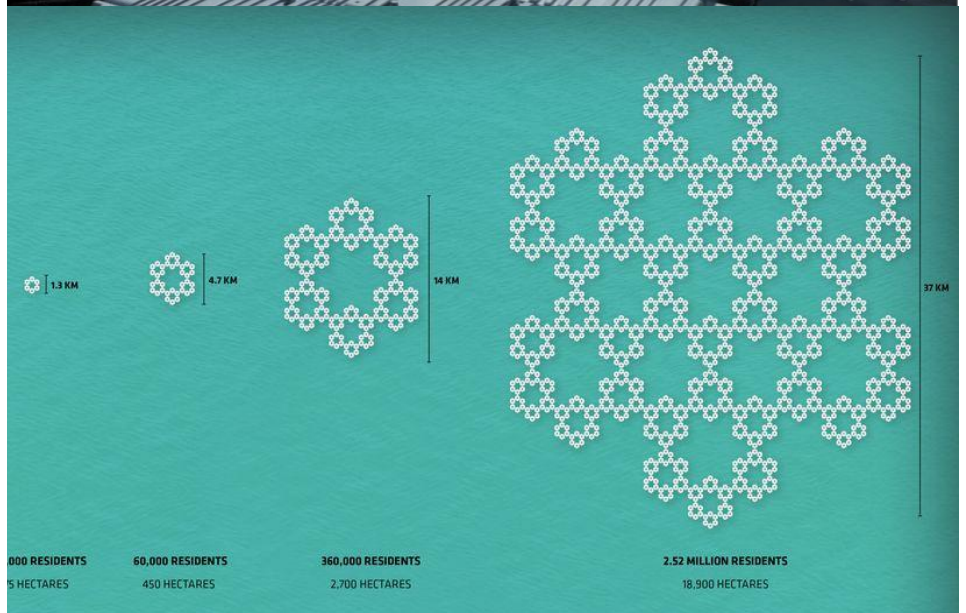
G8 Subsea – Singapore Based Company with Global Expertise in Offshore & Marine Renewable Energy Projects. Enabling Proven Engineering & Marine Installation Techniques.

- 2017 60MW Offshore Wind Power Line Connection, Korea
- 2019 230kV Singapore Power to Malaysia Power Line
- 2020 5MW Woodlands Floating Solar
- 2020 20MW rated floating Substation (Singapore)
- 2020 500MW Pre Front End Engineering Offshore Windfarm, Japan
- 2020 Various Sites for Floating Solar and Offshore Wind Power across the Asia.

GwSolar



1 Tengeh Reservoir
2 Poyan Reservoir
3 Murai Reservoir
4 Sarimbun Reservoir
5 Kranji Reservoir
6 Jurong Lake
7 Pandan Reservoir
8 Upper Peirce Reservoir
9 Upper Seletar Reservoir
10 Lower Seletar Reservoir
11 Lower Peirce Reservoir
12 MacRitchie Reservoir
13 Marina Reservoir
14 Punggol Reservoir
15 Serangoon Reservoir
16 Bedok Reservoir
17 Tekong Reservoir



Lessons Learnt

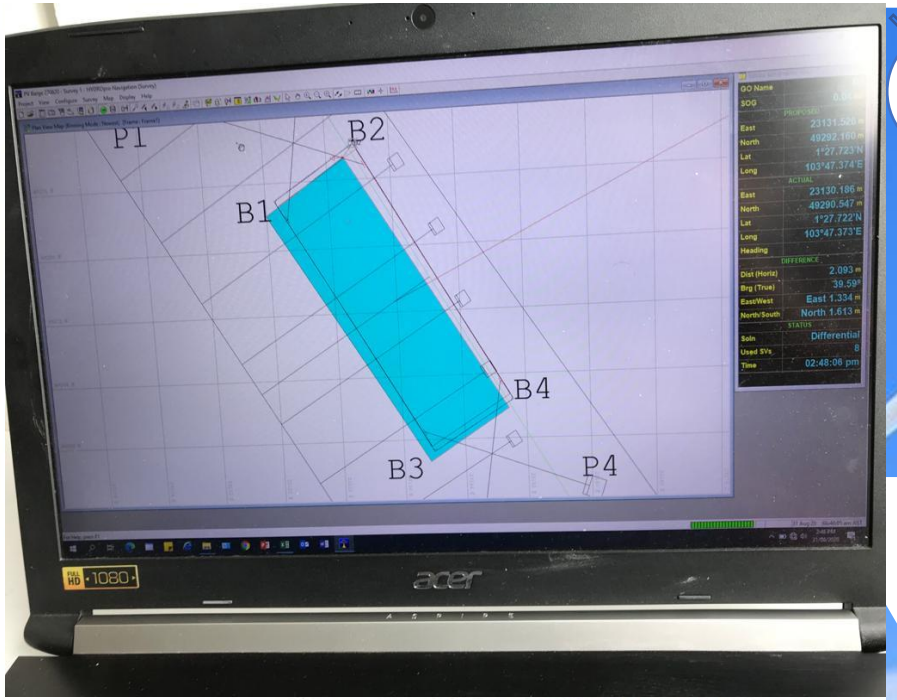
Addressing Problems with Present FPV projects

1. Major Construction Delays
2. Poor Quality, degradable materials and Delayed manufacturing of Floats
3. Environmental Impact of materials and construction
4. Permmiting and Authority approval
5. Improper Engineering of Mooring Systems
6. Unsightly and Intrusion to Aquatic life
7. Non marine based standards in design and construction
8. Logistics and Delays, Site Limitations and Labour
9. Poor Planning, lack of experience in marine engineering and water based operations during project deployment

Accelerating Floating Solar Project Implementation
G8 Turnkey Service Overview

	G8 Solar E Division	
Solar Resource Assessment	**Feasibility Studies**	**Panels & Mountings**
Best practices to estimate fututre energy production of a solar farm.	Surveys and environmental impact studies	Panels, mounting, floatation devices and inteligent mooring
Land/ Floating Substation	**Cable System**	**SCADA & Communicaiton**
Invertersand booster transformer station	Electrical studies, Inter-array and power export cable lay and protection	Automation and remote monitoring and control
Solar Installation	**Operation & Maintenace**	**Financing**
Installation and commssioning of land and floating solar infrastructure	Preventive and predictive maintenance to lower the down time	Equity raising and funding support for accelerating the constructions for early ROI.

Desk Top Studies – Understanding the Seabed & Environment



- Site Survey
- Solar Resource Assessment
- Environmental Impact Analysis
- Geophysical/Geotechnical
- Biological/Water Quality
- Subsurface Soil Conditions
- Grid Access

