

## Supplementary Information

### **Atmospheric emissions of Ti-containing nanoparticles from industrial activities in China**

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## **Abbreviations:**

Air pollution control equipment (APCD)

Bag filter (BF)

Blast-furnace pig iron (BFI)

Cement kiln co-processing solid waste (CK)

Coal-fired power plant (CFPP)

Coking plant (COP)

Electric-arc furnace for steelmaking (EAF)

electrostatic precipitator (ESP)

European Monitoring and Evaluation Programme/European Environment Agency (EMEP/EEA)

Hazardous-waste incineration (HWI)

Iron-ore sintering (IOS)

Municipal solid-waste incineration (WI)

Particle matter (PM)

Particle number concentration (PNC)

Particle size distribution (PSD)

Primary copper smelting (PCu)

Secondary aluminum smelting (SAI)

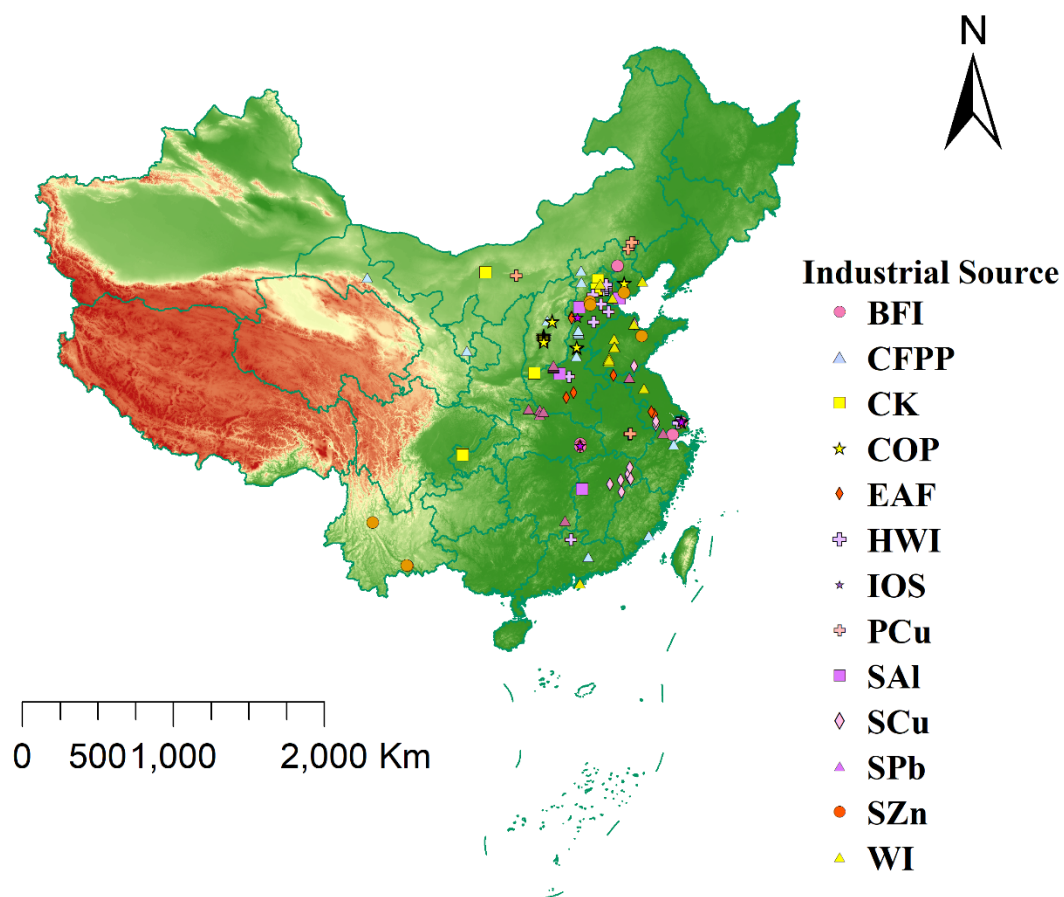
Secondary copper smelting (SCu)

Secondary lead smelting (SPb)

Secondary zinc smelting (SZn)

Single particle - inductively coupled plasma - time of flight - mass spectrometry (SP-ICP-TOF-MS)

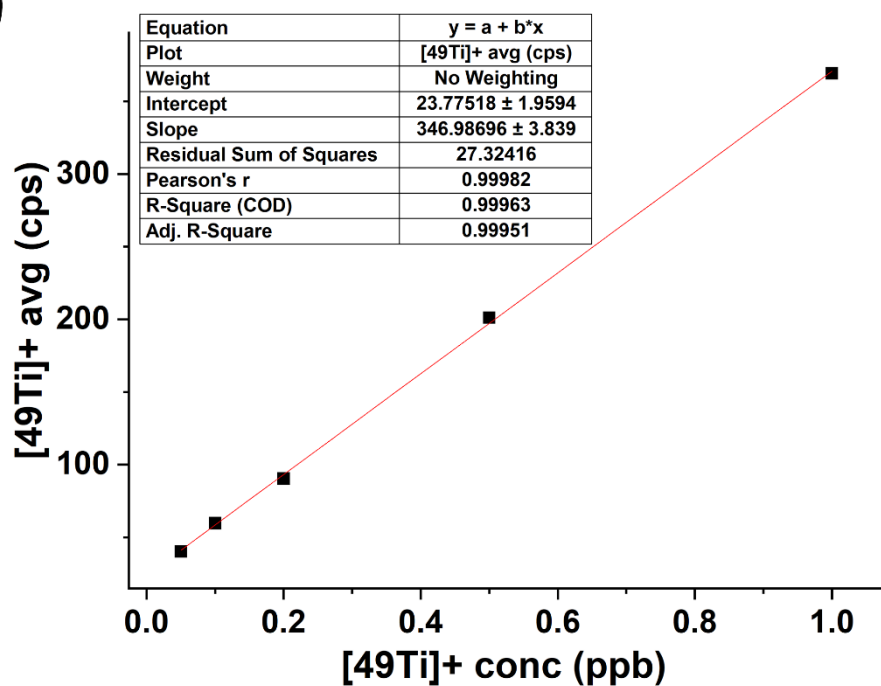
United Nations Environment Programme (UNEP)



**Fig. S1** Distribution map of sampling sites for 132 industrial PM samples\*

\*Part of sampling site were also shown in our previous manuscript <sup>1</sup>. The map is based on free vector data sourced from the “Database of National Catalogue Service for Geographic Information [GS (2020)4619]” (<https://www.resdc.cn/DOI/doi.aspx?DOIid=122>) and created using ArcGIS software.

