**Table S1.** Characteristics of the ten thermal generation units ([Vaisakh et al. 2012](#_ENREF_28)).

|  |  |  |  |
| --- | --- | --- | --- |
| Unit | Power limits | Fuel cost coefficients | Ramp rate limits |
|  | $P\_{imin}$ (MW) | $P\_{imax}$ (MW) | $$a\_{i}$$ | $$b\_{i}$$ | $$c\_{i}$$ | $$e\_{i}$$ | $$f\_{i}$$ | $UR$ (MW/h) | $DR$ (MW/h) |
| 1 | 150 | 470 | 958.2 | 21.6 | 0.00043 | 450 | 0.041 | 80 | 80 |
| 2 | 135 | 460 | 1313.6 | 21.05 | 0.00063 | 600 | 0.036 | 80 | 80 |
| 3 | 73 | 340 | 604.97 | 20.81 | 0.00039 | 320 | 0.028 | 80 | 80 |
| 4 | 60 | 300 | 471.6 | 23.9 | 0.0007 | 260 | 0.052 | 50 | 50 |
| 5 | 73 | 243 | 480.29 | 21.62 | 0.00079 | 280 | 0.063 | 50 | 50 |
| 6 | 57 | 160 | 601.75 | 17.87 | 0.00056 | 310 | 0.048 | 50 | 50 |
| 7 | 20 | 130 | 502.7 | 16.51 | 0.00211 | 300 | 0.086 | 30 | 30 |
| 8 | 47 | 120 | 639.4 | 23.23 | 0.0048 | 340 | 0.082 | 30 | 30 |
| 9 | 20 | 80 | 455.6 | 19.58 | 0.10908 | 270 | 0.098 | 30 | 30 |
| 10 | 55 | 55 | 692.4 | 22.54 | 0.00951 | 380 | 0.094 | 30 | 30 |

**Table S2.** Demand side management (peak load shaving) implementation hours.

|  |  |
| --- | --- |
| Load | Peak load hours |
|  | Peak 1 (h) | Peak 2 (h) |
| Load 1 | 10-12  | 19-21  |
| Load 2 | 1-3  | 22-24  |
| Load 3 | 6-8  | 17-19  |

**Table S3.** Solar PV design considerations and parameters

|  |  |
| --- | --- |
| Solar panel | CNBM-260P |
| Shading loss | 8% |
| Voltage drop | 2% |
| Dirt loss | 7% |
| Temperature loss | 17.6% |
| Inverter efficiency | 95% |
| Manufacturer’s tolerance | 3% |
| Maximum design temperature | 39°C |

**Table S4.** Solar PV cost data (Ramabhotla, Bayne, and Giesselmann 2016).

|  |  |
| --- | --- |
| Quantity | Value |
| Interest rate (base case) | 0.09 |
| Investment lifetime | 20 years |
| Investment cost/unit installed | 5000 $/kW |
| Operation and maintenance cost | 1.6 cents/kW |

