Additional information on calculating the emission factors of Indonesian electricity grids for the JCM project development

In order to secure net emission reductions in the methodology, the following emission factors will be applied depending on the regional grid to which a proposed project activity will connect in Indonesia:

- Table 1 summarizes the emission factors to be applied for renewable energy system(s) in a proposed project activity which is directly connected, or connected via an internal grid not connecting to either an isolated grid or a captive power generator, to a national/regional grid (Case 1).
- Table 1 also summarizes the emission factors to be applied for renewable energy system(s) in a proposed project activity which is connected to an internal grid connecting to both a national/regional grid and an isolated grid and/or a captive power generator (Case 2).

Table 1 Grid emission factor Case 1 and Case 2

National/regional grid name	Emission factor for Case 1 (tCO2/MWh)	Emission factor for Case 2 (tCO2/MWh)
Jamali, 3 Nusa, Karimun Jawa	0.619	0.533
Sumatra	0.458	0.458
Nias, Pulau Tello	0.533	0.533
Siberut, Siberut Utara, Sipora, Pagai Selatan	0.529	0.529
Alai, Batam, Batam-Tanjung Pinang, Durai, Kelong, Ladan, letung, Midai, Moro, Penuba, Ranai, Sedanau, Serasan, Tambelan, Tanjung Balai Karimun, Tanjung Batu, Tarempa	0.499	0.499
Bengkalis, Benteng, Concong Luar, Kota Lama, Lemang, Selat Panjang, Sungai Guntung, Tanjung Samak, Teluk Dalam, Teluk Ketapang, Masohi	0.545	0.533
Bangka, Belitung	0.628	0.533
Barito	0.653	0.533
Khatulistiwa	0.549	0.533
Mahakam and Tarakan	0.534	0.533
Sulutgo	0.274	0.274
Sulselbar	0.243	0.243
Kendari, Bau Bau, Kolaka, Lambuya, Wangi Wangi, Raha	0.564	0.533

Ampana, Balantak, Bualemo, Bulungkobit, Bunta, Lelang, Lipulalong, Lumbi-lumbia, Luwuk, Palapas-Palu, Salakan, Toili, Toli-Toli, Wakai	0.515	0.515
Lombok, Bima, Sumbawa	0.568	0.533
Adonara, Alor, Ende, Maumere, Rote, Timor, Waingapu	0.537	0.533
Ambon, Buano, Bula, Dobo, Geser, Haruku, Kairatu, Kesui, Kian Darat, Kisar, Kobisonta, Laimu, Larat, Liran, Mako, Moa, Ondor, Pasanea, Piru, Saumiaki, Serwaru, Taniwel, Tehoru, Tual, Wahai, Werinama, Wetar	0.557	0.533
Bere-Bere, Bicoli, Buli, Daruba, Ibu, Kedi, Lolobata, Maba, Ternate - Tidore, Tobelo	0.532	0.532
Biak, Genyem, Jayapura, Merauke, Nabire, Serui, Timika	0.491	0.491
Manokwari, Sorong	0.518	0.518
Bantal, Ipuh, Kota Bani, Mukomuko	0.532	0.532

- An emission factor of **0.533 tCO2/MWh** is applied, for renewable energy system (s) in a proposed project activity which is connected to an internal grid only connecting to an isolated grid and/or a captive power generator (Case 3).

Background information and emission factors calculation methods

1. Current status of electric power source mix in Indonesia

There are five major islands in Indonesia: Sumatra, Java, Kalimantan, Sulawesi, and Papua, and 134 electricity interconnection systems or grids which cover 34 provinces as shown in Table 2.

Table 2 Interconnection systems and provinces covered

Interconnection System/grids	Provinces/area covered
1. Jamali	East Java, Central Java, D.I. Yogyakarta, West Java, Banten, D.K.I. Jakarta, Bali
2. 3 Nusa	Bali
3. Karimun Jawa	Central Java
4. Sumatra	Aceh, North Sumatra, West Sumatra, Riau, South Sumatra, Jambi, Bengkulu, Lampung
5. Nias	North Sumatra
6. Pulau Tello	
7. Siberut	West Sumatra
8. Siberut Utara	
9. Sipora	
10. Pagai Selatan	
11. Alai	Kepri
12. Batam	
13. Batam-Tanjung Pinang	
14. Dabo Singkep	
15. Durai	
16. Kelong	
17. Ladan	
18. Letung	
19. Midai	
20. Moro	
21. Penuba	
22. Ranai	
23. Sedanau	
24. Serasan	
25. Tambelan	

26. Tanjung Balai Karimun	
27. Tanjung Batu	
28. Tarempa	
29. Bengkalis	Riau
30. Benteng	
31. Concong Luar	
32. Kota Lama	
33. Lemang	
34. Pulau Halang	
35. Selat Panjang	
36. Sungai Guntung	
37. Tanjung Samak	
38. Teluk Dalam	
39. Teluk Ketapang	
40. Tembilahan	
41. Masohi*	
42. Bangka	Bangka Belitung
43. Belitung	
44. Barito	Kalselteng (South and Central Kalimantan)**
45. Khatulistiwa	West Kalimantan
46. Mahakam	East Kalimantan
47. Tarakan	North Kalimantan
48. Sulselbar	South and West Sulawesi
49. Sulutgo	North Sulawesi and Gorontalo
50. Bau Bau	Southeast Sulawesi
51. Kendari	
52. Kolaka	
53. Lambuya	
54. Raha	
55. Wangi Wangi	
56. Ampana	Central Sulawesi
57. Balantak	
58. Bualemo	
59. Bulungkobit	
60. Bunta	

61. Kotaraya	
62. Lelang	
63. Lipulalongo	
64. Lumbi-lumbia	
65. Luwuk	
66. Palapas-Palu	
67. Paposta	
68. Salakan	
69. Toili	
70. Toli-Toli	
71. Wakai	
72. Lombok	West Nusa Tenggara
73. Bima	
74. Sumbawa	
75. Adonara	East Nusa Tenggara
76. Alor	
77. Ende	
78. Maumere	
79. Rote	
80. Timor	
81. Waingapu	
82. Ambon	Maluku
83. Buano	
84. Bula	
85. Dobo	
86. Geser	
87. Haruku	
88. Kairatu	
89. Kesui	
90. Kian Darat	
91. Kisar	
92. Kobisonta	
93. Laimu	
94. Larat	
95. Liran	

96. Mako	
97. Moa	
98. Namlea	
99. Ondor	
100. Pasanea	
101. Piru	
102. Pulau Buru	
103. Saumiaki	
104. Serwaru	
105. Taniwel	
106. Tehoru	
107. Tual	
108. Wahai	
109. Werinama	
110. Wetar	
111. Bere-Bere	North Maluku
112. Bicoli	
113. Buli	
114. Daruba	
115. Ibu	
116. Jailolo	
117. Kedi	
118. Lolobata	
119. Maba	
120. Tenate - Tidore	
121. Tobelo	
122. Biak	Papua
123. Genyem	
124. Jayapura	
125. Merauke	
126. Nabire	
127. Serui	
128. Timika	
129. Manokwari	West Papua
130. Sorong	

131. Bantal	Bengkulu
132. Ipuh	
133. Kota Bani	
134. Mukomuko	

* Masohi is in Riau and Maluku, but it is included in Riau, which has more conservative emission factor than Maluku.