(a)



(b)

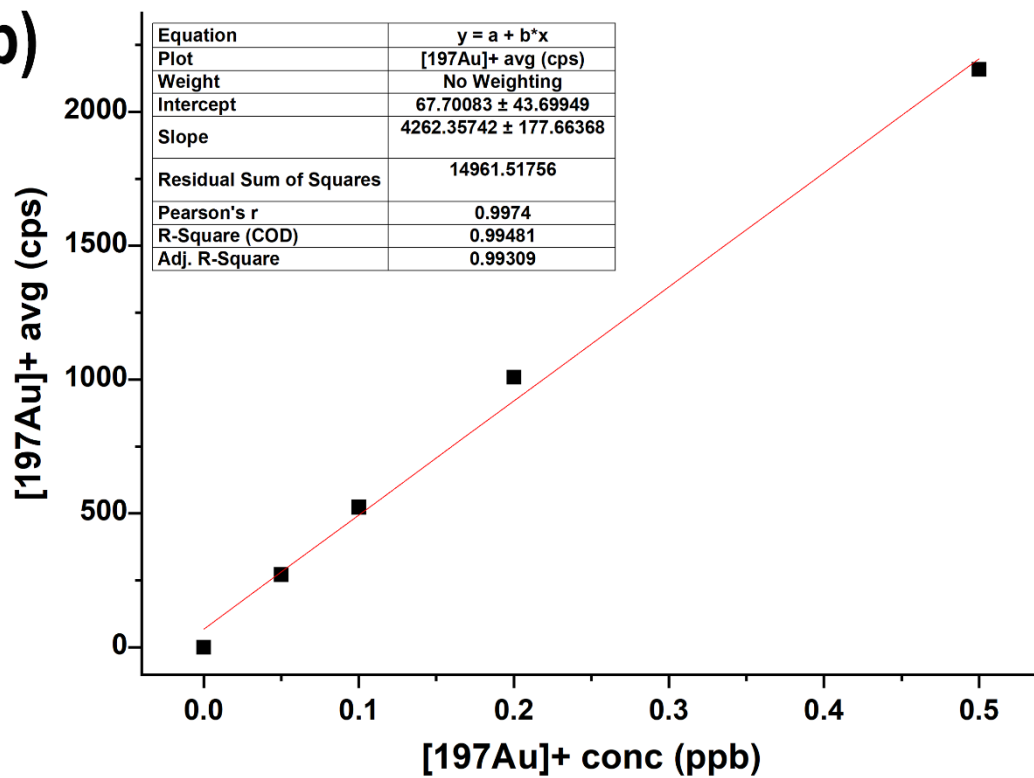


Fig. S2 Standard curves for (a) Ti ions and (b) Au ions

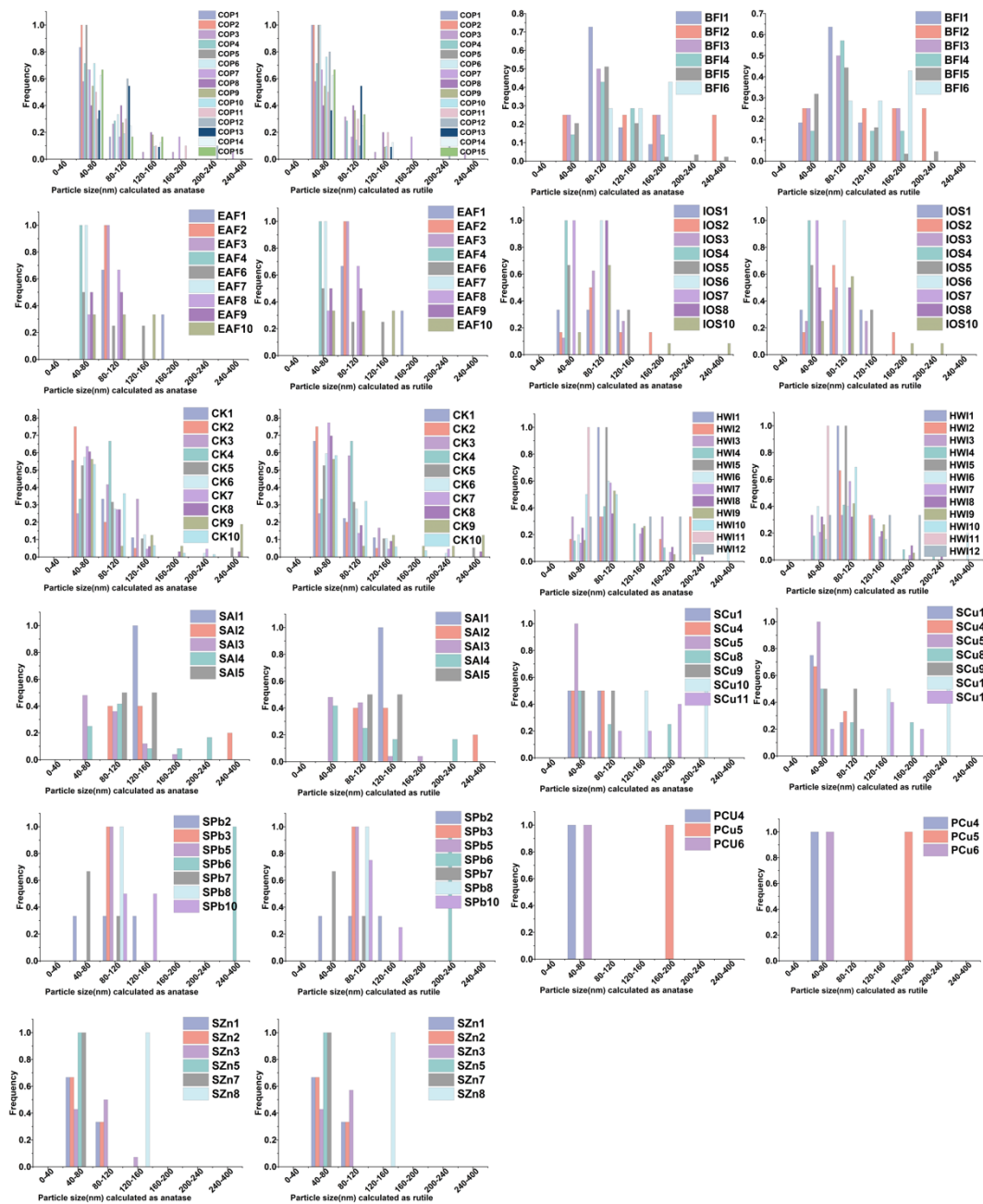


Fig. S3 PSDs of Ti-containing NPs from various industrial sources

**Table S1.** Detailed information on particulate matter samples from 132 industrial activities

Number	Sample ID	Provinces	City/District	Industrial activities	Raw material	APCD
1	BF11	Hebei	Chengde	blast furnace pig iron	Coke, hematite ore	BF
2	BF12	Hebei	Chengde	blast furnace pig iron	Coke, hematite ore	BF
3	BF13	Shanghai	Baoshan	blast furnace pig iron	Coke, hematite ore	BF
4	BF14	Hubei	Wuhan	blast furnace pig iron	Coke, hematite ore	BF
5	BF15	Zhejiang	Jiaxing	blast furnace pig iron	Coke, hematite ore	BF
6	BF16	Hubei	Wuhan	blast furnace pig iron	Coke, hematite ore	BF
7	CFPP1	Hebei	Xingtai	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
8	CFPP2	Hebei	Zhangjiakou	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
9	CFPP3	Zhejiang	Jiaxing	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
10	CFPP4	Hebei	Xingtai	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
11	CFPP5	Hebei	Xingtai	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
12	CFPP6	Hebei	Tangshan	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
13	CFPP7	Hebei	Tangshan	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
14	CFPP8	Gansu	Jiayuguan	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
15	CFPP9	Shanxi	Gujiao	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
16	CFPP10	Ningxia	Guyuan	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
17	CFPP11	Guangdong	Heyuan	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
18	CFPP12	Hebei	Zhangjiakou	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
19	CFPP13	Hebei	Langfang	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
20	CFPP14	Henan	Hebi	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
21	CFPP15	Fujian	Quanzhou	Coal-Fired Power Plant	Bituminous coal, anthracite and lignite	BF
22	CK1	Beijing	Changping	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
23	CK2	Beijing	Changping	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
24	CK3	Beijing	Fangshan	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
25	CK4	Beijing	Fangshan	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
26	CK5	Beijing	Fangshan	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
27	CK6	Inner Mongolia	Bayannur	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF

