Advanced Energy Partnership for Asia

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

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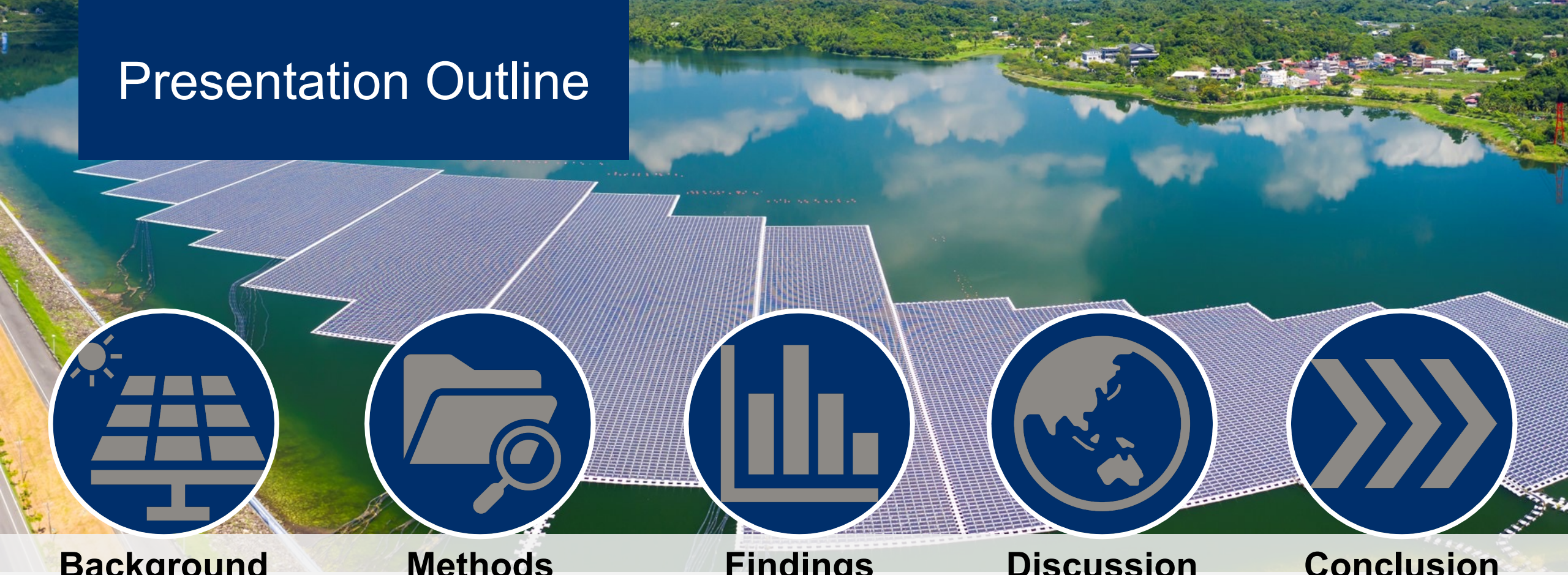
Presentation Outline