** Kalselteng is considered as South and Central Kalimantan.

(Data source: Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, 2020)

There are six types of primary energy used for electricity generation in Indonesia, namely, coal, oil and diesel, natural gas, hydro, geothermal, and solar power[1]. The share of electricity generated from 2016 to 2018 by each type of primary energy is shown in Table 3. The electricity generation from hydro, geothermal, and solar power plants are deemed as low cost/must run (LCMR) power sources.

Table 3 Electricity generation by primary energy type[2]

Electricity generation by primary energy type, PLN only (TWh)	2016	2017	2018
Coal	91.70	105.78	114.40
Oil (HSD, IDO, MFO) and diesel	17.31	56.83	56.09
Natural gas	56.95	2.29	3.47
Hydro	13.89	12.43	10.73
Geothermal	3.96	4.10	4.01
Solar power	0.01	0.01	0.00
Total	183.81	181.42	188.70

*There is a difference between the values listed as “Total“ and the summation of each value of “Coal”, “Oil (HSD, IDO, MFO) and diesel”, “Natural gas”, “Hydro”, “Geothermal” and “Solar power” because these values are rounded.

**Electricity generation represents a net amount which is the amount of electricity generated by a power plant that is transmitted and distributed for consumer use.

When the share of LCMR is less than 50% of the total grid generation, the operation of LCMR

[1] Directorate General of Electricity, Ministry of Energy and Mineral Resources Indonesia (2015) The Book of Electricity Statistics Number 28-2015.

[2] Directorate General of Electricity, Ministry of Energy and Mineral Resources Indonesia (2019) The Book of Electricity Statistics Number 32-2019.

resources would not be affected by a newly installed power plant including a hydro power project[3]. Therefore, only electricity from gas-fired, coal-fired, oil and diesel-fired power plants are taken into account for calculating the official regional grid emission factor in Indonesia. Based on this assumption, the Government of Indonesia published emissions factor of each regional grid (Appendix 2).

2. Calculation of emission factors of the national/regional grids

In order to identify the emission factors of the Indonesian regional electricity systems which can secure net emission reductions, the emission factors in this methodology are established by an operating margin that is calculated using emission factors of power plants including LCMR resources. In calculating the emission factors of each fossil fuel power generation, the best heat efficiencies among currently operational plants in Indonesia are applied.

The most efficient coal-fired power plants and gas-fired power plants currently operational in Indonesia are identified in Table 4 and the best heat efficiencies are determined as **42% and 62%**, respectively. With regard to diesel-fired power plants, the heat efficiency of **49%**, an efficiency level which has not been achieved yet by the world's leading diesel generator, is applied due to the data limitation[4].

Table 4 Best efficiency of fossil fuel power plants in Indonesia

Type of power plant	Power plant	Product	Capacity	Plant efficiency (LHV)
Coal-fired Ultra-Super Critical (USC)[5]	Lontar Coal-Fired Thermal Power Plant, Banten	GT13E2	315MW	42%
Gas Turbine Combined Cycle (GTCC)	Muara Karang Combined Cycle Power Plant, Jakarta	Mitsubishi Hitachi Power Systems M701F4[6]	566 MW	62%

[3] CDM EB (2015) Tool to calculate the emission factor for an electricity system.

[4] The approved JCM methodologies (e.g. BD_AM002, CR_AM001, KE_AM002, KH_AM002, MN_AM003, PW_AM001 and MV_AM001, VN_AM007) also applied this value.

[5] https://www.toshiba.co.jp/tech/review/2008/09/63_09pdf/a03.pdf

[6] https://www.mhps.com/jp/products/gasturbines/lineup/m701f/

The emission factor of power generation by each fuel source is calculated from the plant efficiency using the following equation:

Emission factor of fossil fuel power plant [tCO_2/MWh]
= (Emission factor of fuel source [$kgCO_2$/TJ]*10^{-3}*0.0036[TJ/MWh] / (Plant heat efficiency (LHV) [%]/100)

Applying the emission factors of coal, gas and diesel combustion, which are 92,800 $kgCO_2$/TJ, 54,300 $kgCO_2$/TJ and 72,600 $kgCO_2$/TJ, respectively, derived from "2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 2, stationary combustion", together with the plant efficiency (LHV) of 42% for the coal-fired power plant, 62% for the gas-fired power plant and 49% for diesel-fired power plant, and using conversion factors (10^{-3} for conversion from $kgCO_2$ to tCO_2 and 0.0036 for conversion from TJ to MWh), the conservative emission factors are calculated at **0.795 tCO_2/MWh** for coal-fired power plants, **0.315 tCO_2/MWh** for gas-fired power plants and **0.533 tCO_2/MWh** for diesel-fired power plants.

Using the data of electricity generation including LCMR resources (Appendix 1) and the conservative emission factors of each power source, operating margins of each national/regional grid are obtained, as follows:

$$EF_{RE,j} = \frac{\sum_i EG_{i,j} \times EF_i}{\sum_i EG_{i,j}}$$

Where:

$EF_{RE,j}$ = The reference emission factor of regional grid *j* [tCO_2/MWh]

EF_i = Conservative emission factor of power plant type *i* [tCO_2/MWh]

$EG_{i,j}$ = Electricity generated and delivered to the regional grid from power plant type *i* including LCMR resources in grid *j* during 2016-2018 [MWh]

As a result, the emission factor of each national/regional grid is calculated and shown in column "Emission factor for Case1 (tCO_2/MWh)" of Table 1, to be applied for renewable energy system(s) in a proposed project activity which is directly connected, or connected via an internal grid not connecting to either an isolated grid or a captive power generator, to a national/regional grid. For most national/regional grids, those values are lower than the 2017 emission factors of the respective national/regional grids published by the Government of Indonesia (Appendix 2). Therefore, net emission reductions will be ensured by applying the emission factors determined above. For some national/regional girds (Dabo Singkep, Pulau Halang, Tembilahan, Kotaraya, Paposta, Namlea, Pulau

Buru, Jailolo), the values obtained as a result of calculation are higher than the 2017 emission factors of the respective national/regional grids published by the Government of Indonesia (Appendix 2). In order to secure net emission reductions, those national/regional grids are excluded from "Table 1 Grid emission factor Case 1 and Case 2", and this additional information is not applicable for those grids.

