

Supplementary materials:

Cost benefits analysis of municipal solid waste incineration in Chinese provinces

Shitong Yu and Huijuan Dong *

School of Environmental Science and Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

Table S1. Annual amount of MSW incineration in 31 Chinese provinces.

| Annual amount of MSW incineration(t) | |
|---|----------|
| Beijing | 3.27E+06 |
| Tianjin | 1.38E+06 |
| Shanghai | 3.61E+06 |
| Chongqing | 2.14E+06 |
| Hebei | 2.85E+06 |
| Shanxi | 1.15E+06 |
| Inner Mongolia | 6.15E+05 |
| Liaoning | 6.55E+05 |
| Jilin | 1.62E+06 |
| Heilongjiang | 1.00E+06 |
| Jiangsu | 1.29E+07 |
| Zhejiang | 8.24E+06 |
| Anhui | 3.35E+06 |
| Fujian | 4.87E+06 |
| Jiangxi | 5.35E+05 |
| Shandong | 8.97E+06 |
| Henan | 1.59E+06 |
| Hubei | 3.93E+06 |
| Hunan | 1.26E+06 |
| Guangdong | 9.11E+06 |
| Guangxi | 1.24E+06 |
| Hainan | 1.47E+06 |
| Sichuan | 4.57E+06 |
| Guizhou | 7.14E+05 |
| Yunnan | 2.26E+06 |
| Tibet | 1.00E+04 |
| Shaanxi | 0 |
| Gansu | 8.85E+05 |
| Qinghai | 0 |
| Ningxia | 3.46E+05 |
| Xinjiang | 1.48E+05 |

Table S2. MSW composition in 31 Chinese provinces.

| | Kitchen waste | Paper | Plastic and Rubber | Textile | Wood bamboo | Glass | Metal | Lime soil |
|-----------|---------------|--------|--------------------|---------|-------------|-------|-------|-----------|
| Beijing | 56.84% | 18.33% | 18.77% | 1.00% | 0.61% | 0.75% | 0.56% | 1.67% |
| Tianjin | 56.9% | 15.3% | 16.90% | 3.90% | 1.60% | 1.60% | 0.70% | 2.90% |
| Shanghai | 60.40% | 11.88% | 17.56% | 2.85% | 1.95% | 3.57% | 1.08% | 0.02% |
| Chongqing | 59.20% | 10.10% | 16.00% | 6.10% | 4.20% | 3.40% | 1.10% | 0 |

| | | | | | | | | |
|----------------|--------|--------|--------|--------|--------|-------|-------|--------|
| Hebei | 62.71% | 3.07% | 5.97% | 1.61% | 0.97% | 0.73% | 0.48% | 19.05% |
| Shanxi | 45.45% | 9.97% | 18.24% | 2.26% | 1.30% | 2.63% | 0.54% | 17.81% |
| Inner Mongolia | 32.00% | 6.50% | 9.20% | 0.30% | 0.40% | 1.15% | 0.50% | 15.90% |
| Liaoning | 60.40% | 7.90% | 12.90% | 3.60% | 2.50% | 5.40% | 2.10% | 5.30% |
| Jilin | 43.00% | 4.90% | 15.00% | 2.70% | 2.70% | 2.60% | 0.50% | 4.60% |
| Heilongjiang | 44.80% | 13.40% | 3.30% | 4.70% | 0 | 6.60% | 2.70% | 24.50% |
| Jiangsu | 66.00% | 9.00% | 12.00% | 1.00% | 0 | 9.00% | 1.00% | 1.00% |
| Zhejiang | 64.50% | 6.70% | 10.10% | 1.20% | 0.10% | 2.00% | 0.30% | 15.10% |
| Anhui | 61.50% | 1.90% | 11.40% | 2.10% | 0.90% | 0.60% | 0 | 21.70% |
| Fujian | 54.90% | 13.73% | 13.26% | 3.11% | 0.26% | 2.05% | 0.13% | 3.34% |
| Jiangxi | 62.50% | 5.50% | 6.00% | 3.00% | 3.00% | 5.50% | 3.00% | 20.50% |
| Shandong | 58.70% | 11.20% | 9.90% | 3.00% | 1.00% | 1.30% | 0.30% | 14.60% |
| Henan | 55.02% | 5.52% | 3.97% | 1.65% | 1.36% | 1.56% | 0.59% | 26.67% |
| Hubei | 55.30% | 1.50% | 4.50% | 0 | 8.30% | 2.00% | 1.10% | 27.30% |
| Hunan | 47.53% | 0.88% | 14.07% | 7.28% | 3.57% | 0.23% | 1.17% | 9.51% |
| Guangdong | 53.40% | 8.30% | 18.60% | 10.00% | 1.70% | 1.40% | 0.40% | 6.20% |
| Guangxi | 58.93% | 10.74% | 10.82% | 2.12% | 0.56% | 4.33% | 0.40% | 4.04% |
| Hainan | 58.42% | 6.44% | 11.93% | 0.89% | 1.60% | 0.53% | 0.68% | 12.92% |
| Sichuan | 64.29% | 11.71% | 7.45% | 1.08% | 1.40% | 2.80% | 0.76% | 7.13% |
| Guizhou | 41.46% | 13.07% | 14.97% | 4.42% | 2.36% | 1.87% | 0.72% | 21.13% |
| Yunnan | 60.59% | 9.69% | 9.99% | 1.70% | 1.21% | 1.70% | 0.46% | 8.03% |
| Tibet | 57.00% | 6.00% | 12.00% | 7.00% | 14.00% | 0 | 1.00% | 3.00% |
| Shaanxi | 38.60% | 9.30% | 10.10% | 1.40% | 7.40% | 6.50% | 3.40% | 23.30% |
| Gansu | 36.38% | 9.70% | 11.34% | 2.10% | 1.36% | 0.93% | 0.23% | 37.81% |
| Qinghai | 51.93% | 6.85% | 9.41% | 2.72% | 1.75% | 2.89% | 1.21% | 27.22% |
| Ningxia | 35.70% | 2.10% | 4.10% | 1.20% | 1.70% | 0.40% | 0.20% | 45.70% |
| Xinjiang | 76.00% | 2.40% | 5.40% | 4.20% | 2.50% | 2.40% | 0.80% | 6.40% |