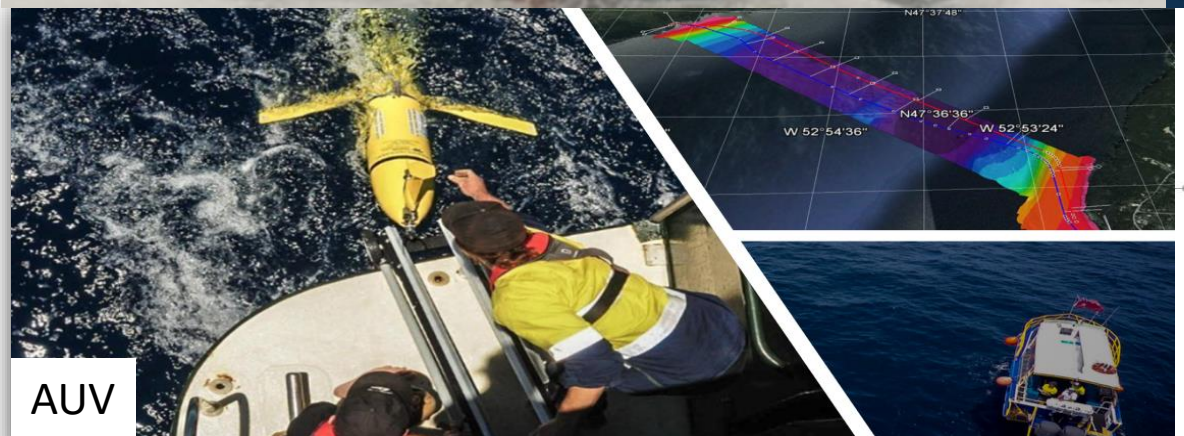
Survey Techniques

Met Ocean Surveys

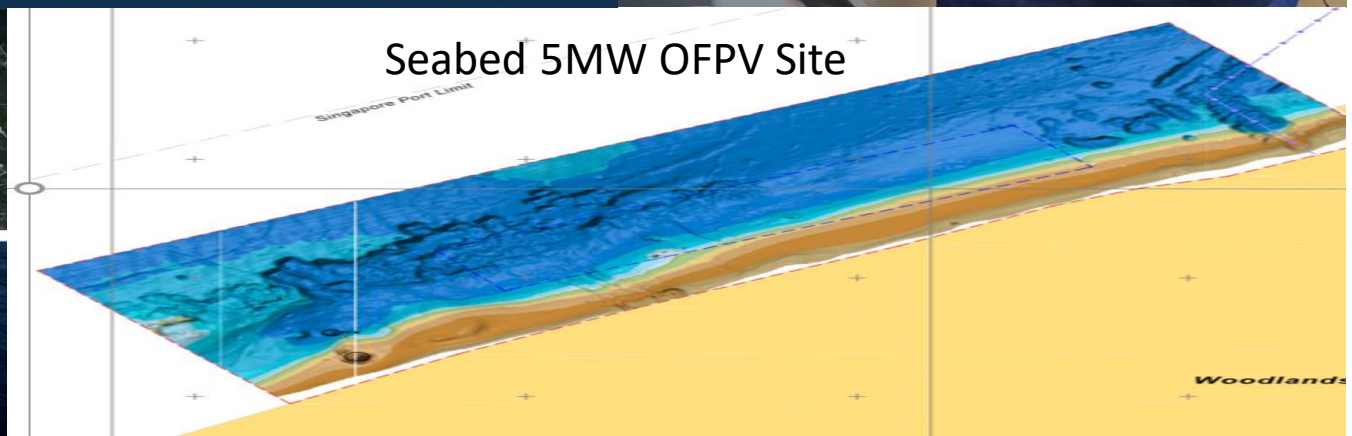
- Meteorological
- Geophysical (MBS,SBP,SSS)
- Geotechnical (Coring)
- Water Quality Monitoring

Survey Boat

SEE gathers site-specific satellite data on shading, wind, waves, water level fluctuations, object detection, air pollution and more in addition to solar irradiation and basic weather data



AUV

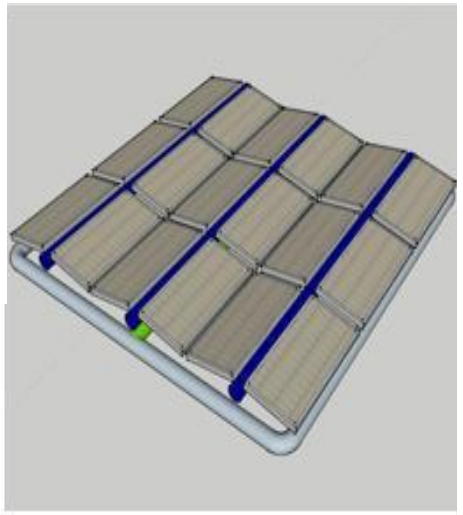


MTB – Advance Floatation Device

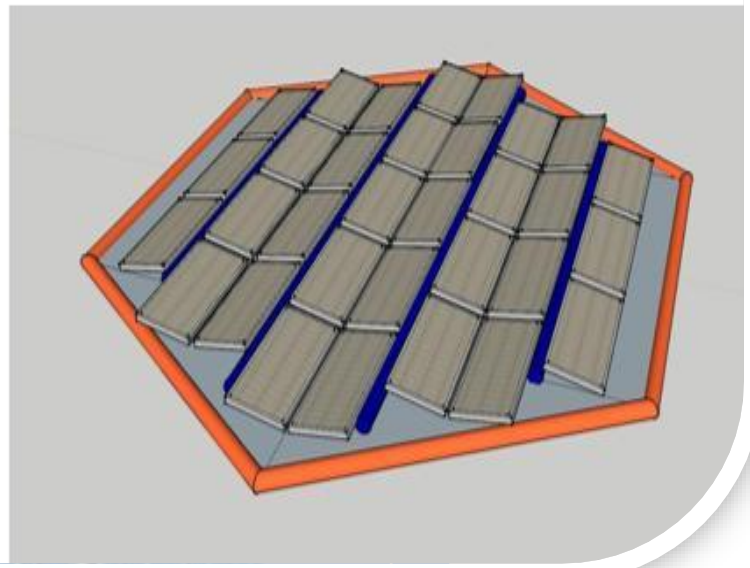
Modular Tube Bouyancy System – 100% Environmentally Inert

- Proprietary Marine Engineering Design
- 6x Faster Deployment
- Minimal Parts & Easy Transportation
- Non Corrosive Components
- (STM) Integrated mooring structure
- High Modularity & Aesthetical Features
- Easy Maintenance & Future Expandability

Design Criteria: Marine engineered Grade, Buoyancy, structural strength, cost, environmental friendly, environmental resistive, easy installation, less time to market ++



PATENT PENDING



MTB – Floatation Systems

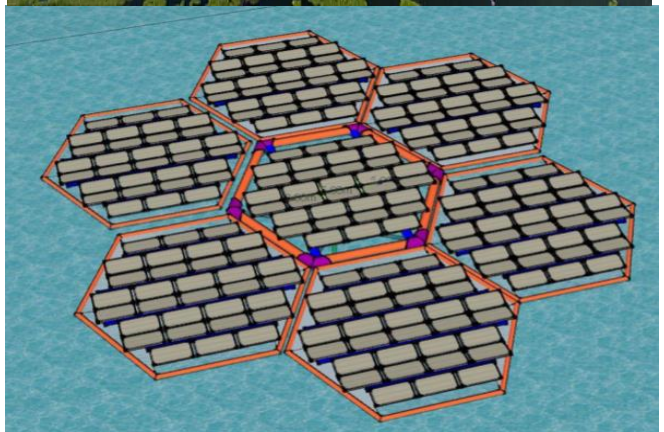
Current limitations of the Floating PV Systems

- Floats in market are manufactured by injection molding
- Longer lead time of delivery
- Floats vulnerable due to poor durability and strength
- Multiple/higher number of components cause fatigue and leaks in marine environment.
- Labor intensive to handle
- Not friendly with conventional mooring methods

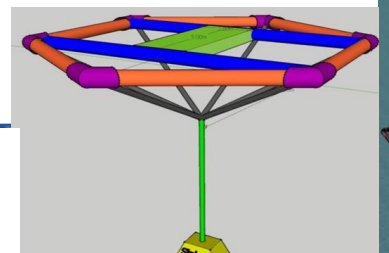
G8 Patented Innovation and Technology Solution – Next Generation Implementation

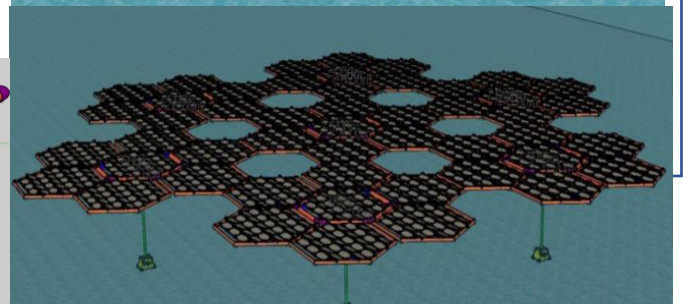
G8 MTB design improves on the modular installation concept by enabling each hexagon structure (SolarPod) to safely interlock with one another. Overall marine construction is significantly reduced due to the simplified design and structure, benefits in terms of cost, time and labor required for mooring.

This allows for G8 Floating Solar plants to scale from **MW to GW** scale in a cost effective way while achieving significant scalability of plants. The design will also enable modular upgradability.