3. Calculation of the emission factor of a captive power generator

To determine the emission factor of a captive power generator, which normally uses a diesel generator, in a conservative and simple manner, the heat efficiency of 49%, an efficiency level which has not been achieved yet by the world's leading diesel generator, is applied.

The emission factor of diesel power generation is calculated from the heat efficiency using the following equation:

Emission factor of diesel power plant [tCO_2/MWh]
= (CO_2 emission factor of diesel oil [$kgCO_2$/TJ]*10^{-3}*0.0036[TJ/MWh] / (Plant heat efficiency (LHV) [%]/100)

Applying the default value of the emission factor of diesel combustion which is 72,600 $kgCO_2$/TJ derived from "2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 2, stationary combustion", together with the heat efficiency of 49%, the emission factor of an isolated grid and/or captive power generator is calculated at **0.533 tCO_2/MWh**.

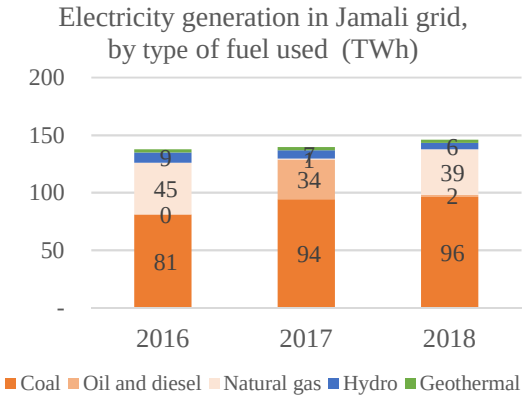
4. Selection of the calculated emission factors

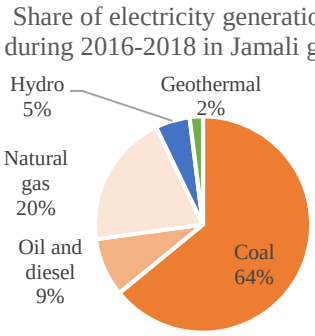
In case the renewable energy system(s) in a proposed project activity is directly connected, or connected via an internal grid not connecting to either an isolated grid or a captive power generator, to a national/regional grid (Case 1), the value of operating margin including LCMR resources, using the best heat efficiency among currently operational plants in Indonesia in calculating emission factors of fossil fuel power plants, are applied. The emission factors to be applied are shown in column "Emission factor for Case 1 (tCO_2/MWh)" of Table 1.

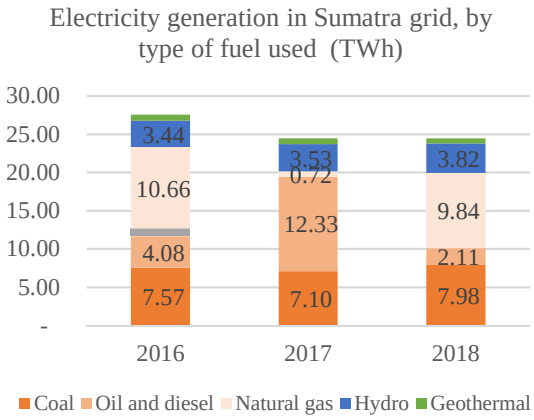
In case that the renewable energy system(s) in a proposed project activity is connected to an internal grid connecting to both a national/regional grid and an isolated grid and/or a captive power generator (Case 2), the lower values between "Emission factor for Case 1 (tCO_2/MWh)" of Table 1 and the conservative emission factor of diesel-fired power plant of 0.533 tCO_2/MWh are applied. The emission factors to be applied are shown in column "Emission factor for Case 2 (tCO_2/MWh)" of Table 1.

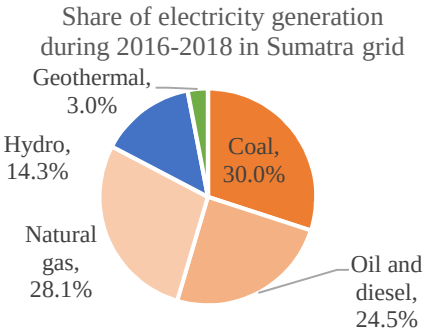
In case that the renewable energy system(s) in a proposed project activity is only connected to an internal grid connecting to an isolated grid and/or a captive power generator (Case 3), the emission factor of 0.533 tCO_2/MWh is applied.

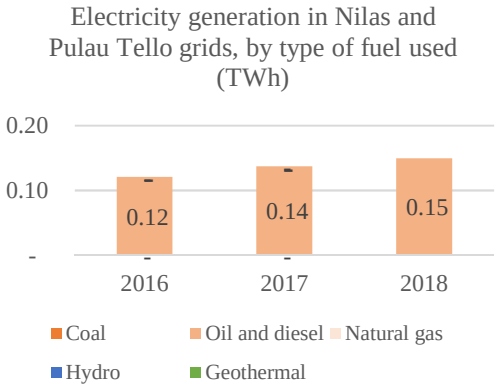
Appendix I Electric power source mix of each regional grid

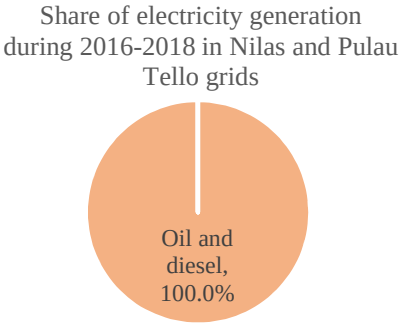




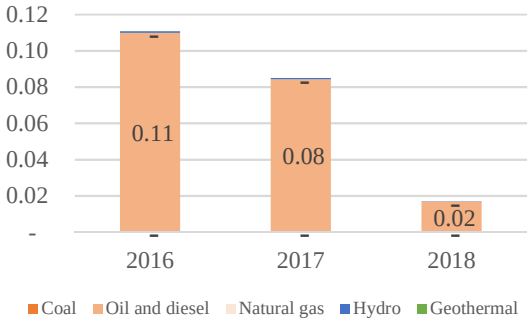




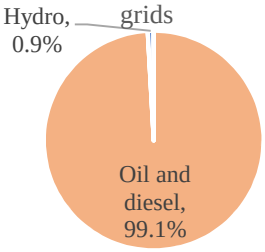




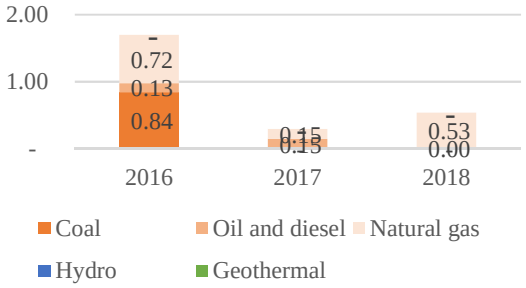
Electricity generation in Pagai Selatan, Siberut, Siberut Utara, and Sipora grids, by type of fuel used (TWh)