Background

Motivation for study and FPV overview

Methods

Data collection and analysis scenarios

Findings

Technical potential results

Discussion

Regional and Country-specific implications

Conclusion

Key takeaways and next steps

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Motivation for Study

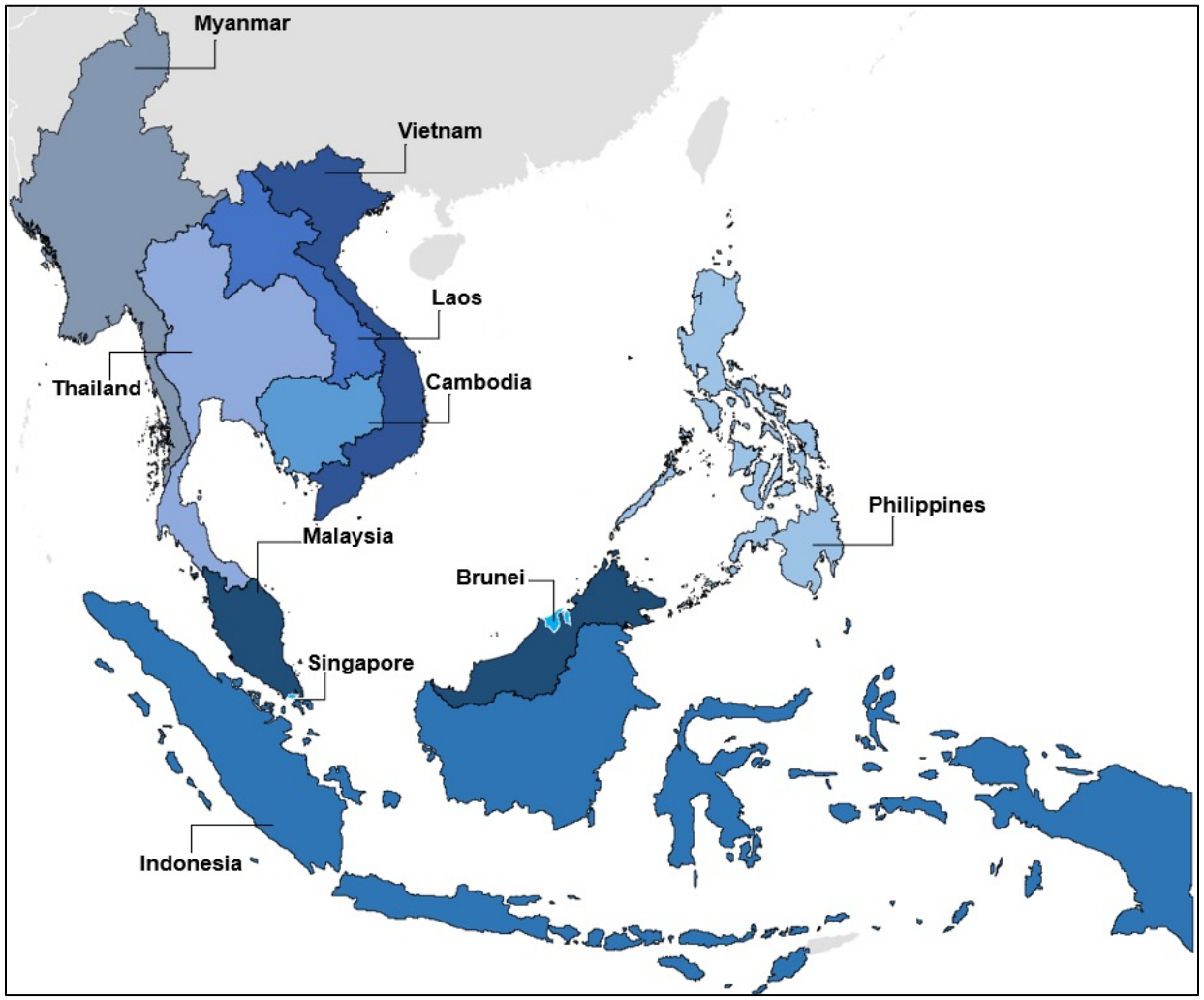

Figure. Countries included in the FPV technical potential assessment

Association of Southeast Asian Nations (ASEAN)

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

Source: ASEAN 2022

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.

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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

