

## Supplementary materials

**Table S1** Inventory for construction schemes of transmission lines under 110 kV

| Number | Scheme number | Terrain     | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|-------------|--------------|------------------------------------|---|
| 1      | 1AP           | Flatland    | 5.04E+01     | 2.11E+03                           | 4.19E+01  |
| 2      | 1AH           | River swamp | 3.25E+01     | 1.91E+03                           | 5.88E+01  |
| 3      | 1AQ           | Hill        | 5.00E+01     | 2.24E+03                           | 4.47E+01  |
| 4      | 1BP           | Flatland    | 5.04E+01     | 2.36E+03                           | 4.68E+01  |
| 5      | 1BH           | River swamp | 3.25E+01     | 2.18E+03                           | 6.70E+01  |
| 6      | 1BQ           | Hill        | 5.00E+01     | 2.48E+03                           | 4.96E+01  |
| 7      | 1CP           | Flatland    | 5.04E+01     | 2.84E+03                           | 5.64E+01  |
| 8      | 1CQ           | Hill        | 5.00E+01     | 3.11E+03                           | 6.21E+01  |
| 9      | 1DP           | Flatland    | 5.04E+01     | 2.94E+03                           | 5.83E+01  |
| 10     | 1DQ           | Hill        | 5.00E+01     | 3.20E+03                           | 6.40E+01  |
| 11     | 1EP           | Flatland    | 5.04E+01     | 3.07E+03                           | 6.09E+01  |
| 12     | 1EH           | River swamp | 3.25E+01     | 2.90E+03                           | 8.91E+01  |
| 13     | 1EQ           | Hill        | 5.00E+01     | 3.36E+03                           | 6.71E+01  |
| 14     | 1FP           | Flatland    | 5.04E+01     | 3.14E+03                           | 6.24E+01  |
| 15     | 1FQ           | Hill        | 5.00E+01     | 3.43E+03                           | 6.86E+01  |
| 16     | 1GP           | Flatland    | 5.04E+01     | 3.11E+03                           | 6.17E+01  |
| 17     | 1GH           | River swamp | 3.25E+01     | 2.68E+03                           | 8.25E+01  |
| 18     | 1GQ           | Hill        | 5.00E+01     | 3.21E+03                           | 6.41E+01  |
| 19     | 1HP           | Flatland    | 5.04E+01     | 3.47E+03                           | 6.89E+01  |
| 20     | 1HH           | River swamp | 3.25E+01     | 2.90E+03                           | 8.92E+01  |
| 21     | 1HQ           | Hill        | 5.00E+01     | 3.55E+03                           | 7.10E+01  |
| 22     | 1IP           | Flatland    | 5.04E+01     | 4.50E+03                           | 8.93E+01  |
| 23     | 1IH           | River swamp | 3.25E+01     | 3.69E+03                           | 1.13E+02  |
| 24     | 1IQ           | Hill        | 5.00E+01     | 4.44E+03                           | 8.88E+01  |
| 25     | 1JP           | Flatland    | 5.04E+01     | 4.62E+03                           | 9.17E+01  |
| 26     | 1JH           | River swamp | 3.25E+01     | 3.89E+03                           | 1.20E+02  |
| 27     | 1JQ           | Hill        | 5.00E+01     | 4.62E+03                           | 9.23E+01  |
| 28     | 1KP           | Flatland    | 5.04E+01     | 4.94E+03                           | 9.81E+01  |
| 29     | 1KH           | River swamp | 3.25E+01     | 4.11E+03                           | 1.26E+02  |
| 30     | 1KQ           | Hill        | 5.00E+01     | 5.04E+03                           | 1.01E+02  |
| 31     | 1LP           | Flatland    | 5.04E+01     | 5.16E+03                           | 1.02E+02  |
| 32     | 1LH           | River swamp | 3.25E+01     | 4.40E+03                           | 1.35E+02  |
| 33     | 1LQ           | Hill        | 5.00E+01     | 5.22E+03                           | 1.04E+02  |
| 34     | 1MP           | Flatland    | 8.47E+00     | 9.95E+02                           | 1.18E+02  |
| 35     | 1RP           | Flatland    | 5.04E+01     | 3.76E+03                           | 7.47E+01  |
| 36     | 1RH           | River swamp | 3.25E+01     | 3.15E+03                           | 9.68E+01  |
| 37     | 1RQ           | Hill        | 5.00E+01     | 3.76E+03                           | 7.51E+01  |
| 38     | 1TP           | Flatland    | 5.04E+01     | 4.05E+03                           | 8.04E+01  |

|    |     |             |          |          |          |
|----|-----|-------------|----------|----------|----------|
| 39 | 1TH | River swamp | 3.25E+01 | 3.39E+03 | 1.04E+02 |
| 40 | 1TQ | Hill        | 5.00E+01 | 4.04E+03 | 8.08E+01 |