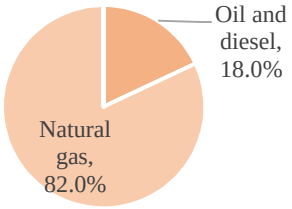
Share of electricity generation during 2016-2018 in Pagai Selatan, Siberut, Siberut Utara, and Sipora grids



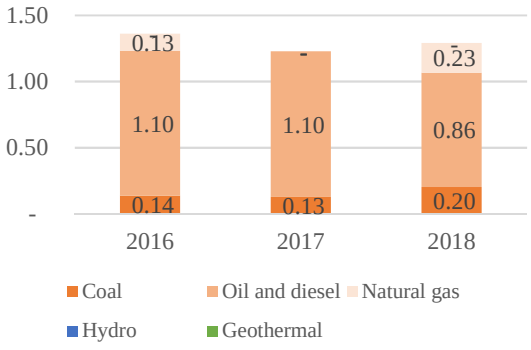
Electricity generation in Alai, Batam, Batam-Tanjung Pinang, Durai, Kelong, Ladan, letung, Midai, Moro, Penuba, Ranai, Sedanau, Serasan, Tambelan, Tanjung Balai Karimun, Tanjung Batu, and Tarempa grids, by type of fuel used (TWh)



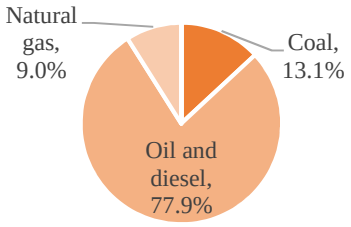
Share of electricity generation during 2016-2018 in Alai, Batam, Batam-Tanjung Pinang, Durai, Kelong, Ladan, letung, Midai, Moro, Penuba, Ranai, Sedanau, Serasan, Tambelan, Tanjung Balai Karimun, Tanjung Batu, and Tarempa grids

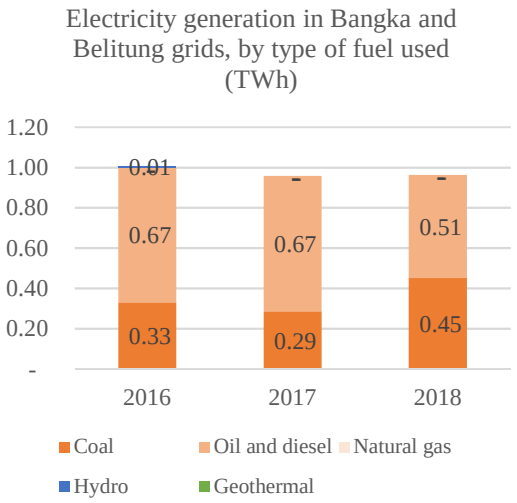


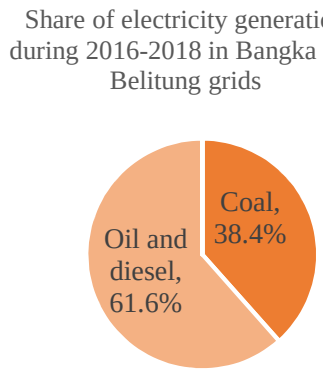
Electricity generation in Bengkalis, Benteng, Concong Luar, Kota Lama, Lemang, Selat Panjang, Sungai Guntung, Tanjung Samak, Teluk Dalam, Teluk Ketapang, and Masohi grids, by type of fuel used (TWh)

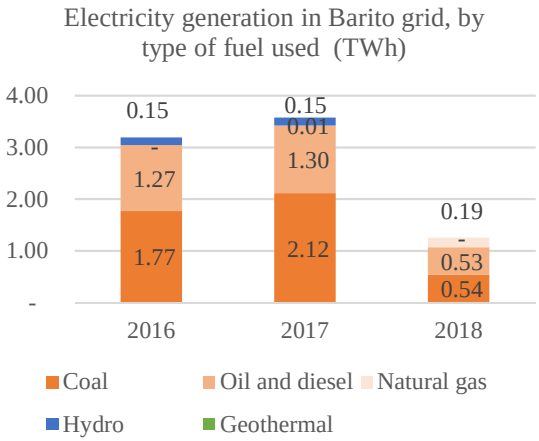


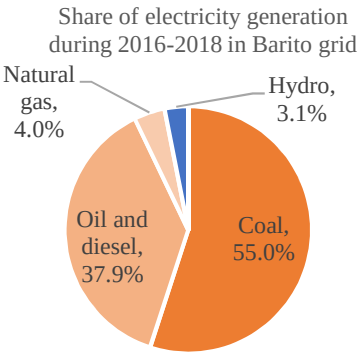
Share of electricity generation during 2016-2018 in Bengkalis, Benteng, Concong Luar, Kota Lama, Lemang, Selat Panjang, Sungai Guntung, Tanjung Samak, Teluk Dalam, Teluk Ketapang, and Masohi grids