**Table S5.** Results of the thermal generation units’ optimal 24-h DED using PSO.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | 1 | 2 | 3 | 4 | 5 | 6 |  |
| 1 | 50.011 | 44.002 | 20.000 | 18.007 | 14.011 | 32.000 | 494.957 |
| 2 | 100.005 | 34.405 | 18.551 | 11.586 | 10.381 | 24.008 | 543.062 |
| 3 | 134.980 | 41.621 | 18.185 | 13.907 | 10.071 | 16.009 | 629.945 |
| 4 | 169.895 | 47.345 | 20.432 | 12.876 | 13.065 | 12.000 | 761.234 |
| 5 | 169.914 | 55.528 | 21.053 | 19.662 | 12.648 | 12.648 | 828.217 |
| 6 | 192.099 | 39.694 | 15.144 | 12.662 | 10.006 | 12.000 | 774.062 |
| 7 | 146.591 | 50.795 | 19.726 | 15.291 | 10.370 | 12.000 | 691.902 |
| 8 | 135.842 | 34.795 | 16.087 | 10.056 | 10.028 | 12.005 | 578.326 |
| 9 | 122.681 | 26.925 | 15.083 | 10.015 | 10.000 | 12.000 | 516.952 |
| 10 | 88.543 | 27.209 | 15.679 | 10.030 | 10.000 | 12.022 | 418.484 |
| 11 | 80.666 | 23.334 | 16.068 | 10.000 | 10.324 | 12.000 | 382.575 |
| 12 | 95.599 | 20.074 | 15.101 | 10.000 | 10.000 | 12.000 | 419.941 |
| 13 | 106.156 | 20.000 | 15.000 | 10.000 | 10.001 | 12.000 | 446.803 |
| 14 | 122.019 | 20.161 | 15.013 | 10.032 | 10.034 | 12.002 | 488.066 |
| 15 | 146.610 | 20.000 | 15.003 | 10.020 | 10.019 | 12.001 | 557.027 |
| 16 | 172.554 | 20.000 | 15.011 | 10.000 | 10.011 | 12.000 | 639.162 |
| 17 | 182.029 | 25.530 | 15.000 | 10.020 | 10.009 | 12.030 | 696.963 |
| 18 | 152.434 | 41.423 | 18.882 | 13.131 | 10.251 | 12.008 | 680.084 |
| 19 | 171.251 | 25.523 | 15.193 | 10.008 | 10.037 | 12.000 | 652.962 |
| 20 | 133.049 | 41.523 | 19.175 | 12.033 | 10.515 | 12.432 | 623.372 |
| 21 | 136.610 | 25.523 | 15.044 | 10.000 | 10.053 | 12.069 | 550.330 |
| 22 | 107.203 | 30.067 | 16.210 | 10.000 | 10.010 | 12.063 | 483.275 |
| 23 | 95.600 | 20.067 | 15.290 | 10.000 | 10.378 | 12.395 | 422.820 |
| 24 | 62.627 | 22.176 | 15.562 | 10.008 | 10.000 | 12.140 | 333.089 |

