

Supporting information for

The Carbon Emissions of Chinese Cities

Haikun Wang ^{a,b}, Rongrong Zhang ^a, Miaomiao Liu ^a, Jun Bi ^{a,b,*}

^a State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, Nanjing 210046, P.R. China

^b Institute for Climate and Global Change Research, Nanjing University, Nanjing 210046, PR China

*Corresponding author Tel/fax: +86-25-89680566; E-mail: jbi@nju.edu.cn (Dr. Jun Bi) or wanghk@nju.edu.cn (Dr. Haikun Wang)

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Table S1

Definition and characteristics of the twelve Chinese cities and ten cities in the world in year 2005 of this study

City	Population (thousand persons)	Total area (km ²)	GDP (million PPP \$U.S.)	Population density (persons/km ²)	Per capita income (PPP \$U.S.)
Beijing	15,380	16,411	199,700	937	5,174
Tianjin	10,430	11,919	107,200	875	3,193
Shanghai	17,780	6,341	265,500	2,804	7,737
Hangzhou	6,600	16,596	85,400	398	4,024
Nanjing	6,890	6,582	69,900	1,047	3,673
Wuxi	4,500	4,788	81,400	940	4,018
Guangzhou	7,500	7,434	149,500	1,009	5,026
Zhengzhou	7,160	7,446	48,200	962	2,786
Wuhan	8,010	8,494	64,900	943	2,785
Chongqing	27,980	82,400	89,100	340	2,199
Lanzhou	3,117	13,086	16,400	238	2,310
Shenyang	6,986	12,980	60,400	538	2,853
Bangkok (city)	5,660	1,569	unknown	3,607	7,560
Barcelona (city)	1,610	100	unknown	16,056	27,403
Cape Town (city)	3,500	2,454	unknown	1,425	9,035
Denver (city and county)	580	397	unknown	1,460	42,476
Geneva (canton)	430	282	unknown	1,532	32,110
London (GLA)	7,360	1,579	unknown	4,664	38,066
Los Angeles (county)	9,520	10,518	unknown	905	31,049
New York City	8,170	789	unknown	10,355	46,221
Prague (GPR)	1,180	496	unknown	2,382	21,595
Toronto (GTA)	5,560	7,195	unknown	772	33,529

Note:

1. The data of twelve Chinese cities are all from the local statistical materials (1-12).
2. GDP and Per capita income are converted to PPP \$U.S. based on the *implied PPP conversion rate national currency per current international dollar* from <http://www.econstats.com/weo/V013.htm>
3. The data of ten cities in the world are derived from Kenney et al's study (13).
4. GLA, GPR and GTA mean Great London Authority, Great Prague and Great Toronto, respectively.

Table S2**Carbon accounting scope of this study**

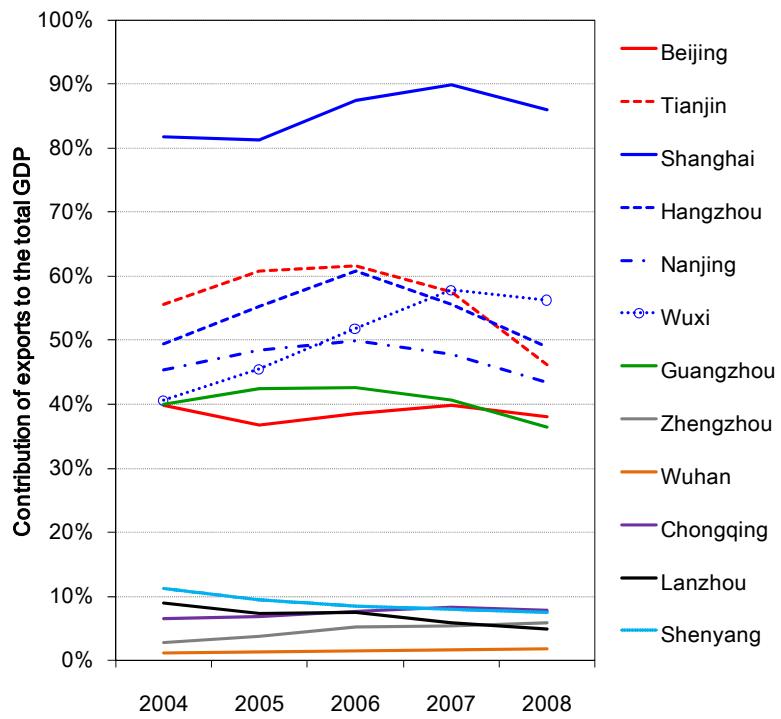
WRI/WBCSD	Spatial boundary	Life-cycle perspective	Components	Measure
Scope 3	Out of boundary energy use (and further out of boundary emissions, not included in Scope 2)	Production chain emissions	*Embodied emissions from food and materials consumed in cities *Emissions upstream of electric power plants *Upstream emissions from fossil fuel use *Combustion of aviation and marine fuels	
			*Out of boundary waste (landfill) emissions *Out of boundary district heating emissions	ICLEI and This Study
Scope 2	In boundary electricity use related emissions		*Out of boundary electricity emissions at power plant	
Scope 1	In boundary emissions	Single process emissions	*In boundary fossil fuel combustion (<u>including industrial, transportation, household and commercial energy used</u>) *In boundary waste (landfill) emissions *In boundary industrial processes and product use *In boundary agriculture, forestry and other land use	IPCC