Table S3. Power generation structure of 31 Chinese provinces.

| | Thermal power generation | Wind power generation | Solar power generation | Nuclear power generation | Hydropower generation |
|----------------|--------------------------|-----------------------|------------------------|--------------------------|-----------------------|
| Beijing | 96.17% | 0.75% | 0.25% | / | 2.83% |
| Tianjin | 99.02% | 0.95% | 0.03% | / | 0.00% |
| Shanghai | 99.11% | 0.83% | 0.06% | / | 0.00% |
| Chongqing | 64.09% | 0.66% | 0.00% | / | 35.25% |
| Hebei | 90.19% | 7.96% | 1.01% | / | 0.85% |
| Shanxi | 93.21% | 4.74% | 0.57% | / | 1.48% |
| Inner Mongolia | 85.44% | 11.75% | 2.11% | / | 0.70% |
| Liaoning | 78.68% | 7.25% | 0.19% | 11.23% | 2.64% |
| Jilin | 77.90% | 11.14% | 0.12% | / | 10.84% |
| Heilongjiang | 89.23% | 8.84% | 0.05% | / | 1.87% |
| Jiangsu | 93.49% | 2.00% | 0.87% | 3.26% | 0.37% |
| Zhejiang | 74.24% | 0.73% | 0.69% | 15.75% | 8.58% |
| Anhui | 94.76% | 1.52% | 0.92% | / | 2.80% |
| Fujian | 44.84% | 2.50% | 0.17% | 20.38% | 32.10% |
| Jiangxi | 78.95% | 1.73% | 1.03% | / | 18.29% |
| Shandong | 96.50% | 2.67% | 0.56% | / | 0.26% |
| Henan | 95.23% | 0.68% | 0.49% | / | 3.60% |
| Hubei | 41.00% | 1.63% | 0.46% | / | 56.91% |

| | | | | | |
|-----------|--------|--------|--------|--------|--------|
| Hunan | 52.22% | 2.86% | 0.05% | / | 44.87% |
| Guangdong | 69.70% | 1.11% | 0.10% | 16.50% | 12.59% |
| Guangxi | 42.67% | 1.03% | 0.06% | 7.65% | 48.60% |
| Hainan | 69.49% | 2.23% | 0.74% | 20.89% | 6.65% |
| Sichuan | 12.15% | 0.55% | 0.19% | / | 87.12% |
| Guizhou | 58.52% | 2.90% | 0.05% | / | 38.54% |
| Yunnan | 8.84% | 5.77% | 0.78% | / | 84.61% |
| Tibet | 3.40% | 0.00% | 5.39% | / | 91.21% |
| Shaanxi | 89.99% | 2.13% | 0.76% | / | 7.12% |
| Gansu | 57.99% | 11.24% | 4.96% | / | 25.82% |
| Qinghai | 27.52% | 1.81% | 16.26% | / | 54.41% |
| Ningxia | 83.32% | 10.96% | 4.49% | / | 1.23% |
| Xinjiang | 81.62% | 7.23% | 2.89% | / | 8.27% |

Note: The data source is (China Energy Statistics Yearbook, 2016).

Table S4. Life cycle inventory of MSW incineration.

| | Amount | Unit |
|---------------------|------------------------|------|
| Model input | | |
| Energy | | |
| electricity | 146.4 | kW.h |
| diesel | 0.1370 | Kg |
| fossil fuel | 34.40 | MJ |
| Raw Material | | |
| Activated carbon | 0.5000 | Kg |
| Ammonia water | 2.400 | Kg |
| CaCO ₃ | 7.100 | kg |
| FeCl ₃ | 0.06000 | Kg |
| NaOH | 0.4000 | Kg |
| Sand | 0.2000 | T |
| Aggregate | 0.2800 | T |
| Cement | 0.02000 | T |
| Water | 202.8 | Kg |
| Model output | | |
| Waste | | |
| slag | 200.0 | Kg |
| Fly ash | 20.00 | Kg |
| Leachate | 250.0 | Kg |
| Emissions | | |
| Particulate | 5.430 | G |
| CO ₂ | 257.8 kg | G |
| SO ₂ | 48.25 | G |
| CO | 95.58 | G |
| HCl | 8.357 | G |
| NO _x | 411.9 | G |
| Dioxins | 3.300×10 ⁻⁹ | G |

Table S5. LCC of MSW incineration and landfill.

| | Incineration (RMB/tMSW) | Landfill (RMB/tMSW) |
|-----------------|-------------------------|---------------------|
| Investment cost | 66.21 | 182.80 |
| Operating cost | | |
| Material cost | 11.74 | 5.58 |

| | | |
|---------------------|--|-------|
| Maintenance cost | 15.89 | 20.47 |
| Labor cost | 14.95 | 25.77 |
| Energy cost | 64.41 | 6.67 |
| Depreciation cost | 59.59 | 76.77 |
| Waste disposal cost | | |
| Leachate disposal | 9.93 | 20.38 |
| Slag disposal | 7.5 | / |
| Fly ash disposal | 18 | / |
| Benefits | Different prices depending on local conditions | / |