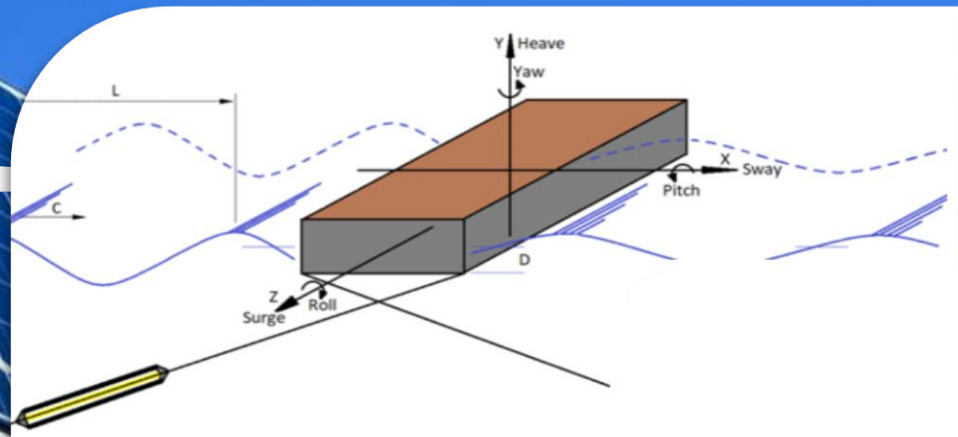


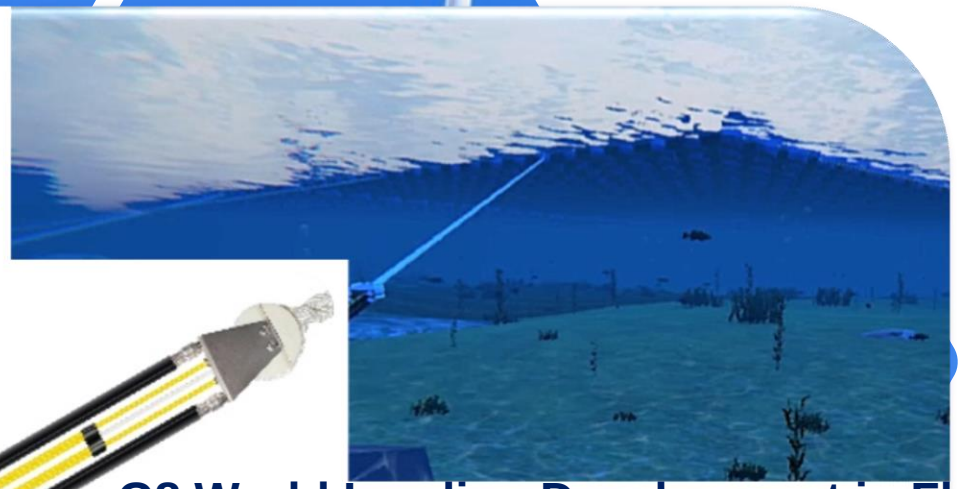
INTERGRATED SUIT FOR REAL TIME WATER QULAITY MONITORING SYSTEM

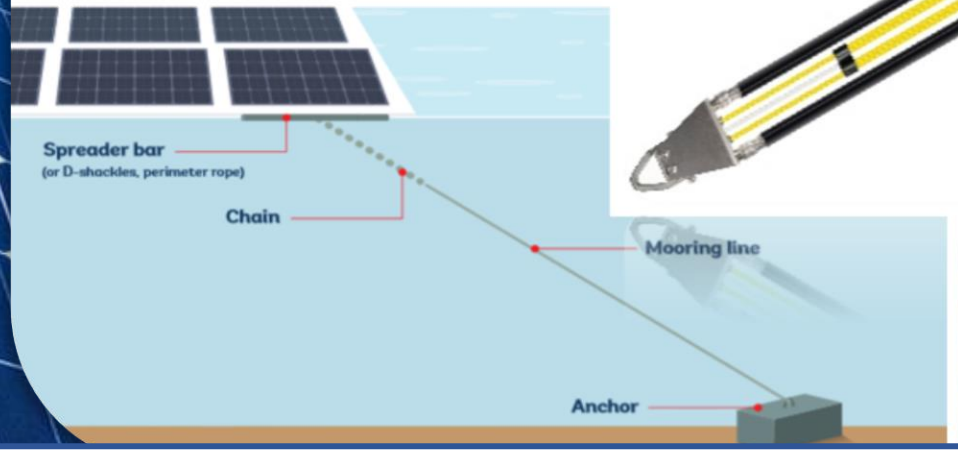


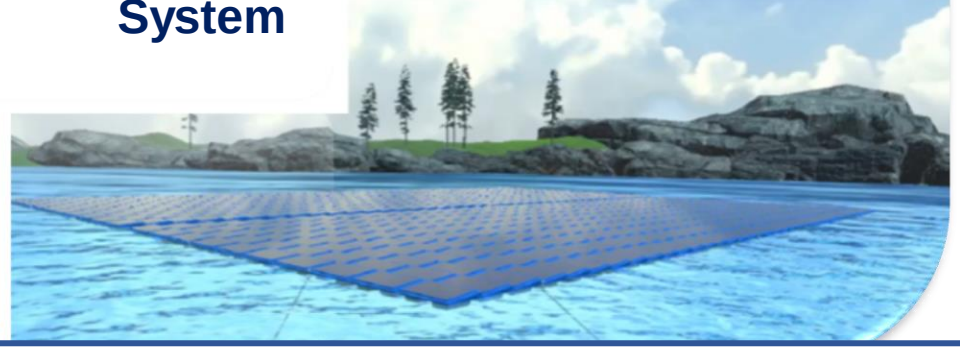


Mooring Engineering
STM Stable Tension Mooring







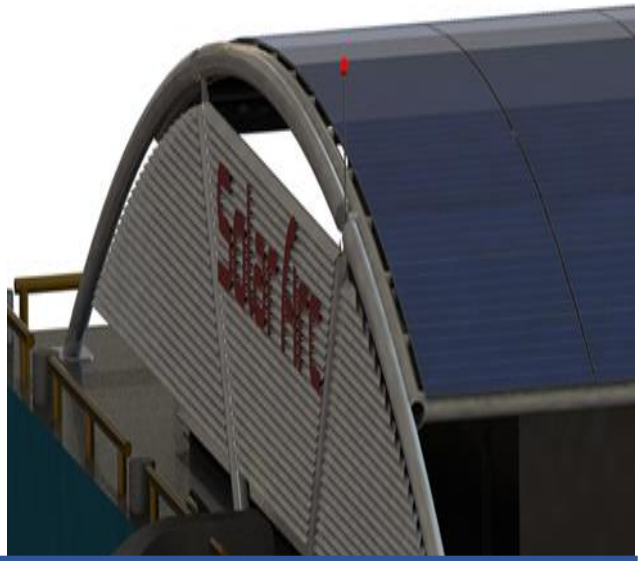


G8 World Leading Development in Floating Solar PV Mooring Technology – Stable Tension Mooring System

STABILISED TENSION MOORING (STM) SYSTEM.

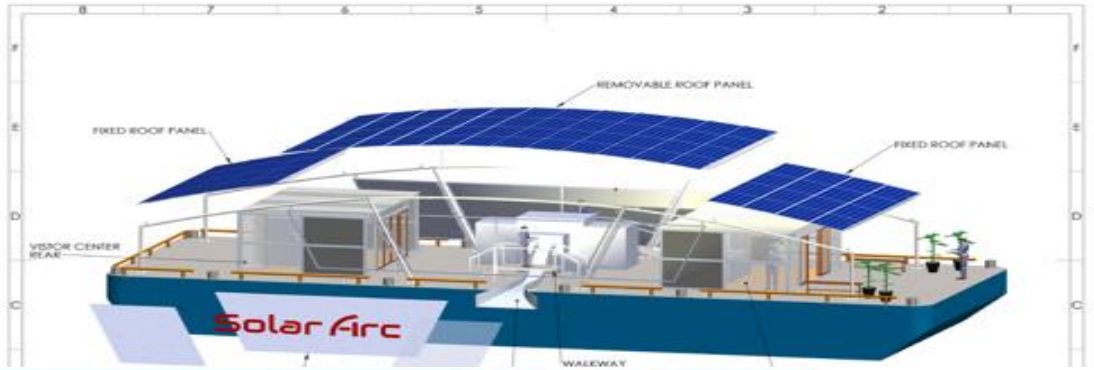
This is G8 proprietary subsea mooring technology presently used in 5MW Woodlands FPV plant. In this mooring technology keeps the entire block, stable and gives only vertical movement with the tidal variation at site.