Table S3**Carbon emission factors of six major power grids from 2004 to 2008, t CO₂/million KWh**

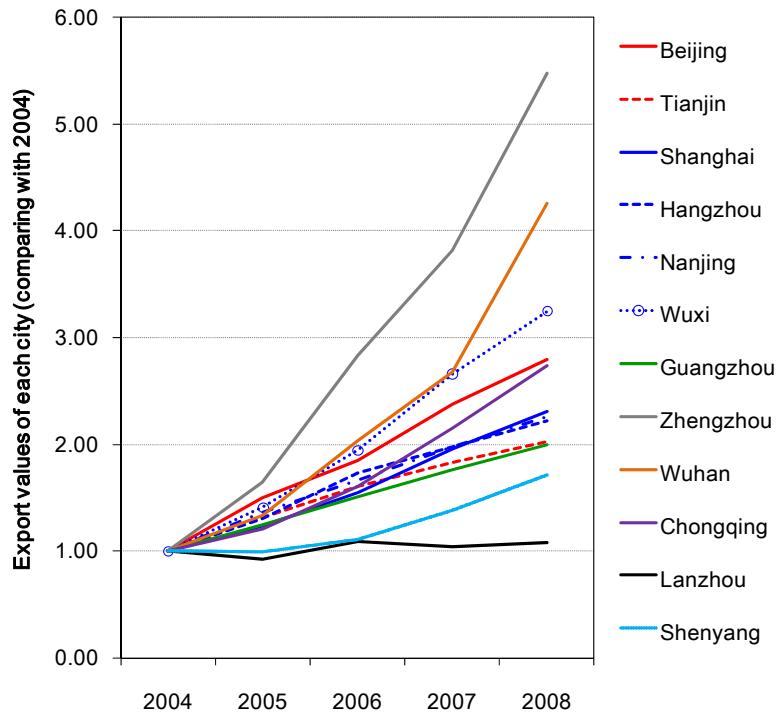
Grid name	Covered cities	2004	2005	2006	2007	2008
Northeast China	Shenyang	940	956	980	905	871
North China	Beijing, Tianjin	913	927	892	867	874
Central China	Zhengzhou, Wuhan, Chongqing	724	697	681	659	555
East China	Shanghai, Hangzhou, Nanjing, Wuxi	741	764	743	720	688
Northwest China	Lanzhou	695	704	699	691	701
South China	Guangzhou	631	668	667	641	552

Note:

1. The emission factors in 2004 are the average of 2003 and 2005.



(a)



(b)

Fig. S1. Export values and the contributions to the total GDP of each Chinese city.