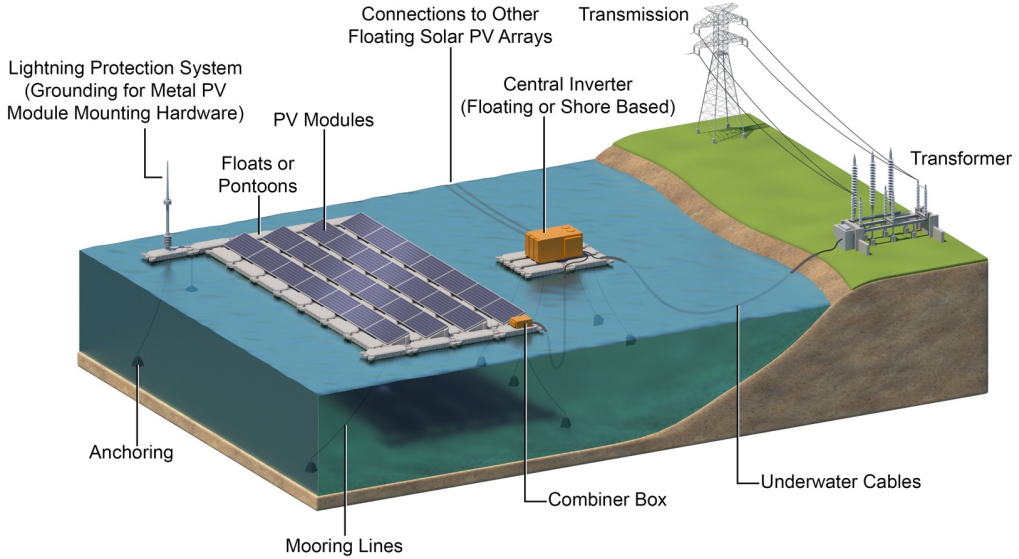

Figure. Schematic of stand-alone FPV system

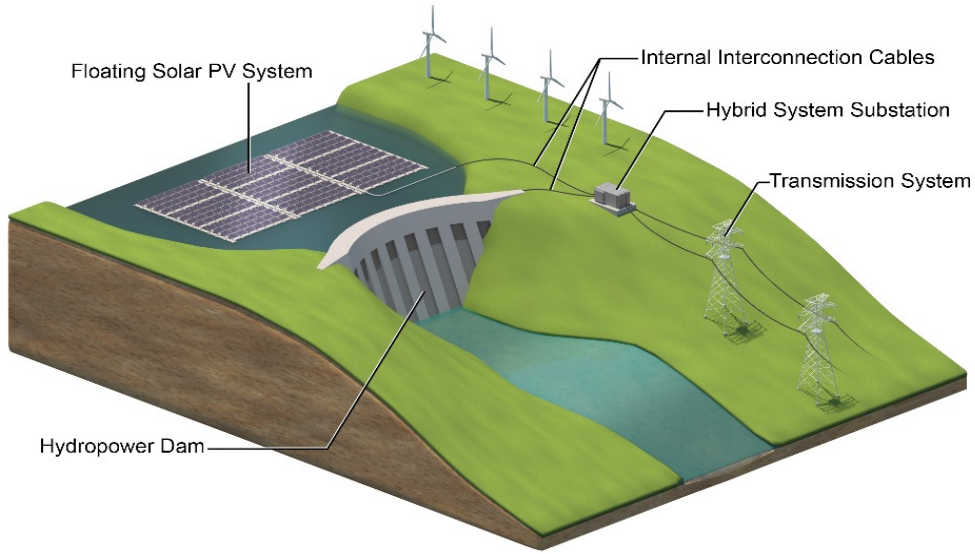

Figure. Schematic of hybrid FPV-hydropower system

Source: Lee et al. 2020

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Data Collection

Waterbodies

Reservoirs (hydropower and non-hydropower)

Global Reservoir and Dam Database (GRanD)

Natural Waterbodies (e.g., inland lakes, ponds, etc.)