28	CK7	Henan	Sanmenxia	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
29	CK8	Beijing	Fangshan	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
30	CK9	Chongqing	Hechuan	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
31	CK10	Chongqing	Hechuan	Cement Kilns Coordinate the Disposal of Solid Waste	Solid Danger Waste	ESP&BF
32	COP1	Shanxi	Jiexiu	Coking Plant	Coal	BF
33	COP2	Shanxi	Taiyuan	Coking Plant	Coal	BF
34	COP3	Shanxi	Taiyuan	Coking Plant	Coal	BF
35	COP4	Shanghai	Baoshan	Coking Plant	Coal	BF
36	COP5	Hebei	Tangshan	Coking Plant	Coal	BF
37	COP6	Hebei	Tangshan	Coking Plant	Coal	BF
38	COP7	Shanghai	Baoshan	Coking Plant	Coal	BF
39	COP8	Hebei	Handan	Coking Plant	Coal	BF
40	COP9	Hebei	Handan	Coking Plant	Coal	BF
41	COP10	Hebei	Handan	Coking Plant	Coal	BF
42	COP11	Shanxi	Taiyuan	Coking Plant	Coal	BF
43	COP12	Shanxi	Taiyuan	Coking Plant	Coal	BF
44	COP13	Shanxi	Taiyuan	Coking Plant	Coal	BF
45	COP14	Shanxi	Taiyuan	Coking Plant	Coal	BF
46	COP15	Shanxi	Taiyuan	Coking Plant	Coal	BF
47	EAF1	Jiangsu	Zhenjiang	Electric Arc Furnace Steelmaking	Scrap	BF
48	EAF2	Jiangsu	Xuzhou	Electric Arc Furnace Steelmaking	Scrap	BF
49	EAF3	Henan	Luohe	Electric Arc Furnace Steelmaking	Scrap	BF
50	EAF4	Shanghai	Baoshan	Electric Arc Furnace Steelmaking	Scrap	BF
51	EAF5	Jiangsu	Zhenjiang	Electric Arc Furnace Steelmaking	Scrap	BF
52	EAF6	Jiangsu	Xuzhou	Electric Arc Furnace Steelmaking	Scrap	BF
53	EAF7	Henan	Luohe	Electric Arc Furnace Steelmaking	Scrap	BF
54	EAF8	Hebei	Shijiazhuang	Electric Arc Furnace Steelmaking	Scrap	BF
55	EAF9	Hebei	Shijiazhuang	Electric Arc Furnace Steelmaking	Scrap	BF
56	EAF10	Hubei	Wuhan	Electric Arc Furnace Steelmaking	Scrap	BF



57	HWI1	Guangdong	Shaoguan	hazardous waste incinerator	Hazardous waste such as medical waste	BF
58	HWI2	Hebei	Baoding	hazardous waste incinerator	Hazardous waste such as medical waste	BF
59	HWI3	Shanghai	Shanghai	hazardous waste incinerator	Hazardous waste such as medical waste	BF
60	HWI4	Shanghai	Shanghai	hazardous waste incinerator	Hazardous waste such as medical waste	BF
61	HWI5	Hebei	Cangzhou	hazardous waste incinerator	Hazardous waste such as medical waste	BF
62	HWI6	Beijing	Tongzhou	hazardous waste incinerator	Hazardous waste such as medical waste	BF
63	HWI7	Beijing	Tongzhou	hazardous waste incinerator	Hazardous waste such as medical waste	BF
64	HWI8	Beijing	Tongzhou	hazardous waste incinerator	Hazardous waste such as medical waste	BF
65	HWI9	Hebei	Hengshui	hazardous waste incinerator	Hazardous waste such as medical waste	BF
66	HWI10	Hebei	Cangzhou	hazardous waste incinerator	Hazardous waste such as medical waste	BF
67	HWI11	Beijing	Tongzhou	hazardous waste incinerator	Hazardous waste such as medical waste	BF
68	HWI12	Henan	Xinzheng	hazardous waste incinerator	Hazardous waste such as medical waste	BF
69	IOS1	Hebei	Tangshan	Iron Ore Sintering	Iron Ore	ESP&BF
70	IOS2	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
71	IOS3	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
72	IOS4	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
73	IOS5	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
74	IOS6	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
75	IOS7	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
76	IOS8	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
77	IOS9	Shanghai	Baoshan	Iron Ore Sintering	Iron Ore	ESP&BF
78	IOS10	Hubei	Wuhan	Iron Ore Sintering	Iron Ore	ESP&BF
79	PCu1	Inner Mongolia	Baotou	Primary Copper Smelting	copper ore	ESP&BF
80	PCu2	Inner Mongolia	Chifeng	Primary Copper Smelting	copper ore	ESP&BF
81	PCu3	Inner Mongolia	Chifeng	Primary Copper Smelting	copper ore	ESP&BF
82	PCu4	Inner Mongolia	Chifeng	Primary Copper Smelting	copper ore	ESP&BF
83	PCu5	Anhui	Tongling	Primary Copper Smelting	copper ore	ESP&BF
84	PCu6	Anhui	Tongling	Primary Copper Smelting	copper ore	ESP&BF
85	SA11	Tianjin	Tianjin	Secondary Aluminum Smelting	Waste Aluminium	ESP

86	SA12	Tianjin	Tianjin	Secondary Aluminum Smelting	Waste Aluminium	ESP
87	SA13	Jiangxi	Yichun	Secondary Aluminum Smelting	Waste Aluminium	ESP
88	SA14	Hebei	Baoding	Secondary Aluminum Smelting	Waste Aluminium	ESP
89	SA15	Henan	Gongyi	Secondary Aluminum Smelting	Waste Aluminium	ESP
90	SCu1	Jiangxi	Shangrao	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
91	SCu2	Jiangxi	Shangrao	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
92	SCu3	Jiangxi	Guixi	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
93	SCu4	Jiangxi	Fuzhou	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
94	SCu5	Jiangxi	Shangrao	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
95	SCu6	Jiangxi	Shangrao	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
96	SCu7	Shandong	Linyi	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
97	SCu8	Shandong	Dongying	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
98	SCu9	Jiangsu	Wuxi	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
99	SCu10	Jiangsu	Wuxi	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
100	SCu11	Jiangxi	Guixi	Secondary Copper Smelting	Waste Mixed Copper	ESP&BF
101	SPb1	Hunan	Bangzhou	Secondary Lead Smelting	Waste Lead	BF-coated film
102	SPb2	Henan	Jiyuan	Secondary Lead Smelting	Waste Lead	BF-coated film
103	SPb3	Henan	Jiyuan	Secondary Lead Smelting	Waste Lead	BF-coated film
104	SPb4	Henan	Jiyuan	Secondary Lead Smelting	Waste Lead	BF-coated film
105	SPb5	Henan	Jiyuan	Secondary Lead Smelting	Waste Lead	BF-coated film
106	SPb6	Hubei	Xiangyang	Secondary Lead Smelting	Waste Lead	BF-coated film
107	SPb7	Hubei	Xiangyang	Secondary Lead Smelting	Waste Lead	BF-coated film
108	SPb8	Jiangsu	Xuzhou	Secondary Lead Smelting	Waste Lead	BF-coated film
109	SPb9	Hubei	Xiangyang	Secondary Lead Smelting	Waste Lead	BF-coated film
110	SPb10	Hubei	Shiyan	Secondary Lead Smelting	Waste Lead	BF-coated film
111	SPb11	Zhejiang	Huzhou	Secondary Lead Smelting	Waste Lead	BF-coated film
112	SZn1	Yunnan	Yuanyang	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
113	SZn2	Yunnan	Dali	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
114	SZn3	Yunnan	Yuanyang	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film