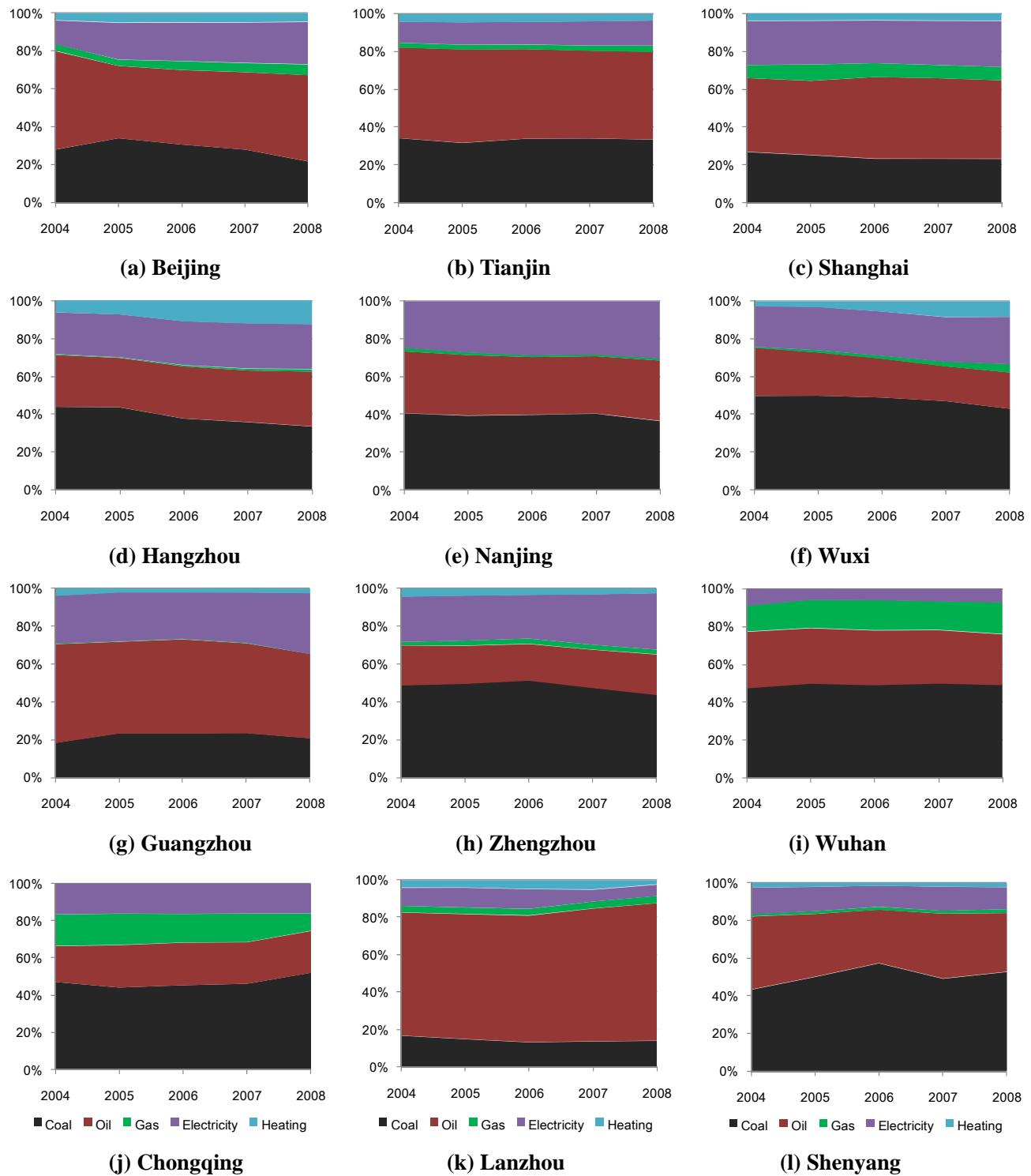


Fig. S2. Energy structures of the 12 Chinese cities from 2004 to 2008.