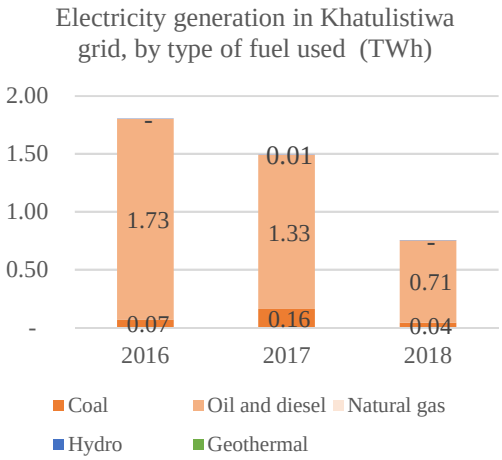


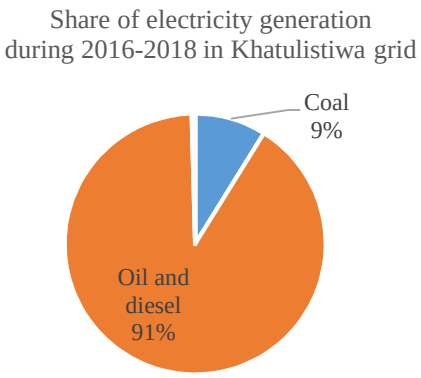

Electricity generation in Bangka and Belitung grids, by type of fuel used (TWh)
1.20
1.00
0.80
0.60
0.40
0.20
-
0.01
0.67
0.33
0.67
0.29
0.51
0.45
2016
2017
2018
Coal
Oil and diesel
Natural gas
Hydro
Geothermal


Share of electricity generation during 2016-2018 in Bangka and Belitung grids
Coal, 38.4%
Oil and diesel, 61.6%

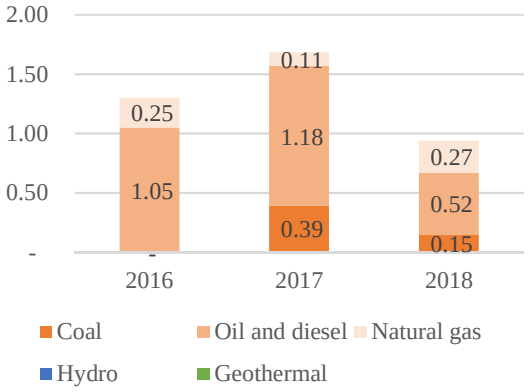

Electricity generation in Barito grid, by type of fuel used (TWh)
4.00
3.00
2.00
1.00
-
0.15
-
1.27
1.77
0.15
0.01
1.30
2.12
0.19
-
0.53
0.54
2016
2017
2018
Coal
Oil and diesel
Natural gas
Hydro
Geothermal


Share of electricity generation during 2016-2018 in Barito grid
Natural gas, 4.0%
Hydro, 3.1%
Oil and diesel, 37.9%
Coal, 55.0%

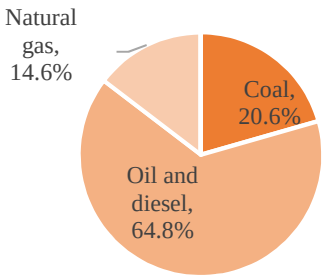

Electricity generation in Khatulistiwa grid, by type of fuel used (TWh)
2.00
1.50
1.00
0.50
-
-
1.73
0.07
0.01
1.33
0.16
-
0.71
0.04
2016
2017
2018
Coal
Oil and diesel
Natural gas
Hydro
Geothermal


Share of electricity generation during 2016-2018 in Khatulistiwa grid
Coal 9%
Oil and diesel 91%

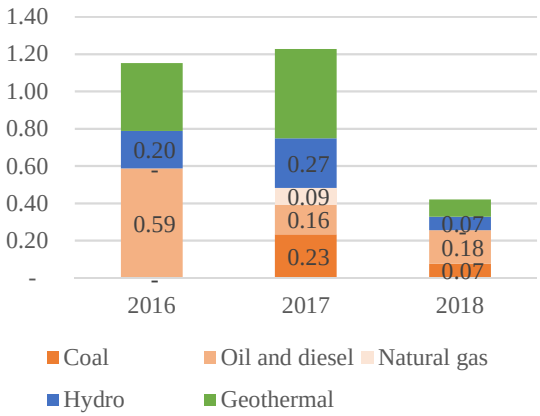
Electricity generation in Mahakam and Tarakan grids, by type of fuel used (TWh)



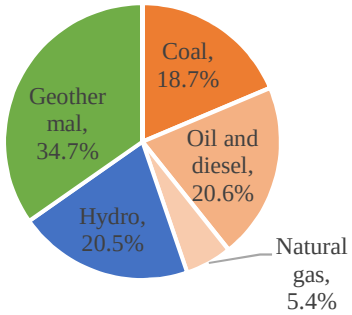
Share of electricity generation during 2016-2018 in Mahakam and Tarakan grids



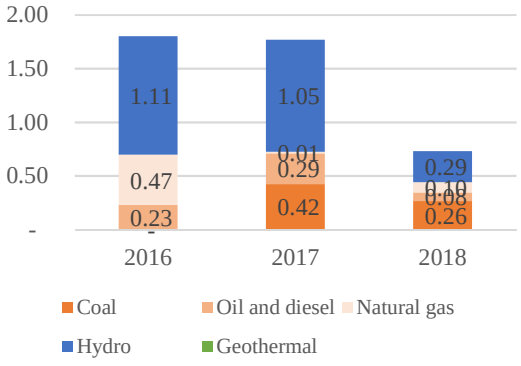
Electricity generation in Sulutgo grid, by type of fuel used (TWh)



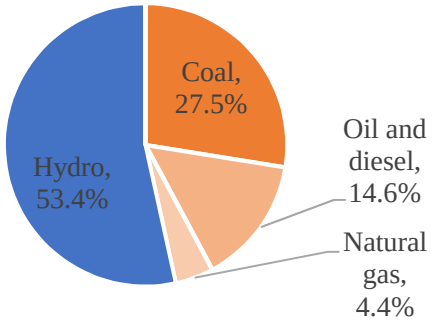
Share of electricity generation during 2016-2018 in Sumatera grid



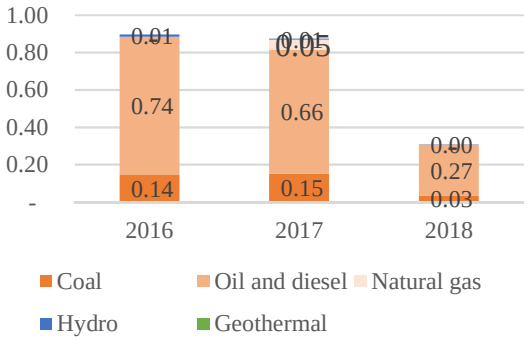
Electricity generation in Sulselbar grid, by type of fuel used (TWh)



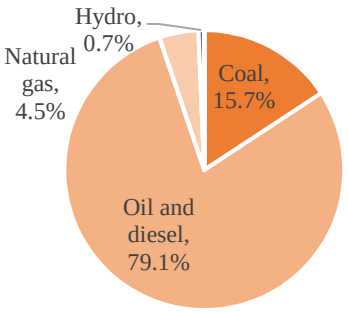
Share of electricity generation during 2016-2018 in Sulselbar grid



