INDONESIAN MINERALS, COAL, AND GEOTHERMAL RESOURCES AND RESERVES 2021

Executive Summary

MINISTRY OF ENERGY AND MINERAL RESOURCES REPUBLIC OF INDONESIA
GEOLOGICAL AGENCY
CENTER FOR MINERAL COAL AND GEOTHERMAL RESOURCES

INDONESIAN MINERALS, COAL, AND GEOTHERMAL RESOURCES AND RESERVES 2021

Executive Summary

MINISTRY OF ENERGY AND MINERAL RESOURCES REPUBLIC OF INDONESIA
GEOLOGICAL AGENCY
CENTER FOR MINERAL COAL AND GEOTHERMAL RESOURCES

PREFACE

Praise be to God Almighty, by His blessing and Guidance we are finally able to finish the Summary of Coal, Mineral and Geothermal Resources Balance Data in 2021. Compiling and updating the mineral, coal and geothermal resources and reserves balance data is one of the functions of the Center for Mineral, Coal and Geothermal Resources (PSDMBP), the Geological Agency. We would like to thank all those who have assisted in compiling and updating the mineral, coal and geothermal resource balance data in 2021 so that it can be completed and published without any obstacles.

Generally, in 2021 the amount of data recorded in the balance of mineral, coal and geothermal resources and reserves consists of 2,611 metallic mineral data, 4,270 non-metallic mineral data and rocks, 1,567 coal data, 70 coal-bed methane data, 69 peat data, and 356 geothermal data. In terms of quantity, the main obstacle in compiling and updating the balance of mineral, coal and geothermal resources is that not all data on business entities, especially the mineral and coal sector are available and can be inventoried, while in terms of quality, not all data on mineral and coal resources and reserves are verified by a competent person.

Realizing that circumstance, every year we continue to make every effort to improve the quality and quantity of national's mineral, coal and geothermal resources balance data through synchronization with other relevant agencies within the Ministry of Energy and Mineral Resources (KESDM), namely the Directorate General of Mineral and Coal (Ditjen Minerba), the Directorate General of Oil and Gas (Ditjen Migas), the Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas) and the Directorate General of New, Renewable Energy and Energy Conservation (Ditjen EBTKE) as well as the local governments. These efforts are made primarily to improve the management of national's mineral, coal (including peat and coal-bed methane) and geothermal resources and reserves data so that every year there is an increase in the number of successfully inventoried data, including data that has been verified.

As a final point, it is our commitment to continuously improve the quality and quantity of national's mineral, coal and geothermal resources balance data. We hope that Indonesia's balance data of mineral, coal and geothermal resources and reserves can continue to provide actual and qualified data that can be utilized by many people in order to optimize the utilization of mineral, coal and geothermal resources and reserves in Indonesia.

Bandung, January 2022

Head of Geological Agency

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INDONESIA MINERALS RESOURCES AND RESERVES 2021

Indonesia's unique geological and tectonic conditions result from the subduction of three significant plates in the world, namely the Indian-Australian Ocean Plate, the Pacific Ocean Plate, and the Eurasian Continental Plate, in which there are microplates from Gondwana, make Indonesia a region rich in various kinds of minerals resources, ranging from minerals that commonly found to minerals with very high economic value and classify as strategic minerals, including gold, copper, nickel, bauxite, tin, zinc, iron ore, and other critical raw materials. It includes strategic non-metallic minerals such as granite, andesite, limestone, quartz sand, dolomite, clay, and zircon.

Minerals are part of the basic needs of human life, and their uses will increase significantly following the development of civilization and technology. Minerals are needed almost in all types of industries, such as agriculture, food technology, telecommunications, transportation, chemicals, housing, and energy supply. The current trend of technological development is directed to support environmentally friendly energy policies or clean energy (zero carbon) policies and is based on electrical energy, which is increasing rapidly, resulting in the need for minerals as raw materials for the battery industry also to increase, especially for several types of minerals, such as nickel, manganese, cobalt, lithium, lead, Rare Earth Elements (REE) and graphite.

Data and information regarding the balance of minerals resources and reserves are needed, especially for strategic and critical minerals, to know the resilience of those minerals resources and reserves to fulfil minerals needs for strategic industries. This data and information can also determine a mineral's criticality in supplying industrial needs, especially in the alternative energy industry.

The balance of minerals resources and reserves in Indonesia refers to the Classification of Minerals Resources and Reserves based on the Indonesian National Standard (SNI) 6728:4 of 2015 concerning the Preparation of the Spatial Balance of Natural Resources - Part 4: Mineral and Coal Resources and Reserves, and SNI 4726 of 2019 concerning Guidelines for Reporting Exploration Results, Minerals Resources and Reserves. The standards adopt the Australasian Code for Reporting of Exploration Results, Minerals Resources, and Ore Reserves ('the JORC Code') and follow the guidelines of CRIRSCO (Committee for Mineral Reserves International Reporting Standards). The updating of the balance of minerals resources and reserves is carried out annually in the form of a database and information on minerals resources and reserves from the metallic and non-metallic minerals exploration carried out by the Center for Mineral, Coal and Geothermal Resources – Geological Agency, provincial government agencies related to mining activities, state-owned enterprises and private mining companies (KK, IUP, and IUPK).

METALLIC MINERALS RESOURCES AND RESERVES

The balance of metallic minerals resources and reserves as of December 2021 contains updated data for 26 types of metallic minerals commodities, adding 108 locations to a total of 2,611 locations and updated

403 locations data. The update is based on the results of data inventory, data verification, new findings from exploration activities of mining companies and the Geological Agency, and upgrading the status of resources to reserves.

Some commodities that experience significant changes in resources and reserves are tin, primary gold, copper, nickel, cobalt, bauxite, primary iron, iron sands, laterite iron, and silver. The recapitulation of the updated balance of the National Metallic Minerals Resources and Reserves are shown in Table 1 below.

Table 1. Recapitulation of Metallic Minerals Resources and Reserves in 2021

No.	Commodity	Total Resources (metric tons) **)		Total Reserves (metric tons)	
		Ore	Metal	Ore	Metal
1	Primary Gold	16,028,926,779	8,699	3,619,471,264	1,987
2	Alluvial Gold*)	1,632,792,609	355	65,726,139	150
3	Copper	15,951,450,554	65,944,875	3,017,819,590	19,936,017
4	Tin*)	7,159,668,511	2,406,880	6,840,343,359	2,165,905
5	Lead	4,009,783,572	94,005,800	76,273,815	2,853,376
6	Nickel	17,685,749,507	177,814,602	5,243,538,419	57,111,962
7	Primary Iron	7,349,424,602	1,671,643,457	1,702,216,159	353,757,486
8	Iron Sand	3,940,294,766	890,695,801	1,216,504,448	476,132,595
9	Manganese	190,890,310	87,638,863	129,433,888	57,417,310
10	Mercury	32,254,882	76	-	-
11	Antimony	11,890,421	375,555	3,958,633	15,835
12	Bauxite	6,632,138,239	1,094,186,118	3,220,859,010	520,475,101
13	Platinum	114,750,000	8	-	-
14	Iron Sediment	5,825,623	3,680,168	-	-
15	Silver	10,545,402,270	78,624	3,115,958,765	11,541
16	Zinc	3,771,823,836	63,535,053	68,642,182	2,785,811
17	Laterite Iron	7,746,537,224	1,164,191,400	1,532,195,254	317,532,880
18	Cobalt	3,283,552,980	7,446,443	682,412,785	484,480
19	Chromite	17,679,700	7,095,982	22,846,799	9,138,061
20	Placer Chromite*)	4,795,844	1,053,322	3,552,165	137,971
21	Molybdenum	2,809,124,333	277,013	-	-
22	Laterite Titanium	1,341,685,306	9,972,609	205,860,784	1,291,700
23	Placer Titanium	598,457,092	37,649,286	206,966,052	11,181,518
24	Vanadium	230,801,000	1,574,148	161,629,516	1,101,899
25	Monazite*)	6,925,944,594	186,663	-	-
26	Xenotime*)	6,466,257,914	20,734	0.09	0.06

*) ore/concentrate unit in m^3
**) exclude hypothetical resources
Metal resources and reserves are calculated from dry metric tons (dmt) of ore

Copper, Gold, and Silver

The current position of Indonesia's copper reserves is 3% of the world's total copper reserves and is among the top 10 in the world (Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2022). Based on the updated data on the balance of Minerals Resources and Reserves in 2021, copper ore resources are 15.95 billion tons, copper ore reserves are 3 billion tons, and copper metal reserves are 19.94 million tons. Most of the copper ore/metal resources fall into the category of inferred resources and probable reserves (Figure 1). Total copper ore resources in 2021 increased by 1.1 billion tons, and reserves also increased by 386 million tons compared to the data in 2020 (Figure 2). Meanwhile, copper metal reserves in 2021 decreased by 3.858 million tons compared to 2020 (Figures 3).

Indonesia's gold reserves are 4%, the 5th rank of the World Gold Reserves. Total World Gold Reserves are 54,000 tons (Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2022). As a result of the 2021 update, most of the gold ore/metal resources belong to the inferred and indicated resources (Figure 4). Total gold ore resources and reserves are relatively constant, but total gold metal reserves have decreased by 251 tons compared to 2020 (Figure 5 and Figure 6). And for silver metal, total resources increased significantly, and total reserves decreased by 1,000 tons compared to 2020 (Figure 7).

