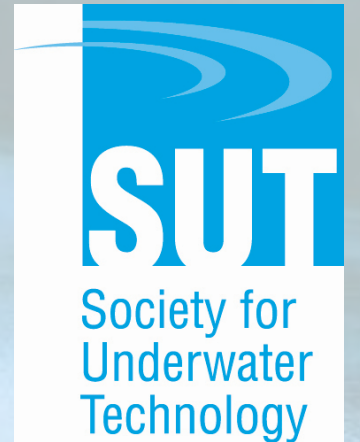


# FLOATING PV OPPORTUNITIES a MENA view



*...Powering a Blue Revolution ...*



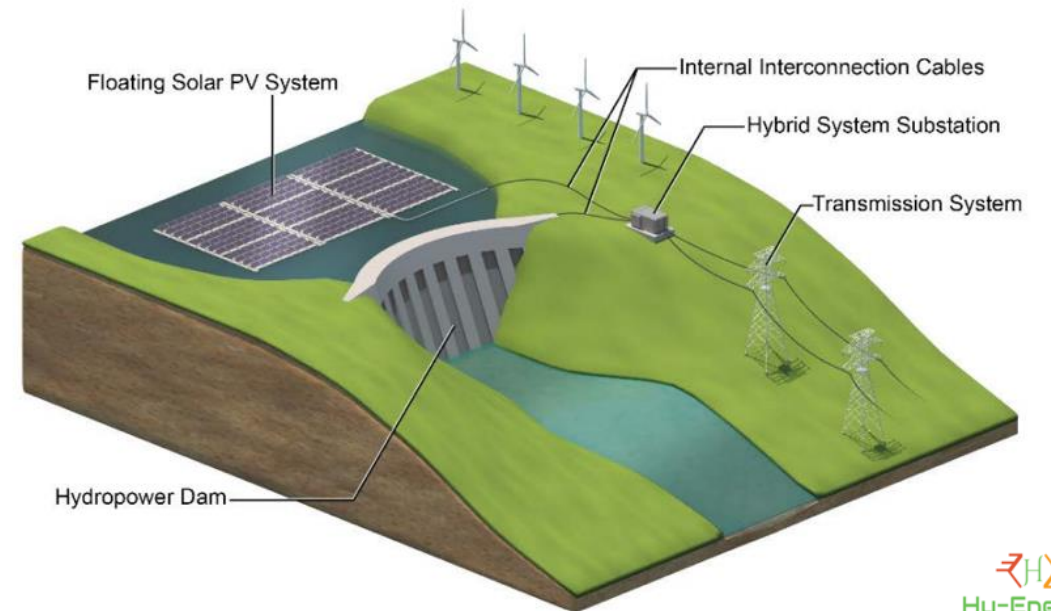
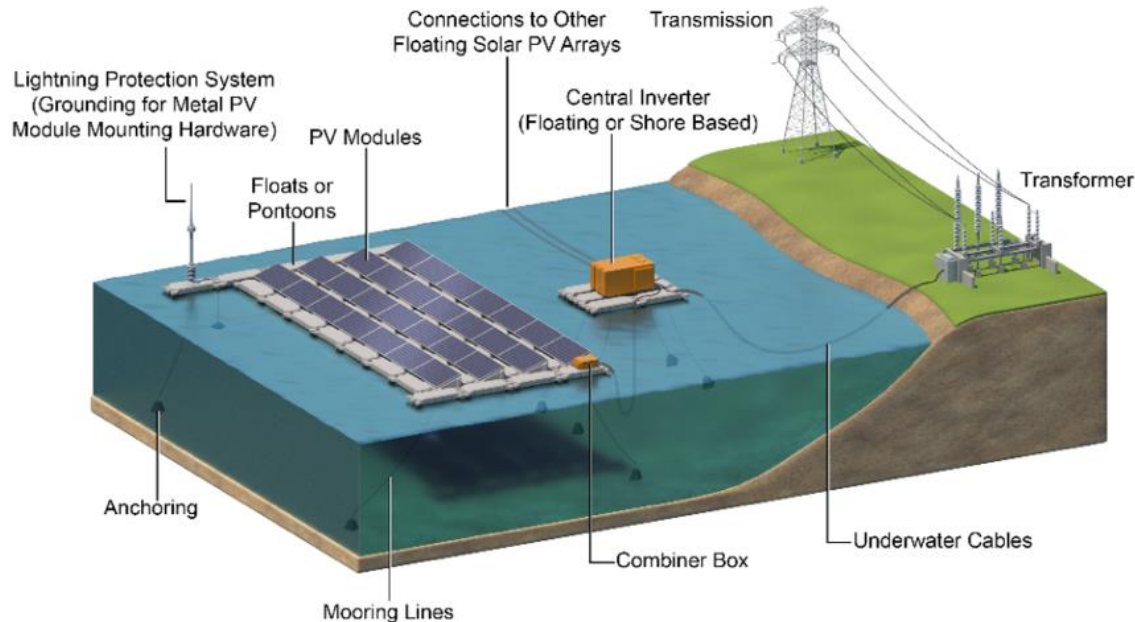
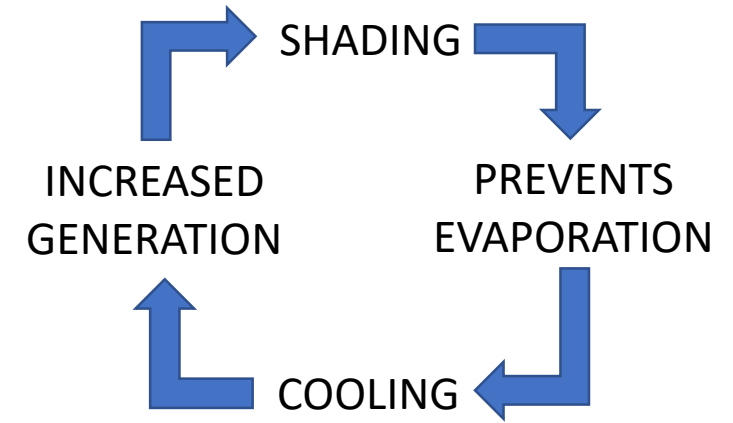
Contents	2
What is Floating PV - Float-o-Voltaics?	3
Floating PV projects installed	4
Floating Solar Segments & Forecasts	6
What are the advantages of Floating PV	7
Co-Location Hydropower & Floating PV	8
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# What is Floating PV ?