HydroLAKES Database

Infrastructure

Transmission lines, major roads, and protected areas

RE Data Explorer

Stimson Mekong Infrastructure Tracker

Solar Energy Resource

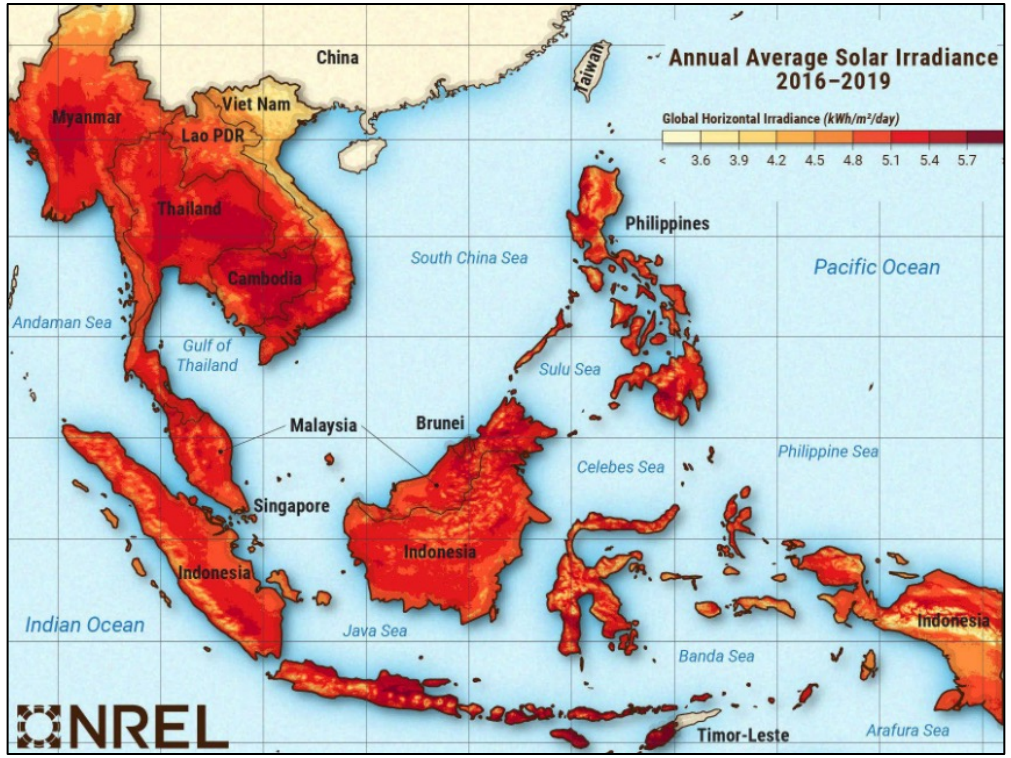

Figure. High-resolution solar resource data available for SE Asia

Source: Maclaurin et al. 2022

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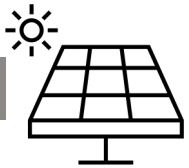
Analysis Scenarios

Waterbody Type

- Reservoir: hydropower and non-hydropower
- Natural: inland
- Natural: offshore

+

FPV Technology



- Fixed Tilt: monofacial
- Fixed Tilt: bifacial
- 1-axis Tracking: monofacial
- 1-axis Tracking: bifacial

Included	Excluded

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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 (km^2)

Technology Assumptions

FPV Technical Potential:
Capacity (GW)

Solar Resource Data

PVWatts

System Advisor Model

FPV Technical Potential:
Generation (TWh/yr)

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Technical Potential: Reservoirs