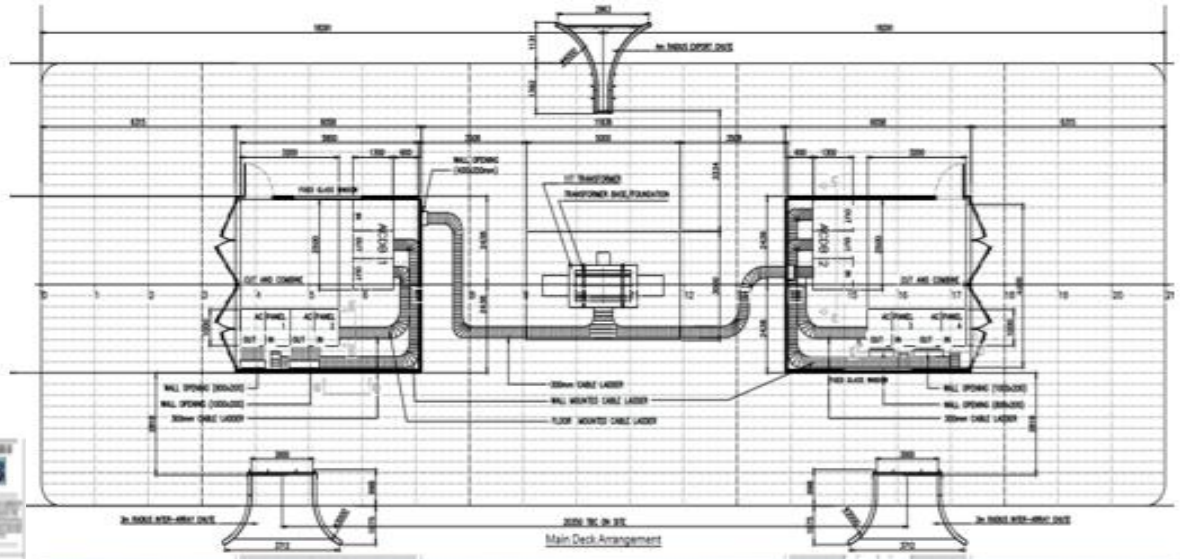
Floating Substation

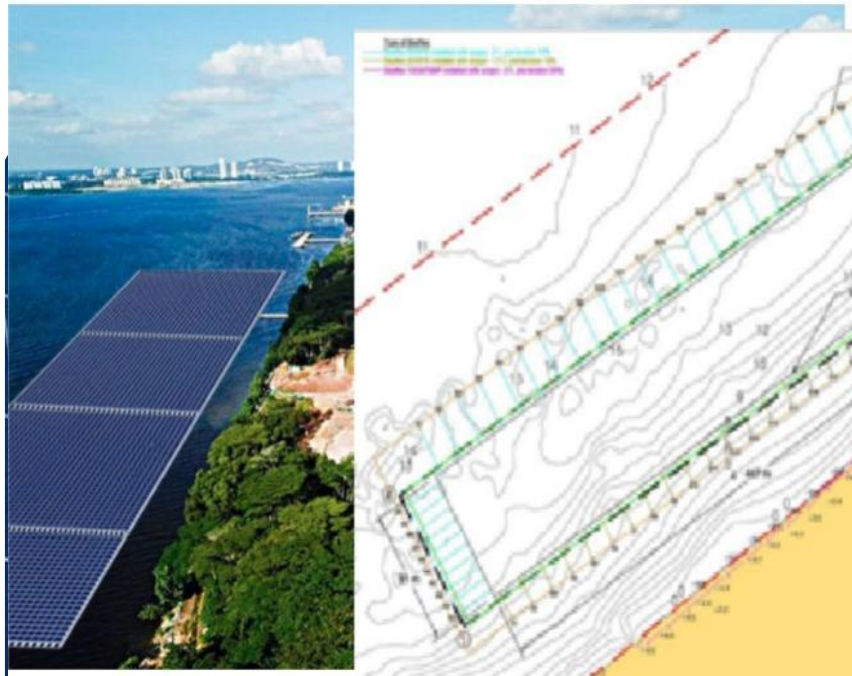


G8 Modular 20MW rated Floating Solar Substation for FPV

Floating Substation

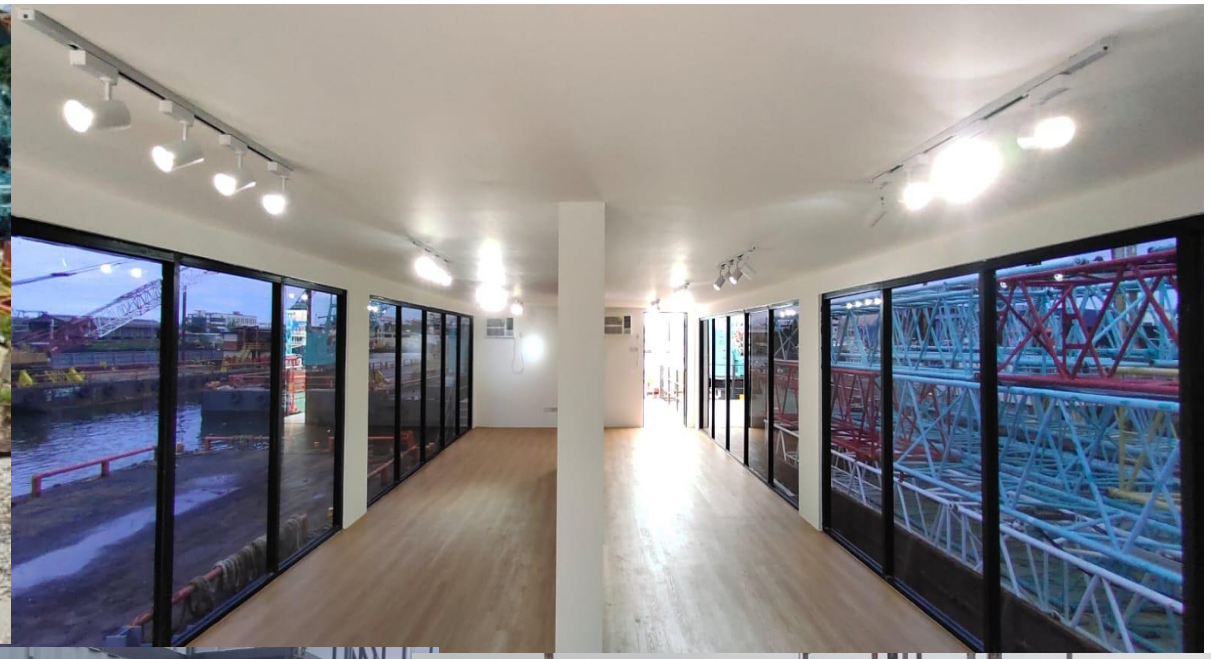






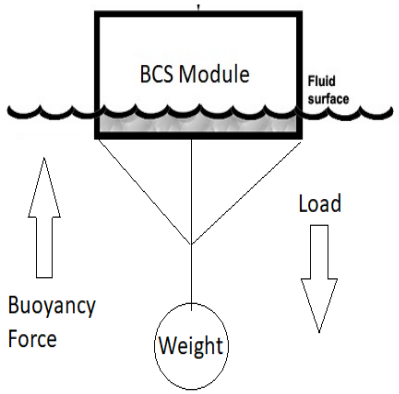
G8 Modular 20MW rated Floating Solar Substation for FPV

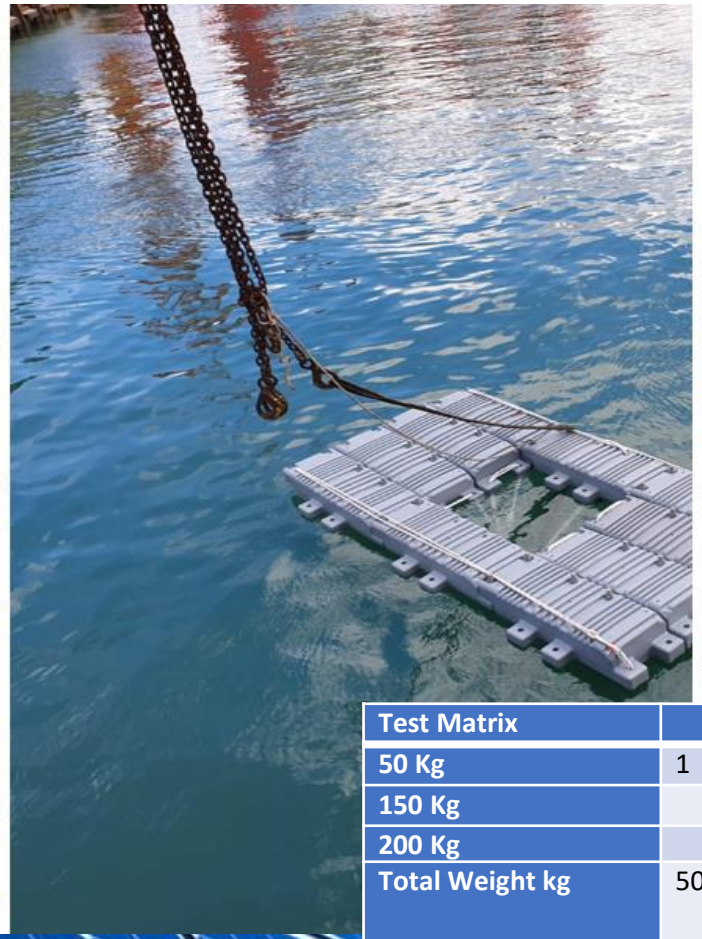
Floating Substation – World's First with Integrated Visitor Centre