**Table S6A.** Hourly output power of generation units in the optimal 24-h DED without DSM under the abundant solar condition at 10% solar penetration of Load 1.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | Solar PV |  |
| 1 | 152.172 | 136.078 | 77.128 | 100.150 | 149.841 | 155.797 | 126.592 | 90.385 | 20.024 | 55.000 | 0.000 | 28775.26 |
| 2 | 150.429 | 216.078 | 73.003 | 114.204 | 149.509 | 160.000 | 96.594 | 98.697 | 20.000 | 55.000 | 0.000 | 30965.86 |
| 3 | 226.624 | 223.345 | 119.022 | 124.621 | 149.376 | 160.000 | 103.125 | 107.009 | 20.000 | 55.000 | 0.000 | 34449.15 |
| 4 | 303.230 | 230.606 | 174.997 | 135.103 | 149.242 | 159.780 | 109.652 | 77.010 | 49.998 | 55.000 | 0.000 | 37733.85 |
| 5 | 299.869 | 237.875 | 254.950 | 185.103 | 149.138 | 125.463 | 116.185 | 47.278 | 52.078 | 55.000 | 0.000 | 39938.07 |
| 6 | 373.073 | 245.146 | 297.973 | 195.530 | 149.006 | 141.028 | 122.768 | 47.027 | 54.135 | 55.000 | 0.000 | 42652.91 |
| 7 | 293.102 | 324.059 | 251.415 | 213.215 | 197.193 | 147.773 | 129.407 | 101.952 | 25.010 | 55.000 | 0.003 | 44174.16 |
| 8 | 289.822 | 331.267 | 305.746 | 223.520 | 172.238 | 159.990 | 129.824 | 110.312 | 49.950 | 55.000 | 8.718 | 46356.89 |
| 9 | 363.028 | 411.236 | 337.328 | 233.201 | 221.964 | 109.996 | 99.824 | 80.313 | 52.012 | 55.000 | 32.865 | 49872.59 |
| 10 | 436.276 | 418.498 | 338.557 | 243.620 | 221.803 | 125.446 | 106.352 | 88.635 | 54.026 | 55.000 | 66.447 | 53046.08 |
| 11 | 432.899 | 425.764 | 334.998 | 254.034 | 221.670 | 140.896 | 112.883 | 96.946 | 56.082 | 55.000 | 100.346 | 54542.84 |
| 12 | 429.558 | 433.157 | 339.546 | 266.585 | 242.766 | 159.321 | 119.595 | 67.003 | 58.164 | 55.000 | 137.151 | 56210.41 |
| 13 | 426.155 | 440.443 | 259.546 | 276.861 | 192.767 | 160.000 | 89.632 | 85.310 | 28.172 | 55.000 | 135.445 | 52424.05 |
| 14 | 346.303 | 447.705 | 290.117 | 226.865 | 192.634 | 110.009 | 96.162 | 93.621 | 20.002 | 55.000 | 112.972 | 48900.71 |
| 15 | 342.916 | 367.705 | 231.667 | 237.331 | 142.750 | 125.838 | 103.220 | 63.679 | 20.034 | 55.000 | 140.826 | 45342.97 |
| 16 | 339.540 | 287.728 | 262.418 | 187.357 | 92.751 | 141.326 | 73.263 | 47.000 | 20.002 | 55.000 | 91.062 | 40292.22 |
| 17 | 336.109 | 294.978 | 182.421 | 194.663 | 73.000 | 156.774 | 43.302 | 47.000 | 49.923 | 55.000 | 86.545 | 39044.00 |
| 18 | 409.152 | 374.978 | 214.556 | 205.035 | 73.157 | 106.816 | 56.538 | 76.988 | 52.024 | 55.000 | 56.962 | 43309.21 |
| 19 | 405.784 | 382.256 | 277.426 | 215.448 | 122.904 | 156.816 | 63.084 | 85.309 | 54.083 | 55.000 | 21.355 | 46782.44 |
| 20 | 469.931 | 459.894 | 313.377 | 264.944 | 172.818 | 159.977 | 92.959 | 115.135 | 56.331 | 55.000 | 0.115 | 54930.50 |
| 21 | 466.555 | 379.907 | 298.177 | 275.376 | 172.700 | 110.360 | 99.496 | 85.140 | 58.375 | 55.000 | 0.000 | 50353.92 |
| 22 | 463.185 | 300.107 | 218.177 | 256.061 | 146.501 | 60.360 | 69.496 | 55.181 | 60.408 | 55.000 | 0.000 | 44018.04 |
| 23 | 383.264 | 220.107 | 196.037 | 206.095 | 96.513 | 57.000 | 39.507 | 85.179 | 30.408 | 55.000 | 0.000 | 36847.07 |
| 24 | 303.388 | 140.177 | 132.892 | 216.941 | 122.892 | 106.994 | 20.009 | 93.540 | 20.010 | 55.000 | 0.000 | 33469.13 |