115	SZn4	Hebei	Tangshan	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
116	SZn5	Shandong	Weifang	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
117	SZn6	Hebei	Baoding	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
118	SZn7	Hebei	Baoding	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
119	SZn8	Hebei	Baoding	Secondary Zinc Smelting	Waste Mixed Zinc	BF-coated film
120	WI1	Beijing	Haidian	Waste Incineration	Municipal soiled waste	BF
121	WI2	Hebei	Qinhuangdao	Waste Incineration	Municipal soiled waste	BF
122	WI3	Tianjin	Tianjin	Waste Incineration	Municipal soiled waste	BF
123	WI4	Shandong	Dongying	Waste Incineration	Municipal soiled waste	BF
124	WI5	Shandong	Taian	Waste Incineration	Municipal soiled waste	BF
125	WI6	Shandong	Taian	Waste Incineration	Municipal soiled waste	BF
126	WI7	Shandong	Jining	Waste Incineration	Municipal soiled waste	BF
127	WI8	Shandong	Jining	Waste Incineration	Municipal soiled waste	BF
128	WI9	Shandong	Jining	Waste Incineration	Municipal soiled waste	BF
129	WI10	Jiangsu	Huaian	Waste Incineration	Municipal soiled waste	BF
130	WI11	Shandong	Jinan	Waste Incineration	Municipal soiled waste	BF
131	WI12	Shandong	Jining	Waste Incineration	Municipal soiled waste	BF
132	WI13	Hong Kong	Hong Kong	Waste Incineration	Municipal soiled waste	BF

Note: Air pollution control equipment (APCD); ESP (electrostatic precipitator); BF (bag filter)

Part of these sample information were also shown in our previous study <sup>1</sup> (Nature Sustainability 2024, DOI:10.1038/s41893-024-01388-6).

**Table S2** Parameters used for access the LADD<sub>inh</sub>.

Parameters	Adult	Child
C (Ti-containing NPs, particles/m <sup>3</sup> )	1.7×10 <sup>7</sup>	1.7×10 <sup>7</sup>
inhR (inhalation rate, m <sup>3</sup> /day) <sup>2</sup>	20	8
EF (exposure frequency, day/year) <sup>2</sup>	365	365
ED (exposure duration, year) <sup>2</sup>	24	6
BW (body weight, kg) <sup>2</sup>	70	15
AT (days) CR, 70*365 <sup>2</sup>	25550	25550
AT (days) non-CR, ED*365 <sup>2</sup>	8760	2190

**Table S3.** PNCs of Ti-containing NPs emitted by 132 industrial processes across 13 sectors

Industry	Mean (Particles/g)	Median (Particles/g)	Range (Particles/g)
EAF	2.0×10 <sup>9</sup>	1.4×10 <sup>9</sup>	2.7×10 <sup>8</sup> -5.7×10 <sup>9</sup>
COP	8.8×10 <sup>8</sup>	8.6×10 <sup>8</sup>	7.8×10 <sup>7</sup> -3.0×10 <sup>9</sup>
CK	1.9×10 <sup>9</sup>	8.2×10 <sup>8</sup>	3.2×10 <sup>8</sup> -1.9×10 <sup>10</sup>
CFPP	1.7×10 <sup>10</sup>	1.1×10 <sup>10</sup>	6.8×10 <sup>8</sup> -4.2×10 <sup>11</sup>
PCu	1.4×10 <sup>8</sup>	1.3×10 <sup>8</sup>	1.4×10 <sup>7</sup> -2.7×10 <sup>8</sup>
SCu	3.3×10 <sup>8</sup>	2.8×10 <sup>8</sup>	1.4×10 <sup>7</sup> -8.3×10 <sup>8</sup>
SAI	3.1×10 <sup>8</sup>	2.9×10 <sup>8</sup>	2.9×10 <sup>7</sup> -3.6×10 <sup>9</sup>
SPb	2.8×10 <sup>8</sup>	8.3×10 <sup>7</sup>	2.6×10 <sup>7</sup> -4.4×10 <sup>9</sup>
SZn	1.3×10 <sup>8</sup>	9.2×10 <sup>7</sup>	2.7×10 <sup>7</sup> -2.0×10 <sup>9</sup>
WI	7.7×10 <sup>9</sup>	7.9×10 <sup>9</sup>	9.7×10 <sup>8</sup> -2.6×10 <sup>10</sup>
HWI	2.2×10 <sup>9</sup>	2.8×10 <sup>9</sup>	6.7×10 <sup>8</sup> -4.2×10 <sup>10</sup>
BFI	5.5×10 <sup>9</sup>	5.3×10 <sup>9</sup>	1.1×10 <sup>9</sup> -1.0×10 <sup>10</sup>
IOS	3.2×10 <sup>8</sup>	2.8×10 <sup>8</sup>	9.7×10 <sup>7</sup> -1.3×10 <sup>9</sup>

**Table S4** The mass (g) of each single Ti-containing particle is determined by 132 actual industrial process from thirteen industrial sectors.

Single Excel

**Table S5.** PSDs of Ti-containing NPs (calculated as anatase-TiO<sub>2</sub>) from 132 industrial processes across 13 sectors

Sample ID	Mean (nm)	Median (nm)	Range (nm)
BFI1	103.1	91.6	80.5 -161.3
BFI2	167.0	174.3	73.2 -246.2
BFI3	116.2	105.2	75.5 -179.1
BFI4	117.4	119.7	78.9 -166.8
BFI5	112.2	94.2	68.9 -488.6
BFI6	147.2	152.1	91.0 -190.7
CFPP1	92.1	81.7	56.5 -373.6
CFPP2	94.3	83.5	59.4 -263.0
CFPP3	79.6	70.6	58.2 -194.5

