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The opportunity for floating solar in the Philippines

Best practices and lessons from both the UK and the wider Asia region

Philip Napier-Moore

Programme Leader, Renewable Energy, East Asia

REpowering Cities of the Future: Transitioning to Renewable Energy

10 November 2021

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We work in **135** countries

170 permanent offices in over 50 countries

16k staff

$2 billion turnover

Over **150** years' heritage

Consultants of the Decade

NCE AWARDS

IJGlobal Awards 2020 — APAC Technical Adviser of the Year — WINNER

FIDIC

Partnerships Awards 2015 — GOLD AWARD WINNER — TECHNICAL ADVISER OF THE YEAR — MOTT MACDONALD

FINANCE MONTHLY GLOBAL AWARDS 2017 — WINNER

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Drawing experience from infrastructure development

Our Journey in Floating Solar

2013

- TA – Floating Solar PV Technology Review
- OE – 3.8MWp Floating Solar PV for Community Wastewater Management System, South Australia

2017

- TA – 18.7MWp Floating Solar PV Plant, Korea (Coastal area)

2018

- TA – Acquisition DD for 40MW Floating Solar PV Portfolio, Taiwan
- TA – Floating Solar PV Plant, Laguna Lake, Philippines
- LEA – 47.5MWp Floating Solar PV plant on Da Mi-Ham Thuan hydropower plant, Vietnam