## The THIRD pillar of the PV Industry

- **Floating PV** refers to **Solar Power Plants** that **float on inland standing water bodies**.
- **Floating PV** has a global potential capacity on manmade waters as high as **4 TeraWatts**.
- **Floating PV** is a versatile tool to protect both **water & energy security**.
- **Floating PV** is installed with adjustable anchors to accommodate **water level variations**.
- **Floating PV** is a **quick win !**

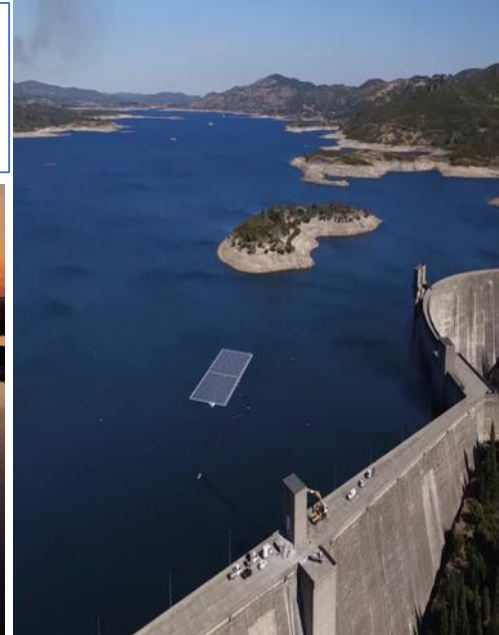




# Floating Solar projects installed

There are over **5 GigaWatt** of Floating Solar systems installed globally and growing fast !

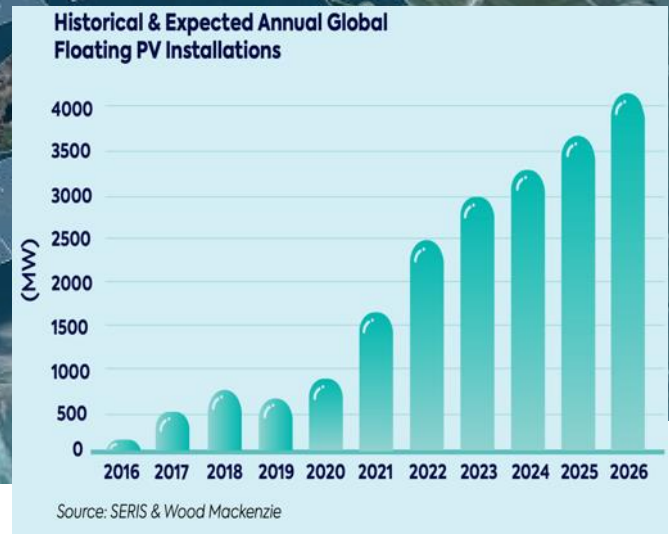
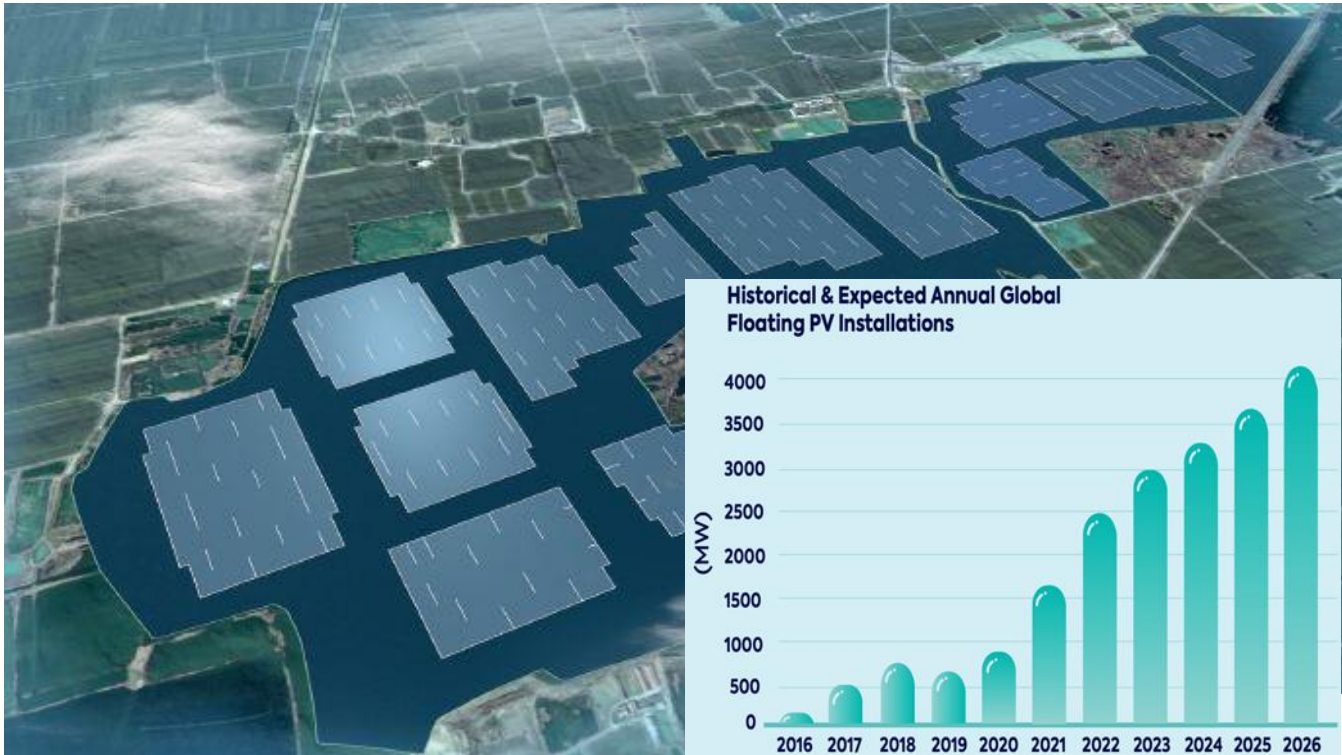
When facing land & evaporation challenges, **Floating Solar has become a "Go To" solution.**