**Table S6B.** Hourly output power of generation units in the optimal 24-h DED without DSM under the abundant solar condition at 10% solar penetration of Load 2.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | Solar PV |  |
| 1 | 436.618 | 457.264 | 331.487 | 268.622 | 229.879 | 159.957 | 126.539 | 80.010 | 45.036 | 55.000 | 0.000 | 53780.37 |
| 2 | 356.724 | 377.340 | 276.158 | 218.639 | 179.902 | 110.090 | 130.000 | 88.284 | 20.114 | 55.000 | 0.000 | 45688.16 |
| 3 | 276.724 | 384.608 | 212.141 | 168.929 | 179.783 | 127.334 | 129.999 | 96.585 | 20.005 | 55.000 | 0.000 | 42103.91 |
| 4 | 273.322 | 304.643 | 190.064 | 179.323 | 179.647 | 77.334 | 129.968 | 104.899 | 49.957 | 55.000 | 0.000 | 40424.56 |
| 5 | 346.571 | 384.643 | 241.840 | 189.720 | 229.376 | 122.456 | 130.000 | 113.211 | 52.052 | 55.000 | 0.000 | 47342.97 |
| 6 | 266.571 | 392.065 | 161.840 | 171.394 | 229.287 | 126.915 | 100.013 | 83.225 | 50.005 | 55.000 | 0.000 | 42366.80 |
| 7 | 237.926 | 387.258 | 236.930 | 151.020 | 179.396 | 97.021 | 129.298 | 91.600 | 20.024 | 55.000 | 0.005 | 40114.59 |
| 8 | 157.926 | 394.530 | 292.886 | 101.060 | 179.293 | 69.690 | 99.315 | 61.679 | 20.000 | 55.000 | 7.581 | 37570.01 |
| 9 | 150.007 | 401.822 | 212.914 | 117.267 | 129.293 | 57.018 | 69.315 | 85.269 | 20.002 | 55.000 | 36.188 | 35122.67 |
| 10 | 150.000 | 321.865 | 136.327 | 127.835 | 79.332 | 57.050 | 75.859 | 93.581 | 49.983 | 55.000 | 77.825 | 32846.32 |
| 11 | 150.003 | 241.867 | 184.462 | 138.003 | 73.018 | 57.000 | 82.389 | 101.889 | 20.001 | 55.000 | 19.060 | 30683.32 |
| 12 | 150.023 | 161.953 | 104.519 | 148.454 | 73.010 | 57.040 | 88.951 | 71.915 | 20.021 | 55.000 | 85.278 | 28029.68 |
| 13 | 150.062 | 135.000 | 73.069 | 158.973 | 73.534 | 59.038 | 58.954 | 47.008 | 20.000 | 55.000 | 82.931 | 25979.53 |
| 14 | 150.098 | 135.000 | 73.000 | 108.985 | 73.667 | 57.076 | 65.490 | 47.000 | 20.127 | 55.000 | 26.979 | 23902.33 |
| 15 | 150.077 | 135.000 | 73.178 | 60.041 | 73.000 | 57.000 | 35.492 | 47.184 | 20.155 | 55.000 | 63.532 | 22837.01 |
| 16 | 150.027 | 135.002 | 73.000 | 60.085 | 73.001 | 57.000 | 20.000 | 47.000 | 20.000 | 55.000 | 49.090 | 22331.91 |
| 17 | 150.001 | 135.000 | 73.047 | 60.011 | 73.001 | 57.029 | 20.003 | 47.000 | 20.286 | 55.000 | 19.152 | 21837.20 |
| 18 | 226.616 | 135.032 | 73.000 | 60.000 | 73.297 | 57.000 | 49.997 | 47.000 | 20.096 | 55.000 | 15.950 | 24112.36 |
| 19 | 150.555 | 214.921 | 73.003 | 109.734 | 73.789 | 96.057 | 56.531 | 47.037 | 20.044 | 55.000 | 19.558 | 26641.24 |
| 20 | 226.615 | 222.267 | 143.320 | 120.404 | 73.001 | 122.448 | 63.062 | 47.002 | 50.039 | 55.000 | 0.558 | 31035.41 |
| 21 | 226.699 | 229.537 | 195.160 | 130.779 | 73.046 | 149.224 | 69.625 | 47.027 | 52.105 | 55.000 | 0.000 | 33071.73 |
| 22 | 303.412 | 236.618 | 241.578 | 141.096 | 123.046 | 159.927 | 76.330 | 47.196 | 54.175 | 55.000 | 0.000 | 37555.18 |
| 23 | 376.662 | 316.611 | 283.441 | 151.508 | 122.911 | 159.996 | 82.862 | 47.006 | 56.237 | 55.000 | 0.000 | 42548.99 |
| 24 | 373.301 | 396.609 | 327.993 | 161.931 | 122.876 | 127.628 | 89.407 | 47.003 | 58.290 | 55.000 | 0.000 | 45022.80 |

