MOTT MACDONALD

Marine Floating Solar

Lessons learned from deployments, and potential for Asia

Philip Napier-Moore

Energy Sector Leader, Asia

Introducing Mott MacDonald

Mott MacDonald's Energy profile

Overview Mott MacDonald's global energy business

2000
dedicated energy staff working globally

150
countries

More than
260GWp
Renewable project experience

More than
300
dedicated renewable energy staff

Leading Asia track-record

Renewable Energy Expertise

We have been at the forefront of renewable energy for over 100 years.

Mott MacDonald has over 100 years of experience in the energy sector. Our energy work spans across UK, Europe, Africa, the Middle East, India, Indonesia, Thailand, Singapore, Malaysia, Japan, Taiwan, Korea, Australia and the US.

Here at Mott MacDonald, we pride ourselves in working closely with our client, solving problems, supporting the successful delivery of projects, and staying at the leading edge of technological and commercial evolution.

In the last 10 years alone, we have helped develop more than:

70GW
of hydro power projects including 40GW in Asia Pacific

70GW
of solar power projects including 40GW in Asia Pacific

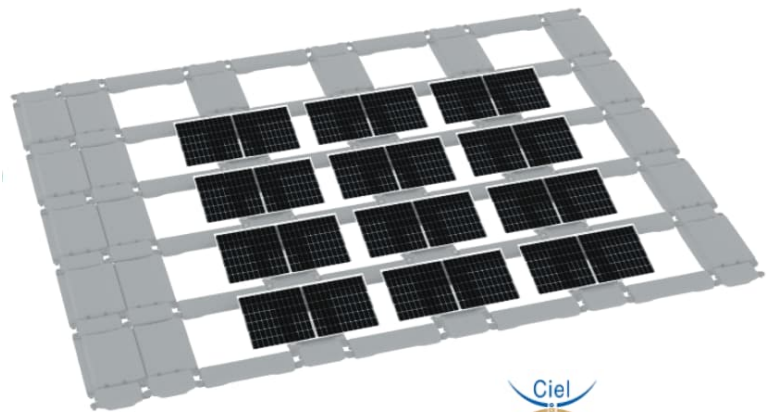
120GW
of wind power projects including 20GW in Asia Pacific

30GW
of power transfer capability in Cables related projects

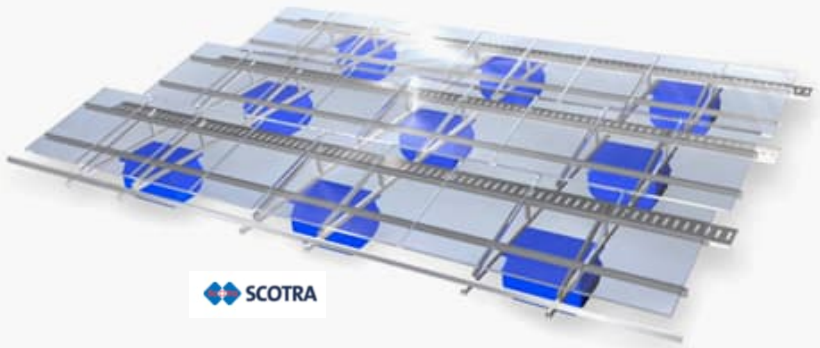
30GWh
of BESS projects including 20GWh ESS projects in Asia Pacific

Floating Solar – key options for float selection

“Pure floats” – modular pontoons



Pontoon floats with metal / FRP mounting structures



Non-pontoon-based floats

North Sea 1-2, Zon-op-Zee (Solar-at-Sea)

The world first offshore solar array tested at open sea (2019), developed by six Dutch companies and research organisations including TNO, MARIN, ONE-Dyas and Oceans of Energy.

The expanded 50kW project has withstood high-wave conditions (wave heights up to 10 meters and hurricane wind gusts of 141 km/hour) and is being upscaled to 1MW.

Ocean Sun

Europe's current largest ocean-based floating solar energy system is a 275 kWp offshore demonstrator in La Palma, Spain using Ocean Sun's membrane based technology.

Ocean Sun has also trialled the world's first offshore wind and floating solar hybrid project, with 0.5MW offshore floating solar based off the coast of China's Shandong province in 10m waves.

Swimsol

Swimsol launched the SolarSea project in 2014, in the Maldives.