❖ Please contact us for detailed project information



# Floating Solar projects installed



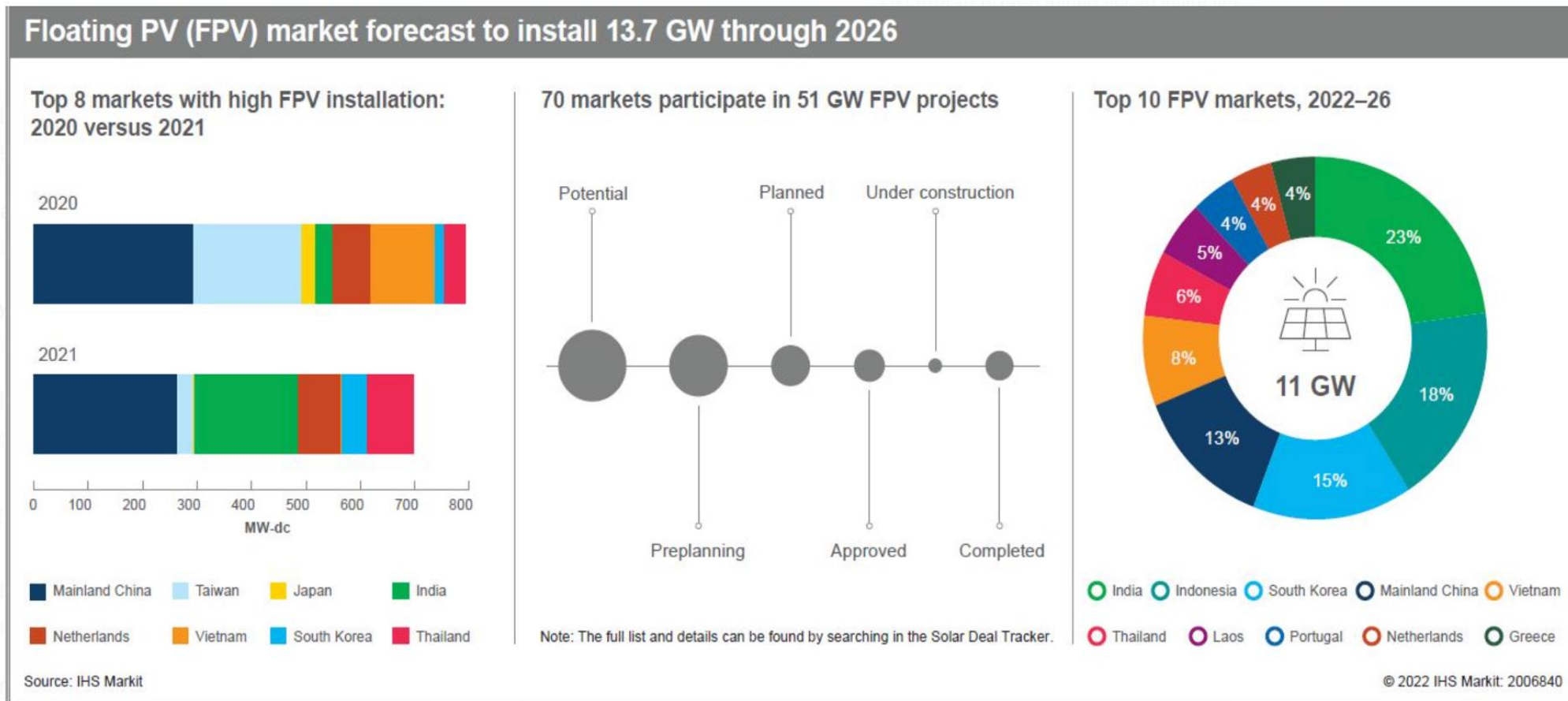


# Floating Solar projects Segments & Forecasts

- IHS MARKIT 2022 research forecasts a 13.7GW market in 3 years, dominated by South East Asia !

- SEGMENTS:**

- Ponds & Lakes
- Reservoirs
- Near Shore
- Off-Shore



# What are the advantages of Floating PV ?

Floating PV offers many advantages but the most striking are:

- Maximizes the value of **underutilized water surfaces** and existing infrastructure.
- **Prevents evaporation** of finite water resource, saving precious water & aiding critical hydro generation capacity
- **No use of valuable land**
- **Increased energy performance** due to cooling effect of water
  - Up to 16% increase in performance!
- **Reduced Soiling** and less dust exposure due to installation over water = higher yield
- **Prevents growth of algae**, improving water quality and saving on water treatment cost
- Provides **shade for fish**
- **Fast to deploy (< 1year)** , making it easy to reach Renewable Energy targets quickly



The power storage potential of reservoirs could further boost the huge prospects for floating solar.

Image: Trina Solar



A 1.2 MW floating PV project in Hyogo Prefecture, Japan. Japan has played a leading role in the development of solutions for floating PV, as it looks to maximize generation on limited space.



# Co-location Hydropower & Floating Solar... a “no brainer”

- The coupling of Floating Solar with existing hydroelectric facilities are seen as a **key growth area** in South-East Asia...
- It significantly **improves** the already **existing** dam electrical **infrastructure** & **conserves water resources**.
- It is executed under a **PPA model = zero Capex** in a Public / Private partnership as the system can pay for itself.

## CORE TECHNICAL ADVANTAGES:

- #1 - Complementary generation allows to conserve waterhead for dispatch at night = creating a **virtual battery** = low-cost storage
- #2 – No use of valuable land
- #3 – Increases **drought protection** through significant prevention of evaporation
- #4 – Time: Faster to build than ground mount because electrical infrastructure is already in place...

## CORE OPERATIONAL ADVANTAGES:

- #1 - Increased yield due to cooling effect of the water
- #2 - Reduced soiling loss by less dust
- #3 - Environmentally safe & ecologically sound
- #4 - Prevents algae growth & improves water quality
- #5 – Low connection cost





# FPV Hydro co-location projects installed

There are over 5000 MW of FPV installed globally.