**Table S6C.** Hourly output power of generation units in the optimal 24-h DED without DSM under the abundant solar condition at 10% solar penetration of Load 3.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | Solar PV |  |
| 1 | 150.122 | 221.970 | 182.555 | 127.922 | 149.872 | 143.517 | 108.221 | 70.015 | 20.564 | 55.000 | 0.000 | 32856.01 |
| 2 | 150.000 | 229.935 | 186.997 | 77.976 | 150.000 | 94.337 | 112.052 | 47.065 | 20.256 | 55.000 | 0.000 | 30501.34 |
| 3 | 150.209 | 149.992 | 118.945 | 121.909 | 150.001 | 58.900 | 120.512 | 47.072 | 49.854 | 55.000 | 0.000 | 28708.35 |
| 4 | 227.692 | 136.915 | 196.000 | 132.223 | 149.924 | 106.993 | 125.236 | 47.003 | 52.222 | 55.000 | 0.000 | 32989.48 |
| 5 | 303.911 | 216.096 | 224.755 | 141.600 | 150.001 | 123.619 | 96.551 | 76.966 | 53.999 | 55.000 | 0.000 | 37900.53 |
| 6 | 377.759 | 295.058 | 302.938 | 190.964 | 149.771 | 141.111 | 101.288 | 85.301 | 55.897 | 55.000 | 0.000 | 45298.87 |
| 7 | 450.007 | 302.435 | 336.093 | 228.877 | 199.096 | 157.458 | 129.990 | 55.694 | 58.356 | 55.000 | 0.003 | 49488.78 |
| 8 | 446.983 | 222.605 | 263.528 | 239.283 | 242.961 | 107.458 | 100.103 | 47.260 | 28.853 | 55.000 | 4.819 | 44594.66 |
| 9 | 444.746 | 142.734 | 189.534 | 189.283 | 193.173 | 123.667 | 70.103 | 47.000 | 51.991 | 55.000 | 36.029 | 39884.36 |
| 10 | 364.746 | 135.094 | 109.534 | 139.647 | 143.177 | 139.116 | 76.632 | 76.838 | 22.005 | 55.000 | 69.363 | 34951.35 |
| 11 | 286.241 | 135.010 | 76.960 | 149.839 | 142.979 | 91.334 | 83.186 | 85.320 | 20.032 | 55.000 | 98.491 | 32540.37 |
| 12 | 206.246 | 135.004 | 73.046 | 99.846 | 92.979 | 57.014 | 53.186 | 93.638 | 20.003 | 55.000 | 88.922 | 27273.60 |
| 13 | 150.520 | 135.000 | 73.418 | 60.014 | 73.000 | 57.010 | 59.462 | 101.980 | 20.063 | 55.000 | 76.638 | 24769.50 |
| 14 | 226.553 | 135.144 | 73.061 | 60.000 | 73.000 | 57.005 | 65.982 | 72.003 | 20.002 | 55.000 | 76.215 | 25807.78 |
| 15 | 303.212 | 215.144 | 133.127 | 60.005 | 73.002 | 57.143 | 72.571 | 85.369 | 49.941 | 55.000 | 120.527 | 32936.36 |
| 16 | 299.826 | 295.125 | 184.186 | 60.036 | 122.914 | 107.143 | 79.084 | 93.680 | 52.015 | 55.000 | 86.307 | 37437.13 |
| 17 | 373.088 | 375.027 | 223.435 | 110.036 | 172.712 | 123.941 | 85.614 | 101.938 | 54.087 | 55.000 | 79.116 | 44434.54 |
| 18 | 446.348 | 455.027 | 275.860 | 120.480 | 172.606 | 139.975 | 92.170 | 110.243 | 56.133 | 55.000 | 48.826 | 49240.00 |
| 19 | 443.138 | 376.082 | 232.531 | 130.942 | 172.711 | 90.232 | 98.355 | 118.779 | 26.579 | 55.000 | 17.350 | 44606.99 |
| 20 | 438.680 | 383.364 | 152.535 | 81.041 | 168.321 | 57.004 | 104.875 | 88.780 | 20.010 | 55.000 | 0.000 | 39898.01 |
| 21 | 358.697 | 390.525 | 124.513 | 60.002 | 168.193 | 57.000 | 111.427 | 97.102 | 20.273 | 55.000 | 0.000 | 37741.98 |
| 22 | 278.717 | 310.671 | 192.590 | 60.038 | 122.277 | 62.124 | 118.120 | 67.102 | 20.085 | 55.000 | 0.000 | 33917.75 |
| 23 | 198.883 | 318.013 | 121.149 | 110.030 | 73.000 | 57.307 | 124.668 | 47.000 | 20.000 | 55.000 | 0.000 | 30672.11 |
| 24 | 150.000 | 325.277 | 97.528 | 60.048 | 73.014 | 67.907 | 94.668 | 47.000 | 50.000 | 55.000 | 0.000 | 28782.88 |