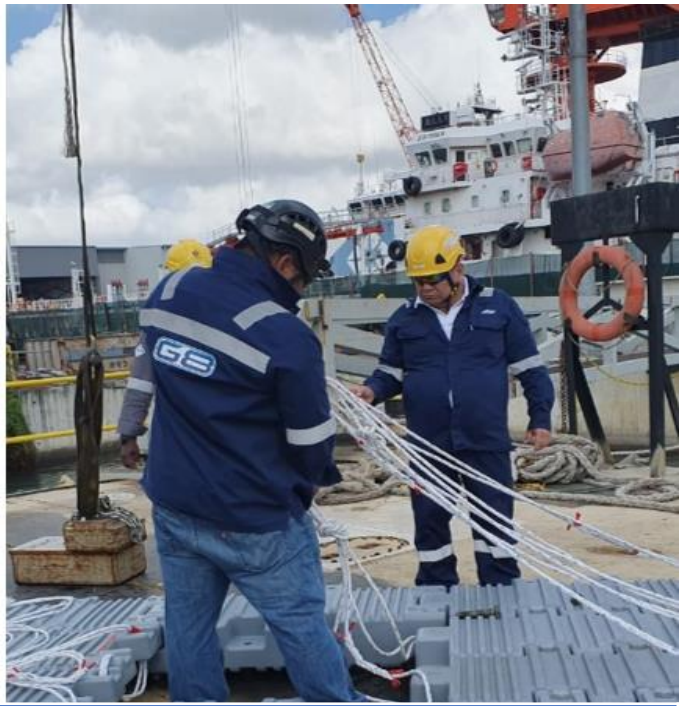


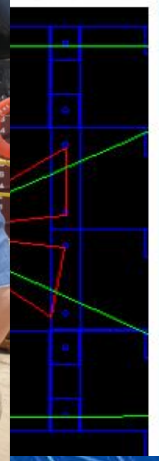
G8 Modular 20MW rated Floating Solar Substation for FPV

Quality Control
Testing & Evaluation (Floatation)





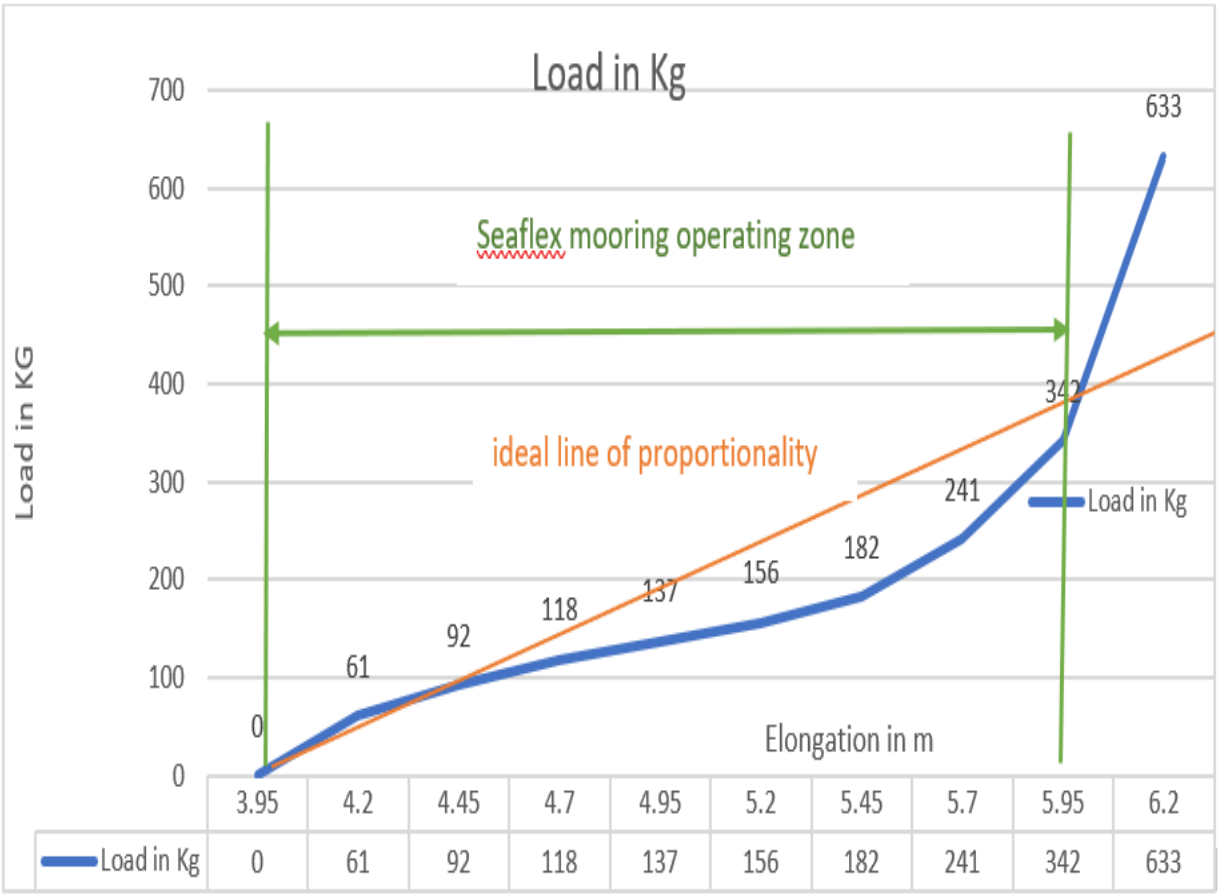




Test Matrix	Number						
50 Kg	1			1			1
150 Kg		1			2	1	1
200 Kg			1	2		1	1
Total Weight kg	50	150	200	250	300	350	400
Result			Afloat	Afloat	Afloat	Afloat	Afloat

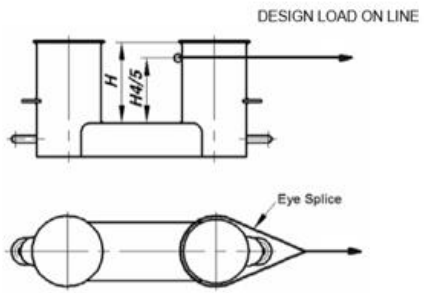
G8 Solar Float - Testing of Buoyancy & Stability

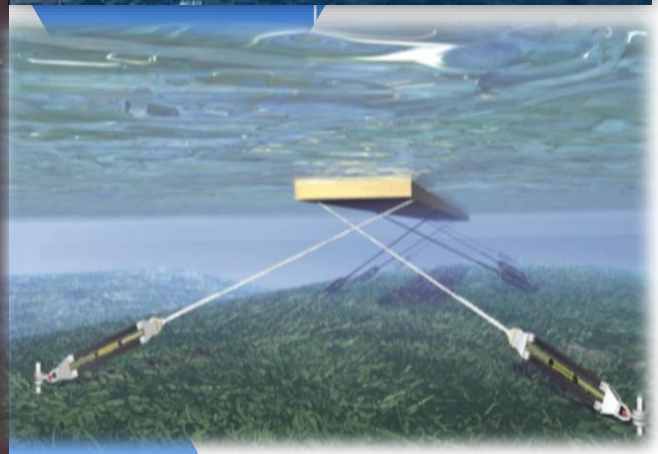
QC Testing & Evaluation (STM Mooring)