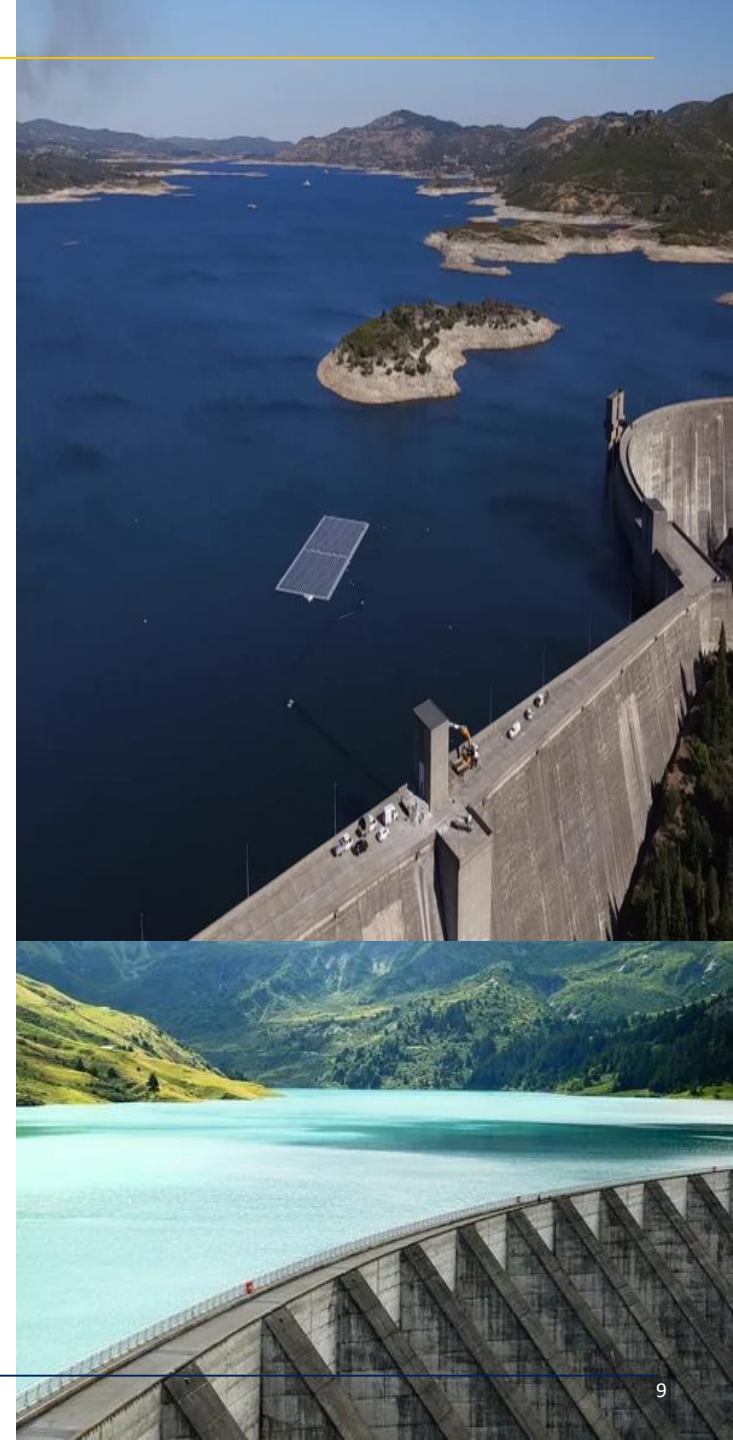
The following are some examples of key Hydro + Floating PV projects installed worldwide:

[Click on the names which will take you to the project website for details.](#)

- 850 MW GM Longyangxia hydropower plant - China
- 600 MW FPV Project at Omkareshwar reservoirs - India
- 263 MW FPV Over 7 dams - Portugal
- 145 MW FPV Cirata dam – Indonesia
- 55.5 MW FPV Project at Sirindhorn Dam – Thailand
- 42 MW FPV Project at Hapcheon Dam – South Korea
- 6 MW FPV Project at Tamil Nadu Dam – India ++
- And many more...

++Case study from the "International Journal of Sustainable Energy", shows evaporation from the reservoir reduces by 2-4 m<sup>3</sup> / sqm covered / year = Resulting in millions of m<sup>3</sup> of water saved !!

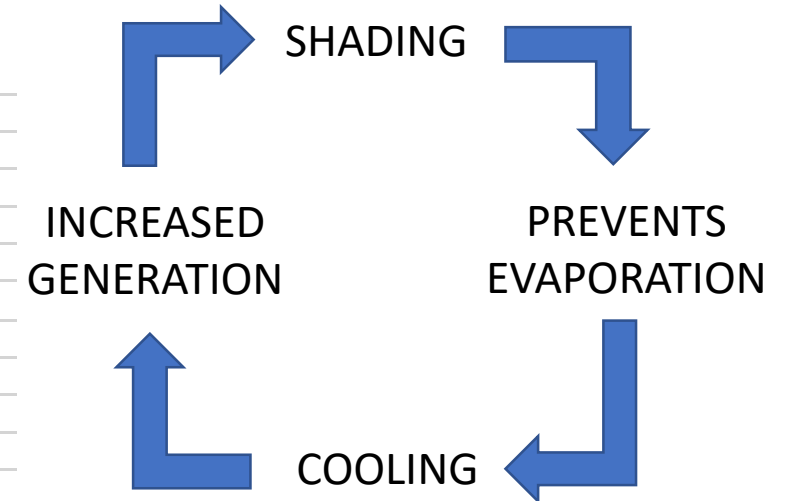
❖ Please contact us for more detailed project information



# Country Mapping MENA - region

## COUNTRY MAPPING FPV -

PRIORITY RANKING		COUNTRY MAPPING FPV -									
		High GHI (>1400)	Hydropp w. reservoirs	land price high	Water saving potential	large population (>50m)	Solar present	Funding good	Energy demand	PV or FPV Policies in place	
<b>MIDDLE EAST</b>											
1	Turkey	1730					83	8GW			
2	Marocco	2123					37	10GW			
3	Iran	2054					80	456MW			
4	KSA	2250					35	1GW			
5	Egypt	2297					88				
6	UAE	2187					10				
7	Israel	2174					9.5				
8	Iraq	1967					37	216MW			
9	Oman	2272					5				
10	Jordan	2201					10				
11	Qatar	2164					3				
12	Bahrain	2128					1.5				
13	Kuwait	2084					4				
14	Lebanon	2042					8				
15	Algeria	2212					44				
16	Tunesia	1967					12				
17	Syria	2015					21	1MW			
18	Yemen	2435					33	253MW			
19	Libya	2253					5				