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**Table S2** Inventory for construction schemes of transmission lines under 220 kV

| Number | Scheme number | Terrain       | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|---------------|--------------|------------------------------------|---|
| 1      | 2AP           | Flatland      | 5.00E+01     | 3.72E+03                           | 7.45E+01  |
| 2      | 2AH           | River swamp   | 5.69E+01     | 5.71E+03                           | 1.00E+02  |
| 3      | 2AQ           | Hill          | 5.00E+01     | 4.00E+03                           | 8.00E+01  |
| 4      | 2AS           | Mountain land | 5.42E+01     | 4.93E+03                           | 9.10E+01  |
| 5      | 2AG           | Plateau       | 5.28E+01     | 5.56E+03                           | 1.05E+02  |
| 6      | 2BP           | Flatland      | 5.00E+01     | 4.14E+03                           | 8.27E+01  |
| 7      | 2BH           | River swamp   | 5.69E+01     | 6.25E+03                           | 1.10E+02  |
| 8      | 2BQ           | Hill          | 5.00E+01     | 4.49E+03                           | 8.98E+01  |
| 9      | 2BS           | Mountain land | 5.42E+01     | 5.46E+03                           | 1.01E+02  |
| 10     | 2BG           | Plateau       | 5.28E+01     | 6.04E+03                           | 1.14E+02  |
| 11     | 2CP           | Flatland      | 5.00E+01     | 3.62E+03                           | 7.24E+01  |
| 12     | 2CH           | River swamp   | 5.69E+01     | 5.58E+03                           | 9.81E+01  |
| 13     | 2CQ           | Hill          | 5.00E+01     | 3.91E+03                           | 7.82E+01  |
| 14     | 2CS           | Mountain land | 5.42E+01     | 4.89E+03                           | 9.03E+01  |
| 15     | 2CG           | Plateau       | 5.28E+01     | 5.55E+03                           | 1.05E+02  |
| 16     | 2DP           | Flatland      | 5.00E+01     | 3.93E+03                           | 7.86E+01  |
| 17     | 2DH           | River swamp   | 5.69E+01     | 5.82E+03                           | 1.02E+02  |
| 18     | 2DQ           | Hill          | 5.00E+01     | 4.07E+03                           | 8.13E+01  |
| 19     | 2DS           | Mountain land | 5.42E+01     | 5.01E+03                           | 9.25E+01  |
| 20     | 2DG           | Plateau       | 5.28E+01     | 5.66E+03                           | 1.07E+02  |
| 21     | 2EP           | Flatland      | 5.00E+01     | 8.03E+03                           | 1.61E+02  |
| 22     | 2EH           | River swamp   | 5.69E+01     | 1.14E+04                           | 2.01E+02  |
| 23     | 2EQ           | Hill          | 5.00E+01     | 8.45E+03                           | 1.69E+02  |
| 24     | 2FP           | Flatland      | 5.00E+01     | 5.90E+03                           | 1.18E+02  |
| 25     | 2FH           | River swamp   | 5.69E+01     | 9.18E+03                           | 1.61E+02  |
| 26     | 2FQ           | Hill          | 5.00E+01     | 6.39E+03                           | 1.28E+02  |
| 27     | 2FS           | Mountain land | 5.42E+01     | 7.96E+03                           | 1.47E+02  |
| 28     | 2FG           | Plateau       | 5.28E+01     | 9.02E+03                           | 1.71E+02  |
| 29     | 2GP           | Flatland      | 5.00E+01     | 6.85E+03                           | 1.37E+02  |
| 30     | 2GH           | River swamp   | 5.69E+01     | 1.07E+04                           | 1.87E+02  |
| 31     | 2GQ           | Hill          | 5.00E+01     | 7.47E+03                           | 1.49E+02  |
| 32     | 2GS           | Mountain land | 5.42E+01     | 8.88E+03                           | 1.64E+02  |
| 33     | 2GG           | Plateau       | 5.28E+01     | 1.02E+04                           | 1.92E+02  |
| 34     | 2HP           | Flatland      | 5.00E+01     | 7.54E+03                           | 1.51E+02  |
| 35     | 2HH           | River swamp   | 5.69E+01     | 1.25E+04                           | 2.19E+02  |
| 36     | 2HQ           | Hill          | 5.00E+01     | 8.06E+03                           | 1.61E+02  |
| 37     | 2HS           | Mountain land | 5.42E+01     | 9.71E+03                           | 1.79E+02  |
| 38     | 2HG           | Plateau       | 5.28E+01     | 1.09E+04                           | 2.07E+02  |
| 39     | 2IP           | Flatland      | 5.00E+01     | 6.51E+03                           | 1.30E+02  |
| 40     | 2IH           | River swamp   | 5.69E+01     | 9.74E+03                           | 1.71E+02  |
| 41     | 2IQ           | Hill          | 5.00E+01     | 7.14E+03                           | 1.43E+02  |