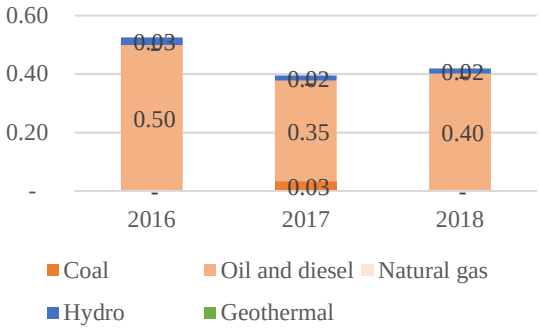
Electricity generation in Kendari, Bau Bau, Kolaka, Lambuya, Wangi Wangi, and Raha grids, by type of fuel used (TWh)



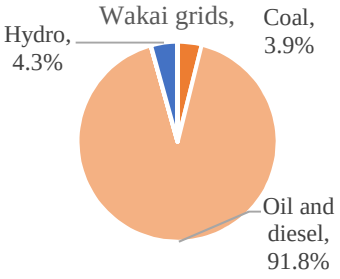
Share of electricity generation during 2016-2018 in Kendari, Bau Bau, Kolaka, Lambuya, Wangi Wangi, and Raha grids



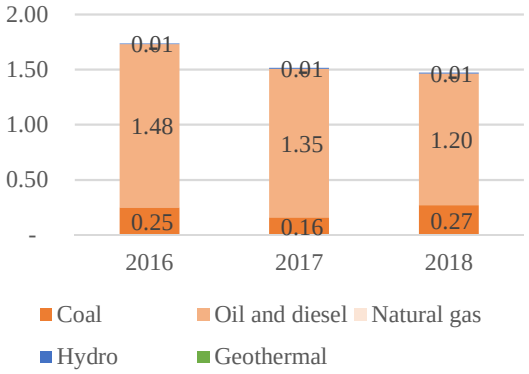
Electricity generation in Ampana, Balantak, Bualemo, Bulungkobit, Bunta, Kotaraya, Lelang, Lipulalongo, Lumbi-lumbia, Luwuk, Palapas-Palu, Paposta, Salakan, Toili, Toli-Toli, and Wakai grids, by type of fuel used (TWh)



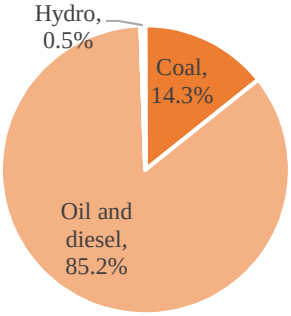
Share of electricity generation during 2016-2018 in Ampana, Balantak, Bualemo, Bulungkobit, Bunta, Kotaraya, Lelang, Lipulalongo, Lumbi-lumbia, Luwuk, Palapas-Palu, Paposta, Salakan, Toili, Toli-Toli, and Wakai grids,

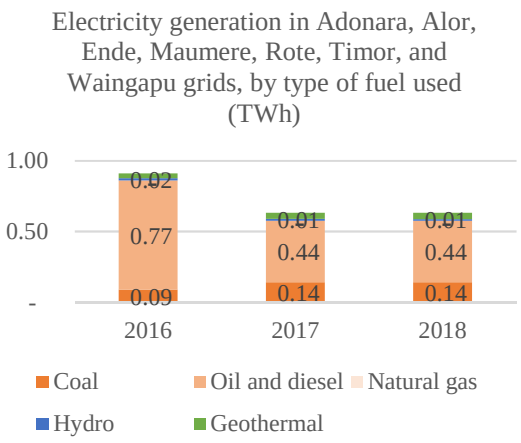


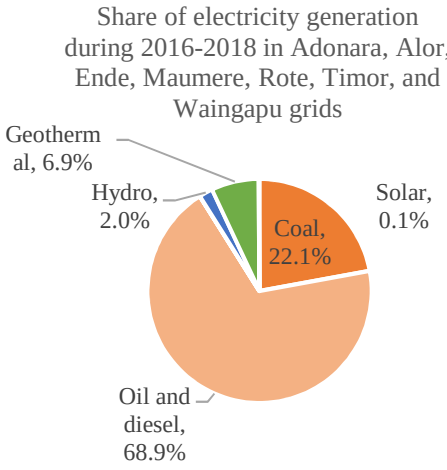
Electricity generation in Lombok, Bima, and Sumbawa grids, by type of fuel used (TWh)

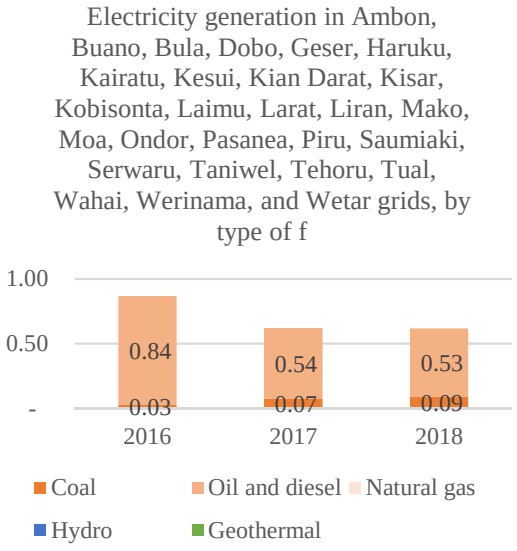


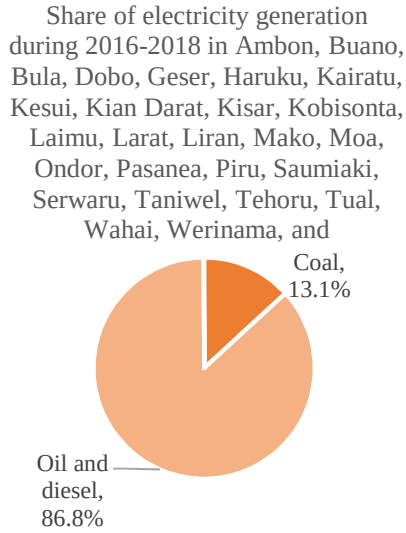
Share of electricity generation during 2016-2018 in Lombok, Bima, and Sumbawa grids