**Table S7A.** Hourly output power of generation units in the optimal 24-h DED without DSM under the abundant solar condition at 30% solar penetration of Load 1.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | Solar PV |  |
| 1 | 150.004 | 135.009 | 73.000 | 150.619 | 100.000 | 155.382 | 126.538 | 90.022 | 20.049 | 55.000 | 0.000 | 29004.58 |
| 2 | 150.000 | 214.981 | 78.812 | 161.142 | 122.867 | 105.435 | 96.538 | 98.336 | 50.018 | 55.000 | 0.000 | 31322.86 |
| 3 | 226.635 | 222.273 | 105.246 | 171.573 | 122.880 | 122.521 | 103.250 | 106.644 | 52.078 | 55.000 | 0.000 | 34630.57 |
| 4 | 303.247 | 229.538 | 123.520 | 181.981 | 172.731 | 137.972 | 109.779 | 76.655 | 54.136 | 55.000 | 0.000 | 37969.32 |
| 5 | 299.848 | 236.817 | 186.202 | 192.383 | 172.591 | 153.383 | 116.326 | 85.306 | 24.259 | 55.000 | 0.000 | 39064.70 |
| 6 | 296.467 | 316.817 | 218.399 | 202.780 | 222.325 | 131.485 | 122.858 | 93.617 | 20.000 | 55.000 | 0.000 | 43121.37 |
| 7 | 293.060 | 324.088 | 251.661 | 213.221 | 222.211 | 147.604 | 129.387 | 101.931 | 20.003 | 55.000 | 0.032 | 44173.20 |
| 8 | 366.201 | 331.704 | 288.921 | 163.221 | 222.942 | 159.820 | 129.942 | 72.071 | 72.071 | 55.000 | 26.146 | 45736.34 |
| 9 | 439.431 | 338.972 | 321.030 | 113.222 | 222.810 | 159.969 | 99.942 | 85.307 | 20.138 | 55.000 | 134.418 | 48486.62 |
| 10 | 436.080 | 346.367 | 340.000 | 123.684 | 222.726 | 117.782 | 106.497 | 93.624 | 50.078 | 55.000 | 248.894 | 51553.35 |
| 11 | 432.687 | 353.635 | 331.591 | 73.691 | 222.573 | 133.219 | 113.034 | 101.950 | 52.187 | 55.000 | 343.751 | 52484.35 |
| 12 | 429.300 | 433.630 | 251.591 | 60.002 | 222.438 | 148.668 | 119.561 | 110.260 | 54.235 | 55.000 | 404.859 | 53788.55 |
| 13 | 425.681 | 353.630 | 171.593 | 60.038 | 222.275 | 159.313 | 126.107 | 118.549 | 24.235 | 55.000 | 412.213 | 49868.01 |
| 14 | 422.240 | 273.860 | 202.401 | 63.522 | 172.275 | 109.325 | 129.990 | 88.549 | 51.929 | 55.000 | 407.233 | 46751.55 |
| 15 | 418.847 | 281.115 | 234.323 | 60.000 | 172.141 | 124.772 | 99.990 | 96.848 | 53.993 | 55.000 | 228.968 | 44519.29 |
| 16 | 338.894 | 288.314 | 154.417 | 60.000 | 171.961 | 140.121 | 106.540 | 66.848 | 24.218 | 55.000 | 186.519 | 39360.82 |
| 17 | 258.965 | 208.468 | 101.693 | 60.058 | 172.009 | 155.878 | 113.298 | 85.311 | 20.801 | 55.000 | 277.324 | 37293.32 |
| 18 | 332.770 | 222.311 | 181.318 | 60.099 | 221.550 | 159.989 | 120.433 | 93.836 | 50.801 | 55.000 | 171.098 | 41486.28 |
| 19 | 405.905 | 302.125 | 257.927 | 60.187 | 221.425 | 159.979 | 127.276 | 102.148 | 79.880 | 55.000 | 63.807 | 46593.89 |
| 20 | 469.565 | 382.118 | 337.855 | 110.075 | 242.965 | 159.981 | 129.862 | 119.778 | 79.878 | 55.000 | 3.389 | 216991.6 |
| 21 | 466.242 | 460.000 | 257.914 | 120.528 | 242.867 | 159.921 | 100.060 | 89.788 | 50.209 | 55.000 | 0.000 | 50026.04 |
| 22 | 386.242 | 380.001 | 264.041 | 70.529 | 192.867 | 110.112 | 106.590 | 98.096 | 20.209 | 55.000 | 0.000 | 42629.65 |
| 23 | 306.247 | 300.001 | 184.674 | 60.000 | 142.867 | 118.834 | 113.111 | 68.096 | 20.234 | 55.000 | 0.000 | 35564.49 |
| 24 | 302.868 | 307.267 | 104.674 | 60.007 | 92.868 | 102.470 | 83.111 | 85.307 | 20.000 | 55.000 | 0.000 | 32717.19 |