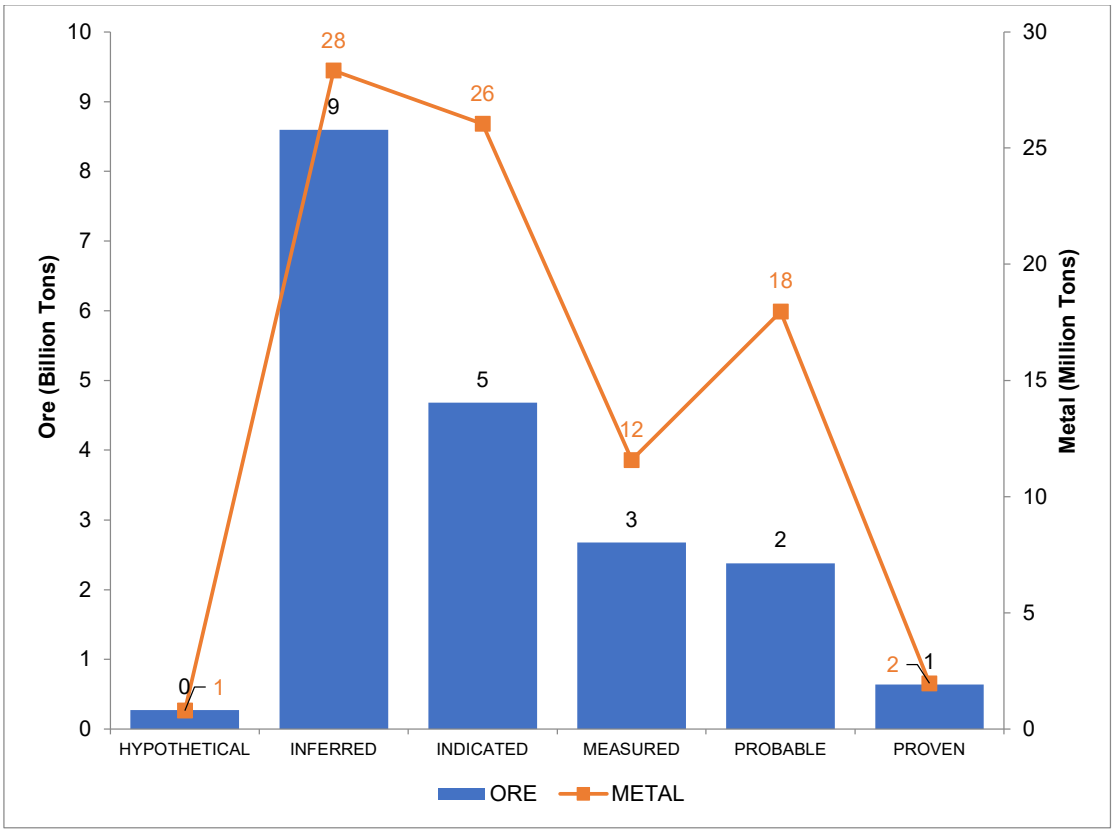


Figure 1. Copper Ore/Metal Resources and Reserves in 2021

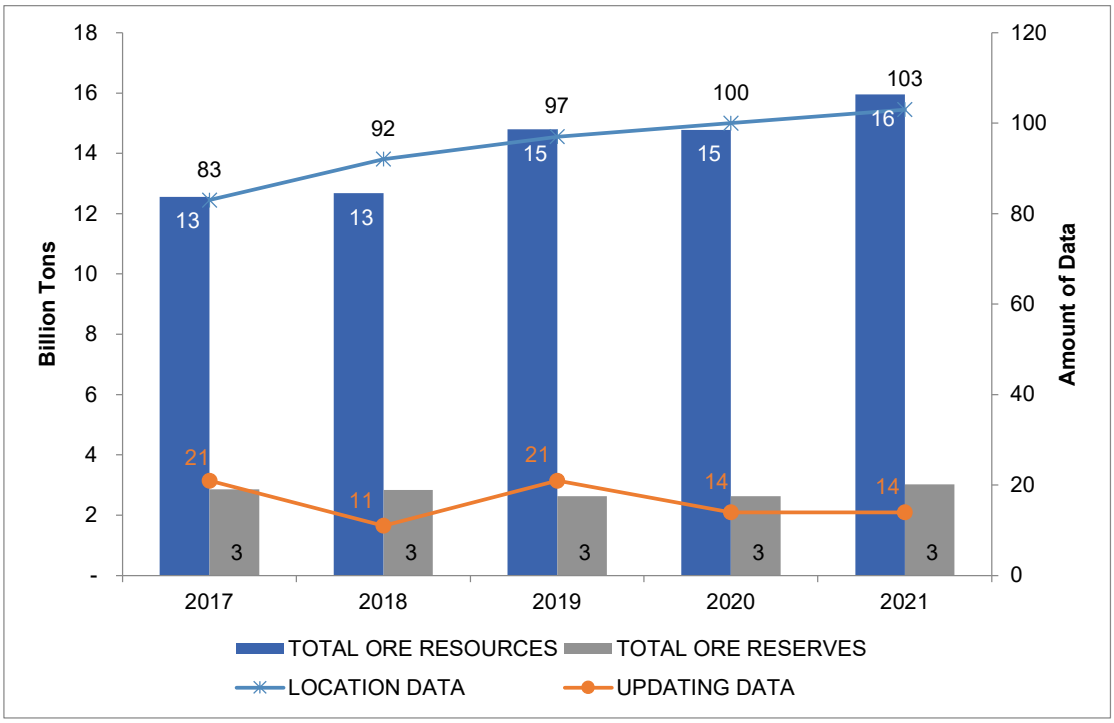


Figure 2. Copper Ore Resources and Reserves in 2017 – 2021

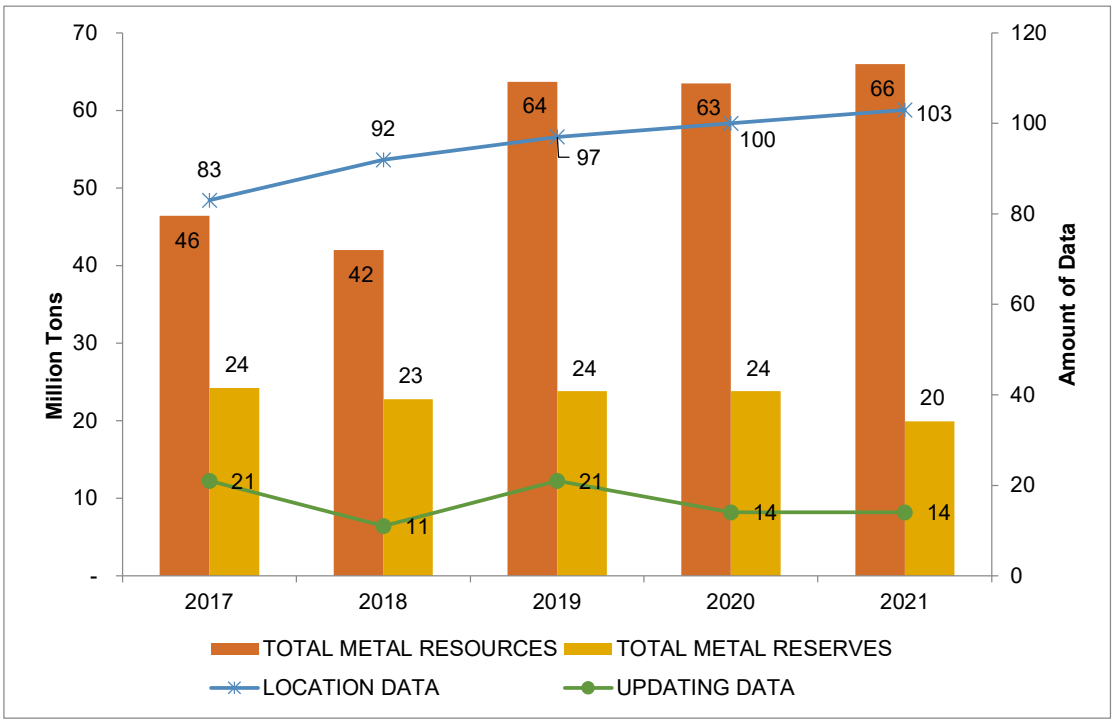


Figure 3. Copper Metal Resources and Reserves in 2017 - 2021

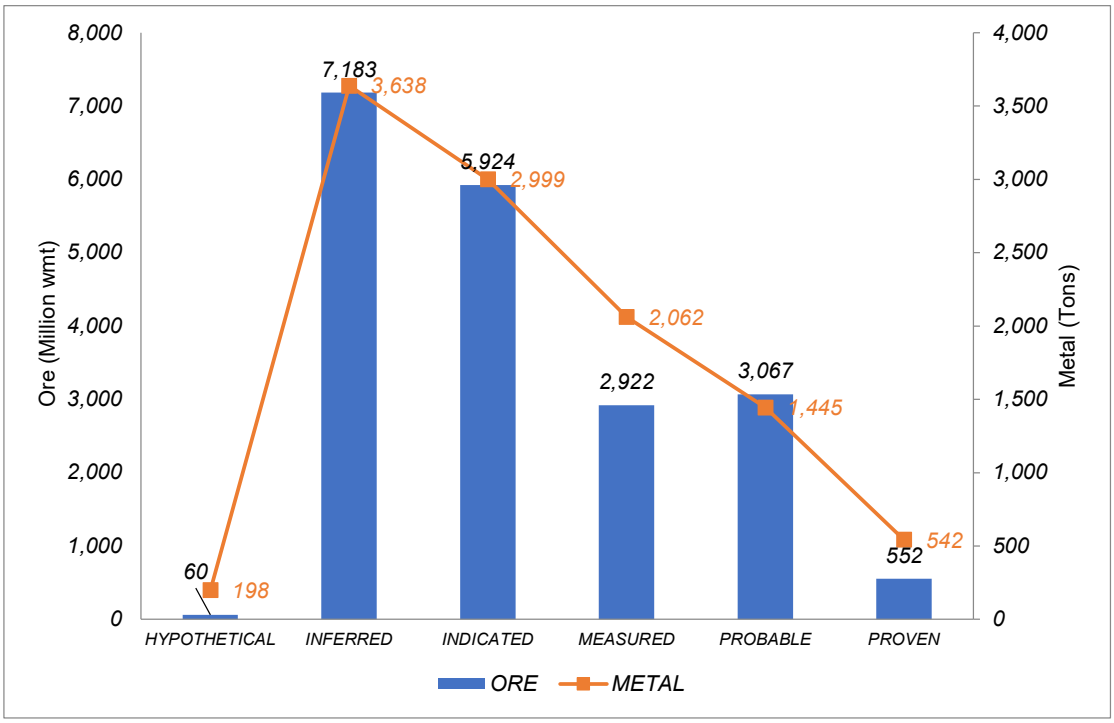


Figure 4. Primary Gold Ore/Metal Resources and Reserves in 2021

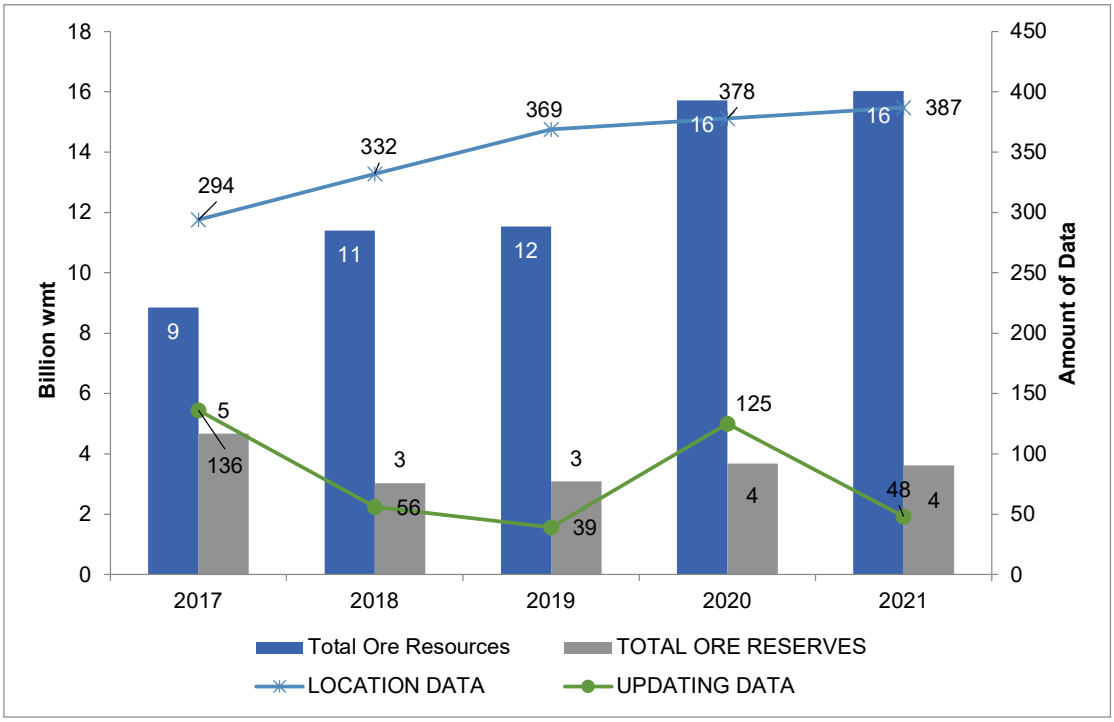


Figure 5. Gold Ore Resources and Reserves 2017 – 2021

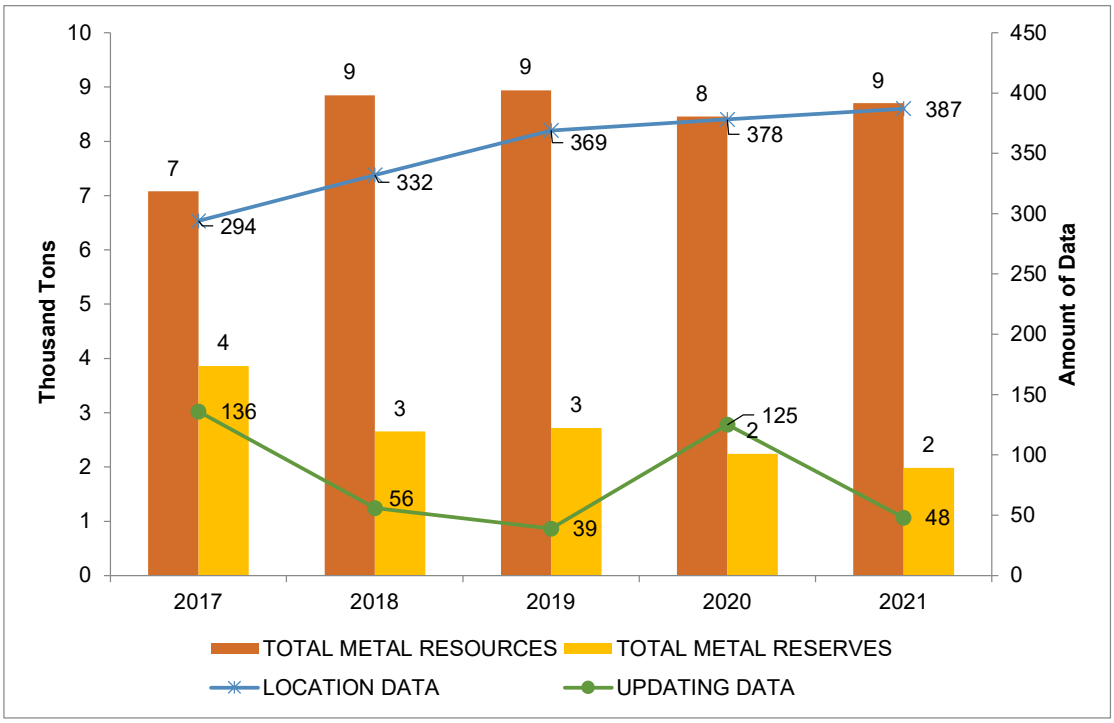


Figure 6. Gold Metal Resources and Reserves 2017 – 2021

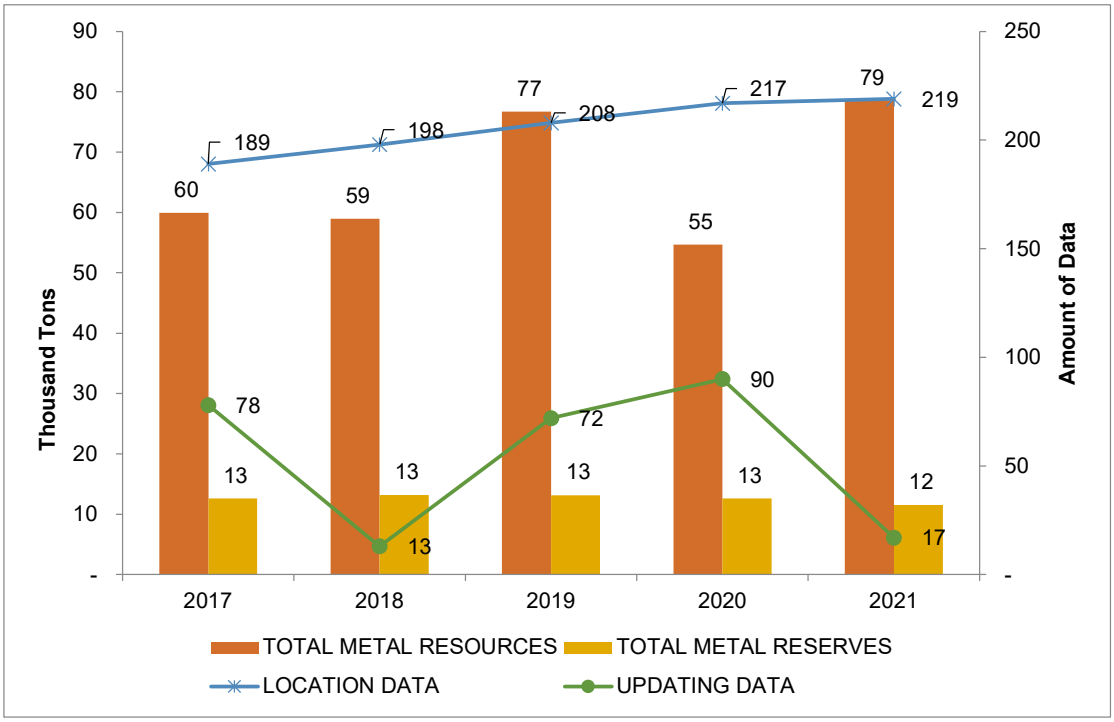


Figure 7. Silver Metal Resources and Reserves in 2017 - 2021

Nickel and Cobalt

The position of Indonesia's nickel-metal reserves is 40% of total world reserves, the largest in the world. Total world nickel-metal reserves are 139.419 million tons, and Indonesia's nickel-metal reserves in 2021 are 57 million tons. Nickel ore resources and reserves are dominated at the inferred resource stage and the probable reserve status (Figure 8). Total nickel ore resources in 2021 experienced a significant increase, while total reserves also increased slightly. The reported nickel content varies from 0.6% to 2.7% Ni. However, the lowest nickel content used in processing is 1.5% and 1.7% Ni. The characteristics of nickel ore, in limonite or saprolite, are also very important in processing nickel ore. Therefore, in Tables 2, 3, and 4, nickel resources and reserves are presented based on the content (1.5% Ni and 1.7% Ni) and the type of deposit (limonite and saprolite). Meanwhile, the development of cobalt resources and reserves in 2017-2021 tends to increase relatively slowly (Figure 9).

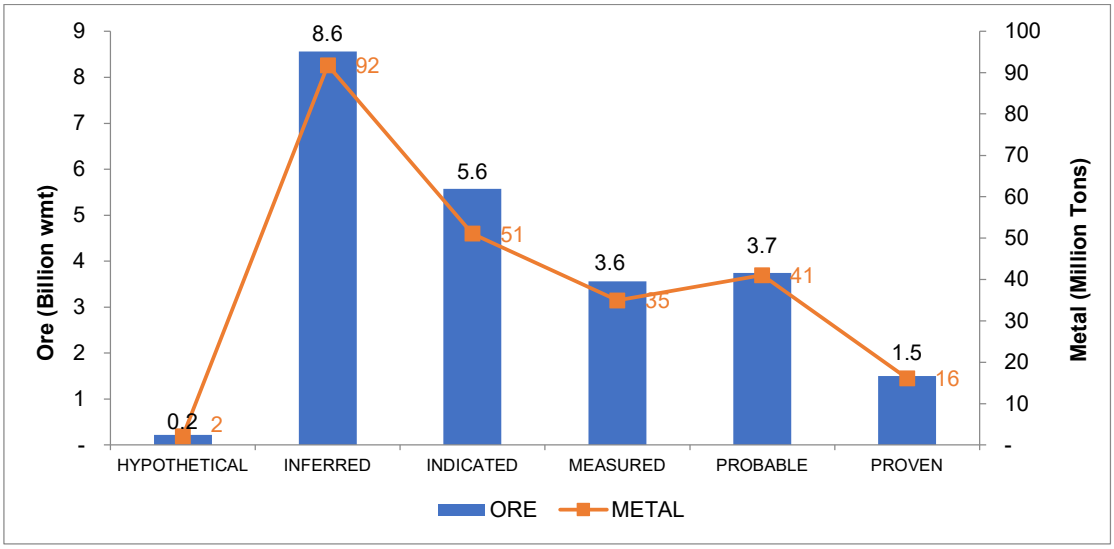


Figure 8. Nickel Ore/Metal Resources and Reserves in 2021

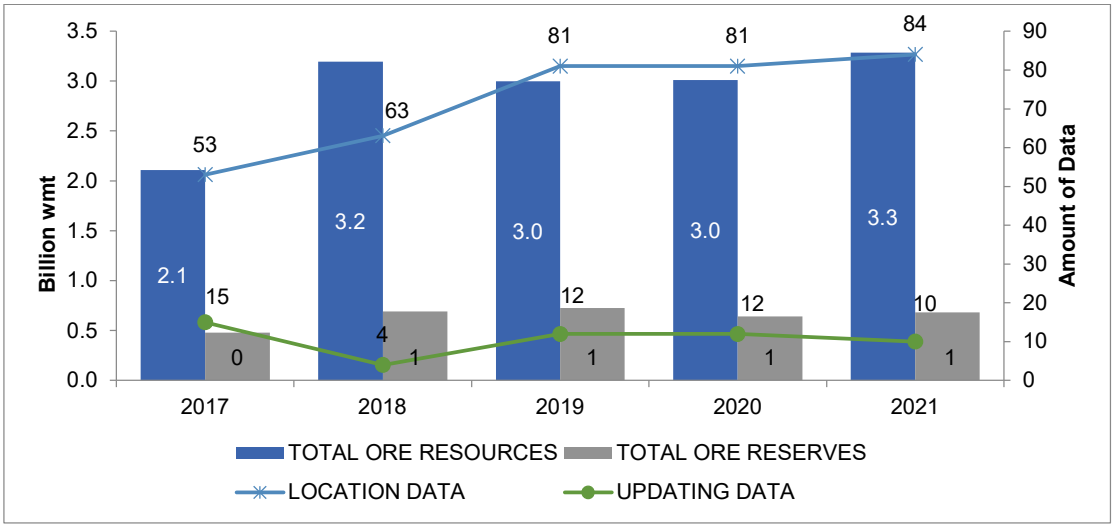


Figure 9. Cobalt Ore Resources and Reserves in 2017-2021

Table 2. Nickel Ore Resources and Reserves Ni < 1.5% and Ni >= 1.5%

Ni Content	Resources								Reserves			
	Hypothetical		Inferred		Indicated		Measured		Probable		Proven	
	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)
Ni < 1.5%	219,933,464	2,082,743	4,719,021,219	32,614,005	3,538,385,978	25,994,338	1,720,427,077	11,982,583	1,397,936,144	12,029,961	156,966,628	1,226,954
Ni > 1.5%	-	-	3,837,229,347	59,139,240	2,033,222,418	25,109,333	1,837,463,468	22,975,101	2,345,693,390	28,965,785	1,342,942,258	14,889,262

Table 3. Nickel Ore Resources and Reserves Ni < 1.7% and Ni >= 1.7%

Ni Content	Resources								Reserves			
	Hypothetical		Inferred		Indicated		Measured		Probable		Proven	
	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)
Ni < 1.7%	219,933,464	2,082,743	6,755,933,662	54,462,075	4,374,676,601	35,875,091	2,452,755,078	20,529,458	2,350,292,045	22,449,861	383,426,858	3,764,062
Ni > 1.7%	-	-	1,800,316,904	37,291,170	1,196,931,795	15,228,581	1,105,135,467	14,428,226	1,393,337,489	18,545,886	1,116,482,028	12,352,153

Table 4. Nickel Ore Resources and Reserves in Limonite, Saprolite, and other materials

Type of Nickel Ore Deposit	Resources								Reserves			
	Hypothetical		Inferred		Indicated		Measured		Probable		Proven	
	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)	Ore (wmt)	Metal (tons)
Limonite	-	-	1,583,883,763	13,848,704	761,933,716	7,208,003	447,886,669	4,542,881	540,782,576	4,792,729	121,705,582	1,280,447
Saprolite	260,000	-	1,708,166,371	19,670,379	739,580,733	9,277,099	727,615,890	8,811,450	648,424,292	7,800,337	341,922,226	4,292,994
Other Materials	219,673,464	2,082,743	5,267,600,432	58,265,102	4,071,393,946	34,634,950	2,384,187,986	21,626,034	2,555,422,666	28,415,980	1,036,681,077	10,548,038

Bauxite

Indonesia's bauxite reserves position is 10% of total world reserves, the 4th order of the world bauxite reserves. Total world bauxite reserves are 32 billion tons (Source: U.S. Geological Survey, Mineral Commodity Summaries, January 2022). The status of bauxite resources in 2021 is 6.63 billion tons, and bauxite reserves are 3.2 billion tons, with Probable Reserves of 2.3 billion tons and Proven Reserves of 922.8 million tons. The indicated resources and probable reserves dominate bauxite resources and reserves, respectively (Figure 10).

Tin

Tin resources and reserves in 2021, mostly in inferred and measured resources and probable reserves. The resource of tin concentrate in 2021 is 7.2 billion m^3, with reserves of 6.8 billion m^3. Tin metal resources are 2.4 million tons, and reserves are 2.17 million tons (Figure 11). Based on developments over the last five years, the value of tin resources and reserves, from 2017 to 2021, generally experienced a slight decline (Figure 12).

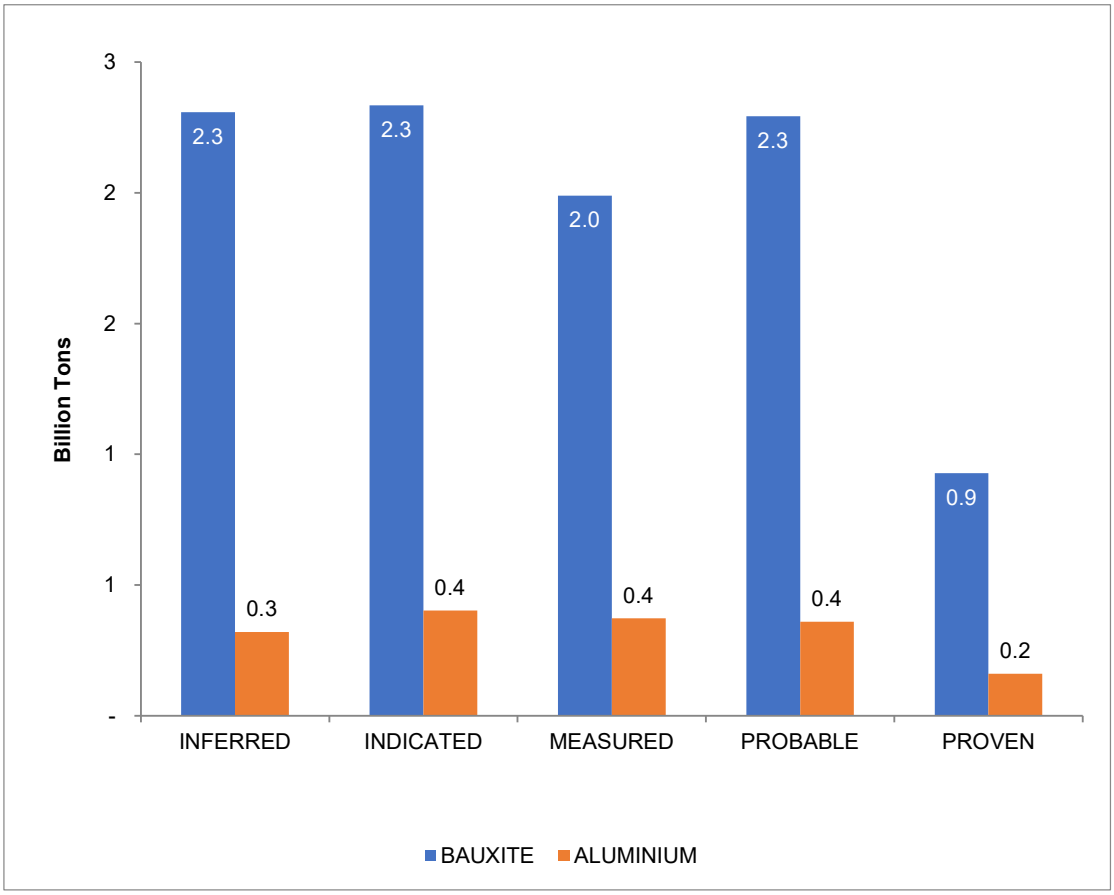


Figure 10. Bauxite and Aluminium Resources and Reserves in 2021

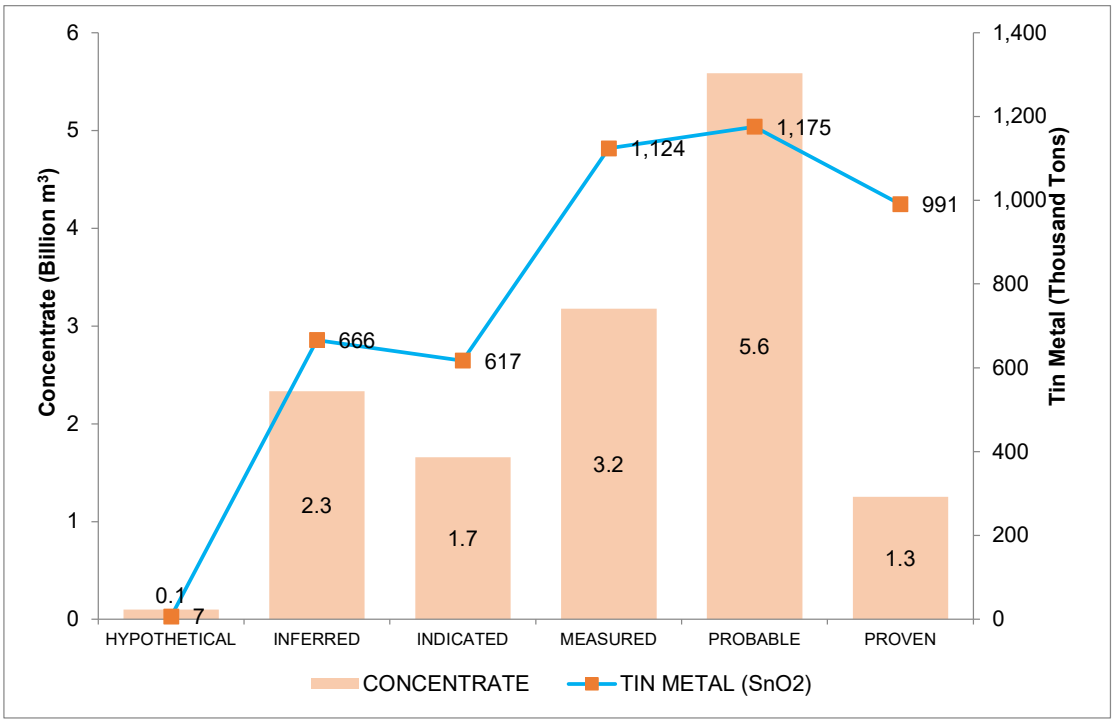


Figure 11. Tin Concentrate and Metal Resources and Reserves in 2021

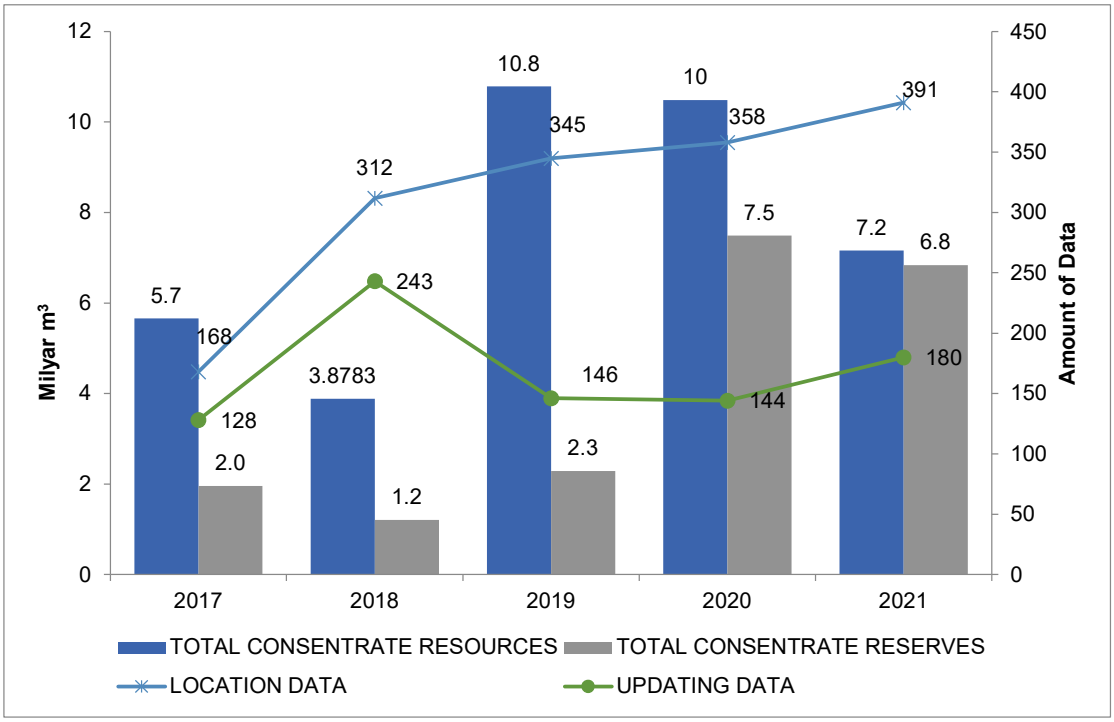


Figure 12. Tin Concentrate Metal Resources and Reserves in 2017- 2021

Iron Ore, Laterite Iron

Iron ore resources and reserves in 2021 are mostly indicated and measured resource status, which can be converted into probable reserves through detailed exploration and feasibility studies and incorporate economic factors to increase the total reserves (Figure 13). The development of iron ore resources and reserves from 2017 to 2021 is relatively fluctuative, although the amount of data tends to increase. Following the data for the last five years, iron ore resources and reserves in 2021 experienced a relatively small increase from 2020 (Figure 14).

