

5. Pumped hydro energy storage technical potential

Another effort to solve the variability issue is providing storage from PHES technology in which its technology has a lifetime of 50 years (Ministry of Energy and Mineral Resources Republic Indonesia & Danish Energy Agency, 2021). By selecting further the location of PHES from Stocks et al. (2021, 2019) considering locations near the water bodies, outside residential and protected areas, and outside transportation routes, we find that the potential of PHES in Indonesia is 7308.8 GWh (detailed in Table 13 and 14).

Table 13. Detailed site numbers per province depending on storage capacity (total energy and hours)

Province	Number of sites depending on the total energy and storage time							
	2 GWh - 6 hours	5 GWh - 6 hours	5 GWh - 18 hours	15 GWh - 6 hours	15 GWh - 18 hours	50 GWh - 6 hours	50 GWh - 18 hours	150 GWh - 18 hours
Aceh	0	12	52	12	132	8	82	37
Bali	0	0	2	0	3	0	1	0
Banten	0	0	1	0	6	0	3	2
Bengkulu	0	0	3	0	13	0	5	4
DI Yogyakarta	0	0	0	0	1	0	0	0
DKI Jakarta	0	0	0	0	0	0	0	0
Gorontalo	0	0	0	0	4	0	1	1
Jambi	0	0	0	0	2	0	0	2
Jawa Barat	0	2	6	2	51	1	32	19
Jawa Tengah	0	0	5	0	24	1	14	10
Jawa Timur	0	1	14	1	32	1	22	10
Kalimantan Barat	0	3	14	4	45	6	35	17
Kalimantan Selatan	0	0	1	0	2	0	2	2
Kalimantan Tengah	0	1	8	3	20	3	11	7
Kalimantan Timur	0	4	30	2	89	1	64	29
Kalimantan Utara	0	3	10	3	39	2	30	10
Kepulauan Bangka Belitung	0	0	0	0	0	0	0	0
Kepulauan Riau	0	0	0	0	0	0	0	0
Lampung	0	0	1	0	10	0	6	4
Maluku	0	10	30	3	45	3	33	12
Maluku Utara	0	2	7	0	14	0	14	8
Nusa Tenggara Barat	0	0	0	0	7	0	1	0
Nusa Tenggara Timur	0	5	25	3	75	4	46	23
Papua	2	17	46	11	112	6	53	23
Papua Barat	0	20	42	8	54	5	23	6
Riau	0	0	0	0	0	0	0	0
Sulawesi Barat	0	8	22	9	61	6	34	16
Sulawesi Selatan	1	6	15	3	78	2	54	23
Sulawesi Tengah	0	21	85	16	184	9	106	47
Sulawesi Tenggara	0	10	20	6	42	6	34	12
Sulawesi Utara	0	0	0	0	0	0	0	0
Sumatera Barat	0	1	6	0	12	1	10	5
Sumatera Selatan	0	0	1	0	10	0	9	6
Sumatera Utara	0	4	25	3	95	4	59	30
Total sites	3	130	471	89	1,262	69	784	365

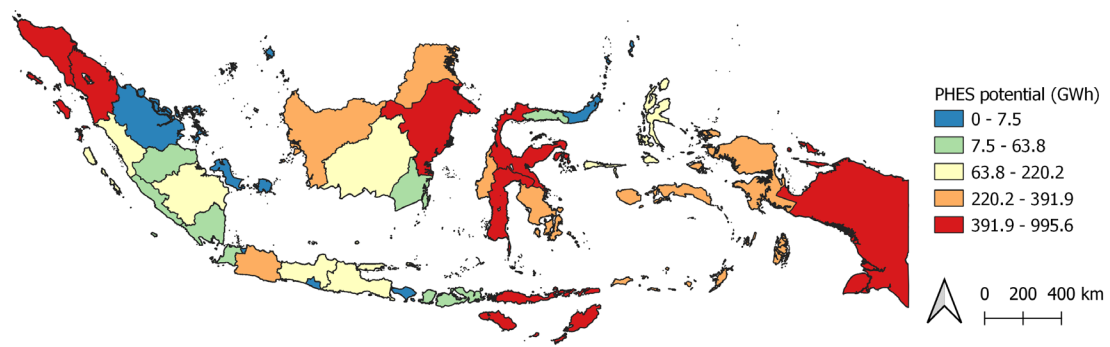


Figure 8. Technical energy potential of PHES grade A in Indonesia, originally done by Stocks et al. (2021, 2019) and furtherly filtered in this study to select the best location for installing PHES.

Table 14. Total generated power per hour per province

Province	Energy per hour (GWh)
Aceh	767.2
Bali	5.8
Banten	30.3
Bengkulu	58.9
DI Yogyakarta	0.8
DKI Jakarta	0.0
Gorontalo	14.4
Jambi	18.3
Jawa Barat	306.4
Jawa Tengah	151.9
Jawa Timur	186.7
Kalimantan Barat	342.8
Kalimantan Selatan	24.2
Kalimantan Tengah	141.1
Kalimantan Timur	518.6
Kalimantan Utara	228.6
Kepulauan Bangka Belitung	0.0
Kepulauan Riau	0.0
Lampung	58.6
Maluku	278.3
Maluku Utara	120.8
Nusa Tenggara Barat	8.6
Nusa Tenggara Timur	433.9
Papua	537.3
Papua Barat	248.9
Riau	0.0
Sulawesi Barat	363.9
Sulawesi Selatan	440.3
Sulawesi Tengah	995.6
Sulawesi Tenggara	308.3
Sulawesi Utara	0.0
Sumatera Barat	90.3
Sumatera Selatan	83.6
Sumatera Utara	544.2
Total	7,308.8