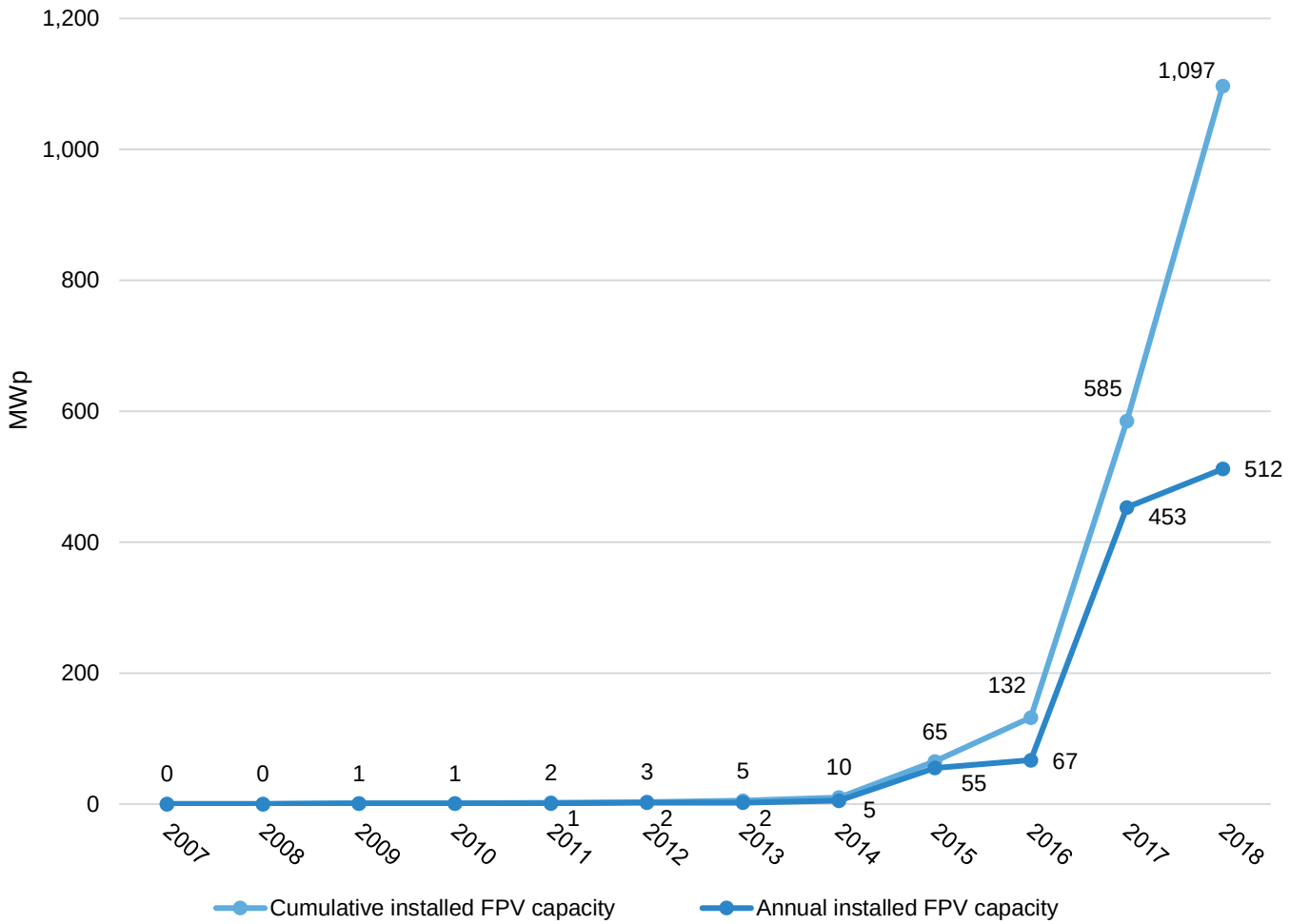
2019

- TA - 181 MWp ChenYa FPV in Taiwan - largest FPV in the world (to date), located in an intertidal site.
- FS – 325 MWp FPV on Tarbela hydropower plant 5th extension, Pakistan

2020

- LTA - 181 MWp ChenYa FPV in Taiwan achieved project financing and commercial operation
- OE – 28 + 7 MWp FPV freshwater reservoirs
- Philippine 1GW+ folio and test bed result review
- Chiba failure review (Japan)

Global Installed Floating PV Capacity



Source: “Where Sun Meets Water” authors’ compilation based on media releases and industry information.

- Floating solar PV plant capacity was limited to a few hundred kilowatts during 2008- 2012
- Installations >10MWp have been seen since 2016
- As of mid-2018, cumulative installed capacity was approaching 1.1 GWp (the same milestone that ground-mounted PV achieved in 2000!)
- FPV plants >100MWp now operating in Taiwan and China; more are planned in India & SE Asia, including in the Philippines

WORLD BANK GROUP
THE WORLD BANK IFC

Source: Valeriepieris

The Asia Pacific region, due to the pressures on land use and its often-complex geography and topography, is set to dominate the floating solar market globally.