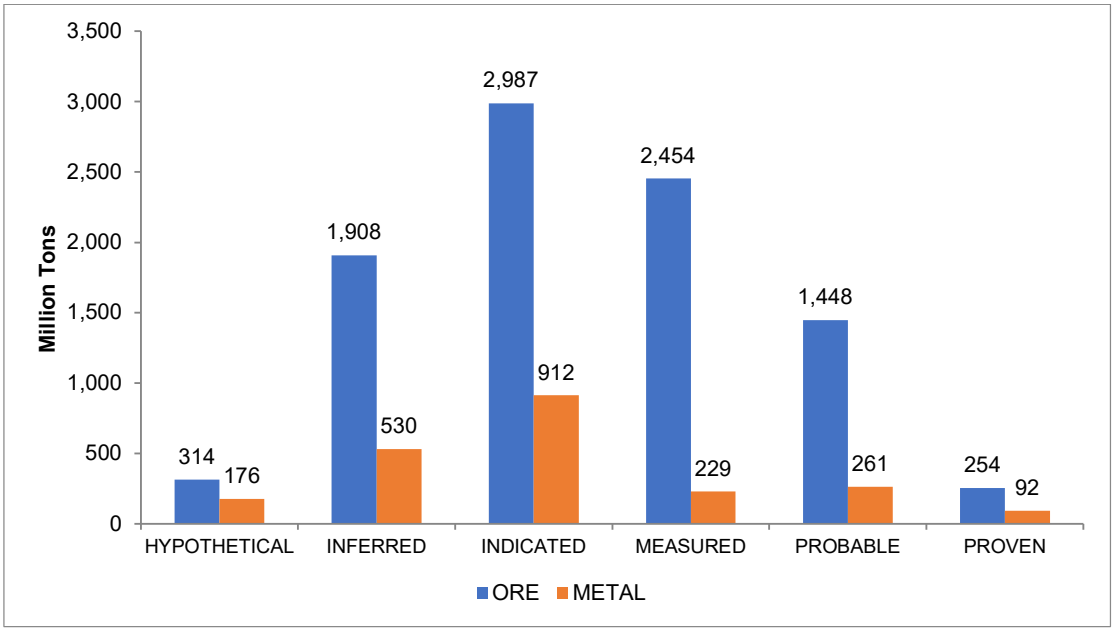


Figure 13. Iron Ore/Metal Resources and Reserves in 2021

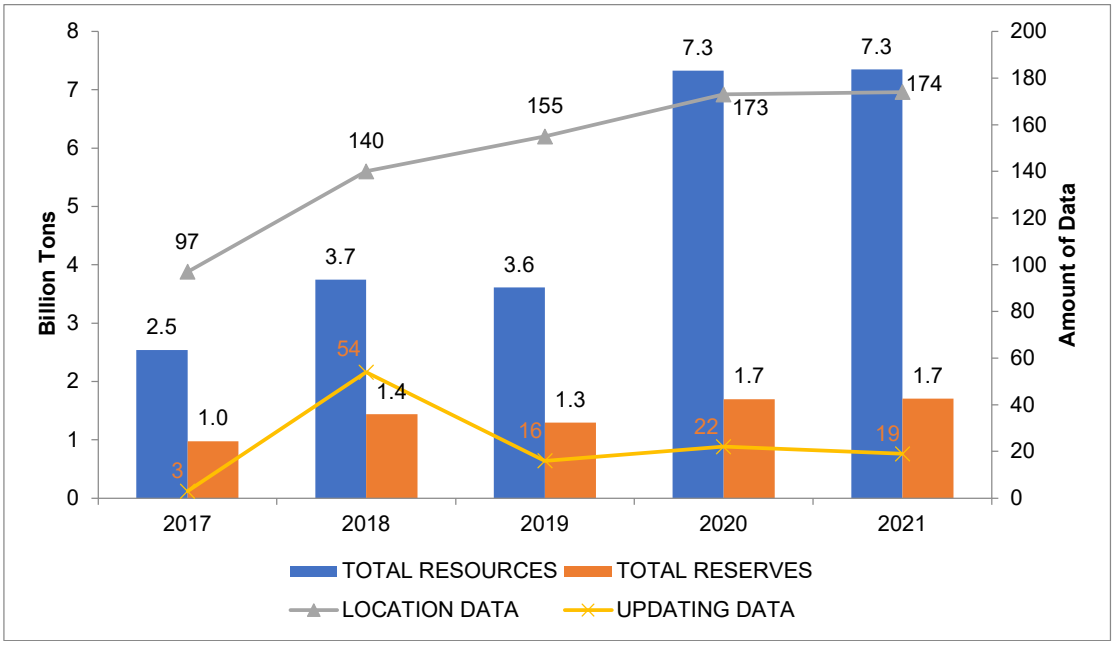


Figure 14. Iron Ore Resources and Reserves in 2017 – 2021

Laterite iron resources and reserves are mostly dominated by inferred resources, while the total reserves are dominated by probable reserves (Figure 15). Laterite iron resources and reserves from 2017 to 2021 increase with the addition of new and updated data. The laterite iron resources significantly increase from 2019 to 2021 (Figure 16).

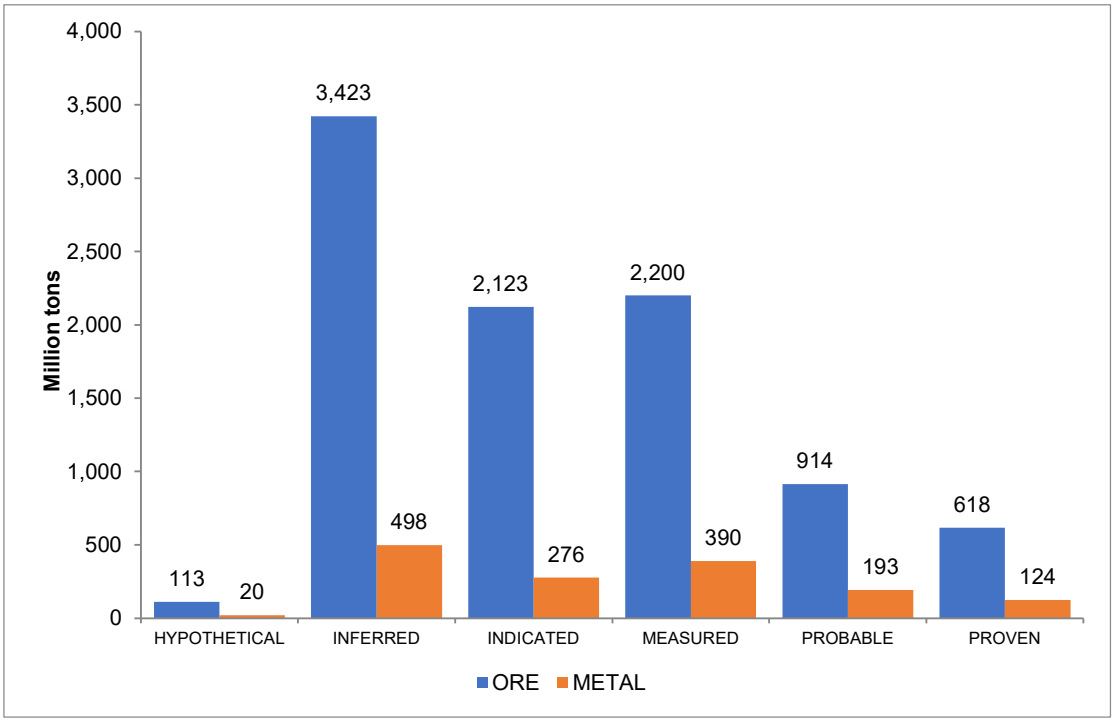


Figure 15. Laterite Iron Ore/Metal Resources and Reserves in 2021

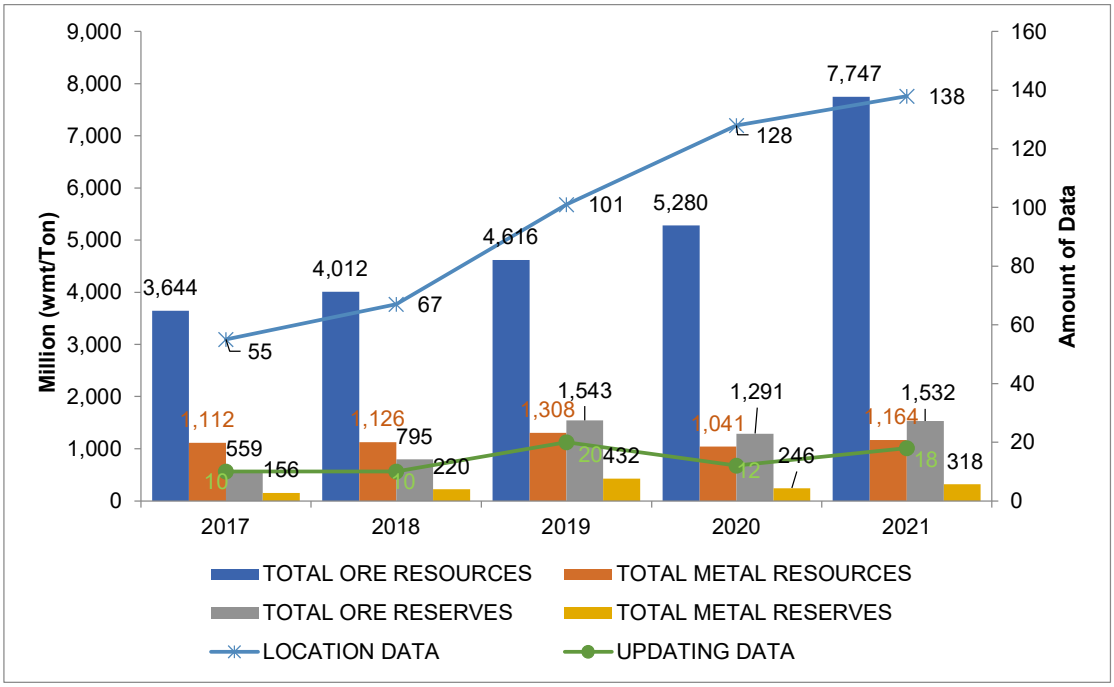


Figure 16. Laterite Iron Ore/Metal Resources and Reserves in 2007 - 2021

NON-METALLIC MINERALS AND ROCK RESOURCES

Based on the Minerals Resources Balance data for 2020, 4,015 commodity locations spread throughout Indonesia with 57 commodities. The update in 2021 acquired 255 new location points (addition of location points) for 16 commodities and updated data for 122 locations for ten commodities. Therefore, the balance of non-metallic minerals and rock in 2021 has 4,270 commodity points with 57 commodities (Table 5).

In 2021, non-metallic minerals and rock commodities changed significantly in resources and reserves. Commodities which experienced increased resources include andesite, basalt, ornamental stone, limestone, feldspar, phosphate, granite, kaolin, clay, marble, quartz sand, sea sand, sand, trass, and zeolite. Most commodities are in hypothetical resource status. Therefore, efforts are needed to increase the status of resources through intensive exploration activities. Meanwhile, the development of resources and reserves of several non-metallic minerals and rock commodities from 2017 to 2021 can be seen in Figures 17 to 24.

Table 5. Recapitulation of Non-Metallic Minerals and Rock Resources and Reserves in 2021

No.	Commodity	Hypothetical (metric tons)	Total Resources (metric tons)	Total Reserves (metric tons)
1	Amethyst	-	8,668	-
2	Andesite	57,689,810,000	21,056,888,602	3,161,691,429
3	Ball Clay	99,620,000	58,258,552	976,624
4	Barite	377,000	37,378,000	-
5	Basal	1,282,160,420	5,043,631,160	1,675,100
6	Ornamental stone	2,940,750,784	61,000	-
7	Quartz stone	390,000	28,335,139	21,408,936
8	Potassium rock	-	71,345,284,840	-
9	Pumice	601.552.780	162.094.000	-
10	Limestone	607,954,760,100	177,537,491,141	12,016,042,580
11	Slate	1,946,958,000	-	-
12	Sulfur	1,697,000	3,221,692	2,610,192
13	Bentonite	501,190,800	351,797,706	9,420,843
14	Dasit	1,189,258,627	2,026,125,000	-
15	Diabas	625,000,000	-	-
16	Diatomacea	107,105,800	31,056,700	-
17	Diorite	8,773,845,000	520,780,730	604,195
18	Dolomite	2,378,907,607	2,471,357,211	158,548,761
19	Feldspar	6,435,680,286	4,820,061,821	34,570,458
20	Phosphate	19,113,040	8,485,580	187,561
21	Gypsum	7,268,422	170,890	-
22	Jade	-	74,475	-
23	Granite	60,760,216,683	21,391,799,589	638,874,252
24	Graphite	-	31.300.000	-
25	Granodiorite	2,126,000,000	-	-
26	Diamond*)	100,640	43,590,201	10,066,271
27	Jasper	600	650,000	-
28	Chalsedony	109,852	1,657,500	-
29	Calcite	60,025,000	62,092,200	377,632,565
30	Kaolin	1,249,877,424	339,389,719	8,293,242
31	Rusted wood	-	13,750	-
32	Quartzite	2,975,259,000	297,248,498	-

No.	Commodity	Hypothetical (metric tons)	Total Resources (metric tons)	Total Reserves (metric tons)
33	Clay	90,949,234,845	9,955,303,296	291,019,605
34	Magnesite	780	-	-
35	Marble	106,220,384,000	4,817,241,264	18,990,004
36	Obsidian	4,150,000	62,720,000	-
37	Ocher	123,085,840	45,000	-
38	Onyx	527,500	-	-
39	Opal	-	1.67	-
40	Zircon	5,026,850	121,951,318	48,215,864
41	Quartz sand	23,223,593,600	2,111,225,091	330,894,485
42	Sea sand**)	-	1,970,452,984	832,657,505
43	Peridotite	8,289,422,000	107,789,630	21,703,646
44	Perlite	1,287,190,100	193,942,000	-
45	Pyrophyllite	104,762,000	96,446,710	17,097,702
46	Prehnit	-	4,200	-
47	Chert	267,663,000	1,089,680	-
48	Serpentinite	1,290,635,000	137,500	-
49	Sand and rock	5,171,218,700	4,124,656,883	796,115,643
50	Talk	185,000	1,946,200	-
51	Toseki	221,651,000	53,896,000	-
52	Trakhite	4,124,316,000	1,286,927,500	-
53	Trass	4,307,815,880	381,894,553	168,179,215
54	Travertine	-	7,500	-
55	Ultrabasic	42,636,369,900	52,737,271,640	-
56	Iodine	-	138,192	10,658
57	Zeolite	236,081,163	290,864,194	4,134,579