**Table S3** Inventory for construction schemes of transmission lines under 330 kV

| Number | Scheme number | Terrain       | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|---------------|--------------|------------------------------------|---|
| 1      | 3AP           | Flatland      | 8.30E+01     | 6.52E+03                           | 7.86E+01  |
| 2      | 3BP           | Flatland      | 8.30E+01     | 6.82E+03                           | 8.21E+01  |
| 3      | 3BM           | Desert        | 4.20E+01     | 4.01E+03                           | 9.55E+01  |
| 4      | 3BS           | Mountain land | 5.30E+01     | 5.00E+03                           | 9.44E+01  |
| 5      | 3BG           | Plateau       | 5.10E+01     | 5.44E+03                           | 1.07E+02  |
| 6      | 3CQ           | Hill          | 6.70E+01     | 5.96E+03                           | 8.89E+01  |
| 7      | 3CM           | Desert        | 4.20E+01     | 4.20E+03                           | 1.00E+02  |
| 8      | 3CS           | Mountain land | 5.30E+01     | 5.12E+03                           | 9.67E+01  |
| 9      | 3CG           | Plateau       | 5.10E+01     | 5.64E+03                           | 1.11E+02  |
| 10     | 3DQ           | Hill          | 6.70E+01     | 6.05E+03                           | 9.02E+01  |
| 11     | 3DM           | Desert        | 4.20E+01     | 4.25E+03                           | 1.01E+02  |
| 12     | 3DS           | Mountain land | 5.30E+01     | 5.30E+03                           | 1.00E+02  |
| 13     | 3DG           | Plateau       | 5.10E+01     | 5.72E+03                           | 1.12E+02  |