Key Plant Components

Floating system

Mooring / anchoring device

Inverters / transformers

Submersible or floating cable

PV modules

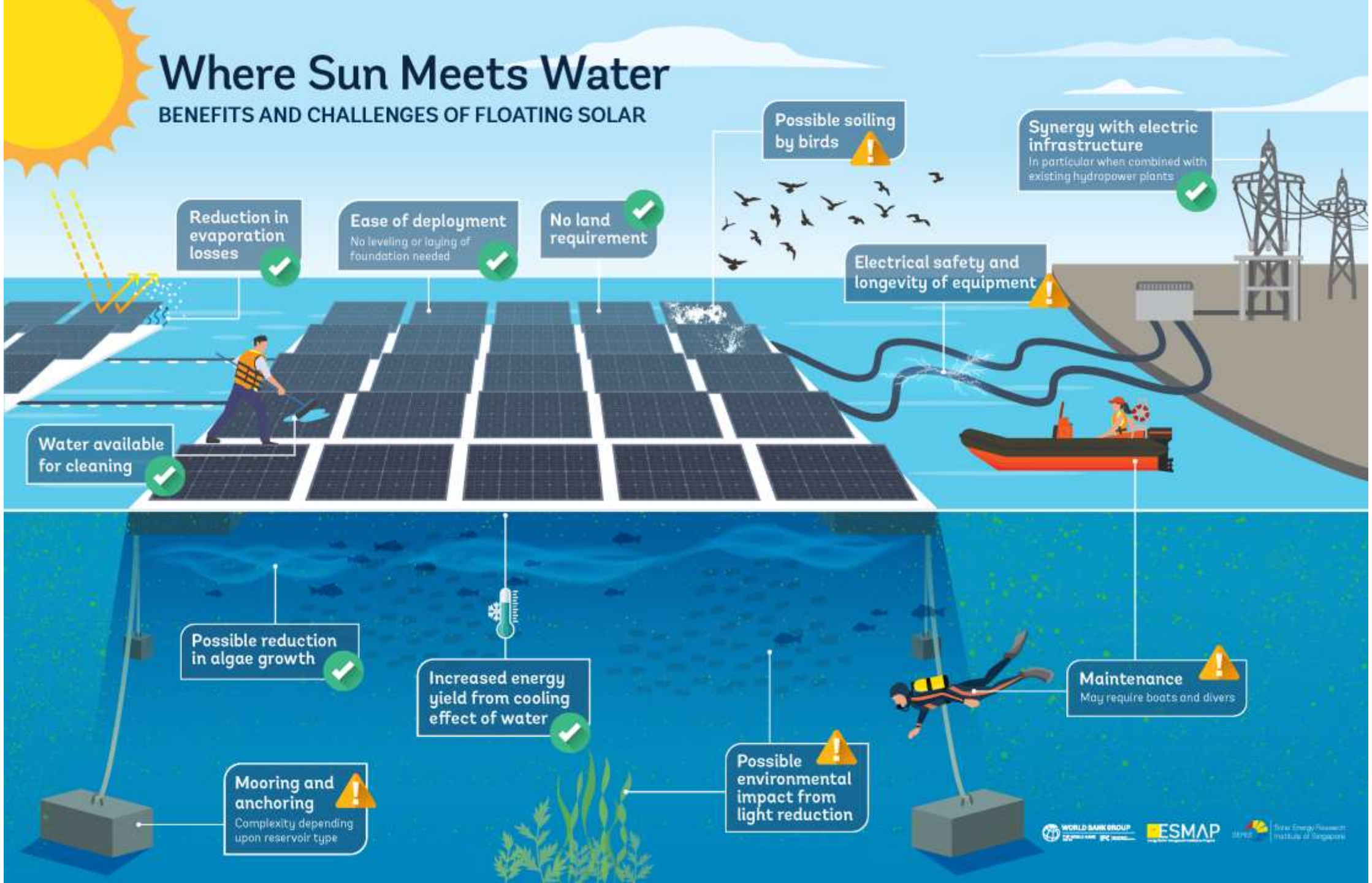
Substation / Grid

Pros & Cons

- ✓ Abundant inland water surfaces
- ✓ Saves land space and land costs
- ✓ Cooling effect of water; output gain
- ✓ Less shading and less dust
- ✓ Less evaporation from waterbodies

- ✗ Lack of track record at scale
- ✗ Technical complexity in key design areas
- ✗ Natural hazard risk
- ✗ Lack of supporting standards
- ✗ Costs, both CAPEX and OPEX

Source:


Where Sun Meets Water
BENEFITS AND CHALLENGES OF FLOATING SOLAR
Possible soiling by birds
Synergy with electric infrastructure
In particular when combined with existing hydropower plants
Reduction in evaporation losses
Ease of deployment
No leveling or laying of foundation needed
No land requirement
Electrical safety and longevity of equipment
Water available for cleaning
Possible reduction in algae growth
Increased energy yield from cooling effect of water
Maintenance
May require boats and divers
Mooring and anchoring
Complexity depending upon reservoir type
Possible environmental impact from light reduction
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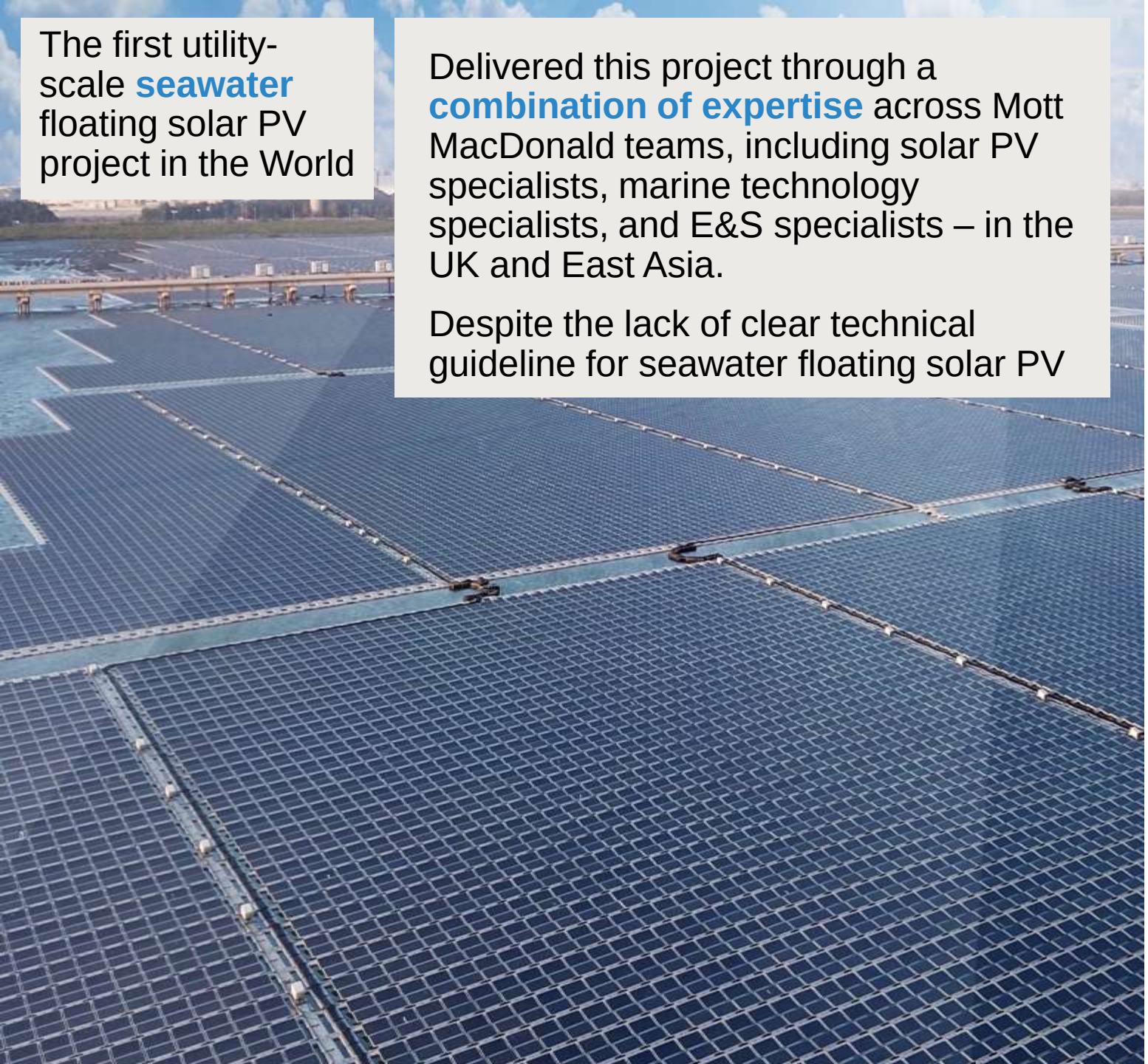
ESMAP


th II reservoir, UK – 6.3 MW

LightSource BP



The first utility-scale **seawater** floating solar PV project in the World

Delivered this project through a **combination of expertise** across Mott MacDonald teams, including solar PV specialists, marine technology specialists, and E&S specialists – in the UK and East Asia.