*) unit in carat
**) unit in m^3

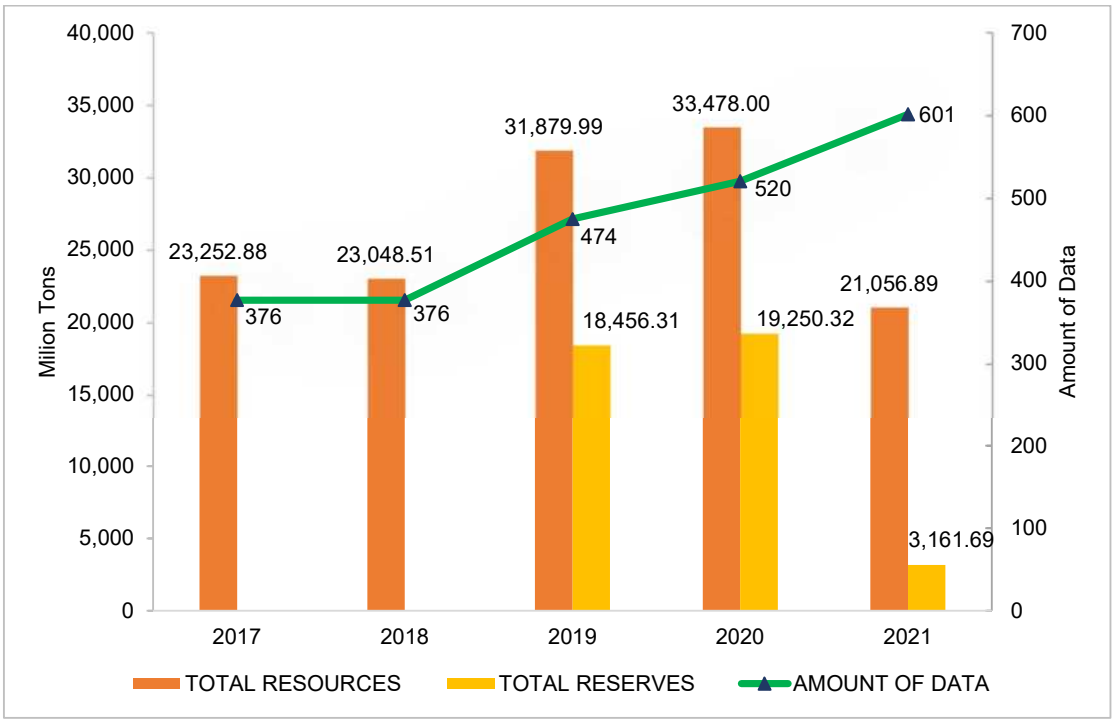


Figure 17. Andesite Resources and Reserves in 2017-2021

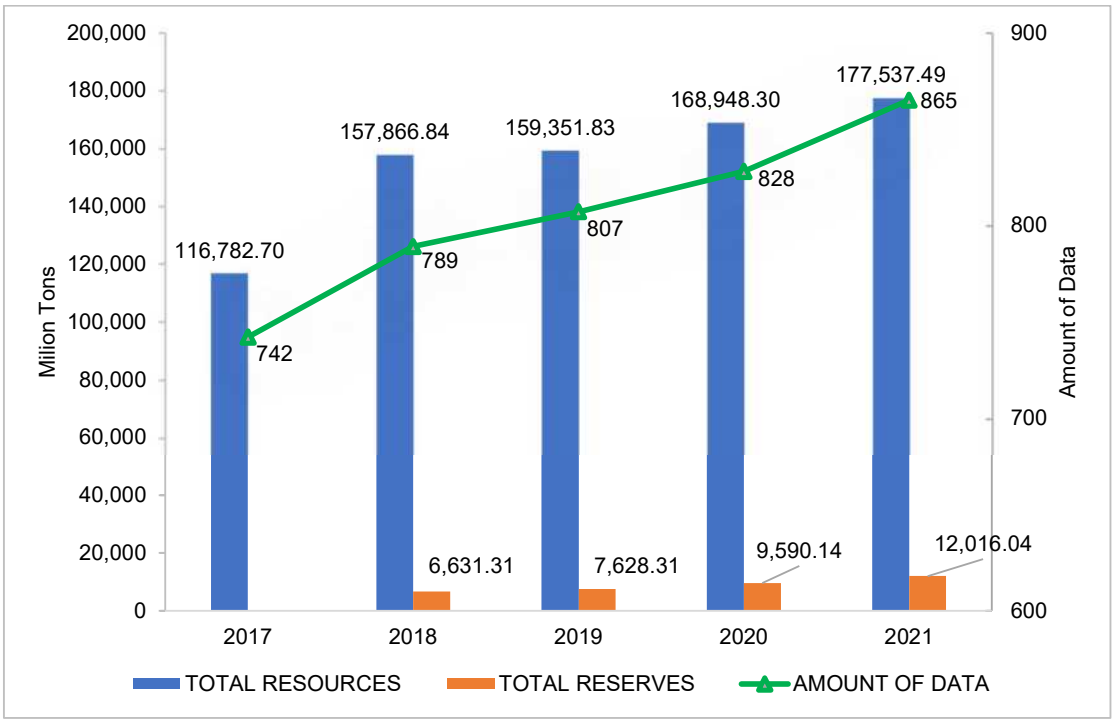


Figure 18. Limestone Resources and Reserves in 2017-2021

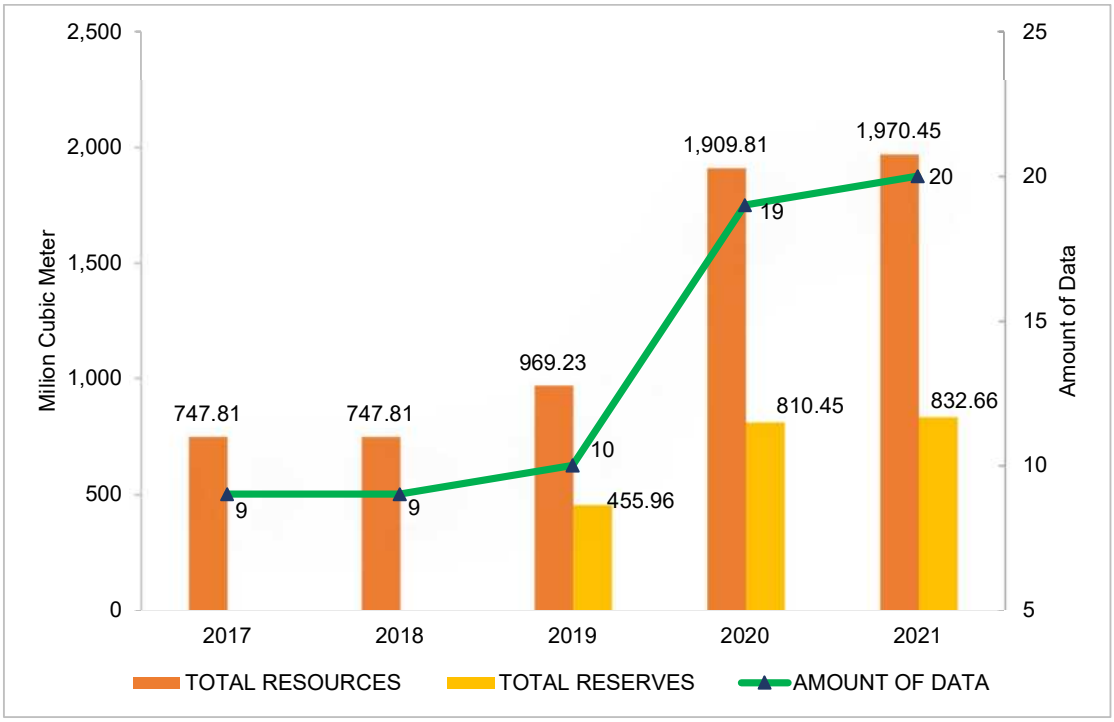


Figure 19. Sea Sand Resources and Reserves in 2017-2021

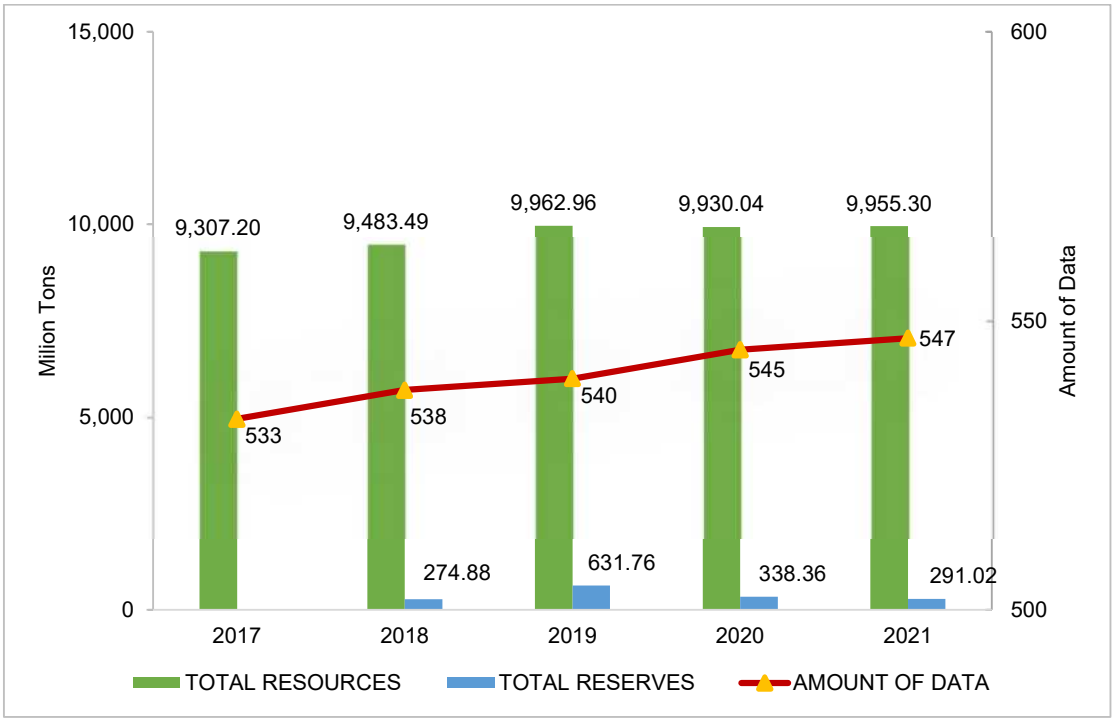


Figure 20. Clay Resources and Reserves in 2017-2021

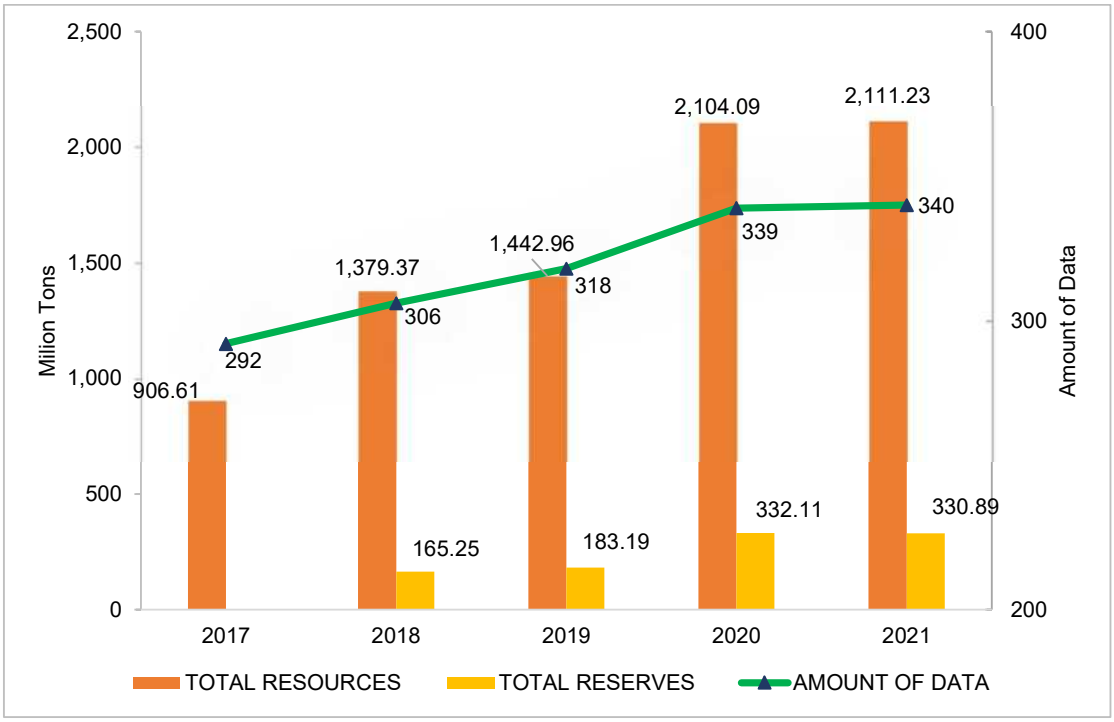


Figure 21. Quartz Sand Resources and Reserves in 2017-2021

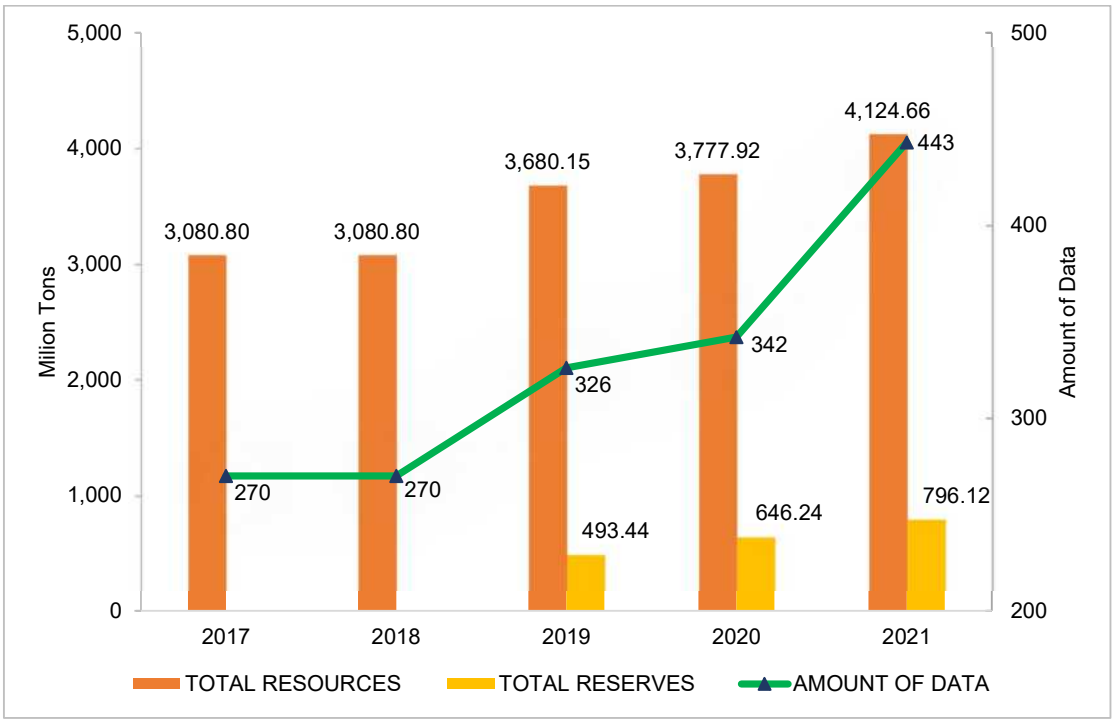


Figure 22. Sand and Rock Resources and Reserves in 2017-2021

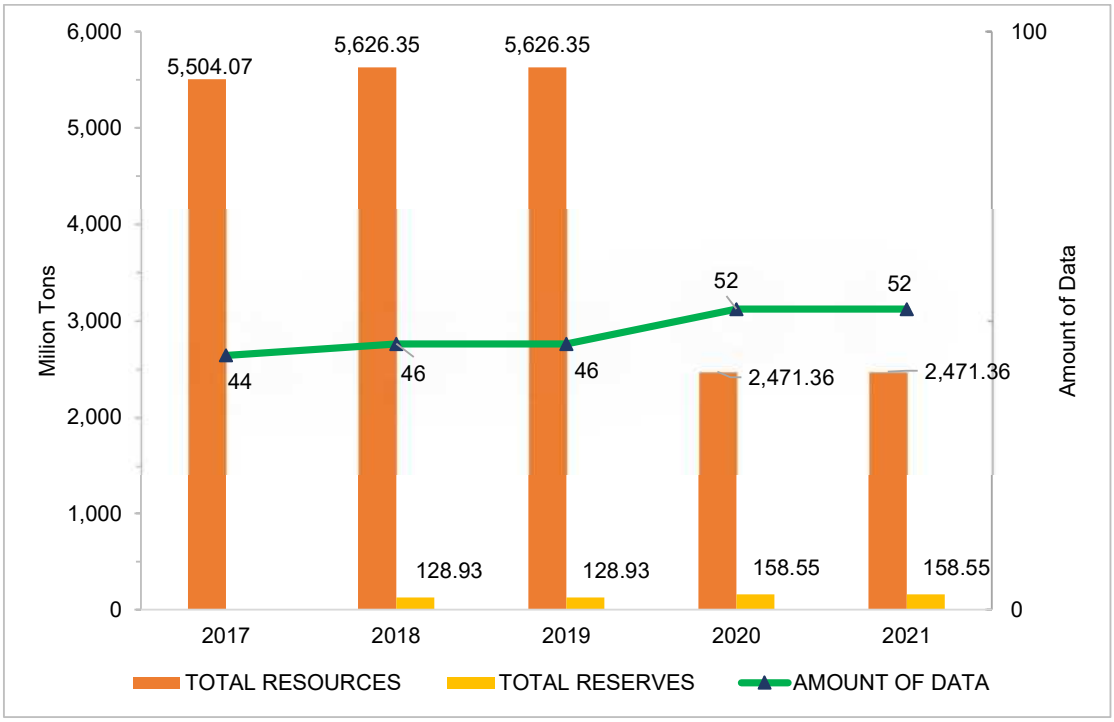


Figure 23. Dolomite Resources and Reserves in 2017-2021

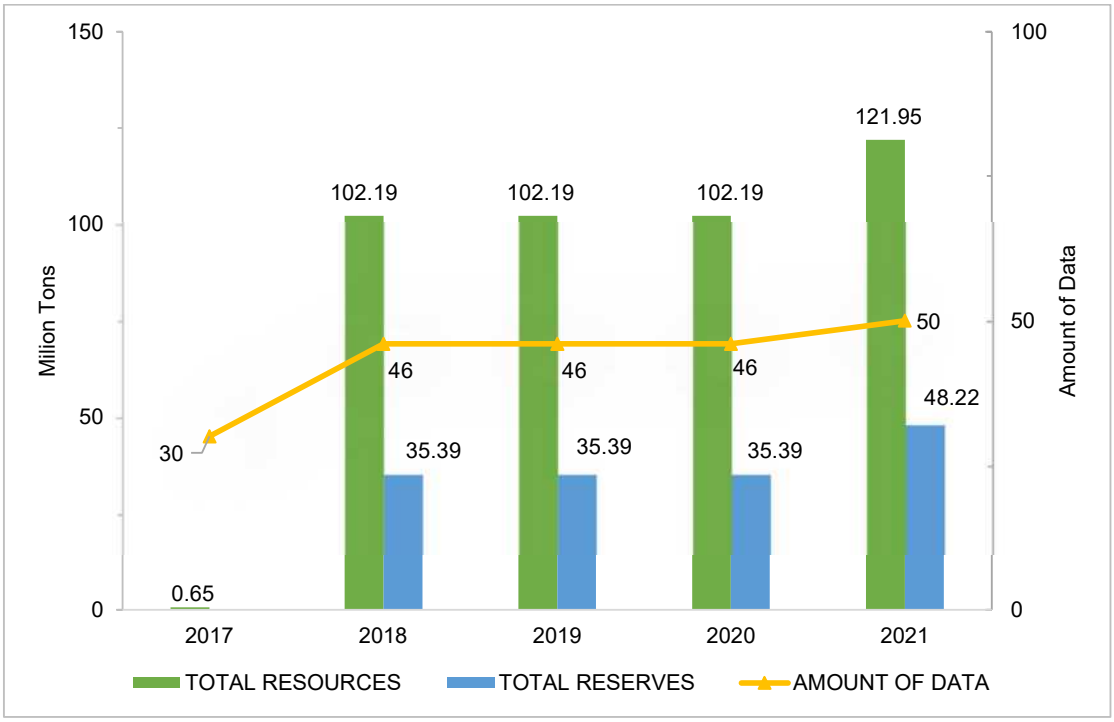


Figure 24. Zircon Resources and Reserves in 2017-2021

INDONESIA COAL RESOURCES AND RESERVES 2021

The Energy and Mineral Resources (ESDM) sector has an important role in national development, especially in supporting the economy through the fiscal, monetary, and other sectors. Coal is one of the energy sources in Indonesia and has long been used as national development capital.

Coal Resources and Reserves Data is updated and published every year. The data used to calculate and update the National Coal Reserves and Resources came from exploration reports by the government and from the exploration and exploitation reports of Business Entity (Coal Mining Concession Work Agreement (PKP2B) and Coal Mining Business Permit (IUP).

The updated Coal Resources and Reserves data tabulated and integrated into the database and web-based map of coal resources potency using Geological Information System (web-GIS). These data are also integrated into “GeoRIMA”, an android-based application that presents data on Indonesia's mineral, coal, and geothermal potential.

The classification of Indonesian coal resources and reserves is guided by the Indonesian National Standard (SNI) issued by the National Standardization Agency with the number SNI 5015:2019 entitled Guidelines for Reporting Exploration Results, Resources and Coal Reserves. In this guideline, the classification of coal resources and reserves is divided into; Exploration Targets, Inventory, Inferred Resources, Indicated Resources, Measured Resources, Probable Reserves and Proven Reserves.

Inventory coal resources published by the government obtained from the results of field observations. This inventory reflects the national coal potential that has not been exploited to date. Its utilization may be constrained by various matters, for example the location of coal in marginal areas or within conservation areas. Coal potency within the conservation areas can be designated as National Reserve Areas (WPN) which later can be used for national strategic reserves.

COAL RESOURCES AND RESERVES

Surface Coal (0-100m)

Surface coal is defined as coal at 0-100 meters depth and suitable for open pit mining. The results of recapitulation and calculations based on internal and external data until December 2021 shows that Indonesia has 110,069.91 million tonnes or 110.069 billion tonnes coal resources, while Indonesia's coal reserves are 36,278.85 million tonnes or 36.278 billion tonnes.
Based on the calorific value on air dried basis, Indonesia's coal resources consist of:

- Low calorie coal (< 5100 cal/g)
  37,343.72 million tonnes
- Medium calorie coal (5100-6100 cal/g)
  59,852.38 million tonnes
- High calorie coal (6100-7100 cal/g)
  9,731.85 million tonnes
- Very high calorie coal (> 7100 cal/g)
  3,141.96 million tonnes

Based on the stages of investigation, Indonesia's coal can be divided into five categories, namely:

- Exploration targets 6,141.12 million tonnes
- Total inventory 24,365.84 million tonnes
- Inferred coal resources 34,350.15 million tonnes
- Indicated coal resources 34,350.38 million tonnes
- Measured coal resources 41,369.38 million tonnes

In 2020, data updating activities also classify resource and reserves data into verified and unverified data. Verified data means resources and reserves data has been verified by competent persons (CP) or has been verified by the Geological Agency.

Indonesia's coal reserves data is obtained from the reports of companies holding PKP2B business permits, PMA IUPs, and PMDN IUPs. The reserves value status until the end of December 2021 is estimated reserves of 18,374.92 million tonnes or 18.374 billion tonnes, while proven reserves are 17,903.92 million tonnes or 17.903 billion tonnes.

Compared to the 2020 status, there was a decrease in coal resources by 33,660.99 million tonnes, while coal reserves decreased by 2,526.63 million tonnes. This decrease in resources is due to coal production operations, as well as the increasing use of Competent Persons (CP), which increases the level of confidence in resources and reserves data. In addition, it was due to changes in the status of resources into exploration targets and inventories.

The results of the data recapitulation and update show that until December 2021, there are 110.069 billion tonnes of total coal resources and 36.278 billion tonnes of total coal reserves. The recapitulation table of resources and reserves is made in two versions, namely the table of resources and reserves based on the calorific value in air dried basis (Table 6) and the table of resources and reserves as per province (Table 7). Exploration activities carried out by the government (CMCGR-Geological Agency) are included in the exploration and inventory targets. Meanwhile, the value of inferred, indicated, and measured resources as well as the value of coal reserves are all obtained from the exploration activities of the Business Entity.

The existence of coal production operations, increasing number of companies that estimate resources and reserves by competent person (CP), and reporting of resources data in 2021 which refers to SNI 5015:2019 will affect the values composition of coal resources and reserves in 2021. In 2021, the Geological Agency's investigation activities are included in the Coal Exploration and Inventory Target column because they have not considered technical and economic factors.

The total number of coal resources and reserves in 2021 is 83.22% (91.606 billion tonnes) of resources data and 87.36% (31.695 billion tonnes) of reserves data have been verified by CP. Details of verified resources and reserves data can be seen in Table 8. The number of verified data in 2021 also increases compared to verified data on the 2020. The verified data is expected to reach 100% in 2022.

Table 6. Indonesia's Coal Resources and Reserves in 2021 Based on Quality

QUALITY	EXPLORATION TARGET (Million Tonnes)	TOTAL INVENTORY (Million Tonnes)	RESOURCES (Million Tonnes)					RESERVES (Million Tonnes)			
			INFERRED	INDICATED	MEASURED	TOTAL	TOTAL (VERIFIED)	PROBABLE	PROVEN	TOTAL	TOTAL (VERIFIED)
Low calorie	417.17	11,252.41	14,961.91	11,979.49	10,402.32	37,343.72	29,703.20	7,523.85	5,401.22	12,925.07	10,869.81
Medium calorie	2.06	547.38	14,625.47	18,356.99	26,869.92	59,852.38	51,868.94	9,464.74	11,220.50	20,685.24	18,811.62
High calorie	5,040.47	10,717.99	3,368.46	3,135.27	3,228.12	9,731.85	7,246.56	1,139.99	885.96	2,025.95	1,456.17
Very high calorie	681.42	1,848.07	1,394.31	878.63	869.02	3,141.96	2,787.34	246.34	396.25	642.59	558.02
TOTAL	**6,141.12**	**24,365.84**	**34,350.15**	**34,350.38**	**41,369.38**	**110,069.91**	**91,606.04**	**18,374.92**	**17,903.92**	**36,278.85**	**31,695.63**

Notes :

- Data sources represent 1517 locations from 67 PKP2B (100%); 69 PMA IUPs (100%); 858 PMDN IUPs (81%); 333 IUPs were not registered, and 190 locations were investigated by CMCGR of Geological Agency. Resources data involves Unregistered IUPs data, while all reserves data comes from Registered IUPs. There is no overlapping area between Registered and Unregistered IUPs
- Verified resources are coal resources resulting from exploration activities of CMCGR and coal resources reported by the Business Entity and estimated by a competent person (CP). Verified reserves are coal reserves reported by the Business Entity and estimated by CP.
- Calculation of coal resources and reserves by the Business Entity has not been entirely carried out by CP and has not entirely referred to SNI 13-5015 2019. Calculation of resources and reserves that have not been verified by CP is in accordance with SNI 13-5015-2015
- Of the total 1,517 points that were successfully inputted, 184 points have been verified by CMCGR of Geological Agency, 57 points have been verified by the CP of the PKP2B Companies, 35 points have been verified by the CP of the PMA IUPs Companies and 216 points have been verified by the CP of the PMDN IUPs Companies.
- Coal resources are inclusive (reserves part of the resources)

1. Coal quality is based on the calorific value of coal on an air dried basis (Presidential decree No. 13/2000, updated by PP No. 45/2003)

a. Low calorie	< 5100 cal/g
b. Medium calorie	5100 - 6100 cal/g
c. High calorie	6100 - 7100 cal/g
d. Very high calorie	> 7100 cal/g

2. Classification of resources

a. Inventory	Result of preliminary survey
b. Inferred	Result of prospecting survey
c. Indicated	Result of preliminary exploration
d. Measured	Result of detail exploration

3. Classification of reserves

a. Probable
b. Proven

Table 7. Indonesia's Coal Resources and Reserves based on Quality by Province in 2021

PROVINCE	EXPLORATION TARGETS	TOTAL INVENTORY	RESOURCES (MILLION TONNES)					RESERVES (MILLION TONNES)			
			INFERRED	INDICATED	MEASURED	TOTAL	VERIFIED	PROBABLE	PROVEN	TOTAL	VERIFIED
1	2	3	4	5	6	7	8	9	10	11	12
Banten	**5.47**	**52.18**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Low Calorie	5.47	5.22	-	-	-	-	-	-	-	-	-
High Calorie	-	46.96	-	-	-	-	-	-	-	-	-
Central Java	**-**	**0.82**	**-**	**-**	**.**	**-**	**-**	**-**	**-**	**-**	**-**
Low Calorie	-	0.82	-	-	-	-	-	-	-	-	-
East Java	**-**	**0.08**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Low Calorie	-	0.08	-	-	-	-	-	-	-	-	-
Aceh	**1.16**	**87.83**	**275.46**	**421.87**	**325.59**	**1.022.93**	**803.79**	**337.85**	**201.49**	**539.34**	**428.65**
Low Calorie	1.16	20.92	152.81	164.54	117.75	435.11	435.11	94.38	94.56	188.94	188.94
Medium Calorie	-	66.91	122.65	2573.3	207.84	587.82	368.69	243.47	106.93	350.40	239.70
Riau	**3.86**	**322.13**	**142.10**	**527.03**	**301.23**	**970.36**	**856.52**	**202.25**	**193.11**	**395.36**	**359.12**
Low Calorie	-	35.06	95.54	415.07	243.55	789.22	710.76	179.93	174.31	354.24	336.34
Medium Calorie	3.86	286.28	41.59	107.95	54.50	494.17	142.66	21.64	15.94	37.58	21.52
High Calorie	-	0.79	4.97	4.02	3.18	12.96	3.10	0.69	2.86	3.54	1.27
West Sumatra	**1.19**	**156.38**	**79.75**	**72.55**	**105.20**	**257.51**	**39.87**	**35.08**	**28.95**	**64.03**	**23.63**
Medium Calorie	1.19	148.75	64.42	45.02	35.67	145.12	25.44	17.75	2.78	20.53	4.54
High Calorie		6.33	13.09	17.59	59.33	90.00	14.43	13.95	24.75	38.71	19.08
Very High Calorie		1.30	2.24	9.94	10.21			3.37	1.42		
Jambi	**140.31**	**1,517.60**	**1,402.50**	**1,183.88**	**1,987.82**	**4,574.21**	**3,829.45**	**735.28**	**1,096.32**	**1,831.60**	**1,658.59**
Low Calorie	51.81	456.16	494.62	423.51	509.52	1,935.61	1,113.84	304.69	284.26	588.95	474.97
Medium Calorie	88.50	1,051.34	901.41	756.34	1,475.04	4,272.63	2,710.65	426.88	810.88	1,237.76	1,182.54
High Calorie	-	10.10	6.48	4.04	3.26	23.87	4.96	3.71	1.18	4.89	1.08
Bengkulu	**36.86**	**208.61**	**140.27**	**113.69**	**174.61**	**428.56**	**363.58**	**49.69**	**75.01**	**124.69**	**103.30**
Low Calorie	-	51.80	53.08	41.41	66.48	160.96	107.34	18.91	26.23	45.14	35.28
Medium Calorie	-	14.31	82.21	63.30	73.12	218.62	210.62	30.77	42.61	73.38	64.04
High Calorie	36.86	142.51	4.98	8.98	35.02	48.98	45.62	-	6.18	6.18	3.98
South Sumatra	**4,885.39**	**9,262.58**	**11,827.36**	**8,830.51**	**8,079.09**	**28,736.96**	**24,021.01**	**5,200.87**	**4,232.03**	**9,432.90**	**9,291.17**
Low Calorie	334.95	2,513.94	8,260.13	5,348.65	3,576.33	20,034.00	13,773.42	3,817.08	2,063.74	5,880.82	5,803.46
Medium Calorie	4,513.26	6,748.64	3,384.92	3,313.12	4,345.10	22,305.05	9,738.90	1,232.00	2,115.85	3,347.85	3,283.48
High Calorie	37.18	-	181.24	167.12	156.85	542.39	505.21	149.59	52.12	201.70	201.70
Very High Calorie	-	-	1.06	1.62	0.81	3.49	3.488	2.20	0.33	2.53	2.53
North Sumatra	**-**	**14.62**	**10.24**	**8.48**	**7.55**	**26.26**	**-**	**-**	**7.12**	**7.12**	**-**
Low Calorie	-	7.62	-	-	-	-	-	-	-	-	-
Medium Calorie	-	7.00	10.24	8.48	7.55	26.26	-	-	7.12	7.12	-
Lampung	**-**	**106.95**	**149.60**	**134.20**	**29.60**	**313.40**	**-**	**109.80**	**-**	**109.80**	
Low Calorie	-	-	149.60	134.20	29.60	313.40	-	109.80	-	109.80	-
Medium Calorie	-	14.00	-	-	-	-	-	-	-	-	-

