[Supporting information]

Glare-free airport-based photovoltaic system via optimization of its azimuthal angle

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Table S1. List of previous studies for A-PV

Group	Purpose	Simulation tool	[ref]
RWTH Aachen University	Glare analysis of A-PV without solution for them	Own developed	1
University Malaysia Pahang	Designing self-sustainable airport (glare analysis)	SGHAT	2
Michigan Technological University	Development of design procedures for A-PV	SGHAT	3
University Malaysia Pahang	Case study of solar powered airport (Cochin International Airport)	SGHAT	4
Sandia National Laboratory/ Harris Miller Miller and Hanson Inc.	Guidance for renewable energy in airports, including A-PVs	SGHAT	5
Federal Aviation Administration	Evaluation of Glare for Aviation Pilots on Final Approach	A survey from pilots & Experiment with flight simulator and angle-controlled light source*	6

* The result was adopted to the SGHAT program.

[1] Rose T, Wollert A, The dark side of photovoltaic - 3D simulation of glare assessing risk and discomfort, Environ. Impact Assess. Rev., 2015, 52, 24-30

[2]Sreenath S, Sudhakar K, Yusop AF, Cuce E, Solomin E. Analysis of solar PV glare in airport environment: Potential solutions. Results Eng. 2020, 5, 100079

[3] Anurag A, Zhang J, Gwamuri J. General design procedures for airport-based solar photovoltaic systems, Energies, 2017, 10, 1194

[4] Sukumaran S, Sudhakar K. Fully solar powered airport: a case study of Cochin International Airport. J Air Transp Manag. 2017, 62, 176-188.

[5] Barrett S, Devita P, Ho C, Miller B. Energy technologies compatibility with airports and airspace: Guidance for aviation and energy planners. Airpt Manag. 2014;8(4):318-326

[6] Rogers J. A, Ho C. K, A. Millan A, Beben M, Drechsler G, Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach, 2015

Table S2. The number of steps to optimize θ_{PV} in A-PVs in the GMP. Here, we assumed that the minimum rotation angle of θ_{PV} is 22.5 degrees.

Model \ Sites	GE1	GE2	GW1	GW2	GW3	GW4	GW5	**Sum**
Proposed	2	3	2	2	2	2	2	**15**
Start from south facing A-PV	3	2	3	3	3	3	3	**20**