Despite the lack of clear technical guideline for seawater floating solar PV

Project
Chenya Energy floating solar

Client
DBS, Chenya Energy

Capacity (DC)
181MWp

Location
Taiwan

MM Role
Independent Technical Advisor

Inherent Project Challenges

- Complex, intertidal site environment
- Limited site data at design stage
- Immaturity of design codes
- Corrosion risk, from saltwater
- Tidal-bed could change over lifetime
- Supplier qualification; no precedents

Roundup: The opportunity for floating solar in the Philippines

- Floating solar is booming globally
- Well suited to archipelago geographies with land constraints and large freshwater bodies
- Technical challenges remain, but are being resolved through experience
- Very large-scale projects in complex conditions are going ahead across Asia
- Projects can be developed at various scales – from municipal water storage and industrial ponds up to GW scale
- Philippine LGUs can work together with locally-active developers to explore and harness the opportunity for local, carbon neutral power

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Floatovoltaics…

Let’s Help Set the Standard!

Philip Napier-Moore
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Technical Challenges (1/2)

- Site characteristics and natural hazards
  - ✓ Bathymetry (level variation)
  - ✓ Wind speed, waves, currents
  - ✓ Storms, swell…
- Anchoring/mooring lines
  - ✓ Tension & stress
  - ✓ Anchor at the banks/bottom
  - ✓ Material of lines, chains, bars, shackles
- Floats
  - ✓ UV corrosion
  - ✓ Wind tunnel tested, resistant to fatigue and strength for loads and waves
  - ✓ Rails and clamps


Kyocera's 13.7 MW -before

Kyocera's 13.7 MW -after

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Technical Challenges (2/2)

- PV module specifications against:
  - ✓ Humidity, PID, salt mist corrosion
  - ✓ Microcracking, hot spots

- Inverter type and specifications:
  - ✓ Humidity and corrosion
  - ✓ IP rating
  - ✓ Maintainability

- Other electrical equipment
  - ✓ Material selection
  - ✓ Lighter weight
  - ✓ IP rating (junction boxes, transformers)
  - ✓ Waterproof cable conduits

Source: Huawei

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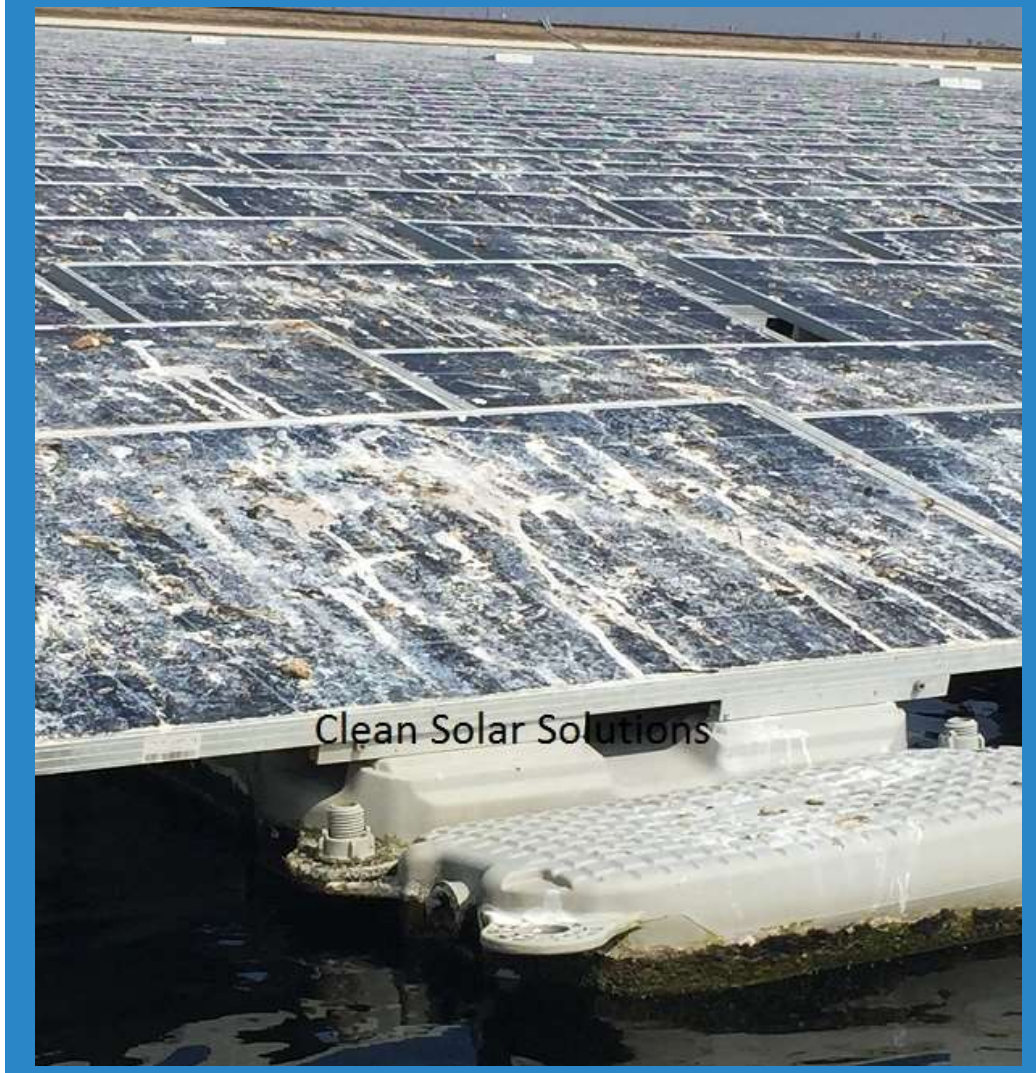
Other considerations