**Table S7B.** Hourly output power of generation units in the optimal 24-h DED without DSM under the abundant solar condition at 30% solar penetration of Load 2.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | Solar PV |  |
| 1 | 436.624 | 457.266 | 332.268 | 270.414 | 229.872 | 119.360 | 126.534 | 118.311 | 45.000 | 55.000 | 0.000 | 54171.71 |
| 2 | 356.636 | 377.266 | 252.272 | 220.414 | 179.872 | 134.719 | 96.624 | 88.311 | 50.696 | 55.000 | 0.000 | 45699.05 |
| 3 | 277.700 | 384.687 | 180.139 | 170.416 | 179.662 | 153.370 | 103.177 | 96.657 | 52.740 | 55.000 | 0.000 | 42131.75 |
| 4 | 198.111 | 391.878 | 226.443 | 120.417 | 179.538 | 104.313 | 109.715 | 104.973 | 54.788 | 55.000 | 0.000 | 39887.10 |
| 5 | 277.919 | 459.993 | 303.812 | 130.834 | 229.538 | 122.327 | 116.240 | 113.271 | 56.840 | 55.000 | 0.000 | 47823.50 |
| 6 | 274.541 | 379.995 | 316.928 | 140.613 | 179.538 | 72.331 | 122.769 | 83.276 | 26.849 | 55.000 | 0.000 | 42054.99 |
| 7 | 270.898 | 387.257 | 236.928 | 90.613 | 178.321 | 122.306 | 92.772 | 91.580 | 20.000 | 55.000 | 0.020 | 39496.03 |
| 8 | 267.568 | 307.257 | 186.944 | 60.130 | 178.348 | 137.908 | 99.850 | 99.945 | 20.000 | 55.000 | 24.994 | 37168.92 |
| 9 | 264.200 | 227.258 | 106.950 | 60.000 | 178.227 | 153.363 | 106.381 | 69.945 | 20.005 | 55.000 | 87.687 | 34152.00 |
| 10 | 184.213 | 234.501 | 73.041 | 60.169 | 178.142 | 103.401 | 112.915 | 47.007 | 20.000 | 55.000 | 153.471 | 31600.80 |
| 11 | 150.001 | 154.524 | 74.577 | 60.251 | 128.144 | 122.473 | 119.448 | 76.953 | 38.824 | 55.000 | 138.869 | 29953.92 |
| 12 | 150.000 | 135.009 | 73.181 | 60.014 | 128.011 | 137.933 | 125.976 | 47.001 | 20.028 | 55.000 | 83.693 | 27338.41 |
| 13 | 150.026 | 135.048 | 73.082 | 60.125 | 78.121 | 153.365 | 95.976 | 47.000 | 49.991 | 55.000 | 17.452 | 25792.40 |
| 14 | 150.304 | 135.018 | 73.066 | 60.095 | 73.164 | 103.365 | 66.128 | 47.000 | 20.030 | 55.000 | 28.084 | 23603.05 |
| 15 | 150.001 | 135.007 | 73.004 | 60.000 | 73.007 | 57.000 | 36.274 | 47.615 | 20.000 | 55.000 | 63.331 | 22835.22 |
| 16 | 150.005 | 135.080 | 73.100 | 60.041 | 73.026 | 57.024 | 56.549 | 47.016 | 20.027 | 55.000 | 13.382 | 22352.93 |
| 17 | 150.119 | 135.514 | 73.003 | 60.008 | 75.836 | 57.000 | 26.559 | 47.000 | 20.090 | 55.000 | 12.599 | 21840.67 |
| 18 | 150.000 | 135.025 | 73.000 | 60.012 | 73.033 | 57.037 | 20.000 | 47.022 | 50.050 | 55.000 | 89.788 | 23874.12 |
| 19 | 150.000 | 135.051 | 73.367 | 109.949 | 123.033 | 57.060 | 20.000 | 77.022 | 52.134 | 55.000 | 60.615 | 26777.11 |
| 20 | 150.000 | 214.949 | 153.325 | 120.429 | 172.766 | 65.177 | 49.983 | 85.330 | 54.192 | 55.000 | 1.814 | 31748.52 |
| 21 | 226.626 | 222.239 | 188.169 | 130.851 | 172.640 | 58.113 | 56.538 | 93.643 | 24.192 | 55.000 | 0.000 | 33217.85 |
| 22 | 303.331 | 229.559 | 216.011 | 138.683 | 222.377 | 57.000 | 63.064 | 101.958 | 52.109 | 55.000 | 0.000 | 38008.48 |
| 23 | 376.357 | 236.830 | 295.928 | 149.169 | 222.338 | 58.346 | 93.029 | 110.320 | 54.143 | 55.000 | 0.000 | 43027.27 |
| 24 | 449.165 | 244.127 | 331.567 | 159.408 | 222.217 | 61.464 | 99.624 | 80.340 | 56.199 | 55.000 | 0.000 | 44794.98 |