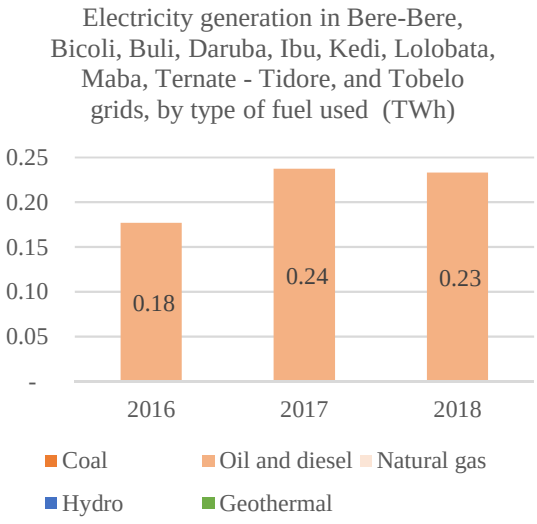


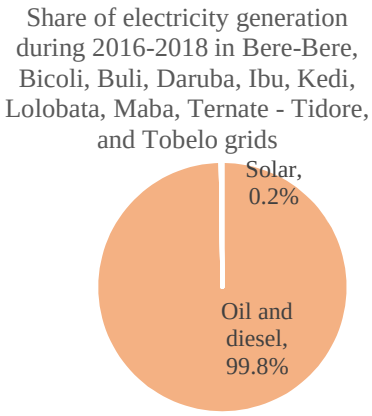

Electricity generation in Adonara, Alor, Ende, Maumere, Rote, Timor, and Waingapu grids, by type of fuel used (TWh)
1.00
0.50
-
0.02
0.77
0.09
0.01
0.44
0.14
0.01
0.44
0.14
2016
2017
2018
Coal
Oil and diesel
Natural gas
Hydro
Geothermal

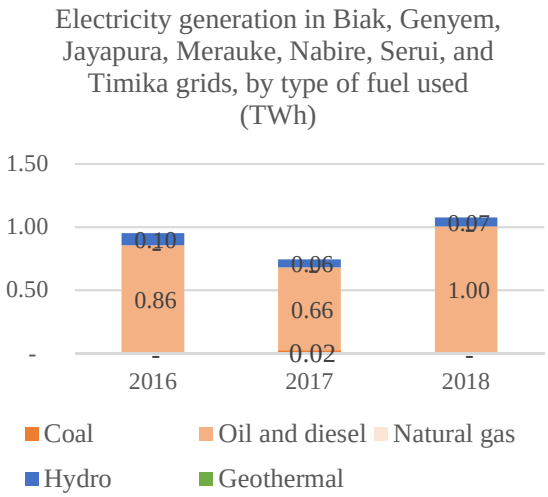

Share of electricity generation during 2016-2018 in Adonara, Alor, Ende, Maumere, Rote, Timor, and Waingapu grids
Geotherm al, 6.9%
Hydro, 2.0%
Solar, 0.1%
Coal, 22.1%
Oil and diesel, 68.9%

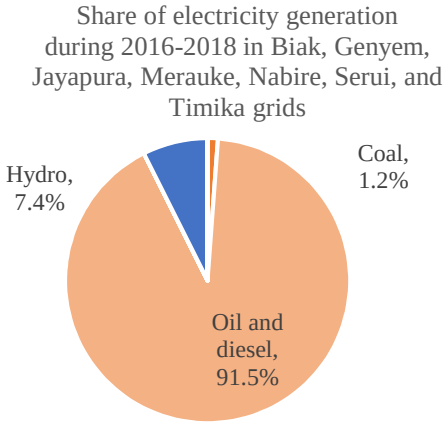

Electricity generation in Ambon, Buano, Bula, Dobo, Geser, Haruku, Kairatu, Kesui, Kian Darat, Kisar, Kobisonta, Laimu, Larat, Liran, Mako, Moa, Ondor, Pasanea, Piru, Saumiaki, Serwaru, Taniwel, Tehoru, Tual, Wahai, Werinama, and Wetar grids, by type of f
1.00
0.50
-
0.84
0.03
0.54
0.07
0.53
0.09
2016
2017
2018
Coal
Oil and diesel
Natural gas
Hydro
Geothermal

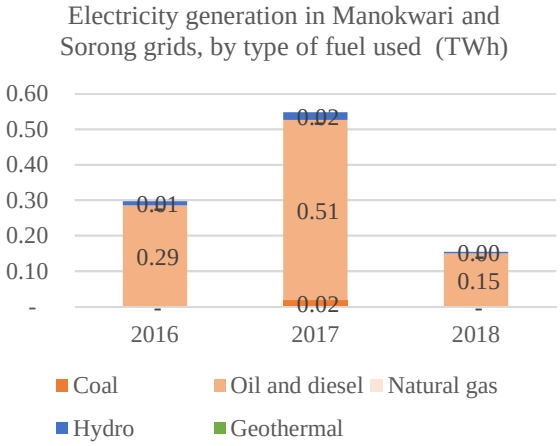

Share of electricity generation during 2016-2018 in Ambon, Buano, Bula, Dobo, Geser, Haruku, Kairatu, Kesui, Kian Darat, Kisar, Kobisonta, Laimu, Larat, Liran, Mako, Moa, Ondor, Pasanea, Piru, Saumiaki, Serwaru, Taniwel, Tehoru, Tual, Wahai, Werinama, and
Coal, 13.1%
Oil and diesel, 86.8%

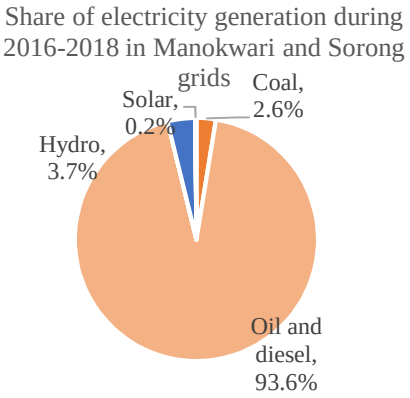

Electricity generation in Bere-Bere, Bicoli, Buli, Daruba, Ibu, Kedi, Lolobata, Maba, Ternate - Tidore, and Tobelo grids, by type of fuel used (TWh)
0.25
0.20
0.15
0.10
0.05
-
0.18
0.24
0.23
2016
2017
2018
Coal
Oil and diesel
Natural gas
Hydro
Geothermal