- Effect of surroundings on the equipment
  - ✓ Biofouling, above and below waterline
  - ✓ Bird droppings
- Occupational Health and Safety
  - ✓ Risk of solar cables submerged in water
  - ✓ Working over water, near electrical equipment
- Environmental and social
  - ✓ Long-term impacts of permanent shading on aquatic flora and fauna
  - ✓ Potential sedimentation impacts during construction
  - ✓ Potential economic displacement
  - ✓ Compliance with drinking water regulations (if applicable)



Source: Clean solar solutions

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How do we achieve bankability for Large Scale Floating Solar?

- Measure site conditions & simulate natural hazards
- Define clear criteria for qualification of selected components (including testing, certification and warranties)
- Consider track record at scale and technical knowledge of suppliers and contractors
- Holistic design for operability and maintainability
- Apply HSSE standards, for construction & operation

Source: ezysolare.com

7 MWp Array, Taiwan; Source: MM

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Powering Up Pakistan’s Hydro Dams – first and largest floating solar PV plant

The project, being delivered by the Water and Power Development Authority of Pakistan in association with the World Bank, will increase the Tarbela power plant’s total generating capacity from 4,888MW to 6,300MW.

Project
Tarbela floating Project

Client
Water and Power Development Authority

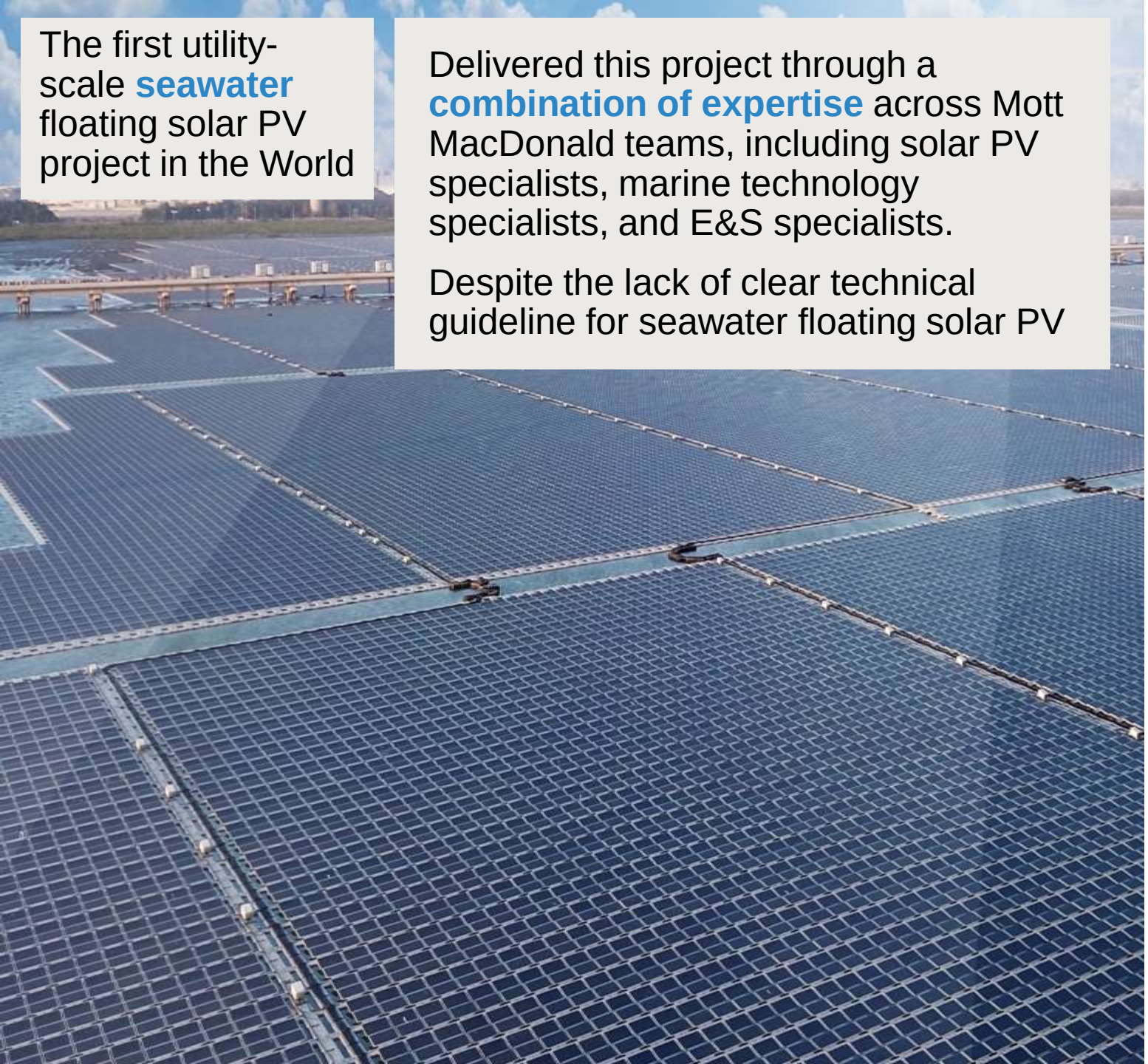
Capacity (DC)
370MWp

Location
Pakistan

MM Role
Owner’s Engineer

Scope
Studying the feasibility of the development, assisting with the Government approval process, tender documentation and tender management including evaluation and negotiations with successful bidder and will continue after project award with supervision and management of the design and construction.

10 November 2020



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Capacity (DC)
181MWp

Location
Taiwan

MM Role
Independent Technical Advisor

Scope
Our services include technical and E&S due diligence to support project financing. Services also expanded to include supplier qualification assessment and assessment of detailed design aspects relevant to the complex, intertidal site environment.

After financial close, the services continue for construction monitoring and operation monitoring.

ADB's first project financing of a floating solar PV project in Southeast Asia, under the **Private Sector Operations Department (PSOD).**