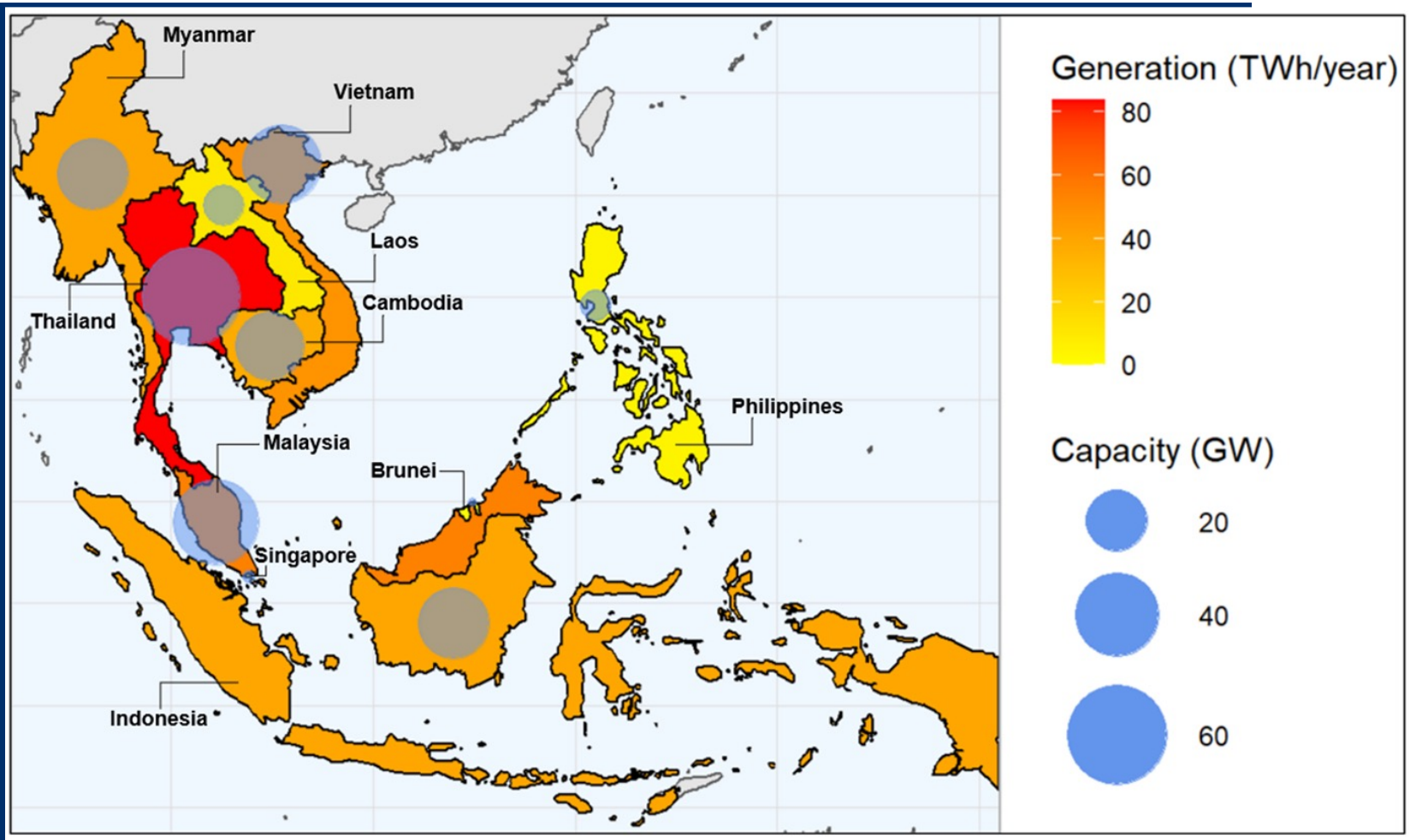

Figure. FPV generation and capacity technical potential for reservoirs in SE Asia

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 km^2

Capacity: ~134 – 278 GW

Generation: ~187 – 389 TWh/yr

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

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Technical Potential: Natural Waterbodies