Each modular floating offshore plant is approximately 25kWp, installed close to shore. The company's 96kWp assembly was the world's first modular floating solar power plant at sea, in 2016, composed of four identical platforms.

The largest system installed is 891kWp, launched in 2024.

Seychelles

Masdar plans a 19MW floating PV plant, as the first utility-scale floating PV array in Africa, meeting 19% of Seychelles' electricity demand.

The project will be located on Providence lagoon in the main island of Mahé.

5MWp offshore floating solar system, Singapore

The 5-hectare sea-based solar plant was developed by Sunseap Group, north of Woodlands Waterfront Park, along the Straits of Johor.
The equipment went through series of tests for salt corrosion and heat dissipation for resilience to the harsh environment, and high temperatures of Singapore.
The project uses an undersea cable system connecting the floating platform to the mainland.

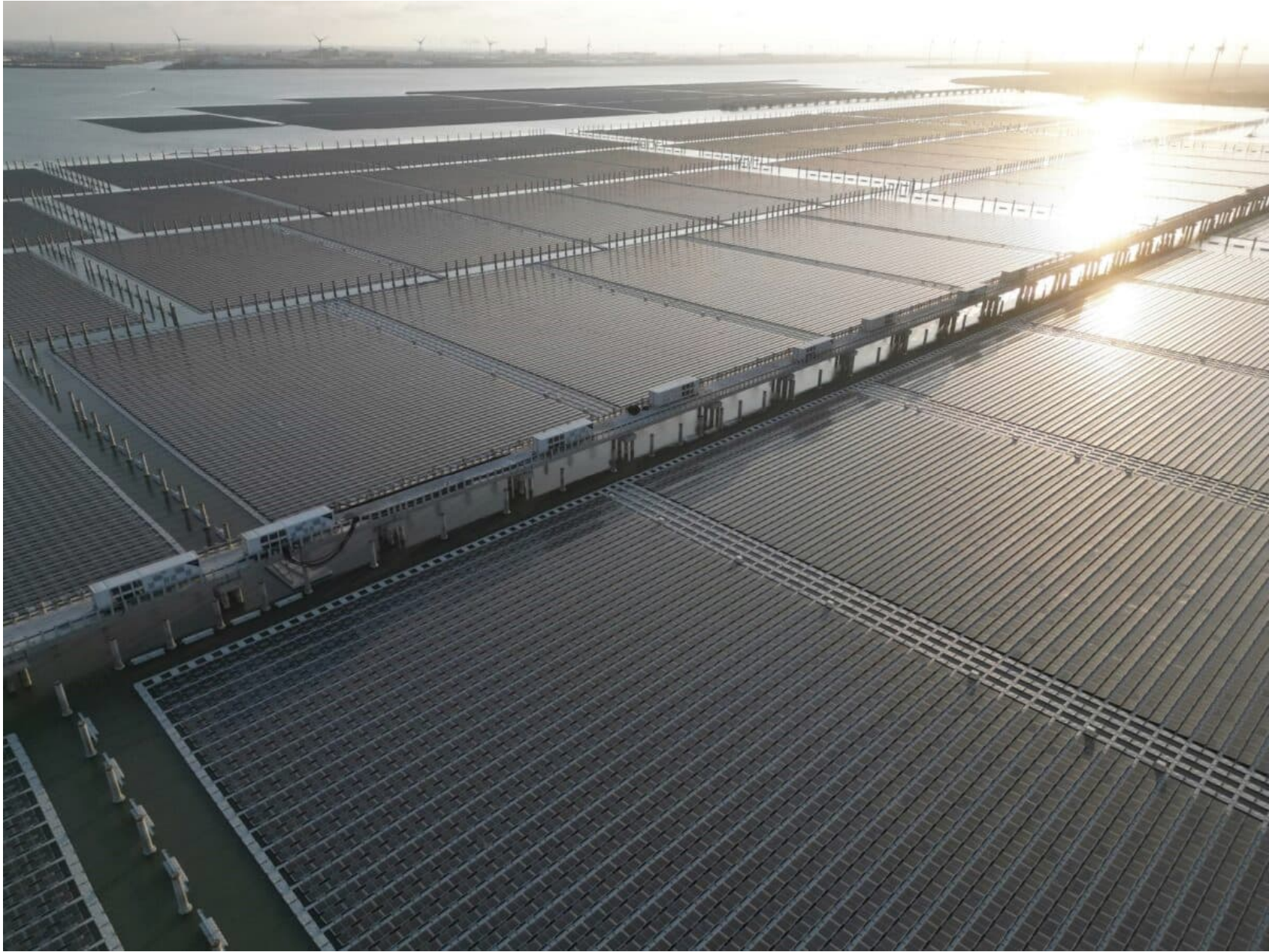
440MWp intertidal FPV complex, Taiwan

Five zones of intertidal floating solar are now operating in Changhua industrial park, on the western seaboard of Taiwan. The complex marks the world’s largest seawater floating solar farm.

The first two zones of 181MWp were commissioned in 2020, comprising arrays of 8-13MWp. Site challenges included the saline environment, biofouling, beaching on an uneven bed seabed during low tide, tide-borne debris, water current flow, wave conditions and high wind speed seasons.

Changbin #3 and #4

Central inverters are installed on a newly constructed central pier, connecting to the shoreline



Changbin #3 and #4

To manage the tidal range – guide piles are used in place of bottom anchors for connection of mooring lines

General Technical and Design Considerations

Wind Load

Wave Load

Variation in Water Level

Anchoring and Mooring Design

Humid/Corrosive Environment

Image source: Kevin Frayer | Getty Images

Example key hazards in construction and operation

Several high-profile failures during typhoons; frequent instances seen of insufficient temporary mooring during construction

Soiling from bird droppings can lead to hot spots, a fire risk