PROVINCE	EXPLORATION TARGETS	TOTAL INVENTORY	RESOURCES (MILLION TONNES)					RESERVES (MILLION TONNES)			
			INFERRED	INDICATED	MEASURED	TOTAL	VERIFIED	PROBABLE	PROVEN	TOTAL	VERIFIED
High Calorie	-	92.95	-	-	-	-	-	-	-	-	-
West Kalimantan	**2.26**	**386.24**	**11.07**	**53.03**	**14.57**	**78.66**	**1.46**	**0.43**	**-**	**0.43**	**0.43**
Low Calorie	0.08	-	-	-	-	-	-	-	-	-	-
Medium Calorie	2.06	-	-	-	.-	-	-	-	-	-	-
High Calorie	0.12	382.44	11.07	53.03	14.57	78.66	1.46	0.43	-	-	0.43
Very High Calorie	-	3.80	-	-	-	-	-	-	-	-	-
Central Kalimantan	**22.54**	**1,445.77**	**4,999.99**	**3,517.60**	**3,474.01**	**11,991.60**	**8,418.80**	**1,639.16**	**1,672.36**	**3,311.52**	**1,995.11**
Low Calorie	-	117.12	581.80	397.19	600.98	1,579.97	734.45	322.64	317.67	640.32	282.32
Medium Calorie	-	441.97	2,299.74	1,623.90	1,597.43	5,521.07	3,761.55	724.25	758.64	1,482.89	901.04
High Calorie	22.54	388.94	918.92	768.47	508.14	2,195.54	1,528.65	374.71	232.66	607.37	307.10
Very High Calorie	-	497.75	1,199.53	728.04	767.46	2,695.02	2,394.15	217.55	363.39	580.95	504.64
South Kalimantan	**7.83**	**643.90**	**3,615.56**	**3,578.78**	**6,310.57**	**13,504.90**	**12,046.99**	**1,650.32**	**2,518.48**	**4,168.80**	**3,679.61**
Low Calorie	-	177.51	798.13	809.67	752.60	2,360.41	2,240.39	265.20	495.57	760.77	699.50
Medium Calorie	-	288.90	1,959.16	2,229.57	4,870.19	9,058.93	8,024.61	1,136.69	1,778.80	2,915.49	2,532.45
High Calorie	7.83	177.49	833.92	524.93	672.41	2,031.26	1,732.74	245.34	238.07	483.41	438.95
Very High Calorie	-	-	24.34	14.60	15.36	54.30	49.25	3.09	6.04	9.13	8.71
East Kalimantan	**872.99**	**9,741.05**	**10,716.07**	**14,907.98**	**19,309.23**	**44,933.27**	**40,024.10**	**7,592.51**	**7,092.48**	**14,684.99**	**13,614.09**
Low Calorie	3.81	7,843.91	3,930.33	3,769.68	3,767.40	11,467.41	10,196.03	1,839.11	1,449.62	3,288.72	2,875.68
Medium Calorie	301.24	1,499.81	5,403.17	9,576.01	13,804.82	28,784.00	26,196.20	5,440.36	5,345.14	10,785.50	10,245.53
High Calorie	567.94	389.73	1,215.42	1,438.73	1,662.64	4,316.79	3,291.43	292.92	272.66	565.58	450.74
Very High Calorie		7.61	167.15	123.55	74.37	365.07	340.45	20.12	25.07	45.19	42.14
North Kalimantan	**25.79**	**302.73**	**971.75**	**996.25**	**1,246.44**	**3,214.44**	**1,183.61**	**818.73**	**779.17**	**1,597.89**	**531.57**
Low Calorie	6.70	25.50	445.86	475.57	738.11	1,659.55	391.87	572.10	495.26	1,067.36	173.32
Medium Calorie	19.09	76.94	347.52	371.43	396.59	1,115.54	674.58	189.77	229.68	419.45	329.48
High Calorie	-	188.90	178.37	148.37	110.92	437.66	117.16	56.86	54.23	111.08	28.78
Very High Calorie	-	11.39	-	0.87	0.82	1.69	-	-	-	-	
South Sulawesi	**13.79**	**25.74**	**3.02**	**1.84**	**0.72**	**5.57**	**5.57**	**1.16**	**0.61**	1.77	**1.77**
Low Calorie	4.16	-	-	-	-	-	-	-	-	-	
Medium Calorie	4.47	11.84	3.02	1.84	0.72	5.57	5.57	1.16	0.61	1.77	1.77
High Calorie	5.16	13.90	-	-	-	-	-	-	-	-	
West Sulawesi	**11.46**	**16.78**	**5.42**	**2.71**	**3.15**	**11.28**	**11.28**	**1.80**	**6.79**	**8.59**	**8.59**
Low Calorie	8.13	-	-	-	-	-	-	-	-	-	-
Medium Calorie	-	15.13	5.42	2.71	1.35	9.48	9.48	-	5.53	5.53	5.53
High Calorie	3.34	1.65	-	-	1.80	1.80	1.80	1.80	1.26	3.06	3.06
Central Sulawesi	**0.52**	**1.98**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Low Calorie	0.52	1.98	-	-	-	-	-	-	-	-	-
Southeast Sulawesi	**0.64**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Low Calorie	0.64	-	-	-	-	-	-	-	-	-	-
North Maluku	**8.22**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

PROVINCE	EXPLORATION TARGETS	TOTAL INVENTORY	RESOURCES (MILLION TONNES)					RESERVES (MILLION TONNES)			
			INFERRED	INDICATED	MEASURED	TOTAL	VERIFIED	PROBABLE	PROVEN	TOTAL	VERIFIED
Low Calorie	4.74	-	-	-	-	-	-	-	-	-	-
Medium Calorie	3.48	-	-	-	-	-	-	-	-	-	-
West Papua	**93.66**	**40.51**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Medium Calorie	89.63	9.60	-	-	-	-	-	-	-	-	-
High Calorie	4.03	5.38	-	-	-	-	-	-	-	-	-
Very High Calorie	-	25.53	-	-	-	-	-	-	-	-	-
Papua	**7.20**	**31.36**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Low Calorie	7.20	-	-	-	-	-	-	-	-	-	-
Medium Calorie	-	31.36	-	-	-	-	-	-	-	-	-
TOTAL	**6,141.12**	**24,365.84**	**34,350.15**	**34,350.38**	**41,369.38**	**110,069.91**	**91,606.04**	**18,374.92**	**17,903.93**	**36,278.85**	**31,695.63**

Notes :

- Data sources represent 1,567 locations from 151 of CMCGR investigation activities, 67 PKP2B (100%); 72 PMA IUPs (100%); 943 PMDN IUPs registered (90%) and 334 Unregistered IUPs. Resource data still involves Unregistered IUPs data, while reserves data comes from Registered IUPs. There is no overlapping area between Registered and Unregistered IUPs.
- Verified resources are coal resources resulting from exploration activities of CMCGR and coal resources reported by the Business Entity and estimated by competent person (CP). Verified reserves are coal reserves reported by the Business Entity and have been estimated by CP.
- In 2021 the reporting of data refers to SNI 5015:2019. Therefore, data of CMCGR investigations is included in the Coal Exploration and Inventory Target column because it has not considered technical and economic factors.
- Of the total 1,567 points that have been successfully inputted, 151 points verified by CMCGR, 65 points verified by the CP of PKP2B Company, 49 points verified by the CP of PMA IUPs Company and 598 points verified by the CP of PMDN IUPs Company.
- Several factors affecting the decline of resources and reserves in 2021:
  1. The increase the use of CP in Business Entities
  2. Some of the resources status moved to Inventory and Exploration Targets

Table 8. Indonesia's Coal Resources and Reserves by Province in 2021

NO	PROVINCE	EXPLORATION TARGETS	TOTAL INVENTORY	RESOURCES (MILLION TONNES)					RESERVES (MILLION TONNES)			
				INFERRED	INDICATED	MEASURED	TOTAL	TOTAL (VERIFIED)	PROBABLE	PROVEN	TOTAL	TOTAL (VERIFIED)
1	Banten	5.47	52.18					-	-	-	-	-
2	Central Java		0.82	-	-	-	-	-	-	-	-	-
3	East Java		0.08	-	-	-	-	-	-	-	-	-
4	Aceh	1,155	87.83	275.46	421.87	325.59	1,022.925	803.794	337.85	201.49	539.342	428.646
5	North Sumatra		14.62	10.24	8.48	7.55	26.260	-	-	7.12	7.115	-
6	Riau	3.86	322.13	142.10	527.03	301.23	970.360	856.522	202.25	193.11	395.359	359.124
7	West Sumatra	1.19	156.38	79.75	72.55	105.20	257.510	39.867	35.08	28.95	64.031	23.627
8	Jambi	140.31	1,517.60	1,402.50	1,183.88	1,987.82	4,574.209	3.829.45	735.28	1,096.32	1,831.599	1,658.592
9	Bengkulu	36.86	208.61	140.27	113.69	174.61	428.562	363.579	49.686	75.01	124.694	103.300
10	South Sumatra	4,885.39	9,262.58	11,827.36	8,830.51	8,079.09	28,736.962	24,021.015	5,200.87	4,232.03	9,432.902	9,291.166
11	Lampung		106.95	149.60	134.20	29.60	313.400	-	109.800	-	109.800	-
12	West Kalimantan	2.26	386.24	11.07	53.03	14.57	78.662	1.460	0.430	-	0.430	0.430
13	Central Kalimantan	22.54	1,445.77	4,999.99	3,517.60	3,474.01	11,991.600	8,418.798	1,639.16	1.672.36	3,311.524	1,995.107
14	South Kalimantan	7.83	643.90	3,615.56	3,578.78	6,310.57	13,504.899	12,046.986	1,650.32	2,518.48	4,168.802	3,679.610
15	East Kalimantan	872.99	9,741.05	10,716.07	14,907.98	19,309.23	44,933.273	40,024.100	7,592.51	7,092.48	14,684.992	13,614.091
16	North Kalimantan	25.79	302.73	971.75	996.25	1,246.44	3,214.439	1,183.613	818.73	779.17	1,597.895	531.574
17	South Sulawesi	13.79	25.74	3.02	1.84	0.72	5.574	5.574	1.16	0.61	1.769	1.769
18	West Sulawesi	11.46	16.78	5.42	2.71	3.15	11.279	11.279	1.80	6.79	8.591	8.591
19	Central Sulawesi	0.52	1.98	-	-	-	-	-	-	-	-	-
20	Southeast Sulawesi	0.64		-	-	-	-	-	-	-	-	-
21	North Maluku	8.22		-	-	-	-	-	-	-	-	-
22	West Papua	93.66	40.51		-	-	-	-	-	-	-	-
23	Papua	7.20	31.36		-	-	-	-	-	-	-	
TOTAL INDONESIA		**6,141.12**	**24,365.84**	**34,350.15**	**34,350.38**	**41,369.38**	**110,069.91**	**91,606.04**	**18,374.92**	**17,903.92**	**36,278.85**	**31,695.63**

Table 9. Verified Coal Resources and Reserves in 2021

NO	PROVINCE	RESOURCES (MILLION TONNES)				RESERVES (MILLION TONNES)		
		INFERRED	INDICATED	MEASURED	TOTAL	PROBABLE	RPOVEN	TOTAL
1	Aceh	275.42	399.13	129.24	803.79	322.57	106.07	428.65
2	Bengkulu	108.00	94.98	160.60	363.58	45.90	57.40	103.30
3	Jambi	1,057.05	1,018.64	1,753.76	3,829.45	625.47	1,033.12	1,658.59
4	Riau	109.42	481.73	265.38	856.52	184.66	174.47	359.12
5	West Sumatra	14.56	13.21	12.09	39.87	6.20	17.42	23.63
6	South Sumatra	7,890.95	8,299.98	7,830.09	24,021.01	5,090.99	4,200.17	9,291.17
7	West Kalimantan	0.98	0.48	-	1.46	0.43	-	0.43
8	South Kalimantan	3,138.80	3,047.87	5,860.32	12,046.99	1,344.82	2,334.79	3,679.61
9	Central Kalimantan	3,525.03	2,593.39	2,300.38	8,418.80	883.50	1,111.61	1,995.11
10	East Kalimantan	8,763.33	13,395.26	17,865.51	40,024.10	7,184.08	6,430.02	13,614.09
11	North Kalimantan	412.75	420.80	350.06	1,183.61	284.69	246.89	531.57
12	West Sulawesi	5.42	2.71	3.15	11.28	1.80	6.79	8.59
13	South Sulawesi	3.02	1.84	0.72	5.57	1.16	0.61	1.77
TOTAL INDONESIA		**25,304.73**	**29,770.01**	**36,531.30**	**91,606.04**	**15,976.28**	**15,719.35**	**31,695.63**

Notes :

- Data sources represent 1,567 locations from 151 of CMCGR investigation activities, 67 PKP2B (100%); 72 PMA IUPs (100%); 943 PMDN IUPs registered (90%) and 334 Unregistered IUPs. Resource data still involves Unregistered IUPs data, while reserves data comes from Registered IUPs. There is no overlapping area between Registered and Unregistered IUPs.
- Verified resources are coal resources resulting from exploration activities of CMCGR and coal resources reported by the Business Entity and estimated by competent person (CP). Verified reserves are coal reserves reported by the Business Entity and have been estimated by CP
- In 2021 the reporting of data on National resources and reserves refers to SNI 5015:2019. Therefore CMCGR investigations is included in the Coal Exploration and Inventory Target column because it has not considered technical and economic factors.
- Of the total 1,567 points that have been successfully inputted, 151 points verified by CMCGR, 65 points verified by the CP of PKP2B Company, 49 points verified by the CP of PMA IUPs Company, and 598 points verified by the CP of PMDN IUPs Company.
- Several factors affecting the decline of resources and reserves in 2021:
  1) The Increase of CP in Business Entities
  2) Some of the resources status moved to Inventory and Exploration Targets

Characterization, evaluation and verification of high calorie coal (metallurgical coal) has been carried out since 2018. Until 2021, an evaluation has been carried out at 50 business entity locations with 105 samples of coal tested at CMCGR. These locations are spread over several basins and provinces including the Ombilin Basin in West Sumatra Province, Bengkulu Basin in Bengkulu Province, South Sumatra Basin in South Sumatra Province, Tarakan Basin in North Kalimantan, Kutai Basin in East Kalimantan, Pasir Basin in East Kalimantan, Asem-Asem Basin in South Kalimantan, Barito Basin in the Provinces of Central and South Kalimantan, and Upper Kutai Basin in Central Kalimantan.

From 50 indicated locations evaluated, 26 locations were confirmed to have metallurgical coal potential. Total 26 confirmed locations, 24 locations are business entities whose licenses are registered and 2 locations are not registered. The total potential of Indonesia's metallurgical coal resources is 2.74 billion tonnes and reserves of 0.43 billion tonnes from registered locations. and a total inventory of 0.48 billion tonnes from unlisted locations. Details of quantities and records of potential metallurgical coal is in Table 10.

	2017	2018	2019	2020	2021
Coal Resources	124,660.08	151,399.40	149,009.59	143,730.90	110,069.91
Coal Reserves	26,214.30	39,890.95	37,604.66	38,805.48	36,278.85
Amount of Data	1,234.00	1,429.00	1,463.00	1,517.00	1,567.00

Figure 25. Statistics on Coal Resources and Reserves for 2017-2021

Table 10. Indonesian Metallurgical Coal in 2021

NO	ISLAND	PROVINCE	TOTAL INVENTORY (Million Tonnes)	RESOURCES (Million Tonnes)				RESERVES (Million Tonnes)		
				INFERRED	INDICATED	MEASURED	TOTAL	PROBABLE	PROVEN	TOTAL
1	Kalimantan	Central Kalimantan	461.20	1,133.90	721.98	584.35	2,440.23	182.18	220.18	402.36
2		East Kalimantan	-	134.71	85.51	28.56	248.78	9.56	4.86	14.43
3	Sumatra	West Sumatra	-	9.40	8.46	3.01	20.87	7.23	6.51	13.74
4		Bengkulu	23.69	1.21	5.44	28.26	34.91	-	3.38	3.38
Total INDONESIA			**484.89**	**1,279.23**	**821.39**	**644.18**	**2,744.79**	**198.97**	**234.93**	**433.90**

Notes:

- Comes from 26 locations that have characteristics data and can be classified as metallurgical coal including TM, ASH, TS, VM, CV, CSN, GKT, Dilatation, Fluidity, Phosphorus, CSR, CRI, etc.
- The 26 locations consist of 24 registered business entities and 2 unregistered business entities.
- Metallurgical coal here is coal that corresponds to the characteristics of the market (for example index platts) that is Hard Coking Coal. Semi Hard Coking Coal. Semi Soft Coking Coal and Low Volatile PCI.
- Some locations still need to be confirm because in one location there can be metallurgical coal and thermal coal.
- These number can still increase with the increasing of the confirmed locations in the future.

Subsurface Coal (100-500 m)

Subsurface coal resources are coal resources located at 100 – 500 meters below the surface. Data on subsurface coal resources comes from internal data, while data on subsurface coal reserves is obtained from PMA IUPs and PMDN IUPs. Subsurface coal resources in December 2021 are 488.94 million tonnes (Table 11) with total reserves of 173.25 million tonnes.

Subsurface coal is mined using the underground coal mine method, it can also be used for the development of Underground Coal Gasification (UCG) or for the development of Coalbed Methane (CBM).

Peat Resources

Indonesia peat resources until 2021 amounted to 13.52 billion tonnes of dry peat with calorific value of 5,950 cal/g (adb) (Table 12). The peat resources come from 69 locations; 30 locations on Sumatra Island, 38 locations on Kalimantan Island, and one location on Sulawesi Island. During the last three years (2018-2021) peat resources have increased (Figure 26).

Table 11. Indonesia's subsurface coal resources in 2021

NO	ISLAND	PROVINCE	TOTAL INVENTORY	RESOURCES (Million Tonnes)				RESERVES (Million Tonnes)		
				INFERRED	INDICATED	MEASURED	TOTAL	PROBABLE	PROVEN	TOTAL
1	Sumatra	West Sumatra	7.99	120.370	61.406	95.859	277.635	37.970	63.26	101.233
		Jambi	970.60							
		South Sumatra	21.195.92							
2	Kalimantan	South Kalimantan	1.019.16	19.548	33.208	94.149	146.905	12.477	31.29	43.764
		East Kalimantan	17.527.29	0.004	36.117	28.280	64.401	11.387	16.87	28.252
		Central Kalimantan	88.45							
		North Kalimantan	2.210.33							
TOTAL INDONESIA			**43.019.74**	**139.92**	**130.73**	**218.29**	**488.94**	**61.83**	**111.42**	**173.25**

Notes:

- Subsurface resources consist of 16 points. Consist of 13 points from exploration activities for PMDN IUPs and 3 Points from PMA IUPs.
- In 2021 the reporting of subsurface coal resource data refers to SNI 5015:2019. Therefore, for the data from the Geological Agency investigation activities are included in the Inventory column because they have not considered technical and economic factors.
- Some of the factors influencing the reduction of resources in 2021:
  1. Use of CP in Business Entities
  2. Some of tha resources status moved to Inventory

Table 12. Peat Quality and Resources by Province in 2021

NO	PROVINCE	CALORIFIC VALUE (cal/g) adb	AREA (Ha)	VOLUME (Million m^3)	RESOURCES (Million Tonnes)
1	Aceh	1545 - 5035	57,700	2,260.00	239.82
2	North Sumatra	4455 - 5540	27,041	30,966.00	166.76
3	Riau	4395 - 5950	1,311,156	50,050.84	5,242.69
4	Jambi	1405 - 5220	260,407	13,393.00	1,648.68
5	South Sumatra	3018 - 5540	343,638	14,351.10	1,271.53
Sumatra			**1,999,941.07**	**111,020.94**	**8,569.47**
6	West Kalimantan	3210 - 5670	1,016,147	9,009.89	1,129.79
7	Central Kalimantan	3395 - 5330	654,520	26,154.32	3,557.58
8	South Kalimantan	2362 - 5320	250,963	1,267.83	223.07
9	East Kalimantan	3400 - 5480	16,579	442.37	42.48
Kalimantan			**1,938,209**	**36,874.41**	**4,952.91**
10	South Sulawesi	4680 - 5220	1,250	9.50	1.25
Sulawesi			**1,250**	**9.50**	**1.25**
TOTAL Indonesia			**3,939,399.69**	**147,904.85**	**13,523.64**

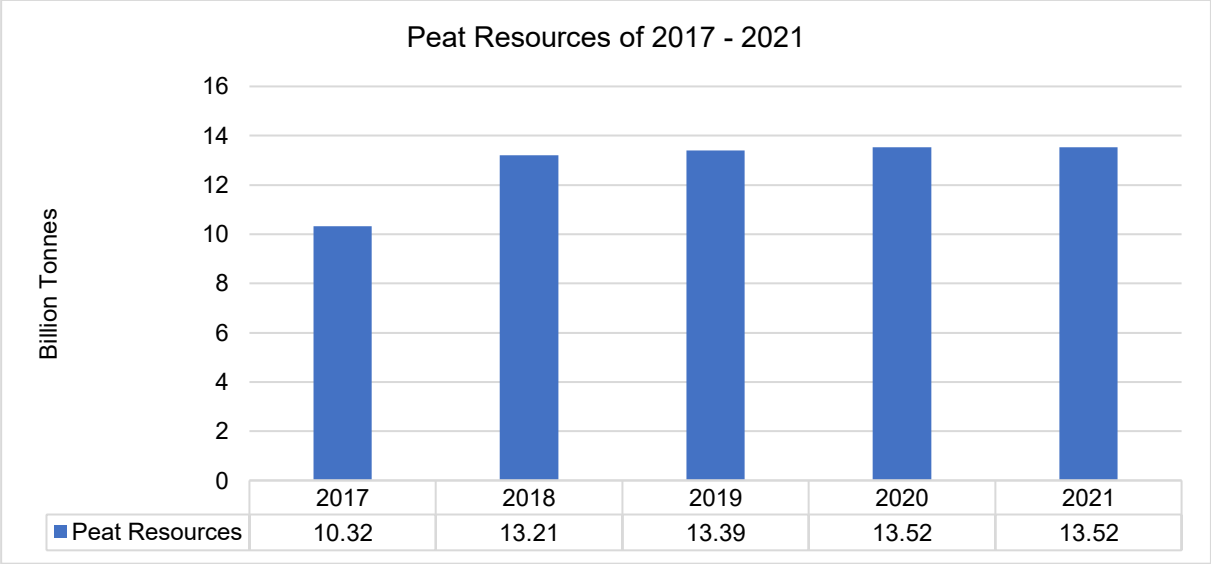


Figure 26. Indonesia peat resources in 2017 – 2021

Coalbed Methane (CBM) Resources

Based on data from SKK Migas, the number of CBM Concession Areas (CAs) active until 2021 is 12 areas consisting of 5 CBM CAs in the South Sumatra Basin, 1 CBM Cas in the Ombilin Basin, 3 CBM CAs in the Kutai Basin, and 3 CBM CAs in the Barito Basin. Resource data from inactive CBM CAs are still included in the CBM database with the consideration that even though the company is no longer active, the potential for CBM in the CAs still exists.

The amount of CBM resources in 2021 has decreased by 2.4 Tcf compared to 2020 (Figure 27). The decrease in the number of CBM resources in 2021 comes from Sangata II Region. Based on data from SKK Migas, throughout 2021 there were no exploration activities from the KKKS CBM CAs. Therefore, technically there is no data update. Several wells that were originally scheduled to be explored in 2021 have been delayed due to technical and non-technical matters (pandemic).