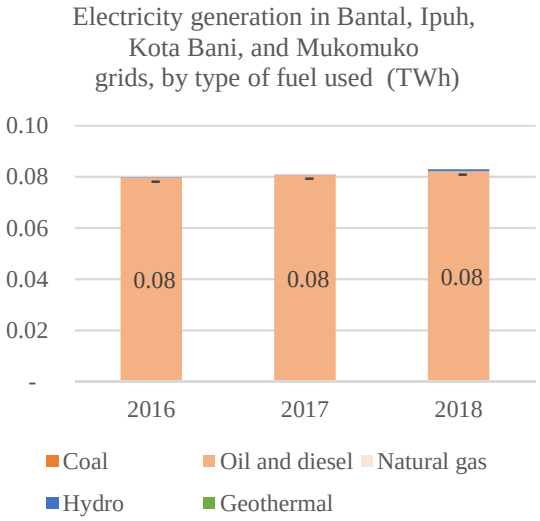

Share of electricity generation during 2016-2018 in Bere-Bere, Bicoli, Buli, Daruba, Ibu, Kedi, Lolobata, Maba, Ternate - Tidore, and Tobelo grids
Solar, 0.2%
Oil and diesel, 99.8%

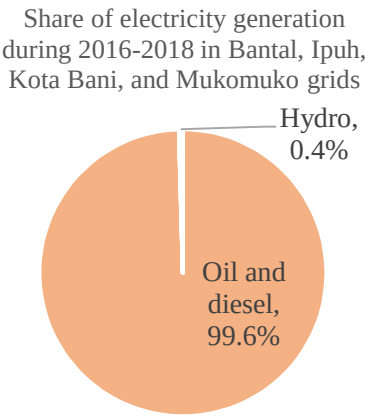












(Data source: Directorate General of Electricity, Ministry of Energy and Mineral Resources, 2019)

Appendix 2 Emission factors of grids published by the Government of Indonesia (2017)

No.	Interconnection of Electric Power Systems	Emission Factor (tCO2/MWh)
1	3 Nusa	N/A
2	Adonara	N/A
3	Alai (Kepri)	0,53
4	Alor	0,78
5	Ambon	0,66
6	Ampana	N/A
7	Balantak	0,77
8	Bangka	1,27
9	Bantal	N/A
10	Barito	0,95
11	Batam	0,62
12	Batam-Tanjung Pinang	1,13
13	Bau-Bau	0,71
14	Belitung	1,77
15	Bengkalis (Riau)	0,70
16	Benteng (Riau)	N/A
17	Bere-Bere (Morotai)	N/A
18	Biak	0,70
19	Bicoli (Halmahera Timur)	N/A
20	Bima	0,86
21	Bualemo	0,67
22	Buano (Seram Barat)	0,76
23	Bula (Seram Timur)	N/A
24	Buli (Halmahera Timur)	0,78
25	Bulungkobit	0,84

No.	Interconnection of Electric Power Systems	Emission Factor (tCO2/MWh)
26	Bunta	0,72
27	Concong Luar (Riau)	0,64
28	Dabo Singkep (Kepri)	0,07
29	Daruba (Morotai)	0,82
30	Dobo	0,72
31	Durai	0,53
32	Ende	2,02
33	Genyem	0,82
34	Geser	0,78
35	Haruku	N/A
36	Ibu	0,76
37	Ipuh	0,74
38	Jailolo	0,43
39	Jamali	0.89
40	Jayapura	0,73
41	Kairatu	N/A
42	Karimun Jawa	N/A
43	Kedi	0,87
44	Kelong	0,61
45	Kendari	1,67
46	Kesui	1,01
47	Khatulistiwa	0,90
48	Kian Darat	0,69
49	Kisar	0,98
50	Kobisonta	0,79

No.	Interconnection of Electric Power Systems	Emission Factor (tCO2/MWh)
51	Kolaka	0,73
52	Kota Bani	0,74
53	Kota Lama	0,57
54	Kotaraya	0,51
55	Ladan	0,77
56	Laimu	0,82
57	Lambuya	N/A
58	Larat	0,76
59	Lelang	0,57
60	Lemang (Riau)	0,78
61	Letung	0,81
62	Lipulalongo	0,86
63	Liran	N/A
64	Lolobata (Halmahera TImur)	N/A
65	Lombok	0,66
66	Lumbi-lumbia	0,82
67	Luwuk	0,58
68	Maba (Halmahera Timur)	0,81
69	Mahakam	1,08
70	Mako (Buru)	N/A
71	Manokwari	0,70
72	Masohi (Maluku Tengah)	N/A
73	Maumere	0,72
74	Merauke	0,71
75	Midai	0,79
76	Moa	0,83
77	Moro (Kepri)	0,52

No.	Interconnection of Electric Power Systems	Emission Factor (tCO2/MWh)
78	Mukomuko	N/A
79	Nabire	0,70
80	Namlea	0,49
81	Nias	0,77
82	Ondor (Seram Utara)	0,79
83	Pagai Selatan	0,86
84	Palapas-Palu	0,55
85	Paposta	0,38
86	Pasanea (Seram Utara Barat)	N/A
87	Penuba (Kepri)	N/A
88	Piru (Seram Barat)	N/A
89	Pulau Buru	0,39
90	Pulau Halang (Riau)	0,51
91	Pulau Tello	0,62
92	Raha	0,77
93	Ranai	0,70
94	Rote	0,80
95	Salakan	N/A
96	Saumlaki	0,71
97	Sedanau	0,80
98	Selat Panjang (Riau)	0,68
99	Serasan	0,76
100	Serui	0,73
101	Serwaru	1,01
102	Siberut	0,94
103	Siberut Utara	0,96
104	Sipora	0,86

No.	Interconnection of Electric Power Systems	Emission Factor (tCO2/MWh)
105	Sorong	0,69
106	Sulselbar	0.87
107	Sulutgo	1.49
108	Sumatera	0.89
109	Sumbawa	0,69
110	Sungai Guntung (Riau)	0,59
111	Tambelan (Kepri)	N/A
112	Taniwel (Seram Barat)	0,66
113	Tanjung Balai Karimun	1,13
114	Tanjung Batu	0,55
115	Tanjung Samak (Riau)	0,76
116	Tarakan	0,69
117	Tarempa	0,77
118	Tehoru (Seram Selatan)	0,79
119	Teluk Dalam (Riau)	N/A
120	Teluk Ketapang (Riau)	0,67
121	Tembilahan (Riau)	0,52
122	Ternate - Tidore	1,24
123	Timika	0,69
124	Timor	0,68
125	Tobelo	0,63
126	Toili	0,60
127	Toli-Toli	0,76
128	Tual	0,58
129	Wahai (Seram Utara)	0,81
130	Waingapu	0,70
131	Wakai	0,70
132	Wangi-Wangi	0,86
133	Werinama (Seram Timur)	0,83
134	Wetar	N/A

(Data source: Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, 2020)