Elastic Mooring Testing – Load Vs Elongation

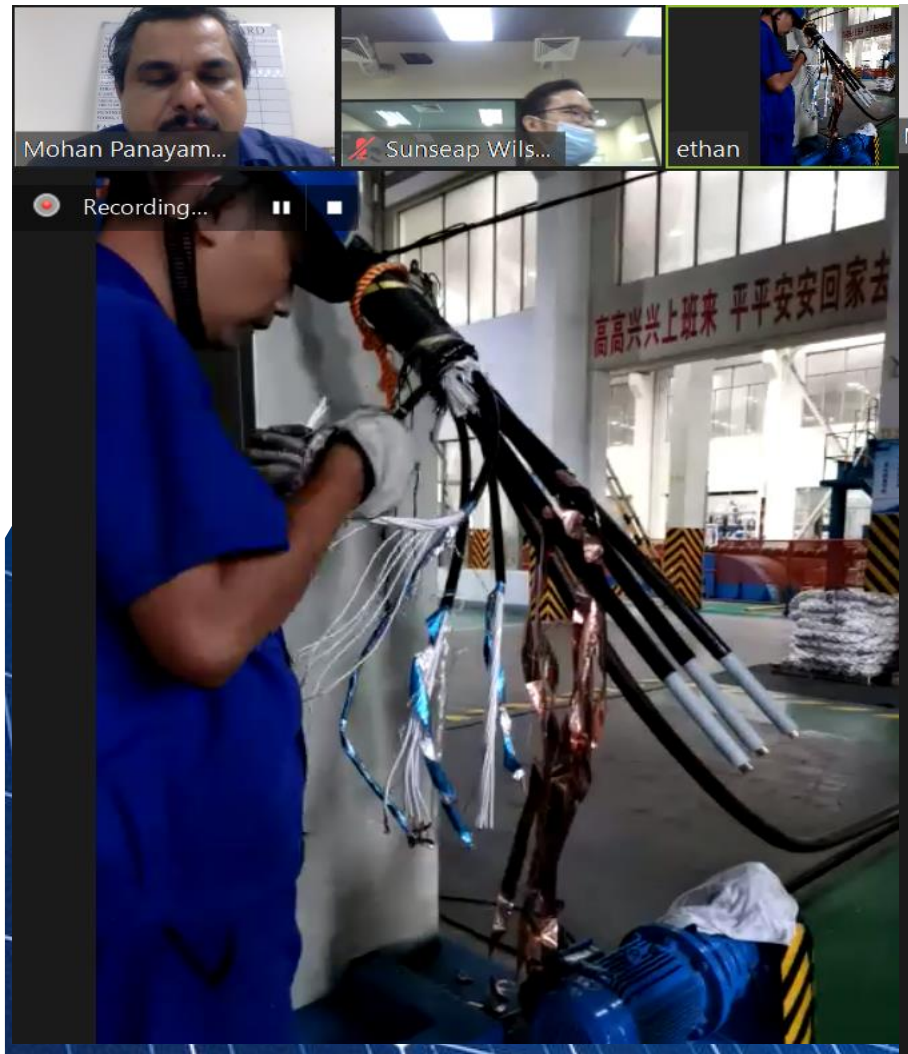
GwSolar QC Testing & Evaluation (FTP Platform)

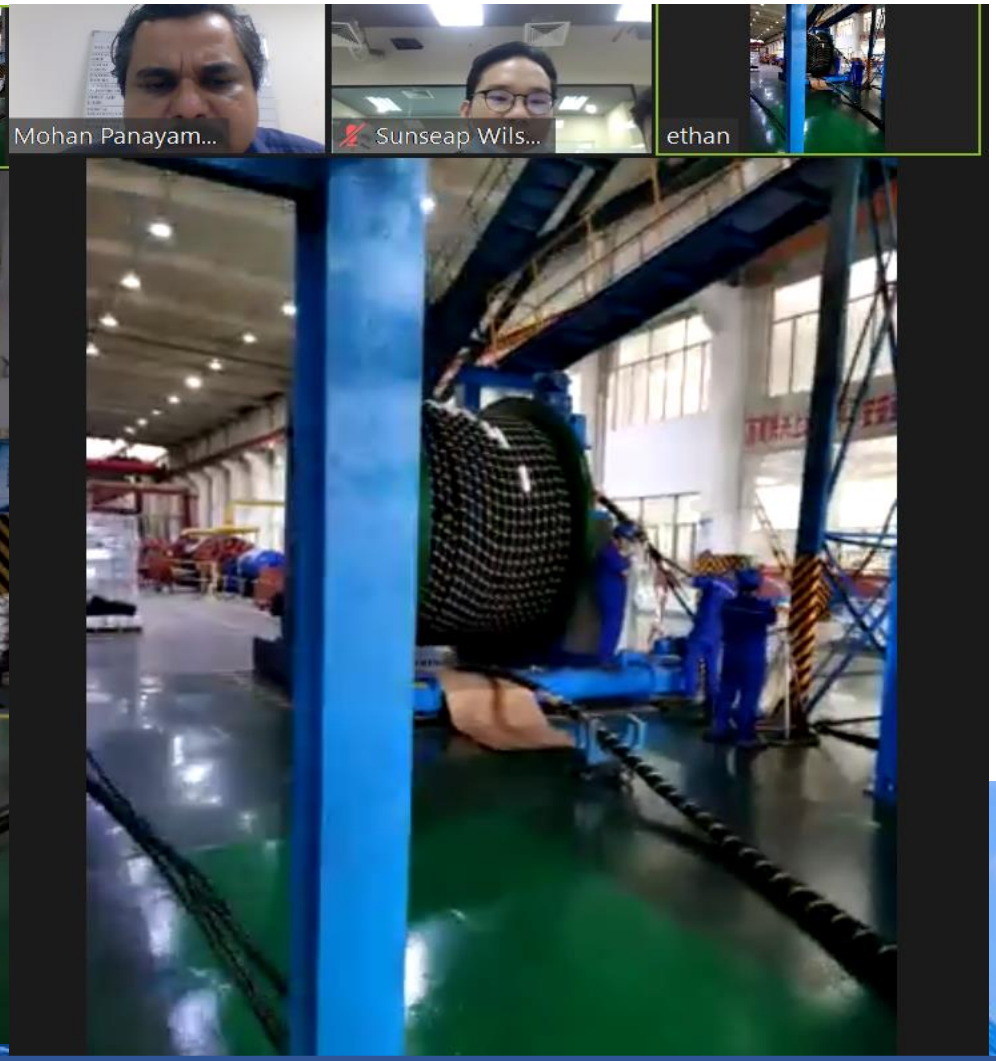




Bollard Load Test /Pull Test

GwSolar QC Testing & Evaluation (Power Transmission)





FAT Covered

Reference: ITP Document

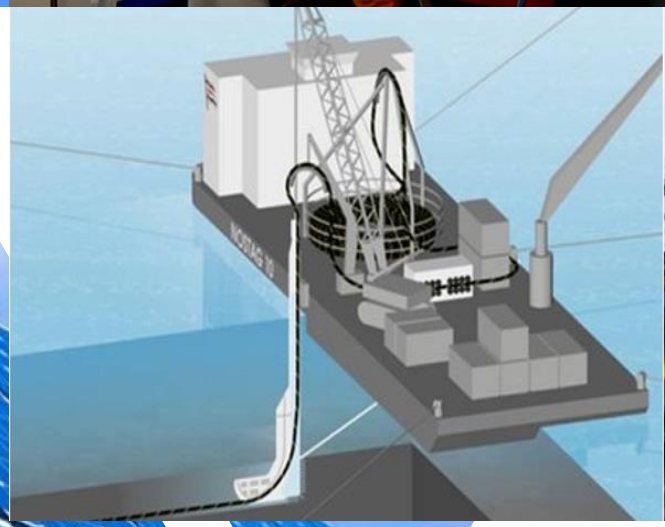
- **Construction Inspection**
- **Electrical Insulation Test**
- **DC Conductor Resistance Test**
- **AC Voltage Test**
- **Continuity of Copper Shield**
- **TDR Test**

FAT - 22KV Subsea Power Transmission Cable

Subsea Power Cable System

G8-CablePro - **Protection of Subsea Power Transmission with Cable Laying System**

Submarine Power Cable System



G8 CablePro - Shallow Water Submarine Cable Deep Burial System

Energy Storage System

HIGH YIELD

- Advanced three-level technology, max. inverter efficiency 98.8%, inverter CEC efficiency 98.5%
- Max. DC/AC ratio more than 1.5

EASY O&M

- Integrated current, voltage and MV parameters monitoring function for online analysis and fast trouble shooting
- Modular design, easy for maintenance
- Convenient external LCD

Company	Rack Model	Energy (kWh)	Voltage Range (V)	Weight (kg)	Dimension (WxDxH,mm)	Rack Q'ty	Total Design Capacity (kWh)
LG chemical	R1500-M48290P5B	357.5	1,008~1,411	2,407	520x1,200x3,150	28	10,010
Samsung SDI	E3-R256	256	1,114~1,444	1,929	876x711x2,750	40	10,240