**Table S7C.** Hourly output power of generation units in the optimal 24-h DED without DSM under the abundant solar condition at 30% solar penetration of Load 3.

|  |  |  |
| --- | --- | --- |
| Time (h) | Generator power (MW) | Cost ($/h) |
|  | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | Solar PV |  |
| 1 | 150.000 | 222.270 | 181.635 | 126.975 | 149.872 | 144.517 | 106.527 | 70.000 | 55.000 | 55.000 | 0.000 | 32846.48 |
| 2 | 150.000 | 229.535 | 187.297 | 76.976 | 149.754 | 94.538 | 113.055 | 47.000 | 20.065 | 55.000 | 0.000 | 30455.57 |
| 3 | 150.109 | 149.592 | 118.847 | 120.509 | 149.679 | 58.670 | 119.630 | 47.000 | 50.053 | 55.000 | 0.000 | 28608.34 |
| 4 | 226.692 | 135.215 | 195.900 | 131.253 | 149.481 | 107.235 | 126.136 | 47.189 | 52.125 | 55.000 | 0.000 | 33019.48 |
| 5 | 303.211 | 215.196 | 223.738 | 141.600 | 149.333 | 122.709 | 96.136 | 77.189 | 54.176 | 55.000 | 0.000 | 37869.02 |
| 6 | 376.759 | 295.158 | 303.738 | 191.564 | 149.361 | 141.813 | 102.731 | 85.694 | 56.301 | 55.000 | 0.000 | 45300.07 |
| 7 | 450.009 | 375.158 | 326.766 | 199.310 | 149.227 | 157.264 | 109.261 | 93.999 | 58.351 | 55.000 | 0.010 | 49469.07 |
| 8 | 446.665 | 295.192 | 256.864 | 210.352 | 149.441 | 114.551 | 115.949 | 64.135 | 28.413 | 55.000 | 22.614 | 44370.69 |
| 9 | 366.674 | 215.192 | 289.028 | 160.352 | 149.311 | 64.552 | 122.461 | 47.000 | 20.004 | 55.000 | 52.996 | 39291.17 |
| 10 | 362.965 | 135.557 | 209.126 | 110.357 | 99.329 | 57.013 | 128.956 | 47.002 | 20.079 | 55.000 | 104.822 | 34371.08 |
| 11 | 282.992 | 135.000 | 241.492 | 60.668 | 73.022 | 57.434 | 99.443 | 47.024 | 20.019 | 55.000 | 151.846 | 31783.69 |
| 12 | 203.002 | 135.002 | 161.508 | 60.001 | 73.000 | 57.000 | 69.956 | 69.518 | 20.062 | 55.000 | 71.881 | 27400.92 |
| 13 | 150.000 | 135.000 | 81.508 | 60.025 | 73.000 | 57.625 | 76.489 | 47.011 | 20.000 | 55.000 | 105.191 | 24387.00 |
| 14 | 226.597 | 135.013 | 73.000 | 60.000 | 73.009 | 57.000 | 46.574 | 47.000 | 20.000 | 55.000 | 119.401 | 25601.17 |
| 15 | 152.421 | 135.326 | 85.007 | 109.537 | 122.844 | 70.346 | 58.429 | 49.609 | 20.059 | 55.000 | 361.580 | 31301.44 |
| 16 | 226.577 | 215.326 | 164.127 | 120.296 | 122.869 | 57.136 | 64.938 | 79.595 | 20.015 | 55.000 | 298.369 | 36265.58 |
| 17 | 303.270 | 295.252 | 196.278 | 166.319 | 172.597 | 107.130 | 71.454 | 87.897 | 49.687 | 55.000 | 237.304 | 43871.52 |
| 18 | 376.513 | 375.251 | 261.084 | 176.854 | 222.337 | 122.636 | 77.980 | 96.209 | 52.062 | 55.000 | 146.610 | 48794.08 |
| 19 | 373.151 | 295.251 | 271.325 | 185.408 | 172.371 | 138.041 | 84.452 | 104.455 | 54.096 | 55.000 | 20.371 | 44581.22 |
| 20 | 293.191 | 302.532 | 307.352 | 137.223 | 172.323 | 88.041 | 91.085 | 74.458 | 24.096 | 55.000 | 1.664 | 39663.47 |
| 21 | 213.191 | 309.737 | 227.352 | 118.110 | 172.194 | 122.450 | 97.622 | 85.316 | 37.117 | 55.000 | 0.000 | 37776.21 |
| 22 | 150.019 | 229.737 | 259.017 | 123.592 | 172.054 | 72.450 | 104.154 | 93.627 | 20.000 | 55.000 | 0.000 | 33995.10 |
| 23 | 193.271 | 149.737 | 179.017 | 133.966 | 122.616 | 57.961 | 110.686 | 102.077 | 20.000 | 55.000 | 0.000 | 31118.68 |
| 24 | 226.802 | 135.024 | 104.188 | 144.358 | 73.013 | 71.699 | 117.283 | 72.104 | 20.000 | 55.000 | 0.000 | 28615.07 |