Enabling Floating Solar Photovoltaic (FPV) Deployment:
FPV Technical Potential Assessment for Southeast Asia

Sika Gadzanku, Prateek Joshi, Evan Rosenlieb National Renewable Energy Laboratory (NREL)
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Motivation for Study

Association of Southeast Asian Nations (ASEAN)

**2025 target:** achieve a 35% share of renewable energy (RE) in installed power capacity

FPV is an option that can help countries leverage existing hydropower resources to meet:

- growing electricity demand
- energy security objectives
- renewable energy targets

This first-of-its-kind upper-bound estimate of FPV technical potential for SE Asia can help policymakers, planners, and decision makers better understand the role that FPV could play in meeting regional energy demand.

Source: ASEAN 2022
What is Floating Solar PV (FPV)?

Solar PV sited on waterbodies such as lakes, reservoirs, and water treatment ponds.

Some Co-Benefits of FPV:

- Reduced land use
- Increased panel efficiency
- Water conservation
- Reduced solar PV curtailment (when hybridized with hydropower)

Source: Gadzanku et al. 2021

Figure. Schematic of stand-alone FPV system

Source: Lee et al. 2020

Figure. Schematic of hybrid FPV-hydropower system

Source: Lee et al. 2020
Data Collection

Waterbodies

- Reservoirs (hydropower and non-hydropower)
- Natural Waterbodies (e.g., inland lakes, ponds, etc.)

Infrastructure

- Transmission lines, major roads, and protected areas

Solar Energy Resource

Figure. High-resolution solar resource data available for SE Asia

Source: Maclaurin et al. 2022
## Analysis Scenarios

<table>
<thead>
<tr>
<th>Waterbody Type</th>
<th>FPV Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir: hydropower</td>
<td>Fixed Tilt: monofacial</td>
</tr>
<tr>
<td>and non-hydropower</td>
<td></td>
</tr>
<tr>
<td>Natural: inland</td>
<td>Fixed Tilt: bifacial</td>
</tr>
<tr>
<td>Natural: offshore</td>
<td>1-axis Tracking: monofacial</td>
</tr>
<tr>
<td></td>
<td>1-axis Tracking: bifacial</td>
</tr>
</tbody>
</table>

| Included | Excluded |
Technical Potential Calculation

**Exclusions**
- Waterbodies in protected areas are excluded.
- Waterbodies further than 50km from the nearest major road are excluded.

**Sensitivities**
- Minimum distances from shore: 0 m, 50 m, and 100 m
- Maximum distances from shore: 500 m, 1000 m, and 2000 m

**FPV Technical Potential:**
- **Suitable Area (km²)**
- **Capacity (GW)**
- **Generation (TWh/yr)**

**Technology Assumptions**

**Solar Resource Data**

**System Advisor Model**

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**FPV Technical Potential Calculation**

Advanced Energy Partnership for Asia

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Technical Potential: Reservoirs

Figure. FPV generation and capacity technical potential for reservoirs in SE Asia

Note: These results assume fixed-tilt monofacial FPV panels, with a 50 m minimum distance-from-shore and 1000 m maximum distance-from-shore buffer. The dataset excludes waterbodies that are more than 50 km from major roads and waterbodies that are within protected areas. These results do not reflect a filter for distance-from-transmission.

SE Asia Regional Results:

- **Waterbodies**: 88
- **Area**: ~1,343 – 2,784 km²
- **Capacity**: ~134 – 278 GW
- **Generation**: ~187 – 389 TWh/yr

Ranges in results are due to different distance-from-shore assumptions.
Technical Potential: Natural Waterbodies

SE Asia Regional Results:

Waterbodies: 7,213
Area: ~3,427 – 7,676 km²
Capacity: ~343 – 768 GW
Generation: ~476 – 1,062 TWh/yr

Ranges in results are due to different distance-from-shore assumptions.

Note: These results assume fixed-tilt monofacial FPV panels, with a 50 m minimum distance-from-shore and 1000 m maximum distance-from-shore buffer. The dataset excludes waterbodies that are more than 50 km from major roads and waterbodies that are within protected areas. These results do not reflect a filter for distance-from-transmission.
Key Takeaways

Role of FPV

- Reservoirs (hydropower and non-hydropower)
  - ~134 – 278 GW

- Natural Waterbodies (e.g., inland lakes, ponds, etc.)
  - ~343 – 768 GW

The installed capacity of renewables in ASEAN countries is expected to reach 235 GW by 2030 (81 GW of utility-scale solar) and 1,311 GW by 2050 (841 GW of utility-scale solar).

FPV can thus play a significant role in meeting SE Asia’s energy needs.

Data Limitations

For specific sites, detailed site-specific analysis will need to be conducted given the lack of bathymetry, wind, wave, and sediment data at a regional level.

Potential Future Research

- More detailed representation of bifacial FPV
- Offshore FPV technical potential
- Aquaculture + PV (“AquaPV”) technical potential

Figure. Food-Energy-Water nexus with role of FPV and AquaPV

Source: Joshi 2023

Source: IRENA and ASEAN Centre for Energy 2022

Thank you!

Sika.Gadzanku@nrel.gov