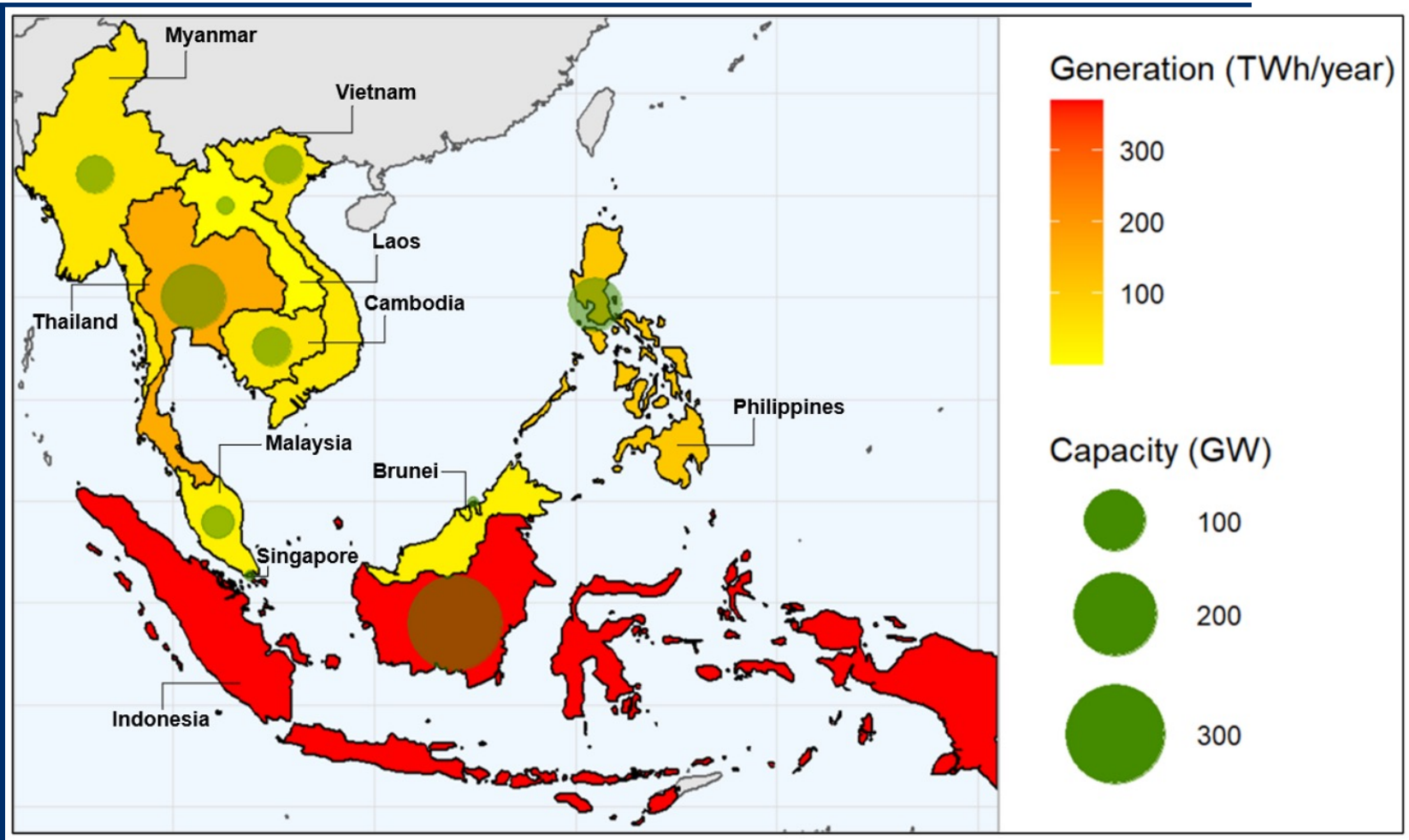

Figure. FPV generation and capacity technical potential for natural waterbodies in SE Asia

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: 7,213

Area: ~3,427 – 7,676 km^2

Capacity: ~343 – 768 GW

Generation: ~476 – 1,062 TWh/yr

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

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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.

Source: IRENA and ASEAN Centre for Energy 2022

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

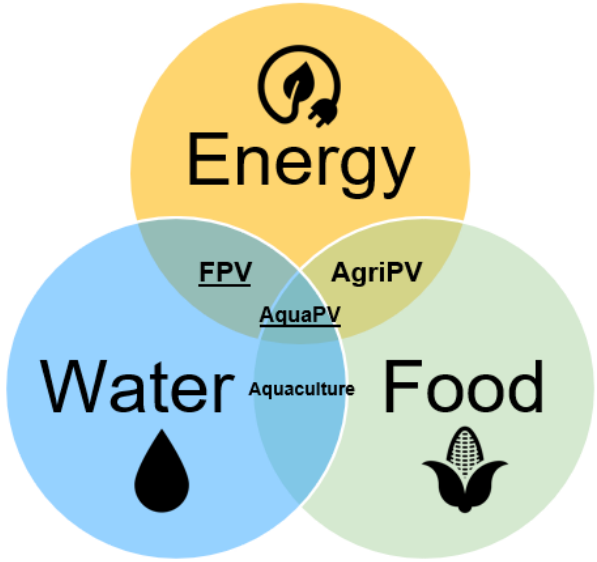

Figure. Food-Energy-Water nexus with role of FPV and AquaPV

Source: Joshi 2023

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Detailed report with country-specific results available here: https://www.nrel.gov/docs/fy23osti/84921.pdf

Thank you!

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