# Country Profile – Iraq




## Current Solar Stats:



2.1.  
bio M<sup>2</sup>



1957  
kWh/ M<sup>2</sup>

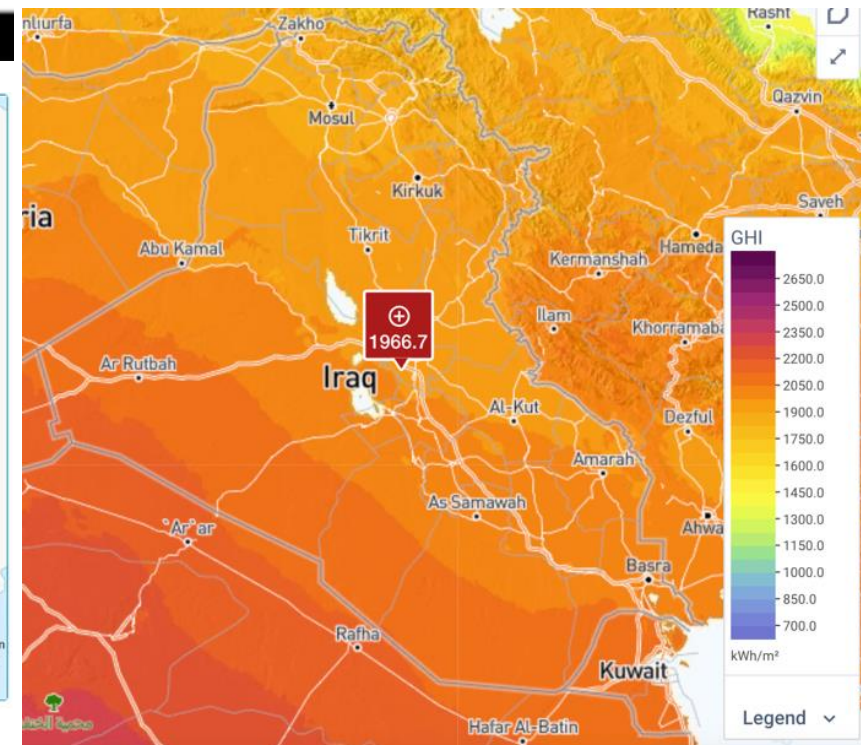


216  
MWp

	Name	Capacity (MWe)
1	Mosul Hydro Power Plant	1060
2	Hadiitha Hydro Power Plant	660
3	Dukan (Dokan) HydroPower Plant	400
4	Darbandikhan Hydro Power Plant	249
5	Adhaim Hydro Power Plant	27
<b>TOTAL =</b>		<b>2396</b>



Map 6. Reservoir management systems [1]



There are **37 dams** in Iraq and **5 major Hydro-electric Power stations** – offering 2396 Mwe Power generation. Evaporation from dams and reservoirs is estimated to lose the country up to **8 billion cubic meters** of water every year. Water scarcity & Evaporation is a major challenge however covering these reservoirs by floating Solar systems, **80% of evaporation can be avoided!**

Evaporation is caused by Iraqs’ excellent solar GHI irradiation of **1967 kWh/sqm**. Iraq is still suffering from a major shortfall of supply to meet electricity demand. Current generation capacity of 20GW falls far short of the 30GW peak demand, but targets are set to reach 33% from renewables by 2030, being **12GW of Solar**. This will require 1.7 GWp solar per year every year for the next 7 years ! To date **only 216 MWp** is connected.

If Floating PV is deployed on the top 5 dams only, a total of **2.4 GWp** capacity of Solar can be achieved, generating a **3.6 TeraWattHours each year** and saving **78.3 Million Cubic Meters of water each year** from evaporation.

In addition, it will increase the capacity of the dams and fight droughts by conserving the waterhead.

# Country Profile – Iraq



1 Google Earth



2 Google Earth



3 Google Earth



4 Google Earth



5 Google Earth

1	Name	Region	Completed	Dam Height (m)	Capacity (MWe)	Sqkm area - Usable	FloatSun capacity (MWp)	GHI (kWh/sqm)	GWh/Yr	CBM water saved / year
1	Mosul Hydro Power Plant	Ninawa	1986	135	1060	54	1060	1845	1,564.6	33,920,000
2	Haditha Hydro Power Plant	Al-Anbar	1987	57	660	100	660	1888	996.9	21,120,000
3	Dukan (Dokan) HydroPower Plant	As-Sulaymaniyah	1979	117	400	8.6	400	1823	583.4	12,800,000
4	Darbandikhan Hydro Power Plant	As-Sulaymaniyah	1994	128	249	2	249	1771	352.8	7,968,000
5	Adhaim Hydro Power Plant	As-Sulaymaniyah	-	77	27	?	77	1910	117.7	2,464,000
<b>TOTAL =</b>						<b>164.6</b>	<b>2446</b>	<b>1847.4</b>	<b>3,615</b>	<b>78,272,000</b>





# Country Profile – MAROCCO

There are **139 existing dams** in Morocco and an additional **57** under construction, totaling a capacity of **20.7 Billion cubic meters**.

Yet water scarcity & Evaporation of water resources remains a major challenge and a national priority as Morocco faces a depletion of groundwater aquifers caused by low groundwater recharge and over expansion of agriculture. In addition, there is the capacity loss of dams that amounts to **70 MCM/year**.

By covering the reservoirs by floating Solar systems, **3 to 4 cbm/m<sup>2</sup>/year** of evaporation can be avoided!

→ A single project on Al Wahda dam can offset 5.7 MCM water loss = 8% of the countries annual loss.

Evaporation is caused by the Kingdoms' excellent solar GHI irradiation of 2123 kWh/sqm.