Table 13. CBM resources from Geological Agency exploration

Basin	Location	Area of Potential (km^2)	Gas Content (scf/tonnes)			Gas Resources (Scf)		
			Min	Avrg	Max	Min	Avrg	Max
South Sumatra	Tanjung Enim (2009)	20,52	1.71	24.47	47.23	1,485,731,064	2,729,535,501	3,896,109,749
	Nibung (2010)	3	2.26	26.48	50.7	-	-	39,996,473,593
	Muara Lawai (2012)	4	0.69	-	56.25	-	-	1,031,504,260
	Bayung Lencir (2012)	23	6.08	-	12.40	-	-	2,159,152,524
	Muara Kilis (2013)	23.86	6,77	-	13.83	-	-	976,743,936
	Srijaya Makmur (2014)	3	4.74	17.84	30.93	-	-	6,456,017,796
	Mangunjaya (2017)	49	12.99	23.16	33.33	9,497,158,189	13,277,514,948	19,257,182,327
Total South Sumatra								**73,773,184,185**
Ombilin	Air Dingin (2009)	1	197.03	327.14	457.25	5,023,911,902	7,073,640,271	8,985,723,639
	Bukit Sibantar (2011)	5	3.15	55.33	107.50	314,201,709	1,602,830,632	1,848,090,939
Total Ombilin								**10,833,814,578**
Berau	Tanjung Redep (2013)	55	0.43	11.27	22.11	1,381,018,377	2,050,348,689	2,957,836,398
Total Kutai								**2,957,836,398**
Barito	Jangkang (2010)	4	6.80	-	12.80	-	-	207,084,800
	Balangan (2012)	1	13.98	44.04	72.21	436,699,320	1.375.783.342	2,255,655,073
	Paser (2014)	54	2.28	42.60	82.92	-	-	15,007,955,791
	Upau (2015)	4	6.85	29.95	53.04	-	-	47,170,560,996
	Tamiang Layang (2015)	8	24.82	36.56	48.60	742,811,429	1,094,225,281	1,454,497,802
	Ampah (2016)	90	0.34	3.54	6.74	156,612,075	554,113,412	1,008,277,484
Total Barito								**67,104,031,946**
TOTAL								**154,668,867,106**

Table 14. CBM Resources from CBM CAs of Sumatra Region

Basin	Location	Institution	Coal Rank	Coal Thickness (m)	Coal Depth (m)	Gas Content (scf/tonnes)	Gas Resources (Tcf)
South Sumatra	Belida *)	Private	Sub-Bituminus	≥ 23	300 - 450	10 - 60	0.520
	Muara Enim *)	Private	Sub-Bituminus C	44	565 - 724	104 - 141	0.098
	Muara Enim II *)	Private	Sub-Bituminus C	43	400 - 700	27 - 36	1.400
	Tanjung Enim *)	Private	Sub-Bituminus C	46	40 - 528	82 - 115	0.900
	Muralim *)	Private	Lignit - Sub-Bituminus C	30	430 - 630	70 - 185	1.980
	Lematang	Private	Sub-Bituminus	1 - 20	300 - 450	10 - 60	0.210
	Ogan Komering	Private	Sub-Bituminus	≥ 18	420 - 680	40 - 80	1.390
	Ogan Komering II	Private	Sub-Bituminus	≥ 17	210 - 350	0 - 40	0.070
	Air Komering	Private	Sub-Bituminus	5.50 - 6.50	400 - 550	18 - 25	0.191
	Muara Enim I	Private	Suban: Sub-Bituminus C	11.08	794	150.53	0.684
		Private	Mangus: Lignit - Sub-Bituminus C	17.72	741	113.11	
		Private	Babat: Lignit - Gambut	18.97	395.50	37.08	
		Private	Lematang: Gambut	16.24	491	33.18	
	Muara Enim III	Private	Suban: Sub-Bituminus B	4.66	722.50	68.50	0.180
		Private	Mangus: Sub-Bituminus C	1.75	699	80.80	0.270
		Private	Babat: Lignit	26.64	476.50	73.05	0.280
		Private	Lematang: Lignit	15.21	409.50	64.45	0.190
	Air Benakat I	Private	-	-	-	-	0.238
	Air Benakat II	Private	-	-	-	-	0.295
	Air Benakat III	Private	Suban: Lignit	8.73	514.30	50.67	0.130
		Private	Mangus: Lignit	4.46	491.70	95.38	0.170
		Private	Babat: Lignit	13.45	345	48.62	0.120
		Private	Lematang: Lignit	5.65	317	21.36	0.090
	Suban I	Private	-	-	-	-	0.162
	Suban II	Private	Suban: -	-	-		-
		Private	Mangus: Lignit - Sub-Bituminus	6	635	80	0.050
		Private	Babat: Gambut	8	339	16.35	0.070
		Private	Lematang: Lignit	8	309	16.60	0.080
	Sekayu	Private	Lignit - Sub-Bituminus	9 - 25	700 - 1000	50 - 200	1.700
	Sekayu II	Private	Lignit - Sub-Bituminus	1 - 30	300 - 850	20 - 130	0.560
	Batangasin	Private	-	-	-	-	-
	Tanjung Enim (2009)	Government	Sub-Bituminus	1.30 - 5	121 - 700	1.71 - 47.23	0.004
	Nibung (2010)	Government	Lignit - Sub-Bituminus	1 - 13.64	300 - 700	2.26 - 50.7	0.040
	Muara Lawai (2012)	Government	Sub-Bituminus	0.75 - 22	0 - 700	0.69 - 56.25	0.001
	Bayung Lencir (2012)	Government	Lignit	1 - 4.25	335 - 355.35	6.08 - 12.40	0.002
	Muara Kilis (2013)	Government	Lignit	1 - 1.70	300 - 700	6.77 - 13.83	0.001
	Srijaya Makmur (2014)	Government	Sub-Bituminus	1 - 1.90	300 - 700	4.74 - 30.93	0.006

Basin	Location	Institution	Coal Rank	Coal Thickness (m)	Coal Depth (m)	Gas Content (scf/tonnes)	Gas Resources (Tcf)
	Mangunjaya (2017)	Government	Lignit - Sub-Bituminus	1.50 - 9.80	271.10 - 700	12.99 - 33.33	0.019
Total South Sumatra							**12.101**
Central Sumatra	Rengat	Private	Lignit	5	160 - 490	18 - 33	1.800
	Indragiri Hulu	Private	-	-	-	-	5.500
Total Central Sumatra							**7.300**
Ombilin	Sijunjung *)	Swasta	*High Volatile* Bituminus A	1 - 20	800	231 - 290	1.250
	Air Dingin (2009)	Government	*High Volatile* Bituminus	1.75 - 13.56	369.75 - 380.24	197.03 - 457.25	0.009
	Bukit Sibantar (2011)	Government	*High Volatile* Bituminus	0.40 - 4.20	166 - 405	3.15 - 107.50	0.002
Total Ombilin							**1.261**

Notes : *)CBM working area active

Table 15. CBM Resources from CBM CAs of Kalimantan Region

Basin	Location	Institution	Coal Rank	Coal Thickness (m)	Coal Depth (m)	Gas Content (scf/tonnes)	Gas Resources (Tcf)
Kutai	Sangatta II *)	Private	Sub-Bituminus	0.70 - 6	500 - 900	34 - 205.50	9.500
	Bangkanai III *)	Private	Sub-Bituminus	5.5 - 20	300 - 1000	118.30 - 266.84	0.730
	Bangkanai IV *)	Private	Sub-Bituminus	5.5 - 20	300 - 1000	118.30 - 266.84	1.400
	West Sanga-Sanga I	Private	Sub-Bituminus	9	347 - 700	185.40	0.140
	Sanga-sanga	Private	Sub-Bituminus - Bituminus	1 - 5	750 - 1500	60 - 450	5.700
	Sangatta I	Private	Sub-Bituminus - Bituminus	0.50 - 7	150 - 850	5 - 520	0.500
	Kutai Barat	Private	Sub-Bituminus	9	433.6 - 700	315.50	1.190
	Kutai Timur	Private	Sub-Bituminus - Bituminus	0.50 - 3	150 - 850	50 - 200	0.630
	Kutai	Private	Sub-Bituminus - *High Volatile* Bituminus	1 - 15.40	300 - 1000	100 - 293.59	2.690
	Kutai II	Private	Sub-Bituminus - Bituminus	0.50 - 4	150 - 850	150 - 370	1.440
	Melak Mendung I	Private	Sub-Bituminus - Bituminus	0.50 - 3	150 - 850	50 - 200	0.410
	Melak Mendung III	Private	-	-	-	-	-
	Bangkanai I	Private	Sub-Bituminus	2.75 - 7.50	300 - 1000	110 - 112	0.260
	Bangkanai II	Private	Sub-Bituminus	2.75 - 7.50	300 - 1000	110 - 112	0.830
	Bentian Besar	Private	-	-	-	-	2.290
	Bontang Bengalon	Private	-	-	-	-	1.900
Total Kutai							**29.610**
Berau	Tanjung Redep (2013)	Government	Sub-Bituminus - High Volatile Bituminus	1 - 9.60	305.60 - 494.35	0.61 - 19.89	0.003
Total Berau							**0.003**
Basin	***Location***	***Institution***	***Coal Rank***	***Coal Thickness*** **(m)**	***Coal Depth*** **(m)**	***Gas Content*** **(scf/tonnes)**	**Gas Resources (Tcf)**
Barito	Barito *)	Private	Sub-Bituminus	4 - 21	250 - 750	60 - 140	1.100
	Kotabu *)	Private	Sub-Bituminus - *High Volatile* Bituminus B	7.33 - 18.30	440 - 850	181.95 - 231.94	0.628
	Kapuas III *)	Private	Sub-Bituminus	1 - 4.30	200 - 750	23 - 79	0.410
	Tanjung II	Private	C: Lignit	11.33	428.5	49.40	0.210
		Private	B: Lignit	7.03	299.75	60	-
		Private	A: Lignit	11.3	507	55.20	0.180
	Tanjung IV	Private	-	-	-	-	1.880
	Tabulako	Private	-	-	-	-	0.800
	Kuala Kapuas I	Private	-	-	-	-	2.700
	Kuala Kapuas II	Private	Sub-Bituminus	9	200 - 750	25.50	0.138
	Pulang Pisau	Private	Sub-Bituminus A - High Volatile Bituminus B	0.40 - 1.02	235 - 476	17 - 34	0.470
	Barito Tapin	Private	Sub-Bituminus	-	-	-	4.820
	Tanah Laut	Private	Sub-Bituminus	14.25 - 45.39	300 - 800	0.16 - 35	0.430
	Kapuas I	Private	Sub-Bituminus	1 - 4.30	200 - 750	23 - 79	0.440

Basin	Location	Institution	Coal Rank	Coal Thickness (m)	Coal Depth (m)	Gas Content (scf/tonnes)	Gas Resources (Tcf)
	Kapuas II	Private	Sub-Bituminus	1 - 4.30	200 - 750	23 - 79	0.700
	Barito Banjar I	Private	Sub-Bituminus	6 - 28	400 - 1200	100 - 229	1.500
	Barito Banjar II	Private	Sub-Bituminus	4 - 28	400 - 1100	90 - 165	1.300
	Belawa	Private	-	-	-	-	0.749
	Jangkang (2010)	Government	Lignit - Sub-Bituminus	1 - 2.58	192.9 - 700	6.80 - 12.80	0.000
	Balangan (2012)	Government	Sub-Bituminus	16.7	203.30 - 500	13.98 - 72.21	0.002
	Paser (2014)	Government	Sub-Bituminus - *High Volatile* Bituminus	0.30 - 1.28	0 - 700	2.28 - 82.92	0.015
	Upau (2015)	Government	Sub-Bituminus	1.11 - 37.25	12.30 - 470.45	6.85 - 53.04	0.047
	Tamiang Layang (2015)	Government	*High Volatile* Bituminus	2.72	190 - 700	24.82 - 48.60	0.001
	Ampah (2016)	Government	Lignit	1 - 1.50	0 - 700	0.34 - 6.74	0.001
Total Barito							**18.522**
TOTAL INDONESIA							**68.797**

Notes : *)CBM working area active

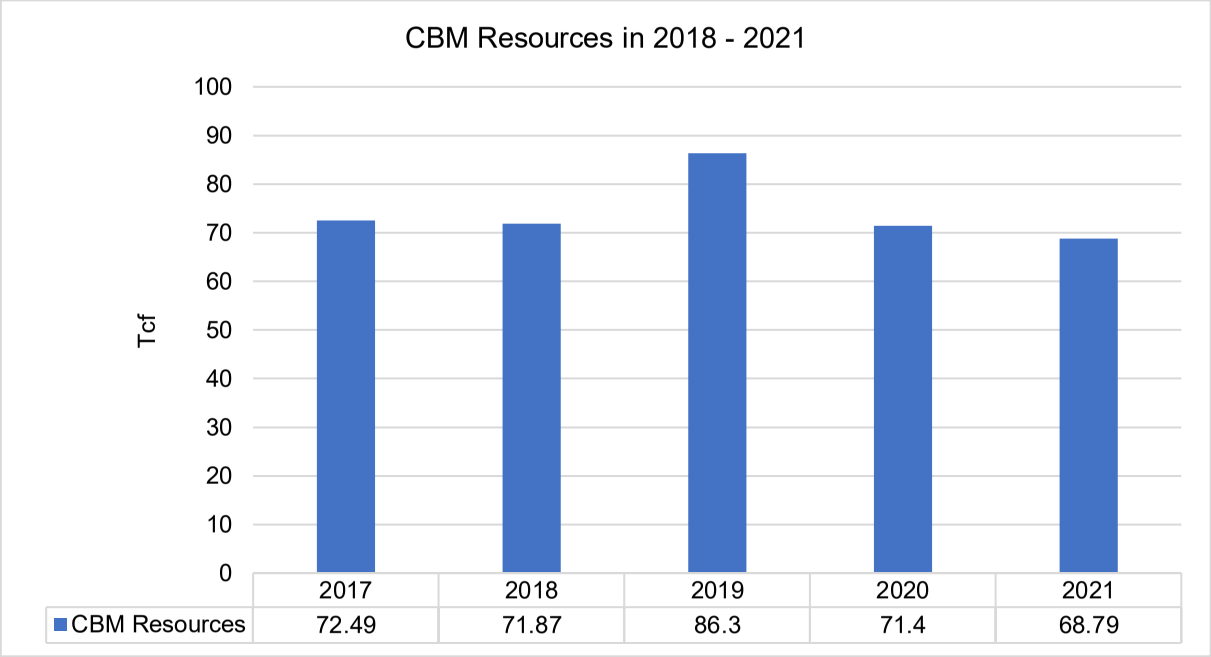


Figure 27. Indonesia CBM resources in 2018 – 2021

INDONESIA GEOTHERMAL RESOURCES AND RESERVES 2021

To realize national energy sovereignty, it is necessary to have the availability of energy resources to meet the needs of national development to support the national economy and prosper the community. The government has an energy policy direction that is oriented towards the continuity of energy supply and increasing accessibility and diversification of energy. In the national energy policy (KEN) of 2014, the Indonesian government has an energy mixture program, one of which is geothermal development roadmap of 7,200 MWe by 2025.

As one of the renewable energies, geothermal is environmentally friendly as well as plays a strategic role in the national energy mixture. Along with the increasing need for data and information on geothermal distribution in Indonesia, a good and sustainable database management system is needed. The Center for Mineral, Coal, and Geothermal Resources (CMCGR) as one of the government institutions has the task of managing and updating data on geothermal resources.

The updating data and balance of geothermal resources in 2021 is a form of activity to provide accurate data and information. The updated data and information have gone through a verification process for better quality and accuracy for compiling Indonesia's geothermal resource balance sheet.

The activities of updating data and balance of geothermal resources include collecting data and information mainly from reports on the results of detailed surveys of CMCGR and reports on exploration results of Business Entities that have gone through data processing in the form of evaluation, verification, and integration into the geothermal database system. The reference used in updating geothermal data and balance sheet 2021 is based on SNI 6009-2017 concerning Classification of Indonesia's Geothermal Resources and Reserves, SNI 6169:2018 concerning Geothermal Potential Estimation Method, and SNI 6482:2018 concerning Parameters in Geothermal Potential Estimation.

The results of the 2021 update show that Indonesia has 356 geothermal areas with total resources of around 23,356.9 MWe, speculative resources of 5,849 MWe, hypothetical resources of 3,376 MWe, possible reserves of 9,251 MWe, estimated reserves of 1,770 MWe, proven reserves of 3,110.9 MWe and an installed capacity of 2,276.9 Mwe. These data make Indonesia the second largest country that utilizes geothermal energy in the world (Table 16). Based on the results of the survey, both preliminary and detailed surveys show the distribution of geothermal prospect areas in Indonesia as follows; Sumatra Island (101 locations), Java Island (75 locations), Sulawesi Island (90 locations), Bali Island (6 locations), Kalimantan Island (14 locations), Nusa Tenggara Islands (34 locations), Maluku Islands (33 locations) and Papua Island (3 locations), as shown in Figure 28.

Based on geothermal prospect area, about 23% are still in the early preliminary survey, 20% are in the preliminary survey, 46% are in the detailed survey, 4% are in the exploration drilling stage or ready to be developed and 7% have been used as geothermal power plants (Figure 29 and Figure 30).

In 2021, CMCGR was in collaboration with the Directorate of Geothermal of the Directorate General of New Renewable Energy and Energy Conservation (DG-NREEC) and supported by the Center for Data and Information Technology on Energy and Mineral Resources (CDITEMR) to reconcile data on the balance of geothermal resources that involving geothermal developers. This was carried out as an effort to improve the quality of geothermal resource

balance sheet. The success of collecting more data on geothermal resources and reserves owned by geothermal developers in 2021 can provide a more accurate picture of the total wealth of geothermal resources in Indonesia.

The updated data in 2021 shows that one area has been deleted, while the total amount of geothermal resources in 2020 is 23,356.9 MWe with geothermal reserves of 14,131.9 MWe. The comparison of the value of resources and reserves in 2021 compared to 2020 had significant change. This is the result of a geoscience integration study at eight geothermal locations conducted by CMCGR in 2021, the results of the re-evaluation of previous reports, as well as the updating of reserves by business entities.

Table 16. Indonesia's Geothermal Resources Status in 2021

NO.	Island	Number of Locations	Resources (MWe)					Installed Capacity (MW)
			Speculative	Hyphothetical	Reserves			
					Possible	Probable	Proven	
1	Sumatra	101	2,167	1,567	3,624	976	1,126.4	880.6
2	Java	75	1,259	1,191	3,260	377	1,820	1,263.8
3	Bali	6	70	21	104	110	30	-
4	Nusa Tenggara	34	215	146	783	121	12.5	12.5
5	Kalimantan	14	151	18	6	-	-	-
6	Sulawesi	90	1,352	342	989	180	120	120.0
7	Maluku	33	560	91	485	6	2	-
8	Papua	3	75	-	-	-	-	-
TOTAL		356	5,849	3,376	9,251	1,770	3,110.9	2,276.9
					14,131.9			
			23,356.9					

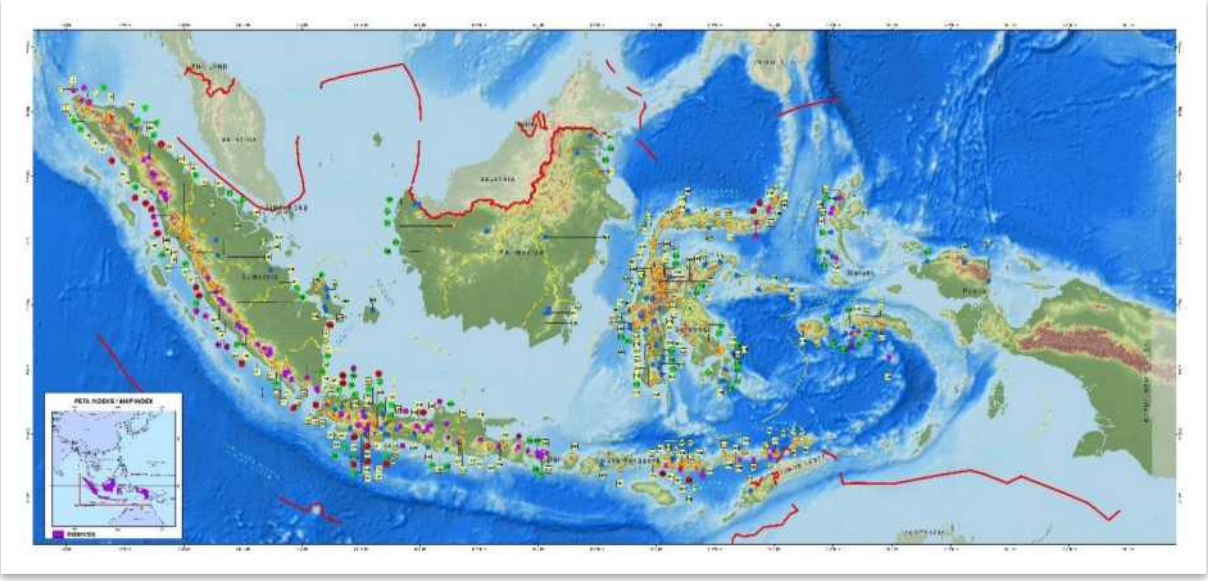


Figure 28. Indonesia's Geothermal Resources Distribution Map Status in 2021

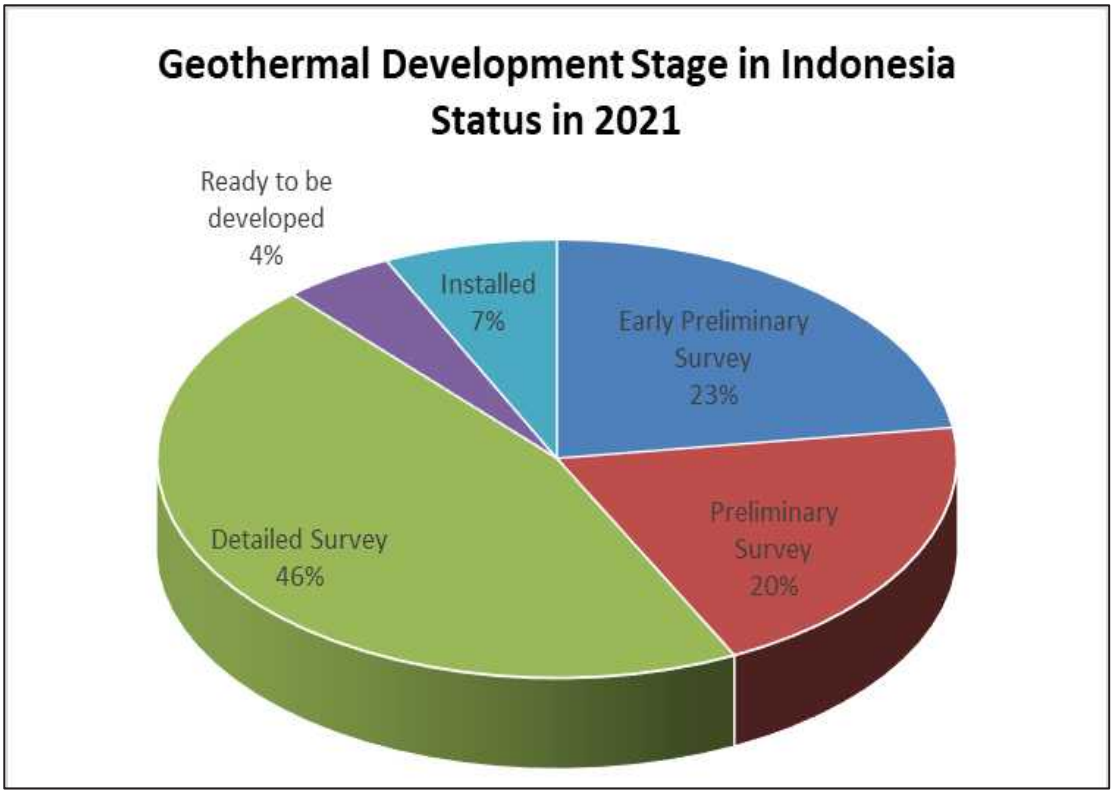


Figure 29. Geothermal Development Stage in Indonesia Status in 2021

Figure 30. Installed Capacity of Geothermal Power Plants in Indonesia (Status of December 2021)

Table 17. Status of Indonesia's Geothermal Resources for 2017-2021

Year	Number of Locations	Speculative (Mwe)	Hypothetical (Mwe)	Possible (Mwe)	Probable (Mwe)	Proven (Mwe)	Installed Capacity (Mwe)
2017	342	6,617	4,457	11,975	2,493.0	2,967.0	1,805.5
2018	349	6,407	3,852	10,099	2,016.0	3,012.5	1,948.5
2019	351	5,952	3,387	9,696	1,875.7	3,054.8	2,130.6
2020	357	5,981	3,363	9,547	1,770.0	3,104.5	2,130.7
2021	356	5,849	3,376	9,251	1,770.0	3,110.9	2,276.9