**Table S4** Inventory for construction schemes of transmission lines under 500 kV

| Number | Scheme number | Terrain       | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|---------------|--------------|------------------------------------|---|
| 1      | 5AP           | Flatland      | 5.00E+01     | 6.66E+03                           | 1.33E+02  |
| 2      | 5AQ           | Hill          | 5.00E+01     | 7.00E+03                           | 1.40E+02  |
| 3      | 5AH           | River swamp   | 5.00E+01     | 8.36E+03                           | 1.67E+02  |
| 4      | 5AS           | Mountain land | 5.00E+01     | 8.09E+03                           | 1.62E+02  |
| 5      | 5AG           | Plateau       | 5.00E+01     | 9.06E+03                           | 1.81E+02  |
| 6      | 5BP           | Flatland      | 4.99E+01     | 6.76E+03                           | 1.35E+02  |
| 7      | 5BQ           | Hill          | 4.99E+01     | 7.09E+03                           | 1.42E+02  |
| 8      | 5BH           | River swamp   | 5.08E+01     | 8.67E+03                           | 1.71E+02  |
| 9      | 5BS           | Mountain land | 5.00E+01     | 8.30E+03                           | 1.66E+02  |
| 10     | 5BG           | Plateau       | 4.70E+01     | 8.78E+03                           | 1.87E+02  |
| 11     | 5CP           | Flatland      | 5.00E+01     | 8.06E+03                           | 1.61E+02  |
| 12     | 5CQ           | Hill          | 5.00E+01     | 8.41E+03                           | 1.68E+02  |
| 13     | 5CH           | River swamp   | 5.00E+01     | 1.08E+04                           | 2.16E+02  |
| 14     | 5CS           | Mountain land | 5.00E+01     | 9.56E+03                           | 1.91E+02  |
| 15     | 5CG           | Plateau       | 5.00E+01     | 1.09E+04                           | 2.18E+02  |
| 16     | 5DP           | Flatland      | 4.99E+01     | 1.28E+04                           | 2.57E+02  |
| 17     | 5DQ           | Hill          | 4.99E+01     | 1.34E+04                           | 2.68E+02  |
| 18     | 5DH           | River swamp   | 5.08E+01     | 1.63E+04                           | 3.20E+02  |
| 19     | 5DS           | Mountain land | 5.00E+01     | 1.57E+04                           | 3.14E+02  |
| 20     | 5DG           | Plateau       | 4.70E+01     | 1.62E+04                           | 3.46E+02  |
| 21     | 5EP           | Flatland      | 4.99E+01     | 1.30E+04                           | 2.61E+02  |
| 22     | 5EQ           | Hill          | 4.99E+01     | 1.36E+04                           | 2.72E+02  |
| 23     | 5EH           | River swamp   | 5.08E+01     | 1.69E+04                           | 3.33E+02  |
| 24     | 5ES           | Mountain land | 5.00E+01     | 1.59E+04                           | 3.17E+02  |
| 25     | 5EG           | Plateau       | 4.70E+01     | 1.67E+04                           | 3.56E+02  |
| 26     | 5FP           | Flatland      | 4.99E+01     | 1.36E+04                           | 2.72E+02  |
| 27     | 5FH           | River swamp   | 5.06E+01     | 1.81E+04                           | 3.59E+02  |
| 28     | 5FS           | Mountain land | 5.00E+01     | 1.71E+04                           | 3.43E+02  |
| 29     | 5FG           | Plateau       | 4.70E+01     | 1.81E+04                           | 3.86E+02  |
| 30     | 5GP           | Flatland      | 5.00E+01     | 1.59E+04                           | 3.17E+02  |
| 31     | 5GQ           | Hill          | 5.00E+01     | 1.64E+04                           | 3.28E+02  |
| 32     | 5GH           | River swamp   | 5.00E+01     | 2.03E+04                           | 4.07E+02  |
| 33     | 5GS           | Mountain land | 5.00E+01     | 1.91E+04                           | 3.82E+02  |
| 34     | 5GG           | Plateau       | 5.00E+01     | 2.14E+04                           | 4.28E+02  |
| 35     | 5HP           | Flatland      | 4.99E+01     | 1.67E+04                           | 3.34E+02  |
| 36     | 5HQ           | Hill          | 4.89E+01     | 1.69E+04                           | 3.45E+02  |
| 37     | 5HH           | River swamp   | 5.06E+01     | 2.26E+04                           | 4.47E+02  |
| 38     | 5HS           | Mountain land | 5.00E+01     | 2.10E+04                           | 4.19E+02  |
| 39     | 5HG           | Plateau       | 4.70E+01     | 2.17E+04                           | 4.62E+02  |
| 40     | 5IP           | Flatland      | 4.99E+01     | 2.73E+04                           | 5.47E+02  |
| 41     | 5IQ           | Hill          | 4.89E+01     | 2.77E+04                           | 5.65E+02  |

42            5IH            River swamp            5.06E+01            3.29E+04            6.51E+02