CFPP4	89.7	79.7	59.2 -232.0
CFPP5	86.0	76.8	60.2 -179.2
CFPP6	91.2	80.1	56.4 -296.8
CFPP7	86.8	76.8	58.7 -269.5
CFPP8	85.5	78.1	58.9 -321.1
CFPP9	84.6	77.0	58.0 -240.1
CFPP10	96.2	77.5	58.3 -313.7
CFPP11	88.1	79.2	56.8 -219.6
CFPP12	87.8	78.3	56.6 -203.7
CFPP13	84.2	72.7	58.2 -307.8
CFPP14	85.0	76.1	59.8 -163.9
CFPP15	76.1	74.0	62.1 -92.7
CK1	86.1	79.4	63.4 -138.6
CK2	76.6	68.2	59.6 -143.6
CK3	109.0	116.7	68.7 -155.8
CK4	82.5	87.4	63.0 -96.9
CK5	92.0	76.8	59.6 -279.4
CK6	86.6	78.7	59.7 -217.4
CK7	82.2	74.0	61.2 -210.6
CK8	92.2	76.3	61.2 -374.6
CK9	130.7	79.5	63.4 -352.2
CK10	86.0	76.3	58.1 -207.6
COP1	71.1	70.0	61.4 -81.0
COP2	70.1	68.7	66.9 -74.6
COP3	96.5	77.3	60.5 -290.9
COP4	72.8	68.8	61.5 -93.0
COP5	108.1	68.7	62.0 -417.3
COP6	78.8	78.2	75.5 -82.7
COP7	92.6	75.8	69.0 -174.8
COP8	98.7	98.5	62.1 -149.8
COP9	86.8	79.0	62.7 -142.8
COP10	81.9	72.2	61.3 -136.4
COP11	90.2	78.0	63.7 -163.3
COP12	94.5	81.1	66.5 -225.6
COP13	88.1	84.0	63.1 -138.3
COP14	82.1	67.4	61.6 -138.2
COP15	83.7	71.9	67.2 -123.1
EAF1	130.2	111.5	89.8 -189.4
EAF2	87.2	87.2	83.5 -90.9
EAF3	90.1	90.1	90.1 -90.1
EAF4	64.1	64.1	64.1 -64.1
EAF6	100.4	97.2	70.0 -137.1
EAF7	63.4	63.4	63.4 -63.4
EAF8	91.0	101.4	66.5 -105.2
EAF9	79.5	79.5	68.7 -90.2
EAF10	97.3	97.0	67.5 -127.4
HWI1	88.6	88.6	88.6 -88.6
HWI2	152.0	144.7	79.2 -234.1

HWI3	116.8	112.5	72.2 -165.7
HWI4	122.0	118.3	72.9 -229.3
HWI5	96.0	96.0	93.8 -98.2
HWI6	132.4	84.6	75.2 -318.8
HWI7	106.5	106.5	106.5 -106.5
HWI8	116.3	109.1	70.4 -221.5
HWI9	133.4	118.9	87.4 -217.9
HWI10	106.9	107.5	78.9 -143.1
HWI11	77.9	77.9	77.9 -77.9
HWI12	140.8	160.0	73.0 -189.5
IOS1	113.7	105.9	79.6 -155.7
IOS2	111.9	107.4	71.7 -170.3
IOS3	102.4	94.6	79.1 -142.5
IOS4	74.6	74.6	73.7 -75.5
IOS5	96.0	75.3	75.2 -137.5
IOS6	84.7	84.7	84.7 -84.7
IOS7	72.0	72.0	72.0 -72.0
IOS8	89.3	89.3	82.4 -96.1
IOS10	108.0	87.7	73.1 -247.8
PCu4	68.1	68.1	68.1 -68.1
PCu5	168.7	168.7	168.7 -168.7
PCu6	77.6	77.6	64.0 -91.3
SAI1	276.9	276.9	130.9 -422.9
SAI2	146.9	139.2	84.7 -255.6
SAI3	92.0	92.1	60.5 -181.9
SAI4	120.2	100.2	64.4 -233.9
SAI5	114.3	114.3	86.6 -142.0
SCu1	77.0	74.1	66.1 -93.5
SCu4	78.6	74.3	63.5 -104.5
SCu5	65.0	65.0	65.0 -65.0
SCu8	106.6	92.9	62.3 -178.3
SCu9	75.2	75.2	62.4 -88.0
SCu10	181.9	181.9	152.4 -211.4
SCu11	130.6	157.5	73.5 -168.2
SPb2	113.6	114.9	73.8 -152.1
SPb3	90.7	90.7	90.7 -90.7
SPb5	85.2	85.2	85.2 -85.2
SPb6	243.9	243.9	243.9 -243.9
SPb7	76.1	74.1	69.3 -84.8
SPb8	97.6	97.6	97.6 -97.6
SPb10	117.4	116.2	101.1 -136.0
SZn1	74.4	69.8	67.9 -85.3
SZn2	81.8	68.0	61.6 -115.7
SZn3	85.1	87.0	62.4 -120.9
SZn5	67.8	67.8	67.8 -67.8
SZn7	77.8	77.8	77.8 -77.8
SZn8	131.8	131.8	126.2 -137.4
WI1	127.3	110.0	75.8 -240.8

WI2	114.4	102.6	74.9 -197.9
WI3	105.9	100.4	73.9 -203.0
WI4	100.1	101.4	83.3 -124.4
WI5	88.8	87.2	73.2 -102.8
WI6	83.8	82.0	70.6 -97.0
WI7	90.6	85.1	76.0 -122.0
WI8	100.9	97.8	72.0 -152.1
WI9	114.8	115.3	87.1 -143.6
WI10	101.6	100.3	75.1 -148.1
WI12	100.6	91.2	76.0 -125.0
WI13	142.7	115.0	71.1 -418.2

**Table S6.** PSDs of Ti-containing NPs (calculated as rutile-TiO<sub>2</sub>) from 132 industrial processes across 13 sectors

<b>Sample ID</b>	<b>Mean (nm)</b>	<b>Median (nm)</b>	<b>Range (nm)</b>
BFI1	99.1	88.1	77.5 -155.1
BFI2	160.6	167.7	70.4 -236.8
BFI3	111.8	101.2	72.6 -172.2
BFI4	112.9	115.1	75.9 -160.5
BFI5	107.9	90.6	66.3 -469.9
BFI6	141.6	146.3	87.5 -183.4
CFPP1	88.6	78.5	54.3 -359.3
CFPP2	90.7	80.3	57.1 -252.9
CFPP3	76.6	67.9	56.0 -187.0
CFPP4	86.3	76.6	56.9 -223.2
CFPP5	82.7	73.9	57.9 -172.3
CFPP6	87.7	77.0	54.2 -285.4
CFPP7	83.5	73.9	56.4 -259.1
CFPP8	82.2	75.1	56.6 -308.8
CFPP9	81.4	74.0	55.8 -230.9
CFPP10	92.5	74.5	56.1 -301.7
CFPP11	84.7	76.2	54.7 -211.2
CFPP12	84.4	75.3	54.4 -195.9
CFPP13	81.0	69.9	56.0 -296.0
CFPP14	81.7	73.2	57.5 -157.6
CFPP15	73.1	71.1	59.7 -89.2
CK1	82.8	76.4	61.0 -133.3
CK2	73.6	65.6	57.4 -138.1
CK3	104.8	112.2	66.1 -149.8
CK4	79.3	84.1	60.6 -93.2
CK5	88.5	73.8	57.3 -268.7
CK6	83.3	75.7	57.5 -209.1
CK7	79.1	71.2	58.8 -202.6
CK8	88.6	73.3	58.8 -360.2
CK9	125.7	76.5	61.0 -338.7
CK10	82.7	73.4	55.9 -199.7
COP1	68.4	67.3	59.0 -77.9