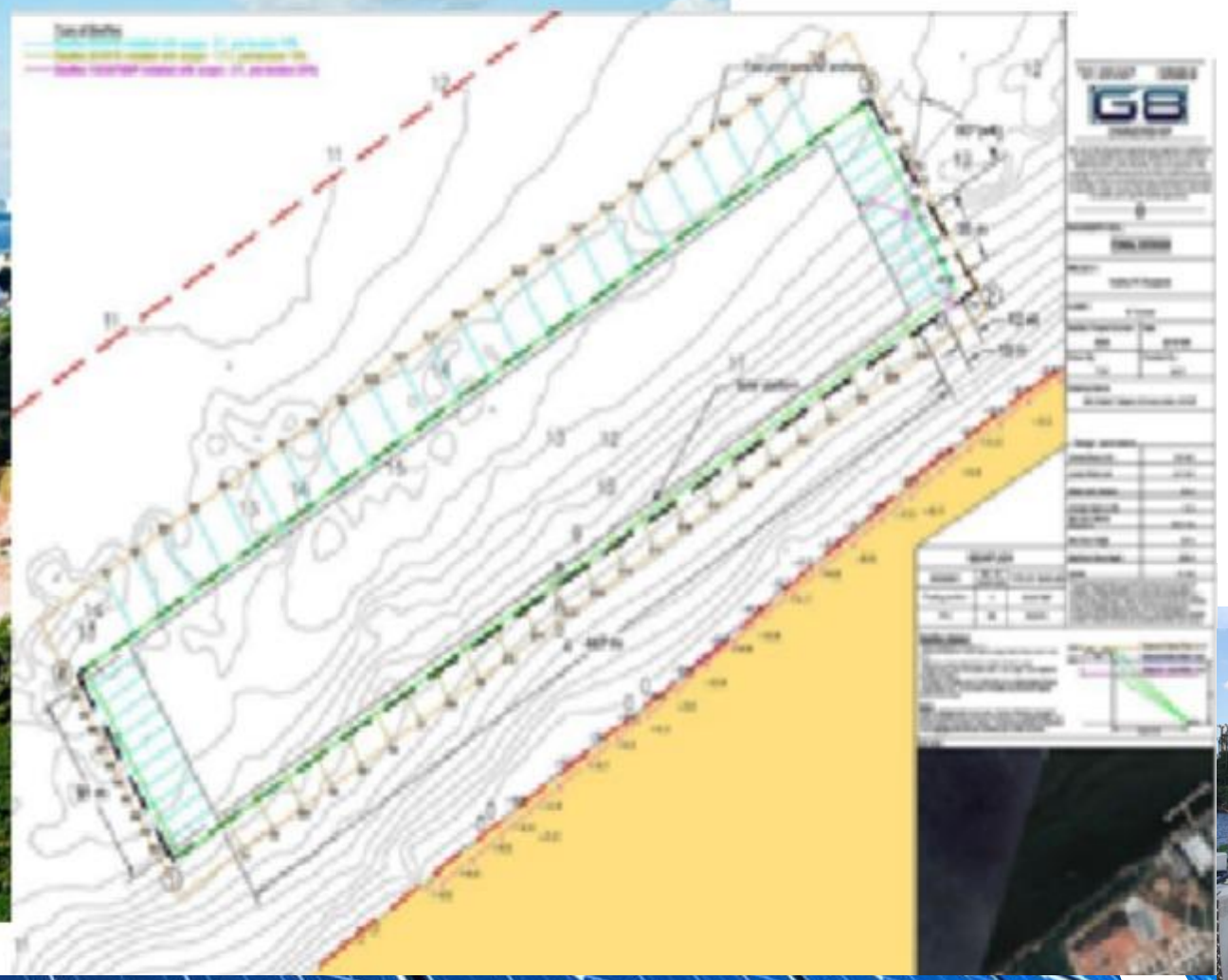
SAVED INVESTMENT

- Low transportation and installation cost due to 20-foot container design
- 1500V DC system, low system cost
- Integrated MV transformer and LV auxiliary power supply

GRID SUPPORT

- Complies with UL 1741, UL 1741 SA, IEEE 1547, Rule 21 and NEC 2014/2017
- Grid support including L/HVRT, L/HFRT, active & reactive power control and power ramp rate control

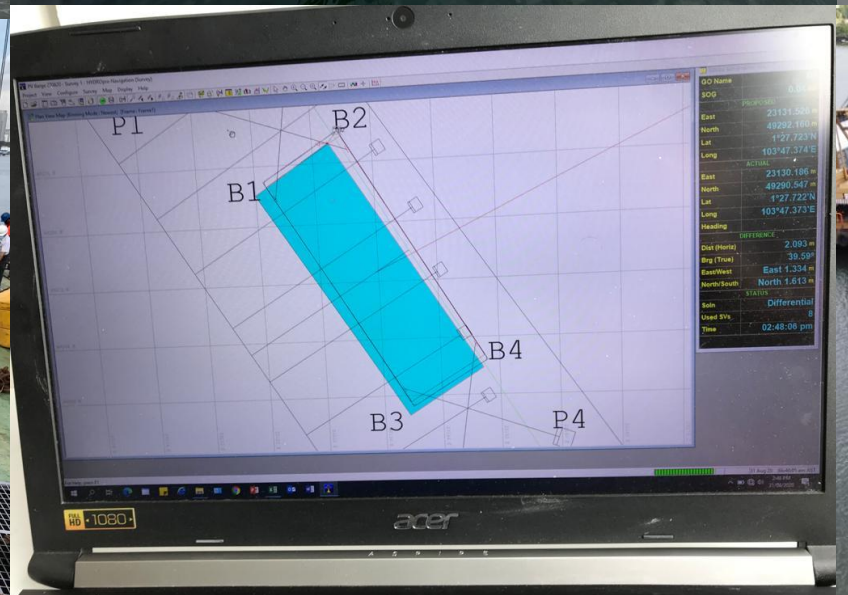
Conceptual Designs-to-FEED



- Geophysical Site Survey
- BCS Design
- Mooring Design
- OFPV Layout
- Mooring Grid Installation
- Cable Route Design
- Pipeline Crossing
- Shore End Cable Approach
- Cable Protection