The **New Energy Strategy targets** to reach 52% share renewables by 2030 = **10.5GW**.

= The solar target is 20%, this requires 0.2 GWp/year of solar every year for the next 7 years! To date only 760 MWp is connected of which 200MWp is Solar PV.

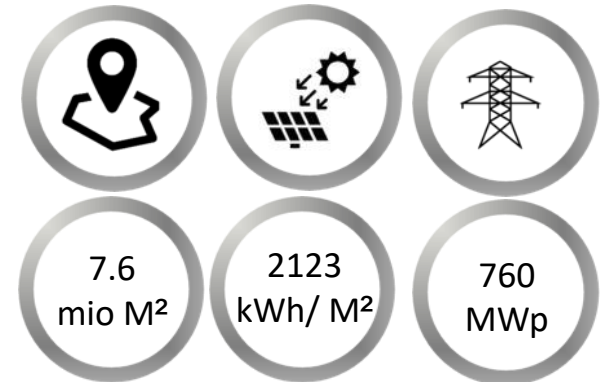
If Floating PV is deployed at the top 5 dams only, a total of **1208 MWp** capacity of Solar can be achieved, generating **1.96 Terawatt Hours each year** AND saving **38.65 Million Cubic Meters of water each year** from evaporation.

In addition, it will increase the capacity of the dams, convert them into low cost Renewable Storage & fight droughts by conserving the waterhead simultaneously.

	Name of largest dams	Capacity (MWe)
1	STEP Afourer I and II Power Project	465
2	Allal el Fassi Hydroelectric Power Project	240
3	Al Wahda Dam Hydroelectric Power Project	240
4	Bin El Ouidane Hydroelectric Power Plant	135
5	Al Massira Hydroelectric Power Project	128
...	Others	439
	<b>TOTAL =</b>	<b>1,647</b>



## Current Solar Stats:

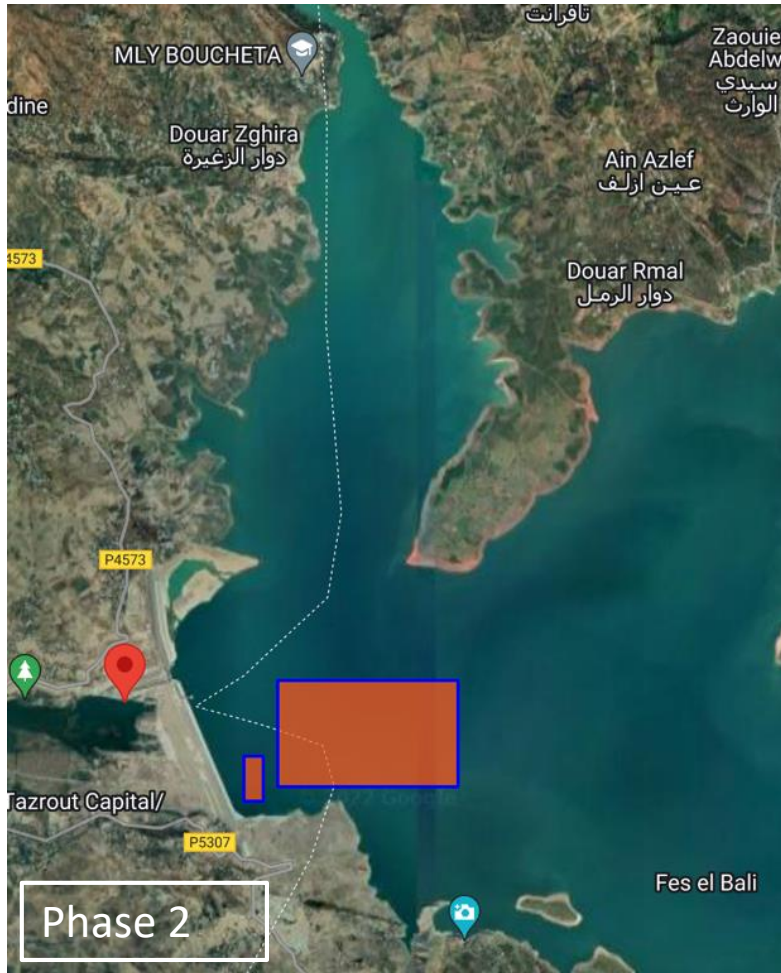
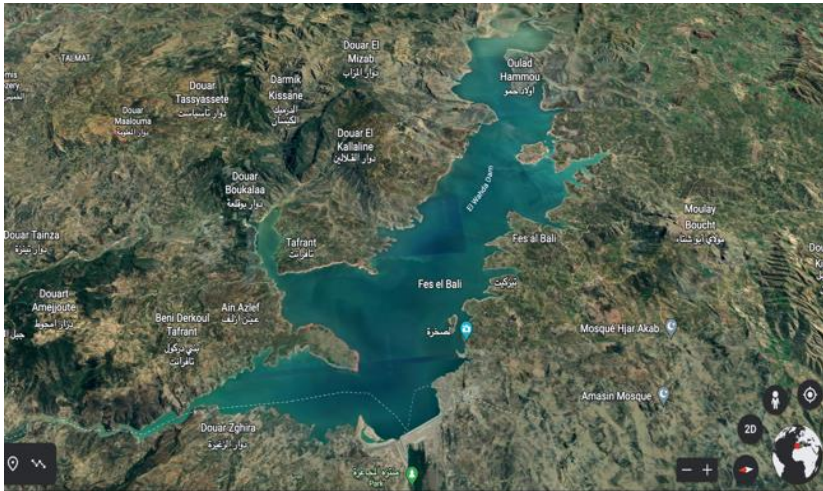


# Case study– Al Wahda Dam Hydroelectric Power Plant

... Al Wahda Dam is very suitable for the addition of 240MWp of Floating Solar ...

## Floating PV at Al Wahda HPP means... :

- Area covered = 1.92 sqkm
- Size = 240MWp FPV
- Generation = + 390.5 GWh/year
- Water saved = 5.76 billion Liters
- Capex = 0 Euro
- PPA agreement = 25 years
- PPA rate = tba



Google Earth



We propose to work in 2 steps:  
**Phase 1.** An initial plant of **10MWp** covering 80.000 sqm area  
**Phase 2.** An expansion with **230MWp** to match the HPP electrical capacity of 240MWe, covering 1.84 sqkm.