COP2	67.4	66.1	64.3 -71.7
COP3	92.8	74.4	58.2 -279.7
COP4	70.0	66.2	59.2 -89.5
COP5	103.9	66.1	59.6 -401.3
COP6	75.8	75.2	72.6 -79.5
COP7	89.0	72.9	66.3 -168.1
COP8	94.9	94.7	59.8 -144.1
COP9	83.5	76.0	60.3 -137.4
COP10	78.7	69.4	58.9 -131.2
COP11	86.8	75.0	61.3 -157.0
COP12	90.9	78.0	63.9 -217.0
COP13	84.7	80.8	60.7 -133.0
COP14	78.9	64.8	59.3 -132.9
COP15	80.5	69.1	64.6 -118.4
EA1	125.2	107.3	86.3 -182.2
EA2	83.9	83.9	80.3 -87.4
EA3	86.6	86.6	86.6 -86.6
EA4	61.6	61.6	61.6 -61.6
EA6	96.5	93.5	67.3 -131.9
EA7	61.0	61.0	61.0 -61.0
EA8	87.5	97.5	63.9 -101.2
EA9	76.4	76.4	66.1 -86.7
EA10	93.6	93.3	64.9 -122.6
HW1	85.2	85.2	85.2 -85.2
HW2	113.8	96.3	89.2 -155.9
HW3	112.3	108.2	69.4 -159.3
HW4	117.4	113.7	70.1 -220.5
HW5	92.3	92.3	90.3 -94.4
HW6	127.3	81.4	72.3 -306.6
HW7	102.0	96.2	71.5 -164.9
HW8	111.9	104.9	67.7 -213.0
HW9	102.6	92.3	68.7 -179.2
HW10	102.8	103.4	75.9 -137.6
HW11	74.9	74.9	74.9 -74.9
HW12	135.4	153.8	70.2 -182.2
IOS1	109.4	101.8	76.6 -149.8
IOS2	107.7	103.3	68.9 -163.8
IOS3	98.5	91.0	76.1 -137.0
IOS4	71.8	71.8	70.9 -72.6
IOS5	92.3	72.4	72.3 -132.2
IOS6	81.4	81.4	81.4 -81.4
IOS7	69.3	69.3	69.3 -69.3
IOS8	85.8	85.8	79.3 -92.4
IOS10	103.9	84.3	70.3 -238.3
PCu4	65.5	65.5	65.5 -65.5
PCu5	162.2	162.2	162.2 -162.2
PCu6	74.7	74.7	61.5 -87.8
SA11	266.3	266.3	125.9 -406.7



SAI2	141.3	133.8	81.5 -245.8
SAI3	88.5	88.5	58.1 -174.9
SAI4	115.6	96.4	62.0 -225.0
SAI5	109.9	109.9	83.3 -136.5
SCu1	74.0	71.3	63.6 -89.9
SCu4	75.6	71.4	61.0 -100.5
SCu5	62.5	62.5	62.5 -62.5
SCu8	102.5	89.4	59.9 -171.5
SCu9	72.3	72.3	60.0 -84.6
SCu10	174.9	174.9	146.6 -203.3
SCu11	125.6	151.4	70.7 -161.7
SPb2	109.3	110.5	71.0 -146.3
SPb3	87.2	87.2	87.2 -87.2
SPb5	82.0	82.0	82.0 -82.0
SPb6	234.6	234.6	234.6 -234.6
SPb7	73.2	71.3	66.7 -81.6
SPb8	93.9	93.9	93.9 -93.9
SPb10	112.9	111.7	97.2 -130.8
SZn1	71.5	67.1	65.3 -82.1
SZn2	78.6	65.4	59.3 -111.2
SZn3	81.9	83.7	60.0 -116.2
SZn5	65.2	65.2	65.2 -65.2
SZn7	74.9	74.9	74.9 -74.9
SZn8	126.8	126.8	121.4 -132.1
WI1	122.4	105.8	72.9 -231.5
WI2	110.0	98.7	72.1 -190.3
WI3	101.8	96.6	71.0 -195.2
WI4	96.3	97.5	80.1 -119.7
WI5	85.4	83.8	70.4 -98.8
WI6	80.6	78.8	67.9 -93.3
WI7	87.1	81.9	73.1 -117.4
WI8	97.0	94.1	69.2 -146.3
WI9	110.4	110.8	83.7 -138.1
WI10	97.7	96.5	72.3 -142.4
WI12	96.7	87.7	73.1 -120.3
WI13	137.2	110.6	68.4 -402.2

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**Table S7.** Emission factors (particles/t-product or particles/t-disposal) of Ti-containing NPs for various industry sectors

Industry	Plant Number (N)	Emission Coefficient of industry PM (Kg/t) or (Kg/TWh)	Ti-Containing NPs (particles/g)-Mean	EF-Mean	EF-Median	EF-Range
BFI	6	0.045	$5.5 \times 10^9$	$2.5 \times 10^{11}$	$2.4 \times 10^{11}$	$4.9 \times 10^{10} \sim 4.5 \times 10^{11}$
CFPP	15	984 (kg/TWh)	$1.7 \times 10^{10}$ (particles/g)	$1.7 \times 10^{16}$ (particles/TWh)	$1.1 \times 10^{16}$ (particles/TWh)	$6.7 \times 10^{14} \sim 4.2 \times 10^{17}$ (particles/TWh)
CK	10	0.899	$1.9 \times 10^9$	$1.7 \times 10^{12}$	$7.4 \times 10^{11}$	$2.9 \times 10^{11} \sim 1.7 \times 10^{13}$
COP	15	0.442	$8.8 \times 10^8$	$3.9 \times 10^{11}$	$3.8 \times 10^{11}$	$3.4 \times 10^{10} \sim 1.3 \times 10^{12}$
EAF	10	0.105	$2.0 \times 10^9$	$2.1 \times 10^{11}$	$1.5 \times 10^{11}$	$2.8 \times 10^{10} \sim 5.9 \times 10^{11}$
HWI	12	0.0098	$2.2 \times 10^9$	$2.2 \times 10^{10}$	$2.8 \times 10^{10}$	$6.6 \times 10^9 \sim 4.2 \times 10^{11}$
IOS	10	0.065	$3.2 \times 10^8$	$2.1 \times 10^{10}$	$1.8 \times 10^{10}$	$6.3 \times 10^9 \sim 8.7 \times 10^{10}$
PCu	6	0.276	$1.4 \times 10^8$	$3.8 \times 10^{10}$	$3.6 \times 10^{10}$	$4.0 \times 10^9 \sim 7.4 \times 10^{10}$
SAI	5	0.478	$3.1 \times 10^8$	$1.5 \times 10^{11}$	$1.4 \times 10^{11}$	$1.4 \times 10^{10} \sim 1.7 \times 10^{12}$
SCu	11	0.479	$3.3 \times 10^8$	$1.6 \times 10^{11}$	$1.3 \times 10^{11}$	$6.9 \times 10^9 \sim 4.0 \times 10^{11}$
SPb	11	0.68	$2.8 \times 10^8$	$1.9 \times 10^{11}$	$5.7 \times 10^{10}$	$1.8 \times 10^{10} \sim 3.0 \times 10^{12}$
SZn	8	0.502	$1.3 \times 10^8$	$6.7 \times 10^{10}$	$4.6 \times 10^{10}$	$1.4 \times 10^{10} \sim 1.0 \times 10^{12}$
WI	13	0.0098	$7.7 \times 10^9$	$7.6 \times 10^{10}$	$7.8 \times 10^{10}$	$9.5 \times 10^9 \sim 2.5 \times 10^{11}$

Note: The emission factor is the number of Ti-containing NPs emitted to the atmosphere by producing one ton of steel, copper, aluminum, lead, or zinc; disposing of one ton of waste; or producing one TWh.