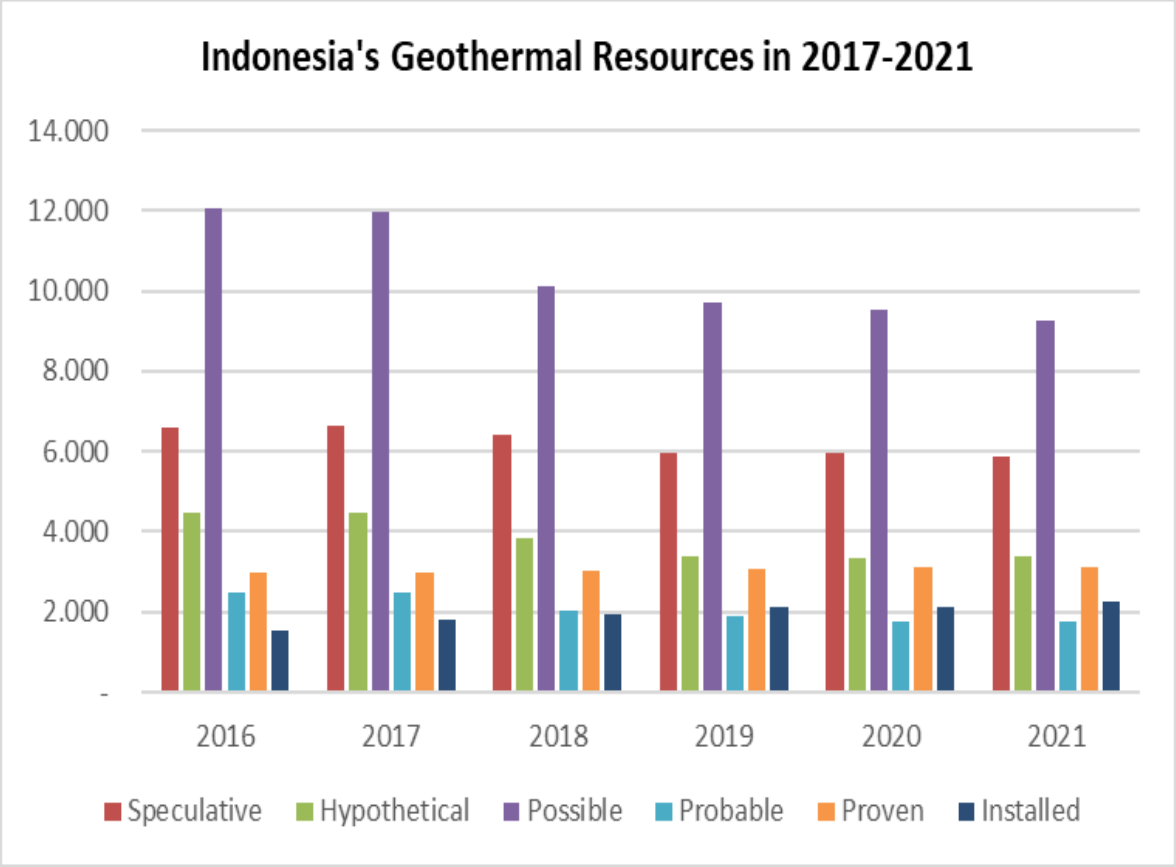
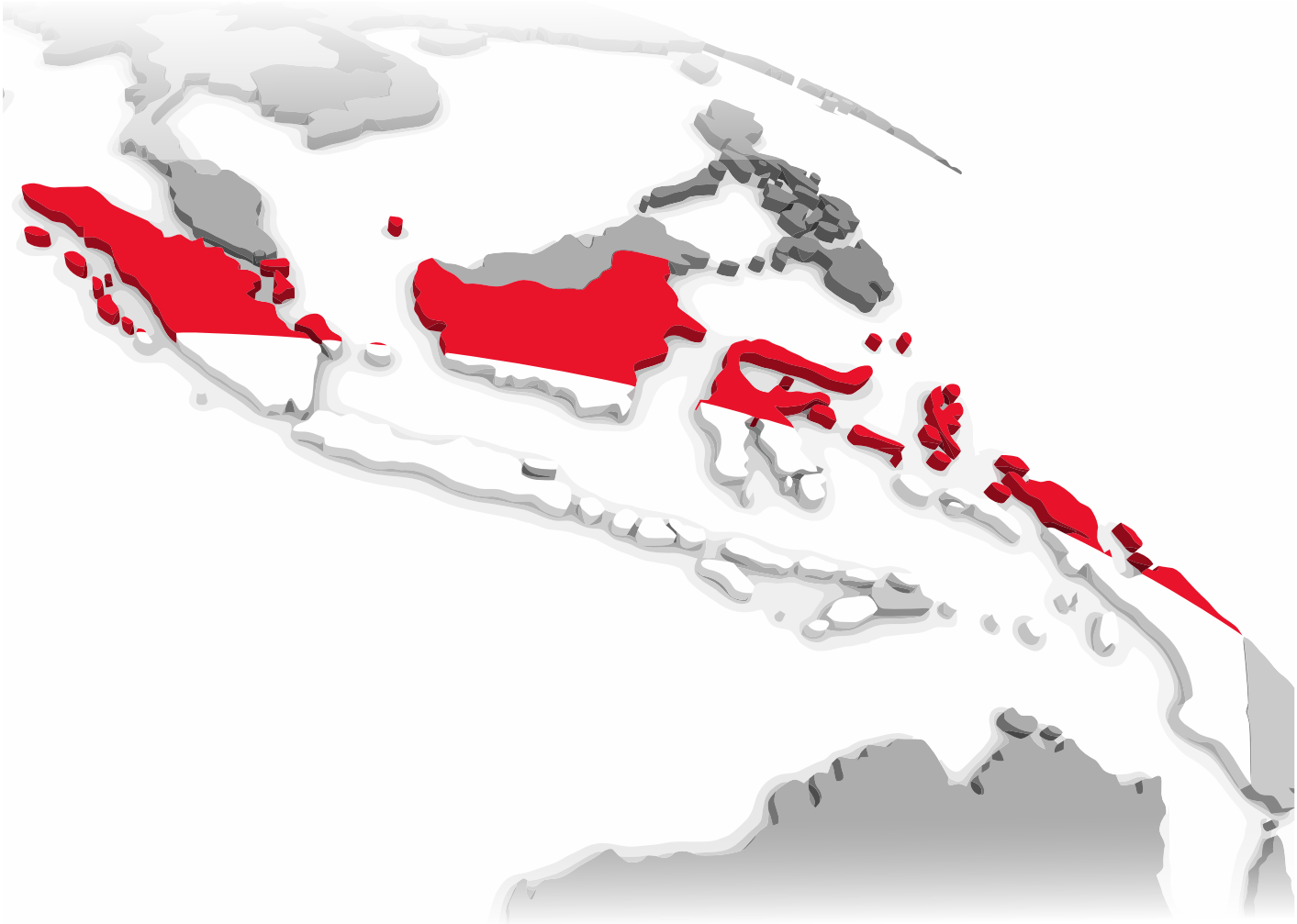


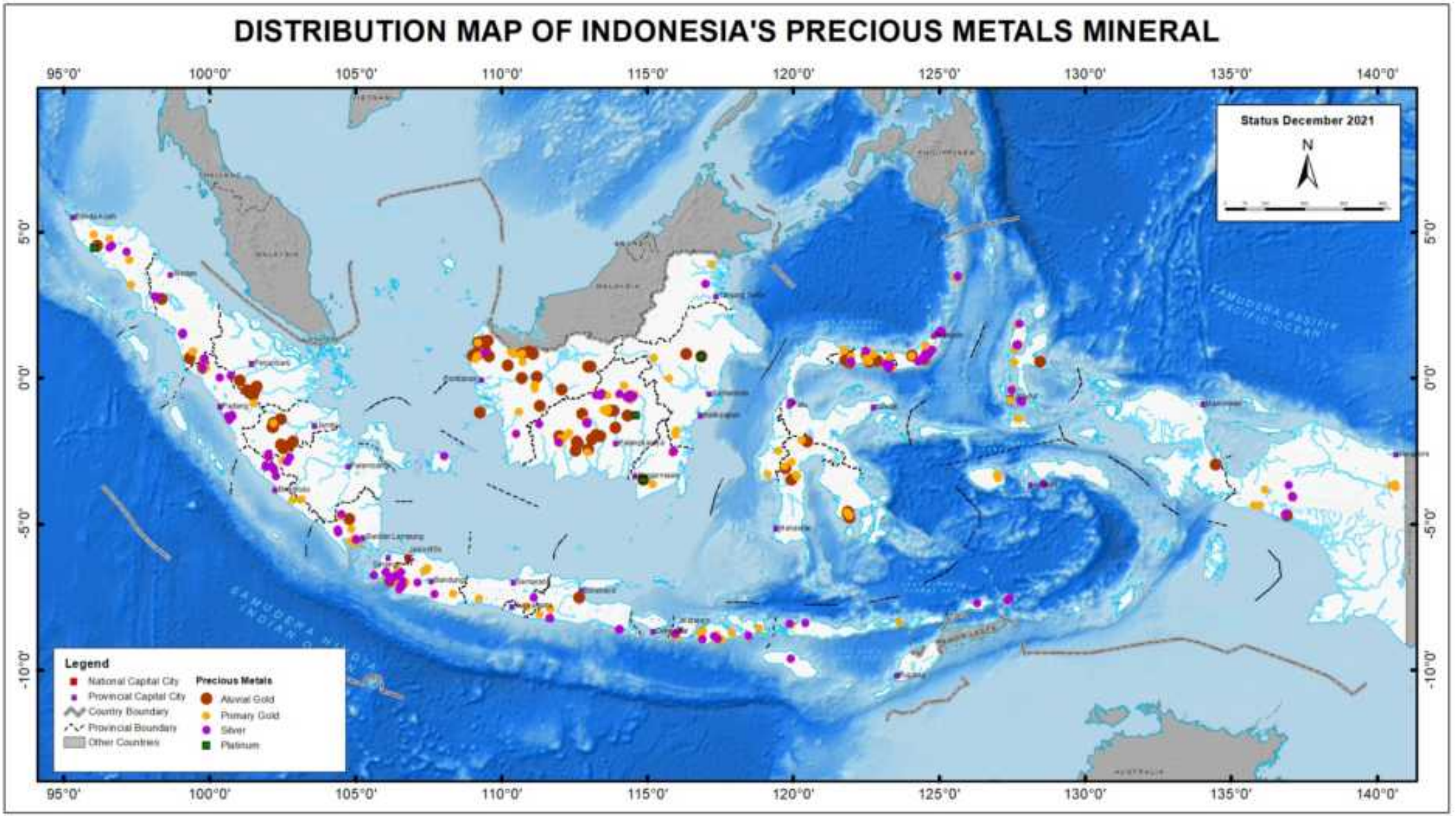
Figure 31. Comparison of Indonesia's Geothermal Resources Status in 2016-2021

In general, despite changes in the value of geothermal resources, the value of resource status in 2021 provides more accurate and realistic data quality with certain level of confidence. The updated results of Indonesia's geothermal resource balance in the 2021 are expected to be used as reference as well as input for consideration of the development of national energy policies.