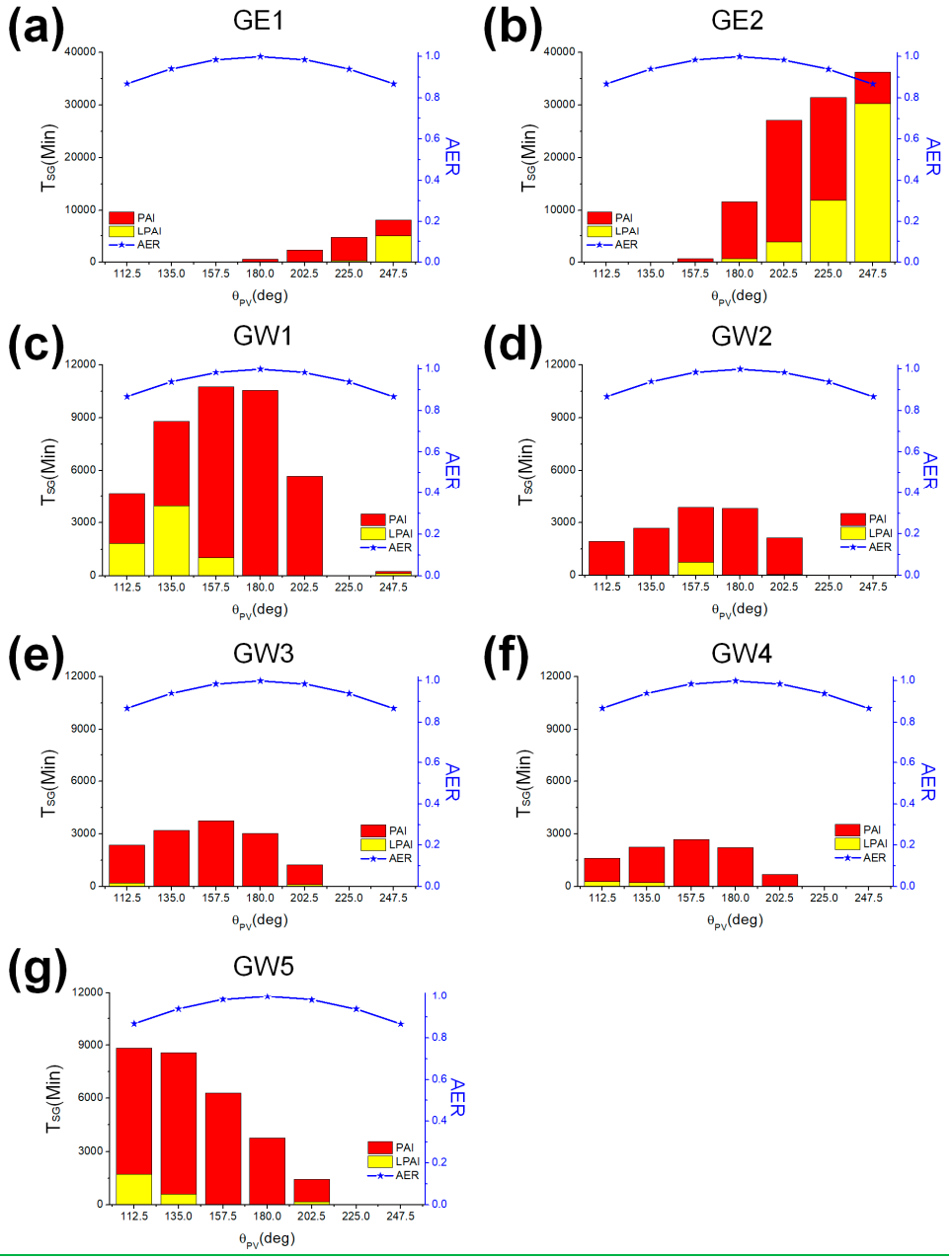


Figure S1. Normalized annual energy rate (AER) and Annual glare time (T_{SG}) of Gimpo International Airport (GMP) in Korea. (a), (b) are located on the east side of the runway of GMP, and (c)-(g) are located on the west side.

Table S3. The number of steps to optimize θ_{PV} in A-PVs in the KWJ. Here, we assumed that the minimum rotation angle of θ_{PV} is 22.5 degrees.

Model \ Sites	KE1	KE2	KE3	KE4	KW1	KW2	**Sum**
Proposed	2	2	2	2	3	3	**14**
Start from south facing A-PV	3	3	3	3	2	2	**16**