**Table S8.** Atmospheric emissions (particles) of Ti-containing NPs from various industrial sources across the 31 provinces in mainland China

Province	Region	COP	CFPP	CK	EAF	IOS	WI	BFI	PCu	SCu	SZn	SPb	SAI	HWI
Beijing	Eastern	$0.0 \times 10^{00}$	$7.5 \times 10^{20}$	$3.5 \times 10^{18}$	$0.0 \times 10^{00}$	$3.8 \times 10^{16}$	$3.0 \times 10^{17}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$1.5 \times 10^{14}$	$5.7 \times 10^{15}$
Tianjin	Eastern	$6.8 \times 10^{17}$	$1.3 \times 10^{21}$	$9.0 \times 10^{18}$	$4.2 \times 10^{17}$	$1.0 \times 10^{18}$	$1.0 \times 10^{17}$	$4.5 \times 10^{18}$	$0.0 \times 10^{00}$	$3.0 \times 10^{15}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$2.3 \times 10^{16}$	$1.5 \times 10^{16}$

Hebei	Eastern	$1.9 \times 10^{19}$	$4.9 \times 10^{21}$	$1.7 \times 10^{20}$	$5.0 \times 10^{18}$	$5.7 \times 10^{18}$	$2.6 \times 10^{17}$	$5.0 \times 10^{19}$	$0.0 \times 10^{00}$	$5.5 \times 10^{15}$	$1.8 \times 10^{15}$	$0.0 \times 10^{00}$	$4.9 \times 10^{16}$	$1.0 \times 10^{17}$
Shanxi	Central	$4.1 \times 10^{19}$	$5.2 \times 10^{21}$	$8.3 \times 10^{19}$	$1.1 \times 10^{18}$	$1.0 \times 10^{18}$	$9.3 \times 10^{16}$	$1.5 \times 10^{19}$	$7.4 \times 10^{15}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$4.6 \times 10^{15}$	$8.1 \times 10^{16}$
Inner Mongolia	Western	$1.6 \times 10^{19}$	$8.3 \times 10^{21}$	$6.1 \times 10^{19}$	$4.8 \times 10^{17}$	$4.8 \times 10^{17}$	$7.0 \times 10^{16}$	$5.8 \times 10^{18}$	$1.3 \times 10^{16}$	$7.0 \times 10^{14}$	$0.0 \times 10^{00}$	$1.8 \times 10^{16}$	$1.2 \times 10^{16}$	$1.3 \times 10^{17}$
Liaoning	Northeastern	$8.9 \times 10^{18}$	$2.6 \times 10^{21}$	$6.7 \times 10^{19}$	$1.4 \times 10^{18}$	$1.5 \times 10^{18}$	$0.0 \times 10^{00}$	$1.7 \times 10^{19}$	$4.2 \times 10^{15}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$7.7 \times 10^{13}$	$3.4 \times 10^{15}$	$4.4 \times 10^{16}$
Jilin	Northeastern	$1.4 \times 10^{18}$	$1.3 \times 10^{21}$	$3.0 \times 10^{19}$	$2.5 \times 10^{17}$	$2.7 \times 10^{17}$	$1.0 \times 10^{17}$	$3.4 \times 10^{18}$	$4.8 \times 10^{15}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$5.3 \times 10^{16}$
Heilongjiang	Northeastern	$4.1 \times 10^{18}$	$1.6 \times 10^{21}$	$3.2 \times 10^{19}$	$1.6 \times 10^{17}$	$1.2 \times 10^{17}$	$7.6 \times 10^{16}$	$2.1 \times 10^{18}$	$1.1 \times 10^{13}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$3.0 \times 10^{15}$	$2.5 \times 10^{16}$
Shanghai	Eastern	$2.1 \times 10^{18}$	$1.4 \times 10^{21}$	$6.3 \times 10^{18}$	$3.4 \times 10^{17}$	$4.2 \times 10^{17}$	$2.9 \times 10^{17}$	$3.5 \times 10^{18}$	$1.2 \times 10^{15}$	$4.3 \times 10^{14}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$2.9 \times 10^{16}$	$3.0 \times 10^{16}$
Jiangsu	Eastern	$5.1 \times 10^{18}$	$7.6 \times 10^{21}$	$2.4 \times 10^{20}$	$2.2 \times 10^{18}$	$2.6 \times 10^{18}$	$1.0 \times 10^{18}$	$2.5 \times 10^{19}$	$1.1 \times 10^{16}$	$1.6 \times 10^{16}$	$2.2 \times 10^{15}$	$5.9 \times 10^{16}$	$1.2 \times 10^{17}$	$1.2 \times 10^{17}$
Zhejiang	Eastern	$8.3 \times 10^{17}$	$4.2 \times 10^{21}$	$2.2 \times 10^{20}$	$2.7 \times 10^{17}$	$6.4 \times 10^{17}$	$7.4 \times 10^{17}$	$2.0 \times 10^{18}$	$9.0 \times 10^{15}$	$1.8 \times 10^{16}$	$1.9 \times 10^{15}$	$0.0 \times 10^{00}$	$5.0 \times 10^{16}$	$1.1 \times 10^{17}$
Anhui	Central	$4.8 \times 10^{18}$	$4.4 \times 10^{21}$	$2.4 \times 10^{20}$	$6.5 \times 10^{17}$	$6.7 \times 10^{17}$	$3.2 \times 10^{17}$	$7.2 \times 10^{18}$	$2.9 \times 10^{16}$	$1.5 \times 10^{16}$	$0.0 \times 10^{00}$	$1.4 \times 10^{17}$	$6.4 \times 10^{16}$	$5.0 \times 10^{16}$
Fujian	Eastern	$8.7 \times 10^{17}$	$2.7 \times 10^{21}$	$1.7 \times 10^{20}$	$4.4 \times 10^{17}$	$6.2 \times 10^{17}$	$4.4 \times 10^{17}$	$2.8 \times 10^{18}$	$1.2 \times 10^{16}$	$0.0 \times 10^{00}$	$1.6 \times 10^{14}$	$0.0 \times 10^{00}$	$2.9 \times 10^{16}$	$3.7 \times 10^{16}$
Jiangxi	Central	$2.7 \times 10^{18}$	$2.0 \times 10^{21}$	$1.5 \times 10^{20}$	$5.2 \times 10^{17}$	$5.4 \times 10^{17}$	$8.6 \times 10^{16}$	$5.8 \times 10^{18}$	$2.9 \times 10^{16}$	$9.4 \times 10^{16}$	$2.1 \times 10^{14}$	$1.5 \times 10^{16}$	$7.3 \times 10^{15}$	$4.0 \times 10^{16}$
Shandong	Eastern	$1.2 \times 10^{19}$	$8.8 \times 10^{21}$	$2.3 \times 10^{20}$	$1.5 \times 10^{18}$	$2.0 \times 10^{18}$	$8.4 \times 10^{17}$	$1.9 \times 10^{19}$	$5.0 \times 10^{16}$	$1.2 \times 10^{17}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$7.9 \times 10^{16}$	$2.2 \times 10^{17}$