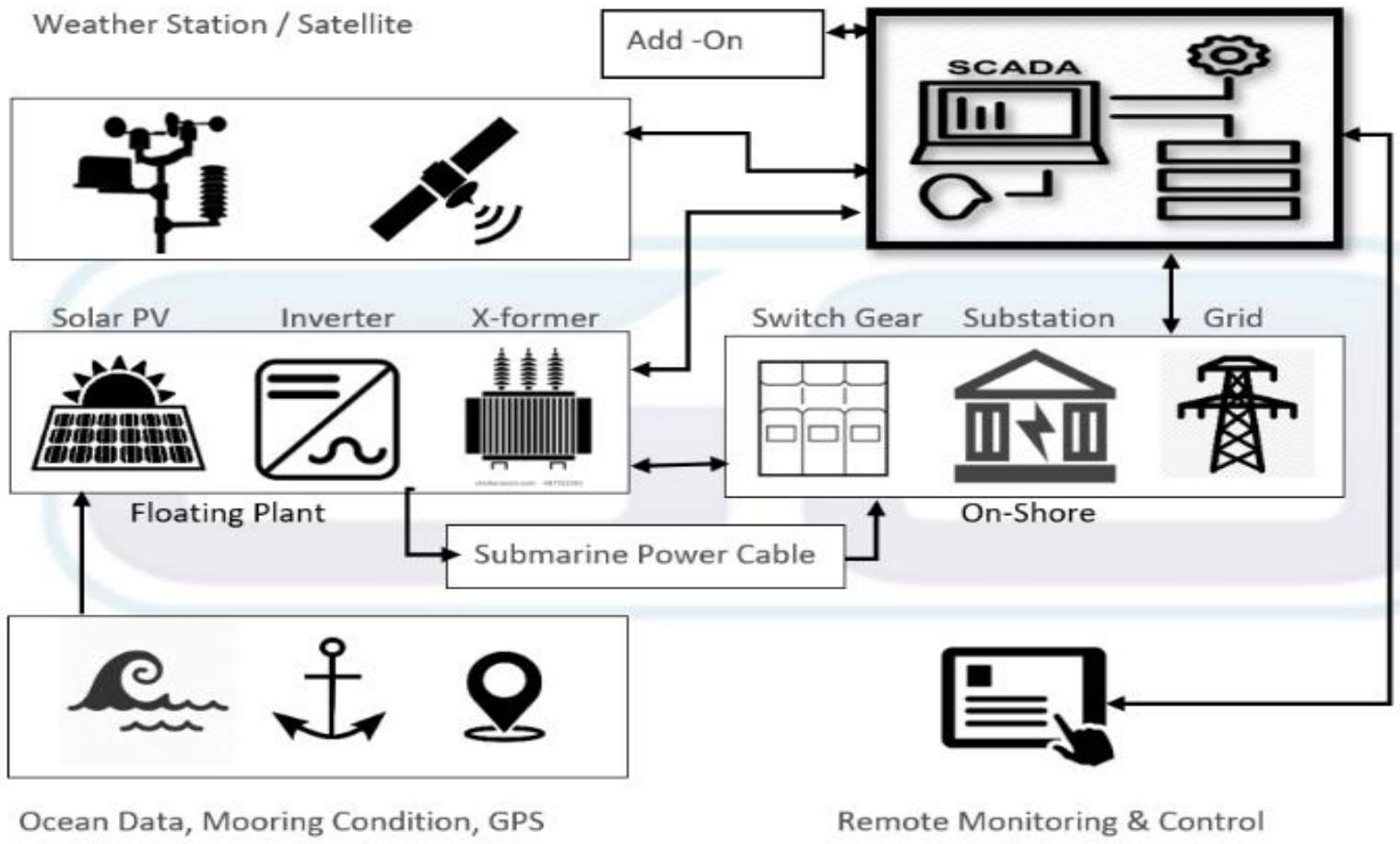
G8 GW Solar – OFPV 5 MW Off Woodlands

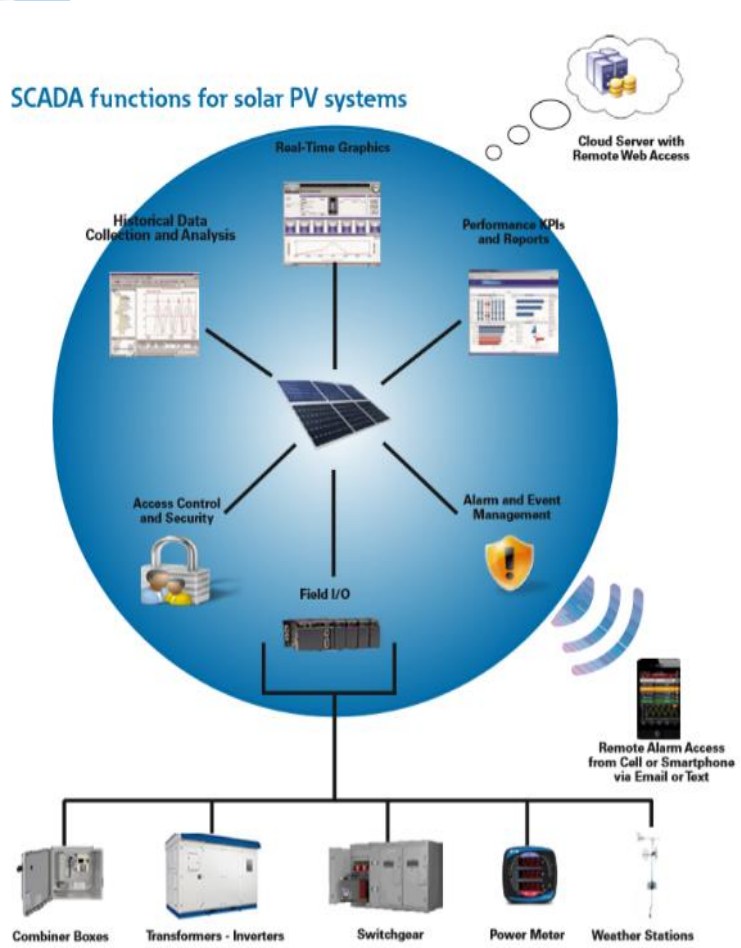
GwSolar Construction Site For Mega Solar Plant



World's First Offshore Floating Substation and Solar PV Plant

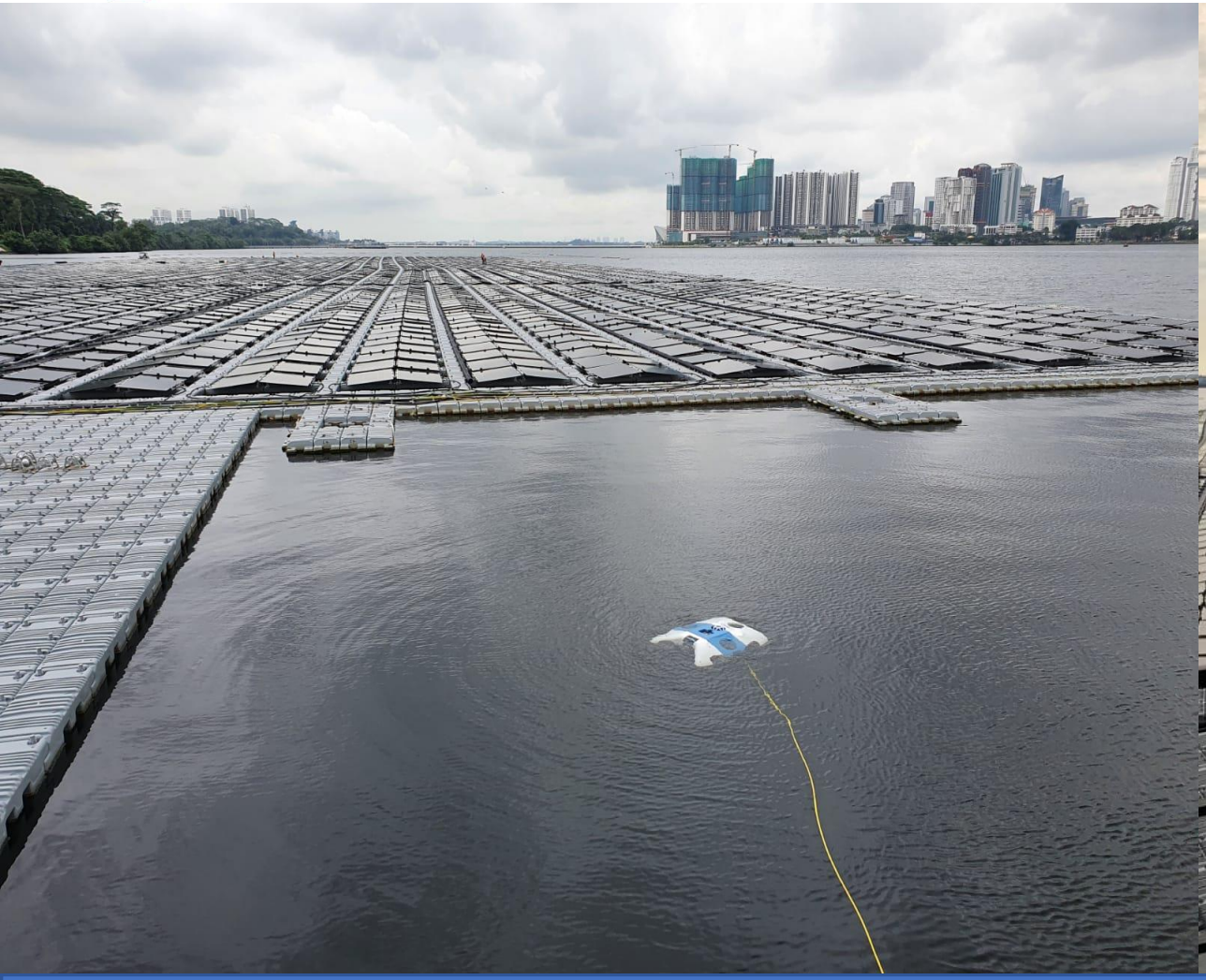
Remonte Control & Monitoring





G8 GW Solar – Control & Monitoring – Safety-Planned & Predictive Maintenance

Operation & Maintenance with Remote Monitoring



G8 GW Solar - Fully Autonomous, remote control, predictive maintenance system using site data analysis

Project Collaboration And Development

Strategy | Development | Financial Modelling & Structuring | Equity Raising | Contracting

G8 GW Solar - Developing – Structuring - Financing

SUMMARY

- **EXPERTISE - G8's wealth of experience in Marine & Offshore Sector.**
- **BANKABILITY - Desktop Studies & Site Specific Survey -Clear picture on ROI**
- **ENGINEERING - FEED for project specific Application (STM, HEXAGON, Real Time Water Quality Monitoring, Hybrid Solutions)**
- **CONSTRUCTION - Procurement, Installation & Commissioning**
- **OAM – Operation, Administration and Management**
- **DEVELOPMENT – Financing and Contracting**
- **PROJECT MANAGEMENT – Planning, Strategy and Implementation. Stakeholder Management & Surprise**

THANK YOU!
Q & A Session

" G8 - In-Depth with Engineering, Relentless in Technical Innovation"

Delivering Engineering Excellence with Uncompromised Safety & Service

G8 Subsea Pte. Ltd.
Tel:+65 6568 3310
http://www.g8-energy.com/

G8-energy.com