**Table S5** Inventory for construction schemes of transmission lines under 750 kV

| Number | Scheme number | Terrain       | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|---------------|--------------|------------------------------------|---|
| 1      | 7A1P          | Flatland      | 5.00E+01     | 1.04E+04                           | 2.08E+02  |
| 2      | 7A1Q          | Hill          | 5.00E+01     | 1.09E+04                           | 2.17E+02  |
| 3      | 7A1H          | River swamp   | 5.00E+01     | 1.24E+04                           | 2.47E+02  |
| 4      | 7A1S          | Mountain land | 5.00E+01     | 1.23E+04                           | 2.45E+02  |
| 5      | 7A1G          | Plateau       | 5.00E+01     | 1.40E+04                           | 2.81E+02  |
| 6      | 7A1M          | Desert        | 3.00E+01     | 7.80E+03                           | 2.60E+02  |
| 7      | 7A3P          | Flatland      | 5.00E+01     | 1.08E+04                           | 2.16E+02  |
| 8      | 7A3Q          | Hill          | 5.00E+01     | 1.13E+04                           | 2.26E+02  |
| 9      | 7A3S          | Mountain land | 5.00E+01     | 1.28E+04                           | 2.56E+02  |
| 10     | 7A3G          | Plateau       | 5.00E+01     | 1.47E+04                           | 2.94E+02  |
| 11     | 7A3M          | Desert        | 3.00E+01     | 8.16E+03                           | 2.72E+02  |
| 12     | 7A5P          | Flatland      | 5.00E+01     | 1.09E+04                           | 2.18E+02  |
| 13     | 7A5Q          | Hill          | 5.00E+01     | 1.15E+04                           | 2.29E+02  |
| 14     | 7A5S          | Mountain land | 5.00E+01     | 1.30E+04                           | 2.60E+02  |
| 15     | 7A5G          | Plateau       | 5.00E+01     | 1.50E+04                           | 2.99E+02  |
| 16     | 7A5M          | Desert        | 3.00E+01     | 8.28E+03                           | 2.76E+02  |
| 17     | 7B1P          | Flatland      | 5.00E+01     | 1.15E+04                           | 2.30E+02  |
| 18     | 7B1Q          | Hill          | 5.00E+01     | 1.19E+04                           | 2.39E+02  |
| 19     | 7B1S          | Mountain land | 5.00E+01     | 1.35E+04                           | 2.71E+02  |
| 20     | 7B1G          | Plateau       | 5.00E+01     | 1.55E+04                           | 3.11E+02  |
| 21     | 7B2P          | Flatland      | 5.00E+01     | 1.30E+04                           | 2.61E+02  |
| 22     | 7B2Q          | Hill          | 5.00E+01     | 1.36E+04                           | 2.73E+02  |
| 23     | 7B2S          | Mountain land | 5.00E+01     | 1.56E+04                           | 3.13E+02  |
| 24     | 7B2G          | Plateau       | 5.00E+01     | 1.79E+04                           | 3.57E+02  |
| 25     | 7C2P          | Flatland      | 5.00E+01     | 2.13E+04                           | 4.27E+02  |
| 26     | 7C2Q          | Hill          | 5.00E+01     | 2.22E+04                           | 4.45E+02  |
| 27     | 7C2H          | River swamp   | 5.00E+01     | 2.54E+04                           | 5.07E+02  |
| 28     | 7C2S          | Mountain land | 5.00E+01     | 2.53E+04                           | 5.06E+02  |
| 29     | 7C2G          | Plateau       | 5.00E+01     | 2.78E+04                           | 5.57E+02  |
| 30     | 7C2M          | Desert        | 3.00E+01     | 1.60E+04                           | 5.33E+02  |
| 31     | 7D1P          | Flatland      | 5.00E+01     | 2.27E+04                           | 4.55E+02  |
| 32     | 7D1Q          | Hill          | 5.00E+01     | 2.37E+04                           | 4.74E+02  |
| 33     | 7D1S          | Mountain land | 5.00E+01     | 2.64E+04                           | 5.27E+02  |
| 34     | 7D1G          | Plateau       | 5.00E+01     | 2.92E+04                           | 5.84E+02  |
| 35     | 7D1M          | Desert        | 3.00E+01     | 1.68E+04                           | 5.58E+02  |

**Table S6** Inventory for construction schemes of transmission lines under  $\pm 800\text{kV}$ 

| Number | Scheme number | Terrain       | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|---------------|--------------|------------------------------------|---|
| 1      | 8B1P          | Flatland      | 5.00E+01     | 1.52E+04                           | 3.04E+02  |
| 2      | 8B1Q          | Hill          | 5.00E+01     | 1.59E+04                           | 3.18E+02  |
| 3      | 8B1H          | River swamp   | 5.00E+01     | 1.96E+04                           | 3.93E+02  |
| 4      | 8B1S          | Mountain land | 5.00E+01     | 1.92E+04                           | 3.83E+02  |
| 5      | 8B1G          | Plateau       | 5.00E+01     | 2.15E+04                           | 4.30E+02  |
| 6      | 8B3Q          | Hill          | 5.00E+01     | 1.89E+04                           | 3.79E+02  |
| 7      | 8B3S          | Mountain land | 5.00E+01     | 2.17E+04                           | 4.34E+02  |
| 8      | 8B6G          | Plateau       | 3.00E+01     | 2.08E+04                           | 6.92E+02  |