Henan	Central	$7.2 \times 10^{18}$	$4.3 \times 10^{21}$	$2.0 \times 10^{20}$	$6.1 \times 10^{17}$	$7.7 \times 10^{17}$	$1.6 \times 10^{17}$	$6.8 \times 10^{18}$	$1.1 \times 10^{16}$	$1.6 \times 10^{16}$	$1.0 \times 10^{15}$	$1.0 \times 10^{17}$	$5.2 \times 10^{16}$	$6.1 \times 10^{16}$
Hubei	Central	$3.1 \times 10^{18}$	$2.1 \times 10^{21}$	$1.9 \times 10^{20}$	$6.4 \times 10^{17}$	$7.7 \times 10^{17}$	$3.1 \times 10^{17}$	$6.5 \times 10^{18}$	$1.3 \times 10^{16}$	$2.4 \times 10^{16}$	$0.0 \times 10^{00}$	$3.9 \times 10^{16}$	$1.8 \times 10^{16}$	$3.1 \times 10^{16}$
Hunan	Central	$2.3 \times 10^{18}$	$1.5 \times 10^{21}$	$1.7 \times 10^{20}$	$4.8 \times 10^{17}$	$5.0 \times 10^{17}$	$2.4 \times 10^{17}$	$5.4 \times 10^{18}$	$0.0 \times 10^{00}$	$1.6 \times 10^{16}$	$8.4 \times 10^{15}$	$1.4 \times 10^{16}$	$1.3 \times 10^{16}$	$4.6 \times 10^{16}$
Guangdong	Eastern	$2.3 \times 10^{18}$	$6.2 \times 10^{21}$	$2.6 \times 10^{20}$	$6.0 \times 10^{17}$	$9.2 \times 10^{17}$	$9.4 \times 10^{17}$	$5.1 \times 10^{18}$	$0.0 \times 10^{00}$	$1.7 \times 10^{16}$	$8.3 \times 10^{14}$	$0.0 \times 10^{00}$	$8.8 \times 10^{16}$	$1.1 \times 10^{17}$
Guangxi	Western	$3.1 \times 10^{18}$	$1.8 \times 10^{21}$	$1.8 \times 10^{20}$	$4.7 \times 10^{17}$	$6.1 \times 10^{17}$	$1.2 \times 10^{17}$	$7.5 \times 10^{18}$	$1.9 \times 10^{16}$	$0.0 \times 10^{00}$	$1.2 \times 10^{15}$	$3.4 \times 10^{15}$	$1.2 \times 10^{16}$	$8.8 \times 10^{16}$
Hainan	Eastern	$0.0 \times 10^{00}$	$3.7 \times 10^{20}$	$2.8 \times 10^{19}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$1.0 \times 10^{17}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$4.2 \times 10^{15}$
Chongqing	Western	$1.1 \times 10^{18}$	$9.3 \times 10^{20}$	$9.1 \times 10^{19}$	$1.3 \times 10^{17}$	$2.5 \times 10^{17}$	$1.9 \times 10^{17}$	$1.7 \times 10^{18}$	$2.2 \times 10^{14}$	$9.5 \times 10^{13}$	$5.2 \times 10^{14}$	$9.0 \times 10^{15}$	$1.1 \times 10^{17}$	$2.1 \times 10^{16}$
Sichuan	Western	$4.2 \times 10^{18}$	$9.1 \times 10^{20}$	$2.2 \times 10^{20}$	$5.0 \times 10^{17}$	$6.1 \times 10^{17}$	$4.2 \times 10^{17}$	$5.2 \times 10^{18}$	$3.8 \times 10^{12}$	$0.0 \times 10^{00}$	$5.4 \times 10^{14}$	$0.0 \times 10^{00}$	$5.9 \times 10^{15}$	$1.1 \times 10^{17}$
Guizhou	Western	$1.7 \times 10^{18}$	$2.3 \times 10^{21}$	$1.1 \times 10^{20}$	$8.8 \times 10^{16}$	$1.2 \times 10^{17}$	$9.8 \times 10^{16}$	$9.3 \times 10^{17}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$8.0 \times 10^{14}$	$6.4 \times 10^{15}$	$1.8 \times 10^{15}$	$1.6 \times 10^{16}$
Yunnan	Western	$4.2 \times 10^{18}$	$7.1 \times 10^{20}$	$1.7 \times 10^{20}$	$4.0 \times 10^{17}$	$4.1 \times 10^{17}$	$1.9 \times 10^{17}$	$4.3 \times 10^{18}$	$2.1 \times 10^{16}$	$8.9 \times 10^{15}$	$1.1 \times 10^{16}$	$4.6 \times 10^{14}$	$6.7 \times 10^{15}$	$6.5 \times 10^{16}$
Tibet	Western	$0.0 \times 10^{00}$	$7.1 \times 10^{18}$	$1.4 \times 10^{19}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$2.2 \times 10^{16}$	$0.0 \times 10^{00}$	$3.2 \times 10^{14}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$2.4 \times 10^{13}$
Shaanxi	Western	$1.9 \times 10^{19}$	$3.5 \times 10^{21}$	$1.1 \times 10^{20}$	$2.5 \times 10^{17}$	$3.0 \times 10^{17}$	$0.0 \times 10^{00}$	$2.8 \times 10^{18}$	$5.4 \times 10^{13}$	$0.0 \times 10^{00}$	$1.3 \times 10^{16}$	$0.0 \times 10^{00}$	$4.9 \times 10^{15}$	$4.9 \times 10^{16}$
Gansu	Western	$2.0 \times 10^{18}$	$1.5 \times 10^{21}$	$6.9 \times 10^{19}$	$1.7 \times 10^{17}$	$1.8 \times 10^{17}$	$8.2 \times 10^{16}$	$2.0 \times 10^{18}$	$1.4 \times 10^{16}$	$8.9 \times 10^{15}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$2.0 \times 10^{15}$	$3.8 \times 10^{16}$

Qinghai	Western	$7.1 \times 10^{17}$	$1.8 \times 10^{20}$	$1.7 \times 10^{19}$	$2.9 \times 10^{16}$	$3.1 \times 10^{16}$	$0.0 \times 10^{00}$	$3.8 \times 10^{17}$	$8.2 \times 10^{14}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$3.1 \times 10^{14}$	$1.2 \times 10^{16}$	$2.6 \times 10^{16}$
Ningxia	Western	$3.6 \times 10^{18}$	$2.6 \times 10^{21}$	$2.8 \times 10^{19}$	$5.3 \times 10^{16}$	$5.6 \times 10^{16}$	$3.8 \times 10^{16}$	$1.1 \times 10^{18}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$5.7 \times 10^{14}$	$0.0 \times 10^{00}$	$2.0 \times 10^{15}$	$2.5 \times 10^{16}$
Xinjiang	Western	$8.7 \times 10^{18}$	$5.6 \times 10^{21}$	$6.6 \times 10^{19}$	$2.4 \times 10^{17}$	$2.8 \times 10^{17}$	$1.2 \times 10^{16}$	$2.8 \times 10^{18}$	$4.4 \times 10^{15}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$0.0 \times 10^{00}$	$7.2 \times 10^{16}$

## Reference

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