In doing so the grid infrastructure is not compromised and the capacity factor of the dam is significantly increased, while also preserving water resources and turning the dam reservoir into a low-cost battery for dispatch at night.





**SOLARDUCK**

# ELECTRIFYING THE WORLD WITH OFFSHORE FLOATING SOLAR

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April 2023

# Offshore floating solar fuelled by strong macro trends

## Addressing need for scalable renewable energy suitable for rapid deployment



### Growth of renewable power demand

- ▶ Over two-thirds of global GDP is covered by policies that target net zero 2050
- ▶ Energy security high on agenda to further accelerate growth of renewables

### Solar critical to meet increasing demand

- ▶ Total solar market is expected to reach a installed capacity of 14.5TW by 2050<sup>1</sup>
- ▶ To stay on track with the IEA roadmap to net zero, annual solar capacity additions should increase to 630 GW by 2030<sup>2</sup>

### Land scarcity and urbanisation

- ▶ Megatrends drives competition for land use, and economics are affected by increasing land prices
- ▶ Scattered ownership hampers centralized planning and large-scale development
- ▶ Available land mass is insufficient to meet the utility scale demand

### Offshore floating solar opens a new frontier for solar development

- ▶ Offshore solar is a new asset class for banks investors and governments in their renewable energy strategy
- ▶ GW scale deployment ties into mature industries and existing supply chains
- ▶ Efficient use of ocean space with hybrid applications

<sup>1</sup>Source: DNV Energy outlook 2022

<sup>2</sup>Source: IEA Roadmap for the Global Energy Sector



# SOLARDUCK OFFSHORE FLOATING SOLAR SOLUTION DESIGNED FOR GW SCALE



1

## Robust & Scalable Design

- ✓ Reliable & Robust
- ✓ Efficient mooring
- ✓ Scales towards GW solar farms



2

## Easy to Install

- ✓ Optimal transport
- ✓ Pop-up factory remote areas
- ✓ Easy towing to final location