**Table S7** Inventory for construction schemes of transmission lines under 1000kV

| Number | Scheme number | Terrain       | Distance /km | Cumulative investment /(1E+04 CNY) | Unit distance investment /(1E+04 CNY·km <sup>-1</sup> ) |
|--------|---------------|---------------|--------------|------------------------------------|---|
| 1      | 10A2S         | Mountain land | 5.00E+01     | 2.33E+04                           | 4.66E+02  |
| 2      | 10A2G         | Plateau       | 5.00E+01     | 2.67E+04                           | 5.35E+02  |
| 3      | 10GB1P        | Flatland      | 5.00E+01     | 3.80E+04                           | 7.61E+02  |
| 4      | 10GB1Q        | Hill          | 5.00E+01     | 4.04E+04                           | 8.09E+02  |
| 5      | 10GB1H        | River swamp   | 5.00E+01     | 4.82E+04                           | 9.63E+02  |
| 6      | 10GB2P        | Flatland      | 5.00E+01     | 3.86E+04                           | 7.73E+02  |
| 7      | 10GB2H        | River swamp   | 5.00E+01     | 5.09E+04                           | 1.02E+03  |
| 8      | 10GB2Q        | Hill          | 5.00E+01     | 4.09E+04                           | 8.18E+02  |
| 9      | 10GB2S        | Mountain land | 5.00E+01     | 4.85E+04                           | 9.70E+02  |
| 10     | 10GB3P        | Flatland      | 5.00E+01     | 4.07E+04                           | 8.14E+02  |
| 11     | 10GB3Q        | Hill          | 5.00E+01     | 4.36E+04                           | 8.71E+02  |
| 12     | 10GB3H        | River swamp   | 5.00E+01     | 5.44E+04                           | 1.09E+03  |
| 13     | 10GB4Q        | Hill          | 5.00E+01     | 4.86E+04                           | 9.72E+02  |
| 14     | 10GB4S        | Mountain land | 5.00E+01     | 5.76E+04                           | 1.15E+03  |

**Table S8** Inventory for construction schemes of transformer substation under 110 kV

| Scheme number | Number of groups | Nameplate capacity /MVA | Cumulative investment /(1E+04 CNY) | Unit capacity investment /(1E+04 CNY·MVA <sup>-1</sup> ) |
|---------------|------------------|-------------------------|------------------------------------|--|
| 1A1           | 1                | 31.5                    | 2.12E+03                           | 6.72E+01   |
| 1A2           | 1                | 40                      | 2.02E+03                           | 5.04E+01   |
| 1A3           | 2                | 50                      | 2.86E+03                           | 2.86E+01   |
| 1B2           | 2                | 50                      | 3.18E+03                           | 3.18E+01   |
| 1B3           | 2                | 50                      | 4.09E+03                           | 4.09E+01   |
| 1B5           | 2                | 50                      | 4.08E+03                           | 4.08E+01   |
| 1C1           | 2                | 50                      | 4.98E+03                           | 4.98E+01   |
| 1C2           | 2                | 50                      | 6.38E+03                           | 6.38E+01   |

**Table S9** Inventory for construction schemes of transformer substation under 220 kV

| Scheme number | Number of groups | Nameplate capacity /MVA | Cumulative investment /(1E+04 CNY) | Unit capacity investment /(1E+04 CNY·MVA <sup>-1</sup> ) |
|---------------|------------------|-------------------------|------------------------------------|--|
| 2A1           | 1                | 120                     | 5.56E+03                           | 4.63E+01   |
| 2A3           | 1                | 180                     | 6.52E+03                           | 3.62E+01   |
| 2A5           | 2                | 180                     | 9.69E+03                           | 2.69E+01   |
| 2A7           | 1                | 180                     | 8.27E+03                           | 4.59E+01   |
| 2A8           | 1                | 180                     | 5.57E+03                           | 3.09E+01   |
| 2B1           | 2                | 180                     | 9.20E+03                           | 2.56E+01   |
| 2B2           | 2                | 180                     | 9.51E+03                           | 2.64E+01   |
| 2B3           | 2                | 240                     | 1.21E+04                           | 2.52E+01   |
| 2B4           | 2                | 240                     | 1.44E+04                           | 3.00E+01   |
| 2B5           | 2                | 180                     | 8.60E+03                           | 2.39E+01   |