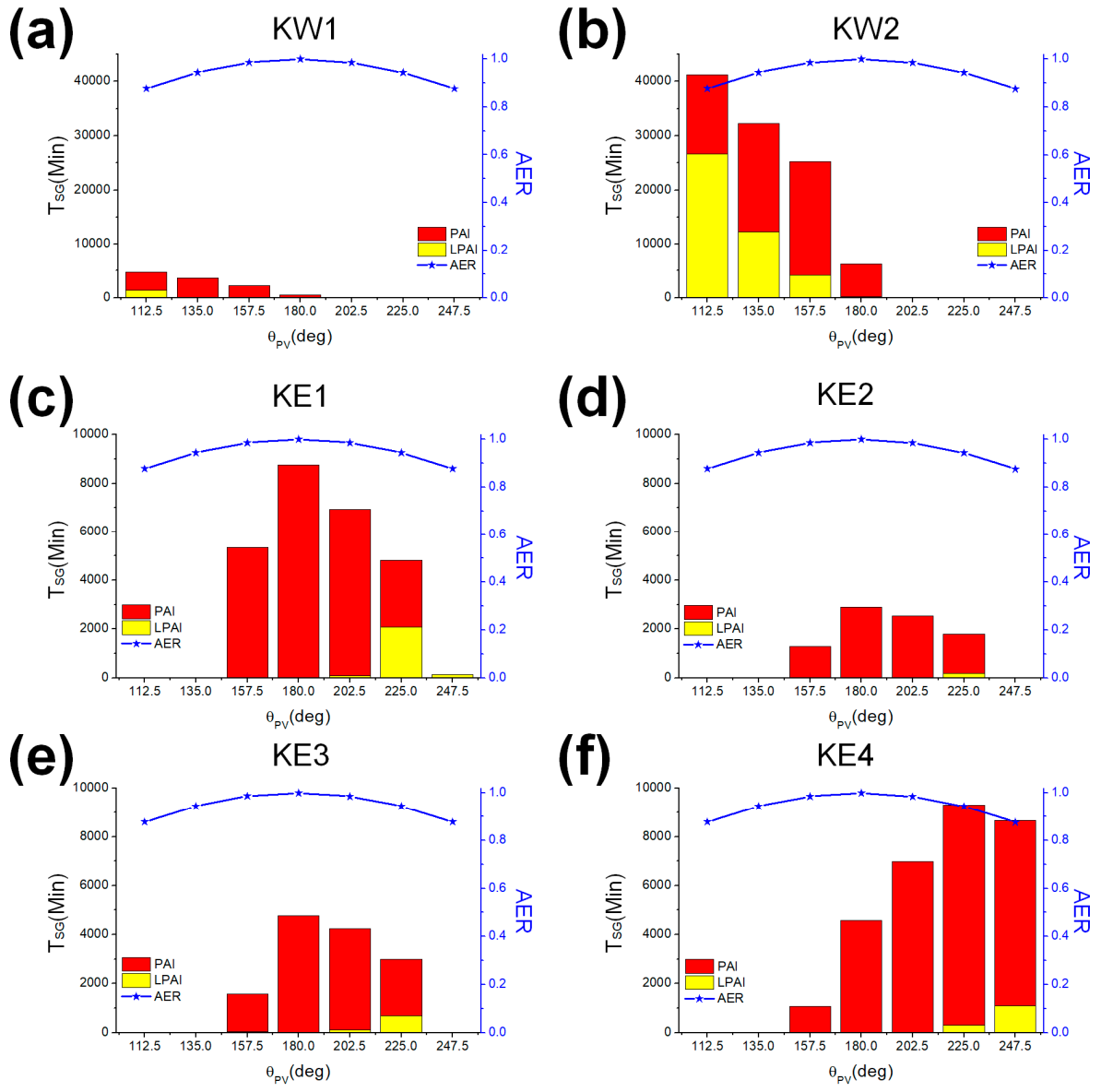


Figure S2. Normalized annual energy rate (AER) and Annual glare time (T_{SG}) of Gwangju Airport (KWJ) in Korea. (a), (b) are located on the east side of the runway of KWJ, and (c)-(f) are located on the west side.

Table S4. The number of steps to optimize θ_{PV} in A-PVs in the NRT. Here, we assumed that the minimum rotation angle of θ_{PV} is 22.5 degrees.

Model \ Sites	NW1	NW2	NW3	NW4	NW5	**Sum**
Proposed	2	2	2	2	2	**10**
Start from south facing A-PV	3	3	3	3	3	**15**