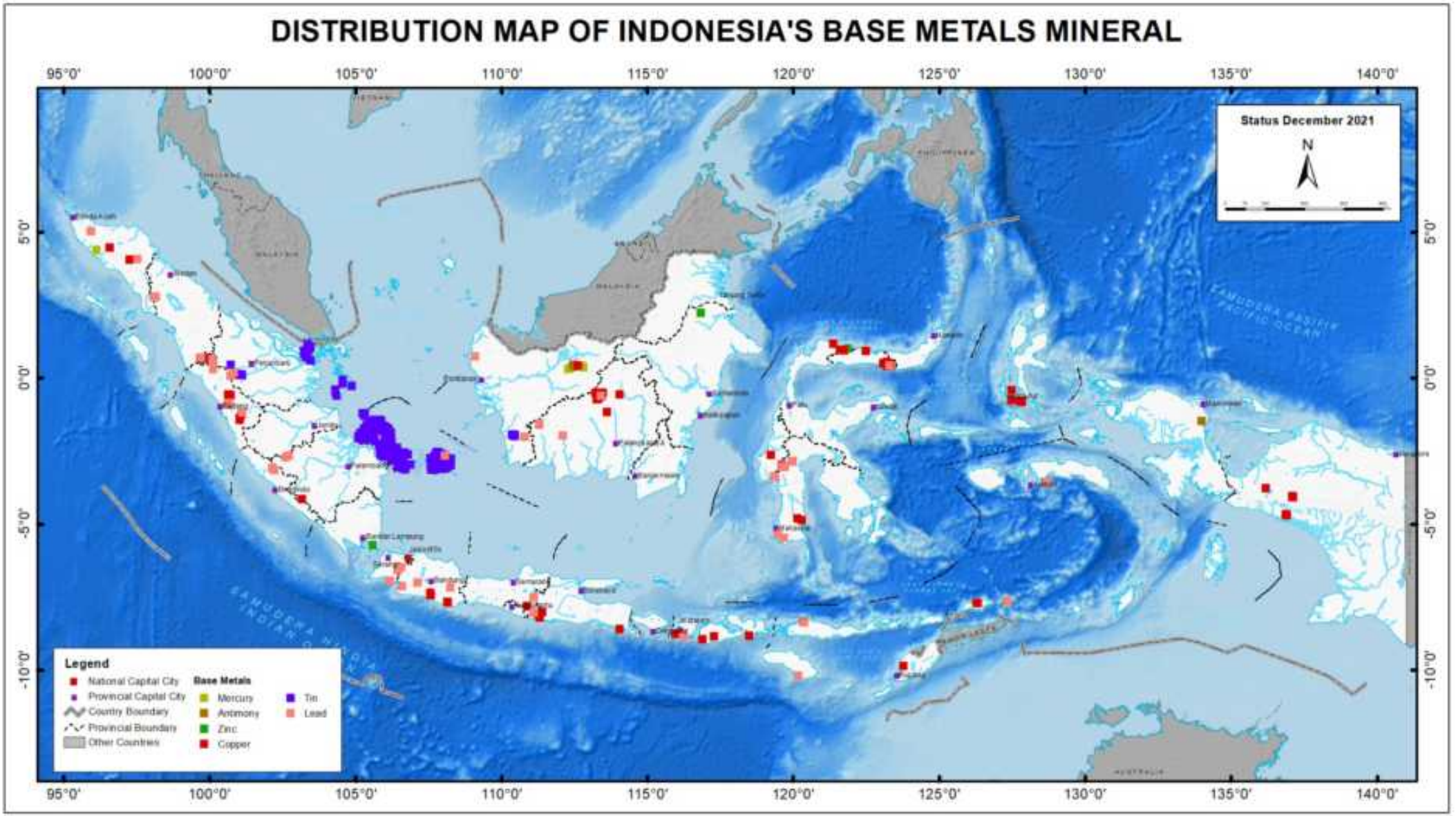
MAP OF INDONESIAN MINERALS, COAL, AND GEOTHERMAL RESOURCES AND RESERVES 2021



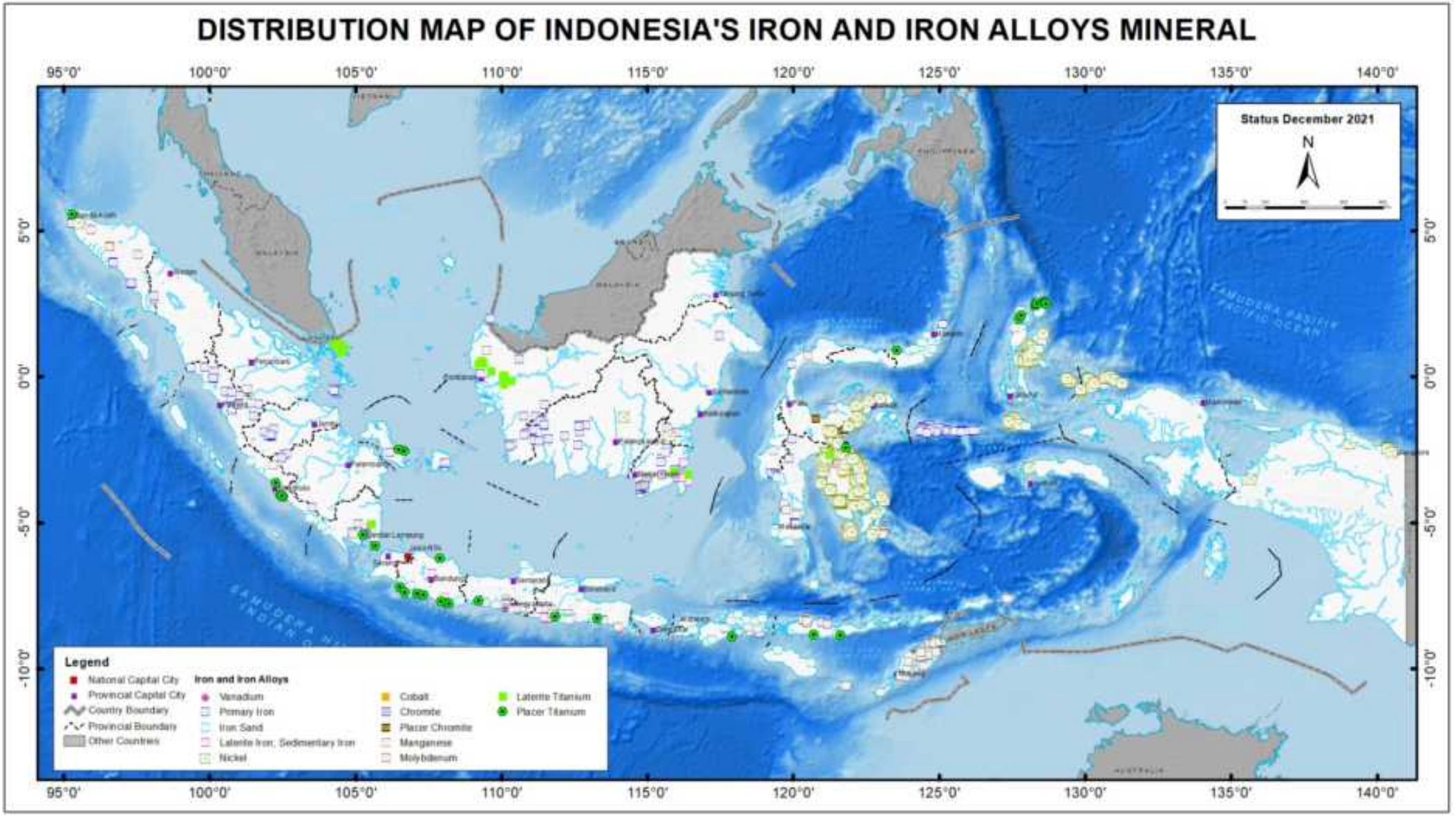
DISTRIBUTION MAP OF INDONESIA'S PRECIOUS METALS MINERAL



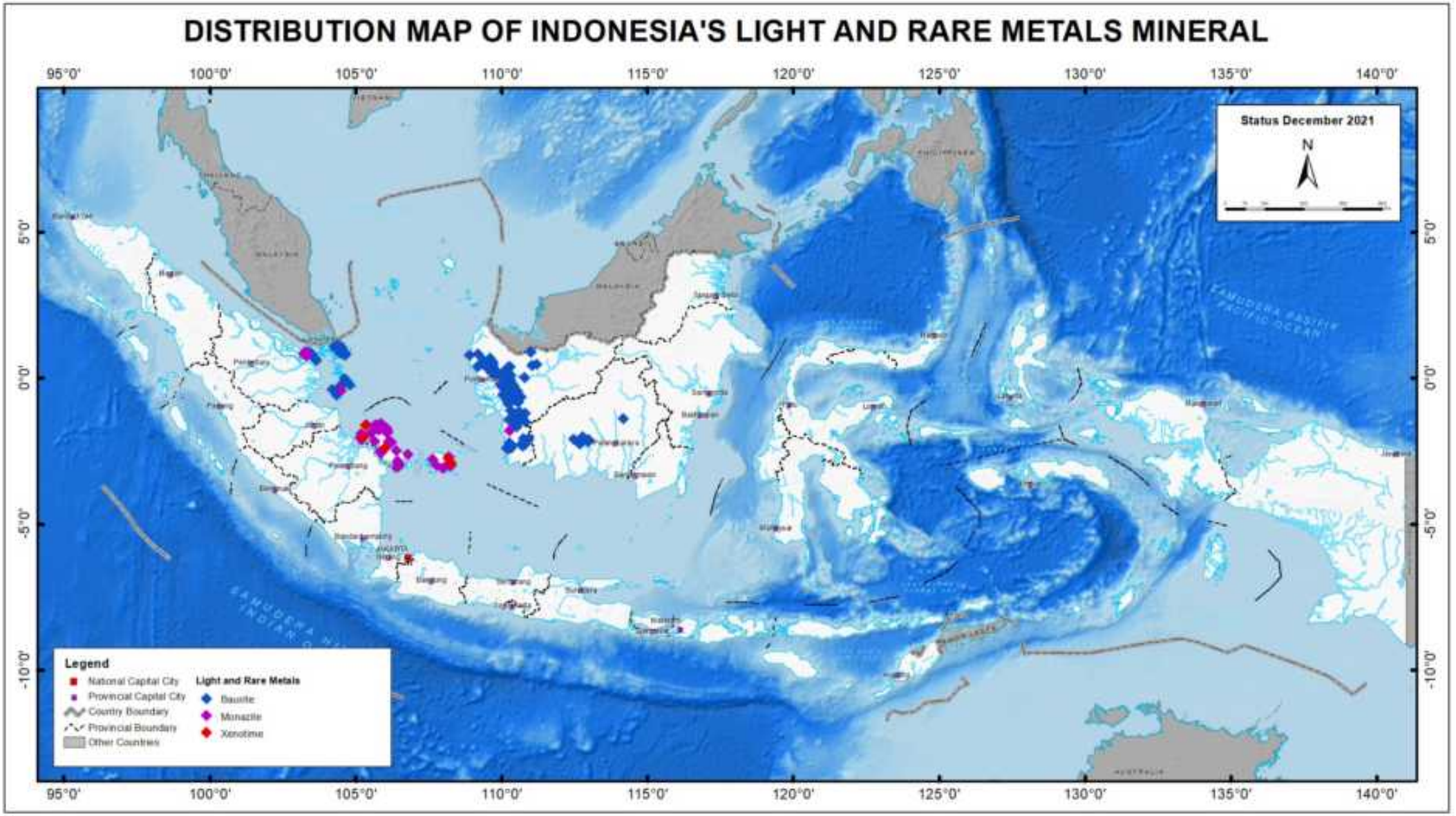
DISTRIBUTION MAP OF INDONESIA'S BASE METALS MINERAL



DISTRIBUTION MAP OF INDONESIA'S IRON AND IRON ALLOYS MINERAL

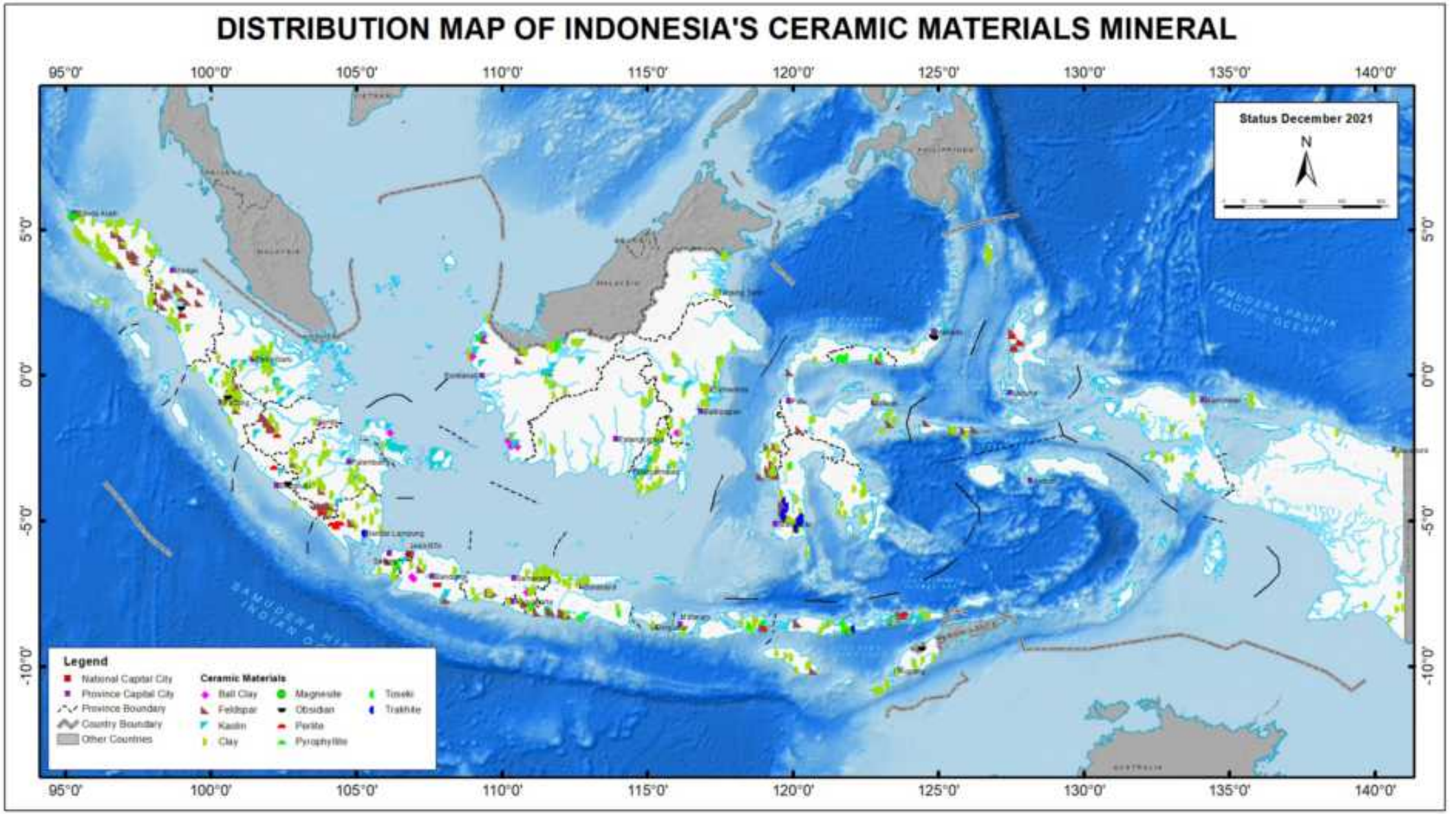


DISTRIBUTION MAP OF INDONESIA'S LIGHT AND RARE METALS MINERAL

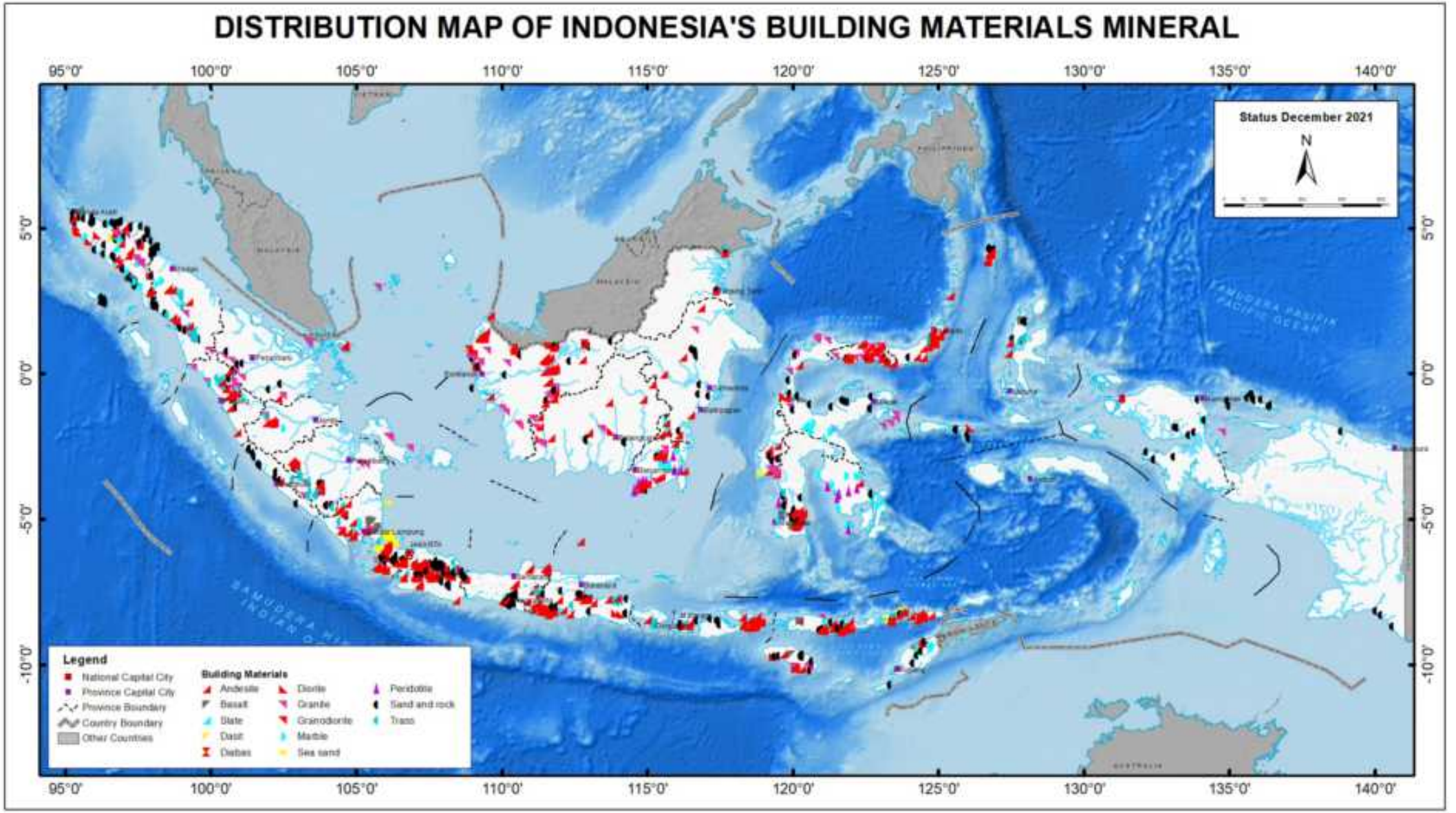


DISTRIBUTION MAP OF INDONESIA'S INDUSTRIALS MINERAL

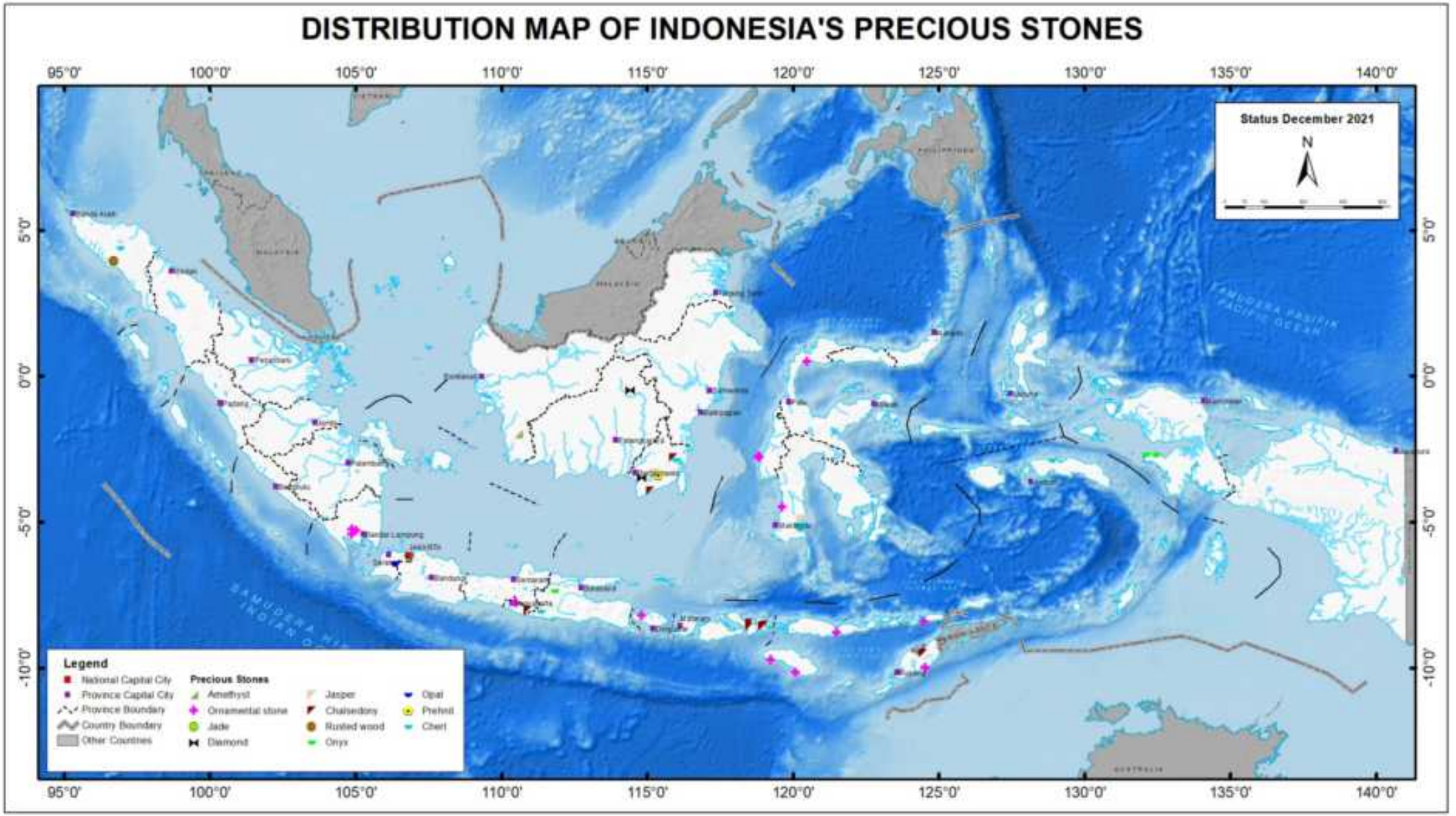
DISTRIBUTION MAP OF INDONESIA'S CERAMIC MATERIALS MINERAL



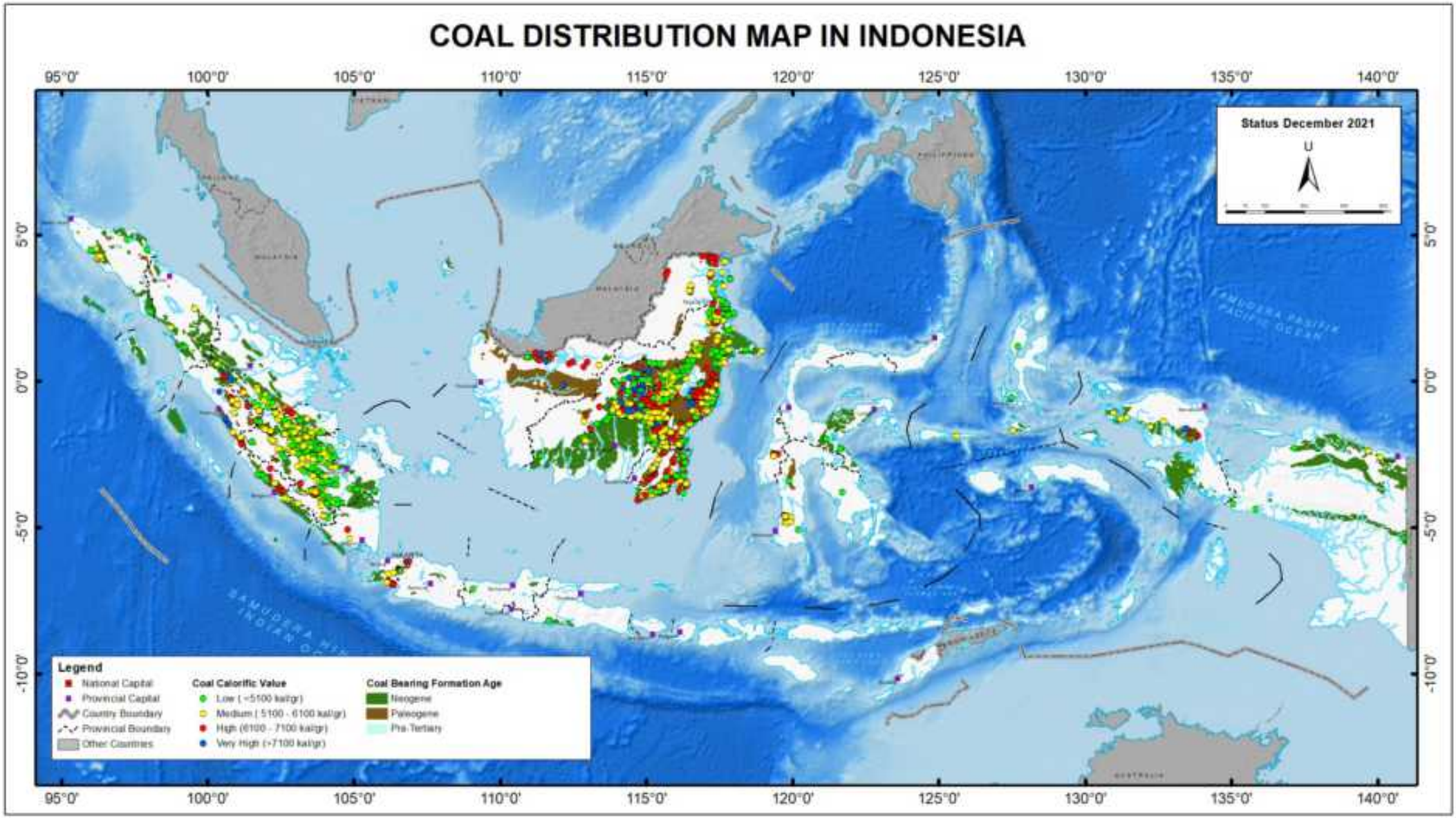
DISTRIBUTION MAP OF INDONESIA'S BUILDING MATERIALS MINERAL



DISTRIBUTION MAP OF INDONESIA'S PRECIOUS STONES

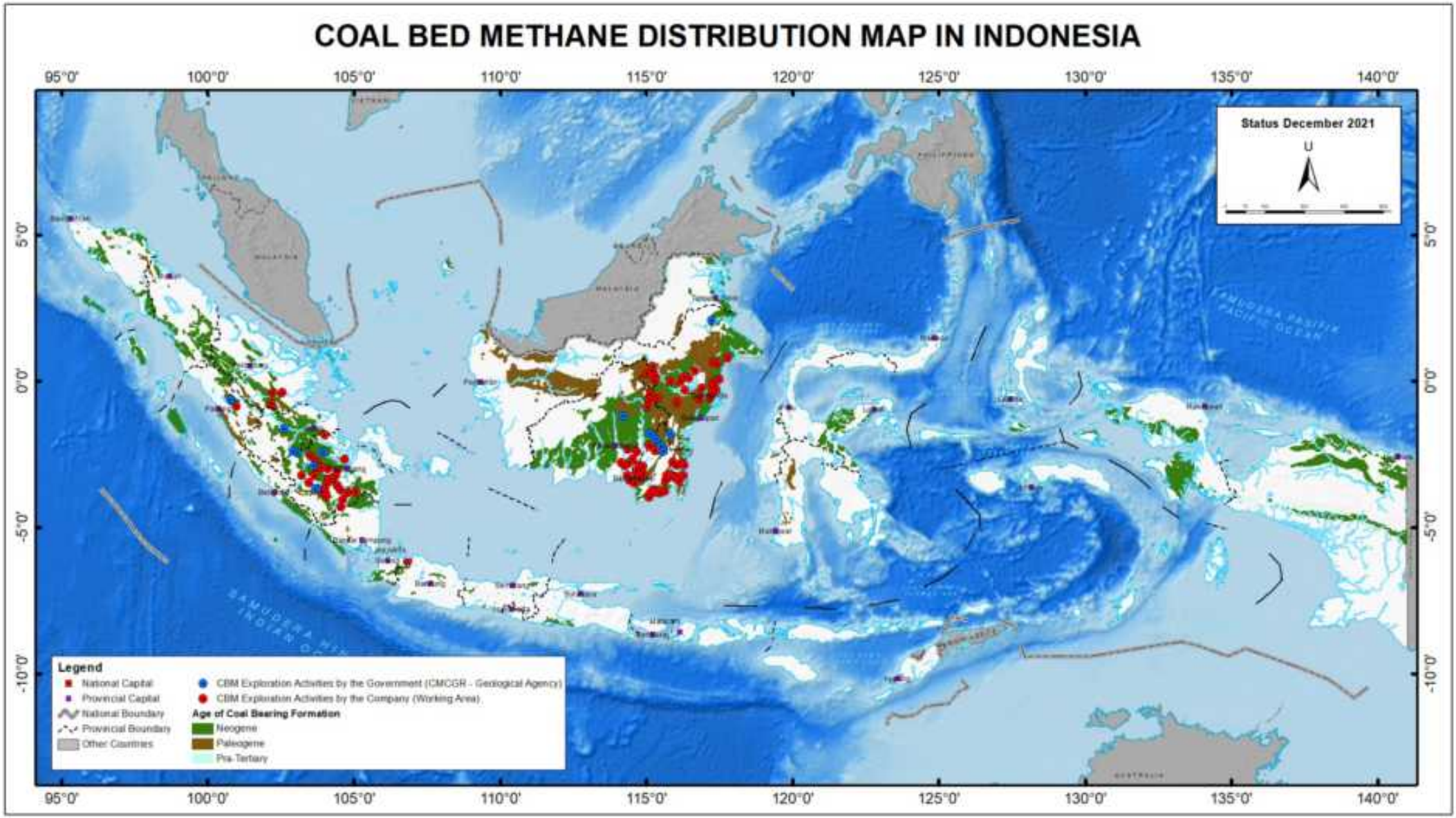


COAL DISTRIBUTION MAP IN INDONESIA

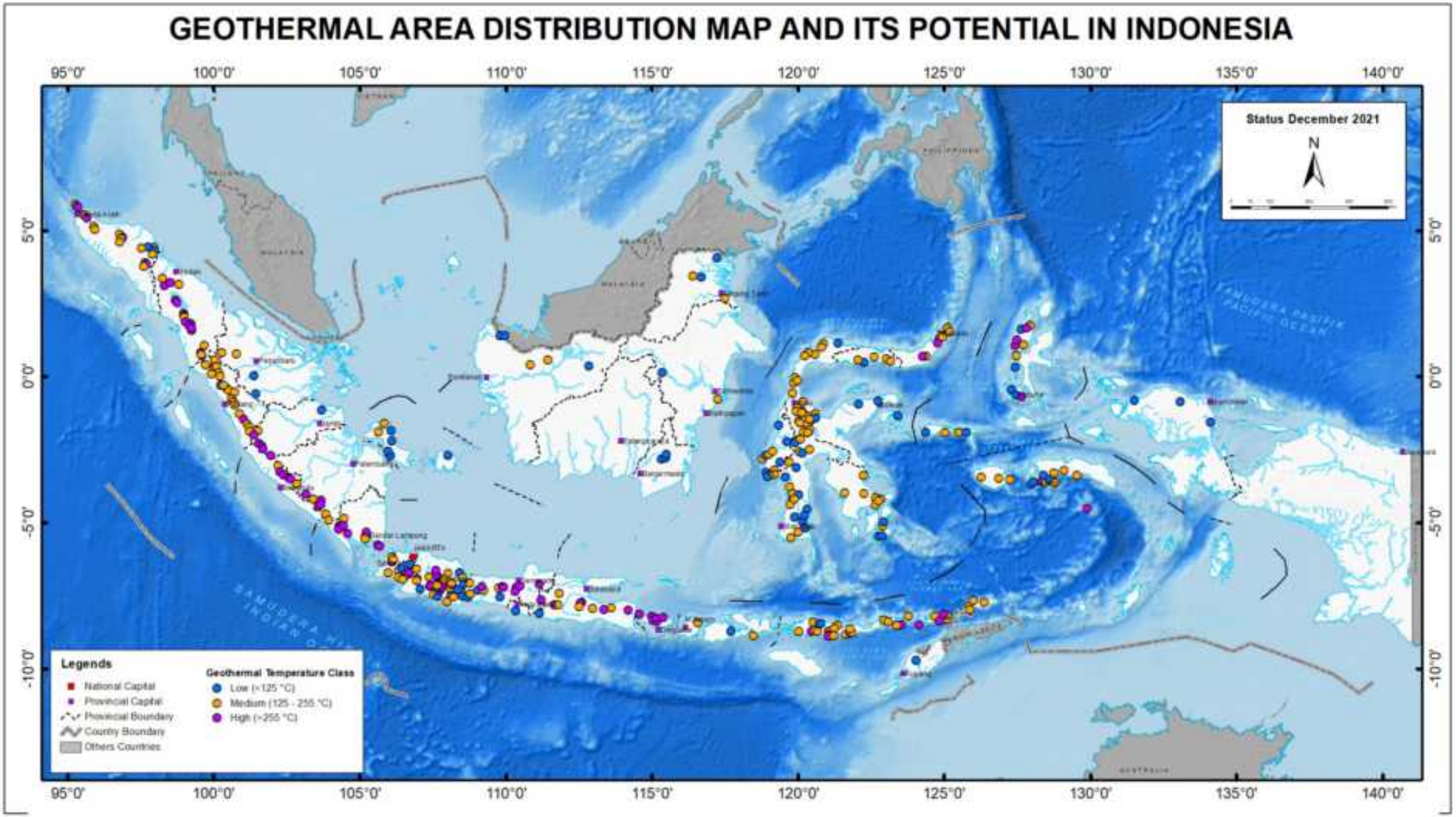


PEAT DISTRIBUTION AND LOCATION MAP IN INDONESIA

COAL BED METHANE DISTRIBUTION MAP IN INDONESIA



GEOTHERMAL AREA DISTRIBUTION MAP AND ITS POTENTIAL IN INDONESIA



CENTER FOR MINERAL COAL AND GEOTHERMAL RESOURCES
444 Soekarno Hatta Street, Indonesia, Bandung 40254
Telephone: +622 - 5202698, 5226270
Facsimile: +622 - 5226263, 5206164
Website: http://psdg.geologi.esdm.go.id