**Table S10** Inventory for construction schemes of transformer substation under 330 kV

| Scheme number | Number of groups | Nameplate capacity /MVA | Cumulative investment /(1E+04 CNY) | Unit capacity investment /(1E+04 CNY·MVA <sup>-1</sup> ) |
|---------------|------------------|-------------------------|------------------------------------|--|
| 3A1           | 2                | 360                     | 1.94E+04                           | 2.70E+01   |
| 3C1           | 1                | 240                     | 1.20E+04                           | 5.00E+01   |
| 3C2           | 2                | 240                     | 1.54E+04                           | 3.21E+01   |
| 3D1           | 1                | 240                     | 1.18E+04                           | 4.93E+01   |
| 3D2           | 1                | 240                     | 1.52E+04                           | 6.34E+01   |

**Table S11** Inventory for construction schemes of transformer substation under 500 kV

| Scheme number | Number of groups | Nameplate capacity /MVA | Cumulative investment /(1E+04 CNY) | Unit capacity investment /(1E+04 CNY·MVA <sup>-1</sup> ) |
|---------------|------------------|-------------------------|------------------------------------|--|
| 5A1           | 1                | 750                     | 3.11E+04                           | 4.15E+01   |
| 5A1           | 1                | 1000                    | 3.19E+04                           | 3.19E+01   |
| 5A2           | 1                | 750                     | 3.07E+04                           | 4.09E+01   |
| 5A3           | 2                | 750                     | 3.89E+04                           | 2.59E+01   |
| 5A3           | 2                | 1000                    | 4.01E+04                           | 2.01E+01   |
| 5A4           | 1                | 750                     | 3.11E+04                           | 4.14E+01   |
| 5B1           | 1                | 750                     | 2.50E+04                           | 3.34E+01   |
| 5B2           | 2                | 750                     | 3.38E+04                           | 2.25E+01   |
| 5B3           | 2                | 1000                    | 3.50E+04                           | 1.75E+01   |
| 5C1           | 1                | 750                     | 1.98E+04                           | 2.63E+01   |
| 5C2           | 1                | 750                     | 2.02E+04                           | 2.69E+01   |
| 5C3           | 2                | 750                     | 2.76E+04                           | 1.84E+01   |
| 5D1           | 1                | 750                     | 2.30E+04                           | 3.07E+01   |
| 5D2           | 1                | 750                     | 2.35E+04                           | 3.13E+01   |
| 5D3           | 2                | 750                     | 3.16E+04                           | 2.11E+01   |

**Table S12** Inventory for construction schemes of transformer substation under 750 kV

| Scheme number | Number of groups | Nameplate capacity /MVA | Cumulative investment /(1E+04 CNY) | Unit capacity investment /(1E+04 CNY·MVA <sup>-1</sup> ) |
|---------------|------------------|-------------------------|------------------------------------|--|
| 7A1           | 1                | 2100                    | 7.29E+04                           | 3.47E+01   |
| 7C1           | 1                | 2100                    | 6.10E+04                           | 2.90E+01   |
| 7C2           | 1                | 2100                    | 4.91E+04                           | 2.34E+01   |
| 7C3           | 1                | 2100                    | 5.52E+04                           | 2.63E+01   |
| 7C4           | 1                | 1500                    | 4.81E+04                           | 3.21E+01   |

**Table S13** Inventory for construction schemes of transformer substation under 1000 kV

| Scheme number | Number of groups | Nameplate capacity /MVA | Cumulative investment /(1E+04 CNY) | Unit capacity investment /(1E+04 CNY·MVA <sup>-1</sup> ) |
|---------------|------------------|-------------------------|------------------------------------|--|
| 10A2          | 2                | 3000                    | 2.04E+05                           | 3.40E+01   |
| 10B1          | 2                | 3000                    | 1.93E+05                           | 3.22E+01   |