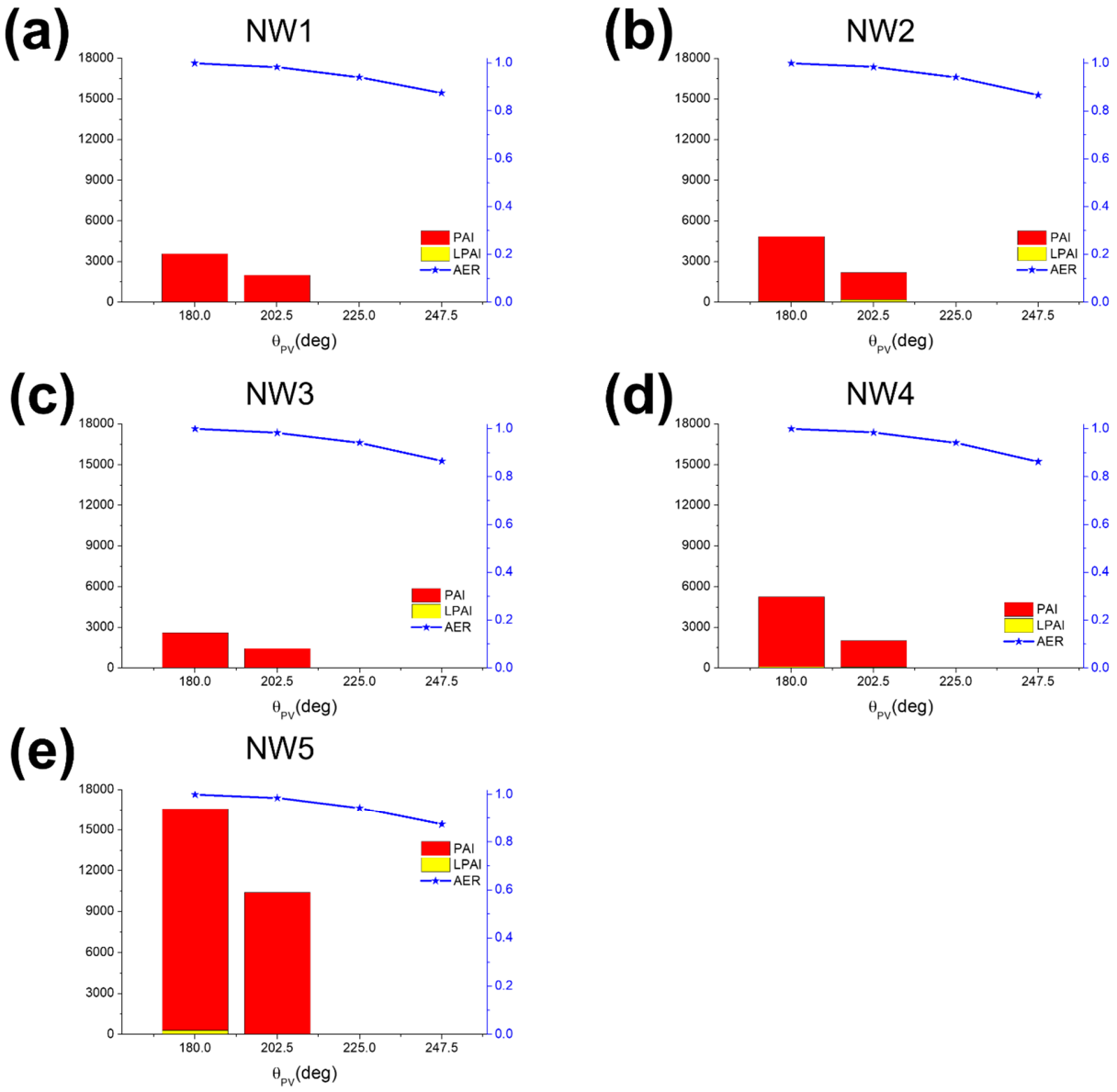


Figure S3. Normalized annual energy rate (AER) and Annual glare time (T_{SG}) of Narita International Airport (NRT). All possible sites are located on the west side of runway and flight paths.

Table S5. The number of steps to optimize θ_{PV} in A-PVs in the PEK. Here, we assumed that the minimum rotation angle of θ_{PV} is 22.5 degrees.