3

## Efficient O&M

- ✓ Safe operation
- ✓ Minimal wear & tear
- ✓ Coupled platforms



4

## Minimal impact

- ✓ Low ecological impact
- ✓ Minimal socio-economic conflict



5

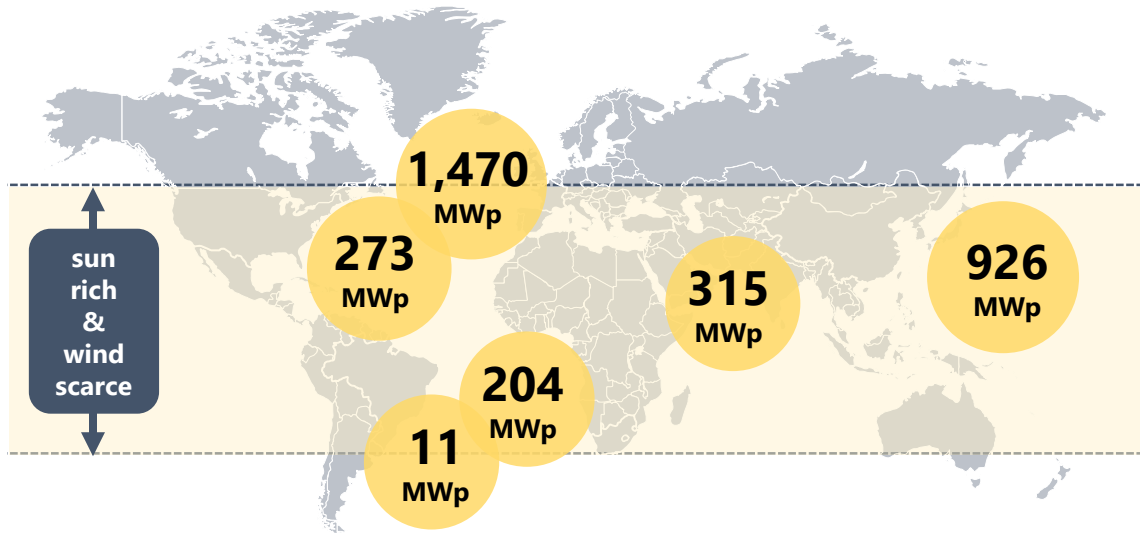
**Competitive LCOE**  
*Next section*



**BUREAU  
VERITAS**



# DELIVERING ON A STRONG PIPELINE

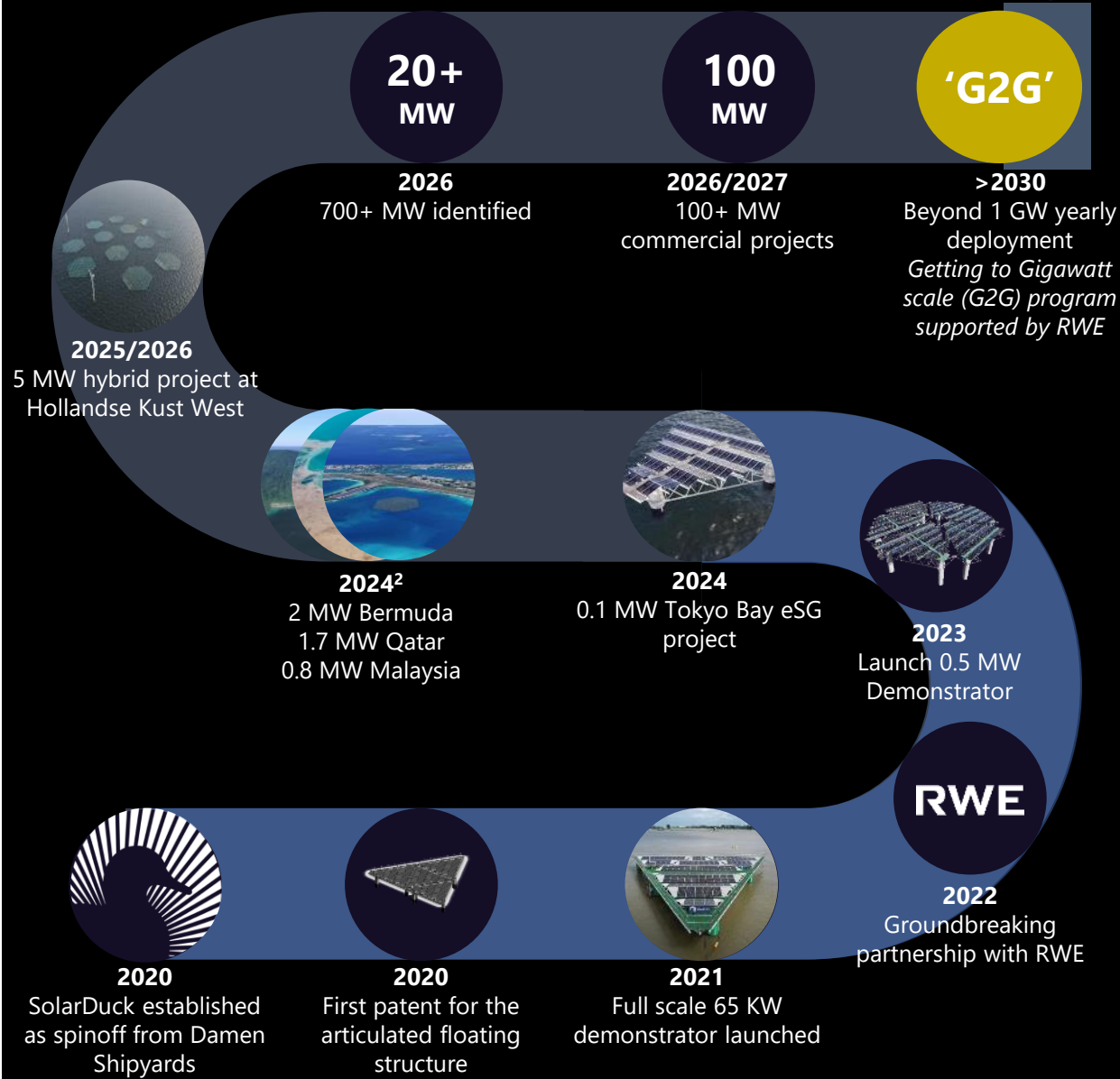


Total Pipeline (unweighted)

**3.3**  
GWp<sup>1</sup>

<sup>1</sup>Note: Further upside project potential of 3GW by Dutch government

<sup>2</sup>Note: Advanced negotiation status





# PROJECT HIGHLIGHTS

## Traction across markets in Europe, Middle East, Asia and Americas




**Hollandse Kust West** **RWE**

Capacity 5 MWp  
COD 2026  
Status **Awarded**




**Ijmuiden Ver**

Capacity 100 MWp  
COD 2028  
Status Preparing for tender



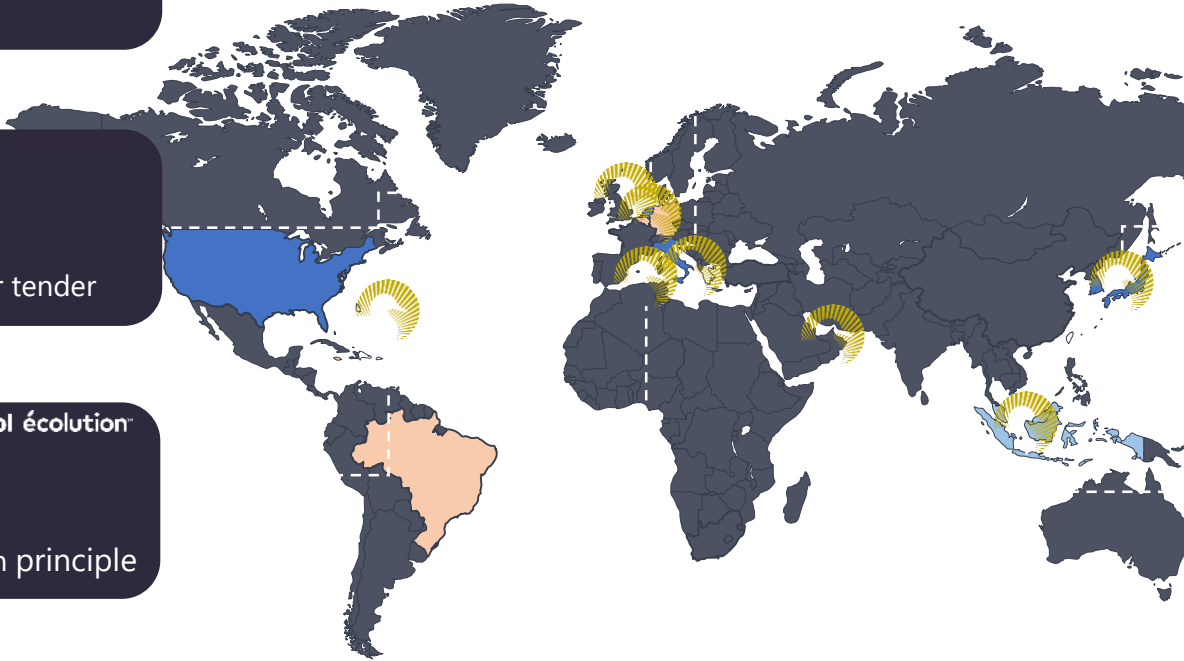
**Bermuda** **sol évolution**

Capacity 2 MWp  
COD 2024  
Status Agreement in principle



**Italy**

Capacity > 100 MWp  
COD 2026/2027  
Status MoU Negotiations




**Greece & Malta**

Capacity 2-60 MWp  
COD 2024  
Status MoU negotiations



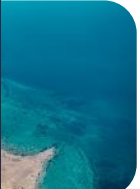
**Tokyo Bay**

Capacity 0.1 MWp  
COD 2024  
Status **Under Procurement**



**Malaysia** **TEMAGA NASIONAL**

Capacity 0.8 MWp  
COD 2024  
Status MoU negotiations



**Qatar**

Capacity 1.7 MWp  
COD 2024  
Status MoU Negotiations





# Let's MAKE it happen! Thank you.

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