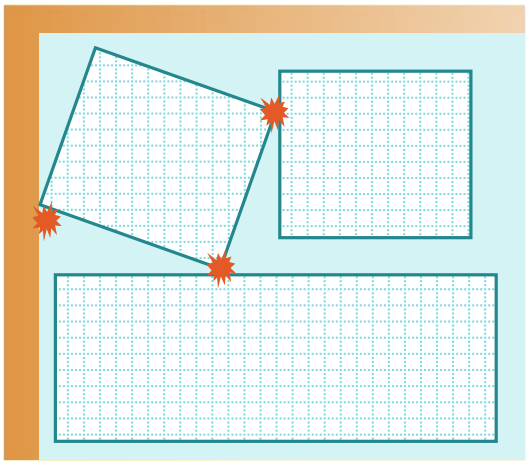


Image source:
Mott MacDonald

Potential applications in **archipelago geographies**

Duriangkang Reservoir, Batam, Indonesia

Gigwatt-scale floating solar PV with large scale BESS in Duriangkang Reservoir, originally a saltwater bay – exporting power via subsea cable to Singapore.

Scaling seawater FPV in archipelago geographies – potential actions

1
Technology

Guidance on current costs, risks to manage, and precedents.

2
Design

Encourage convergence of industry practice (ahead of new design standards)

3
Demo plants

Assess specific site risks and conditions; prove candidate designs

4
Bathymetry

Extend / disseminate experience with shallow water and intertidal sites

5
Wind and wave

Screening for sites that are cost effective – given modelled wind and wave conditions

6
Environment

Develop guidance on potential marine ecology risks

Thank you

Philip Napier-Moore

Mott MacDonald’s Energy Sector Leader for Asia, responsible for the Group’s regional support to clients on the global energy transition.

Working across the energy value chain for over 20 years, he has supported multilateral agencies, national governments and diverse private companies on low-carbon power projects in 30 countries around the world, in particular within Asia and Europe.

With a focus on utility-scale solar and wind power, from their infancy in the region in 2008, he has supported more than 80 GW of projects in Asia, including several hundred plants now successfully in operation.

A Chartered Engineer and Fellow of the Energy Institute, he obtained his Masters of Engineering from Oxford University.

Floating solar project experience includes the 1.2GWp proposed Laguna de Bay project; the 181MWp inter-tidal Chenya floating solar project in Taiwan (part of the largest seawater FPV complex now operating); and the 370MWp scale floating PV on the Ghazi-Barotha hydropower facility in Pakistan, for the World Bank, as well as numerous freshwater reservoir plants. Technical peer reviewer for the World Bank “Where Sun Meets Water” Guidelines for Practitioners, for floating solar project implementation.

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