Model \ Sites	PW1	PW2	PW3	PW4	PE1	PE2	PE3	PE4	PE5	**Sum**
Proposed	2	2	2	2	2	2	2	2	2	**18**
Start from south facing A-PV	3	3	3	3	3	3	3	3	3	**27**

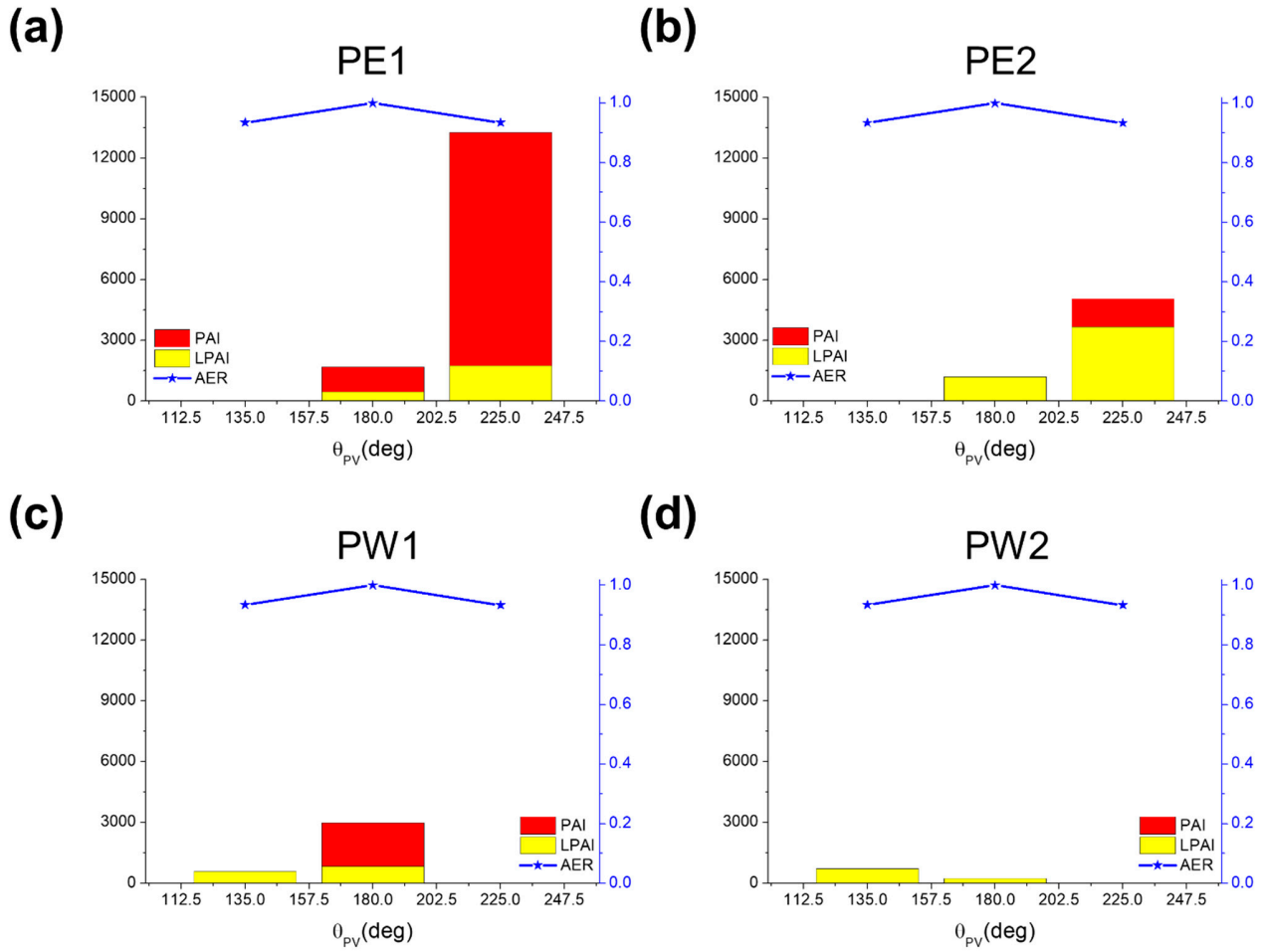


Figure S4. Normalized annual energy rate (AER) and Annual glare time (T_{SG}) of Beijing capital airport (PEK).