Project
47.5MWp Da Mi Floating Solar PV Plant

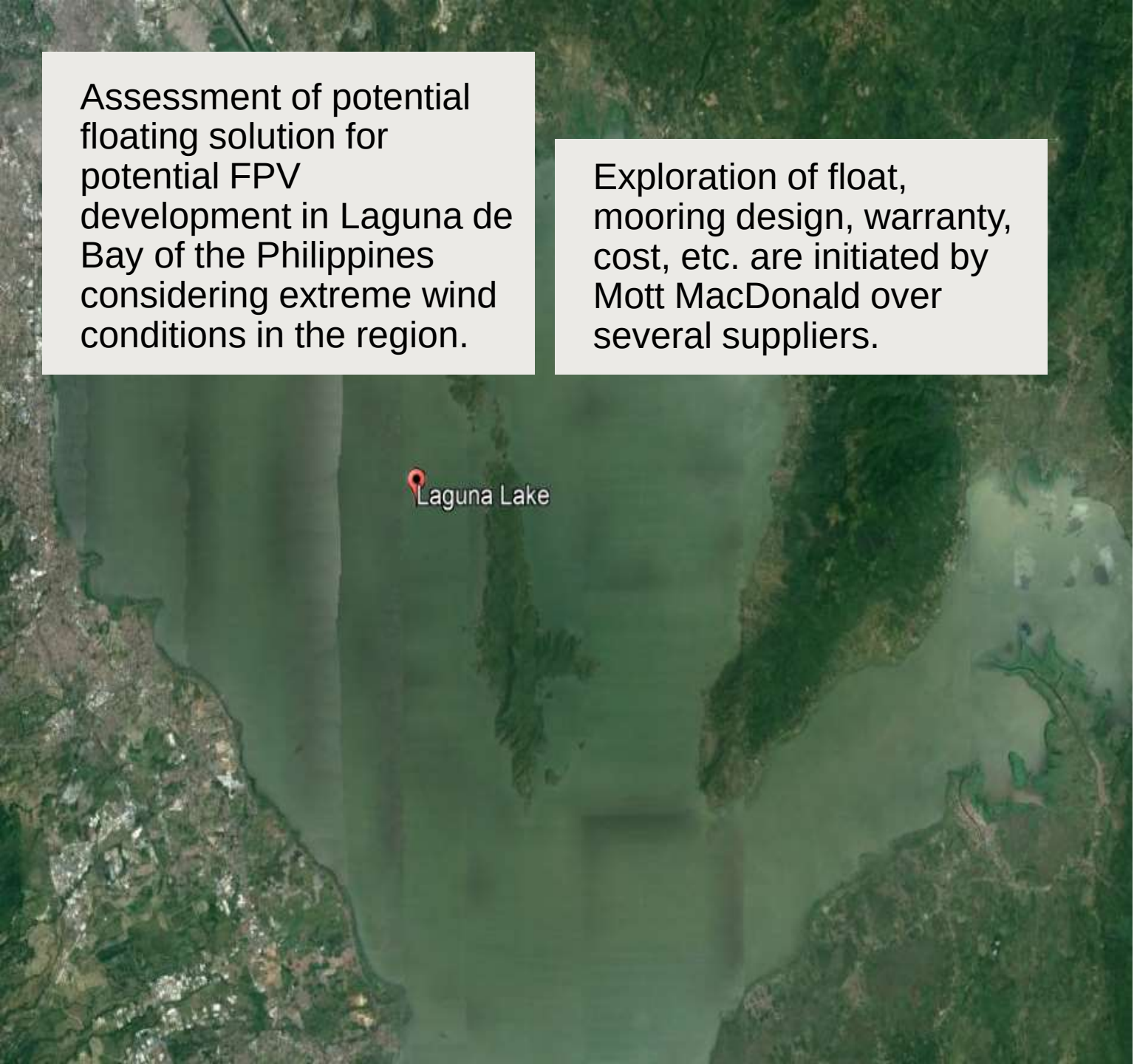
Client
ADB

Capacity (DC)
47.5MWp

Location
Binh Thuan, Vietnam

MM Role
Independent Engineer supporting lender on E&S aspect

Description
The Project is located in Da Mi reservoir which is associated with the 475MW Da Mi-Ham Thuan hydropower plant. The Project also includes two inverter stations, a substation and a 3.3km transmission line connecting the Project to the existing 110kV Ham Thuan-Duc Linh line.



Assessment of potential floating solution for potential FPV development in Laguna de Bay of the Philippines considering extreme wind conditions in the region.

Exploration of float, mooring design, warranty, cost, etc. are initiated by Mott MacDonald over several suppliers.

Project
Floating Solar PV project

Client
Confidential

Capacity (DC)
-

Location
Laguna de Bay

MM Role
Technical advisor for the developer

Scope
Review and compare the design between floating suppliers, and provide recommendations on the most suitable one.

Thank You

Mott MacDonald