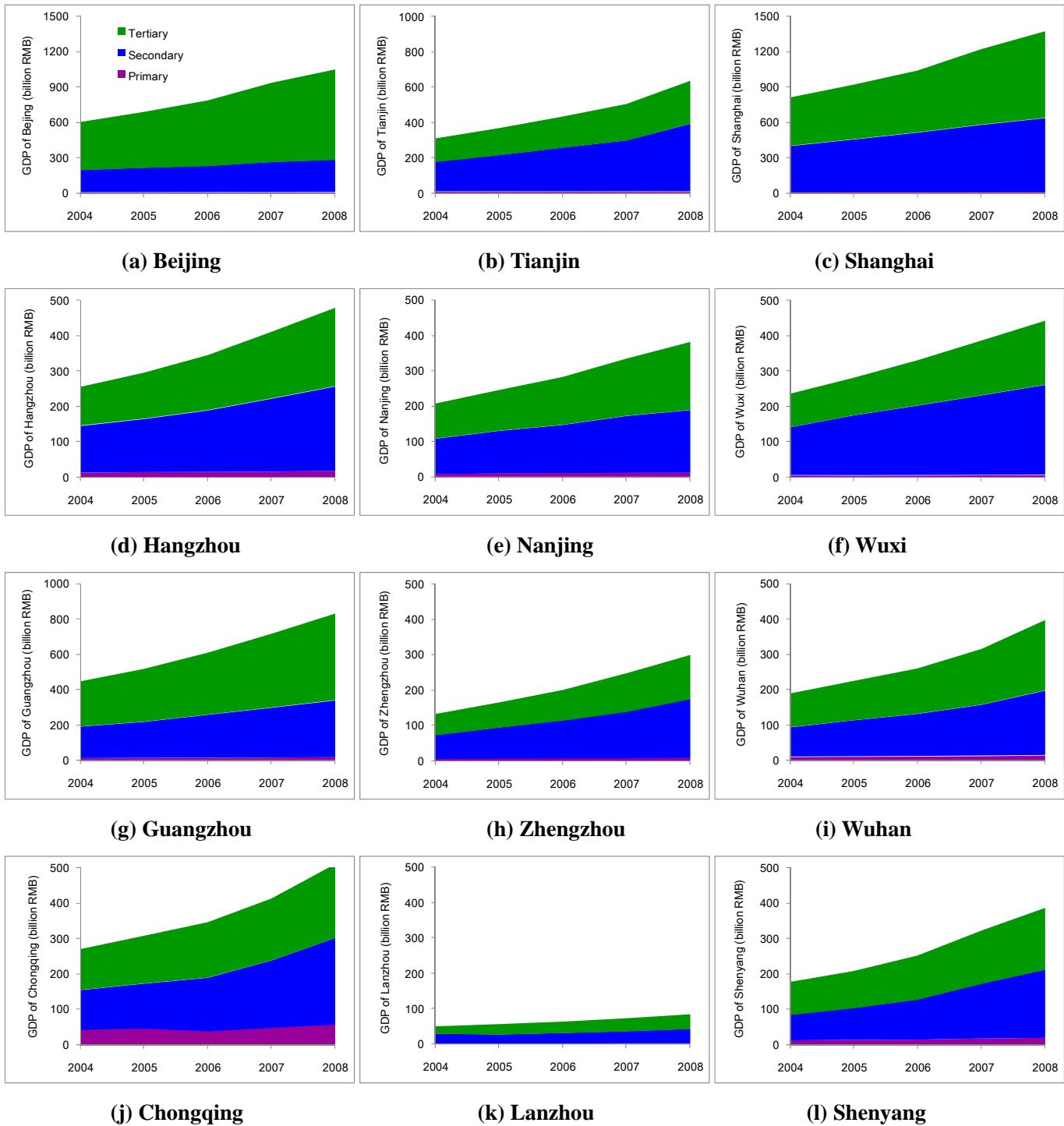
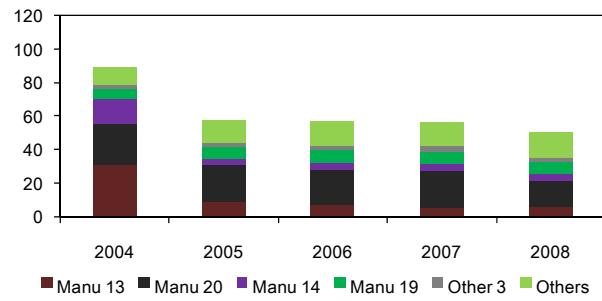
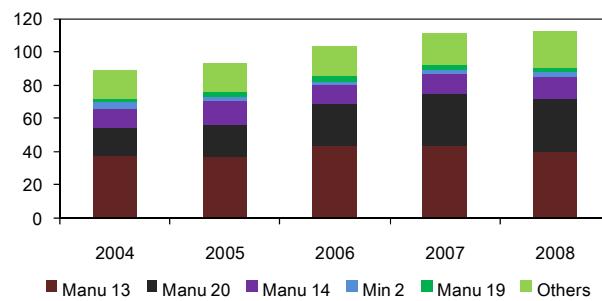


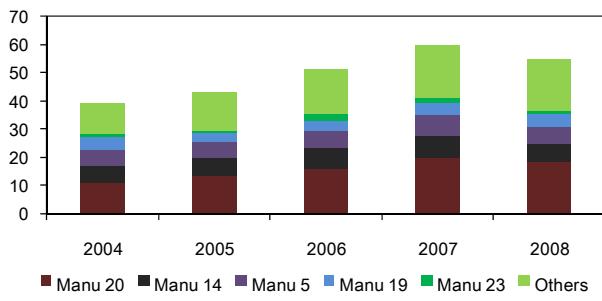
Fig. S3. Economic developments and structures of the 12 Chinese cities from 2004 to 2008. (Note: Primary industry includes agriculture, forestry, animal husbandry and fishery. Secondary industry includes industry (mining, manufacturing and production and supply of electricity, gas and water) and construction. The other economic sectors are included in tertiary industry (e.g. transport, education, Leasing and Business Services, and etc))



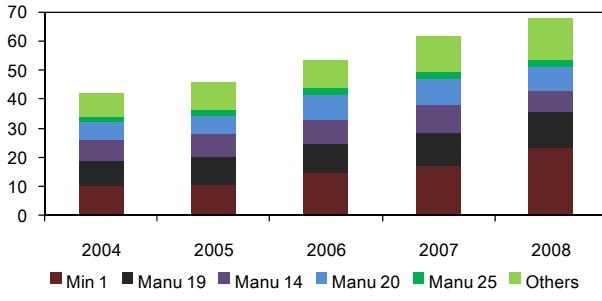
(a) Beijing



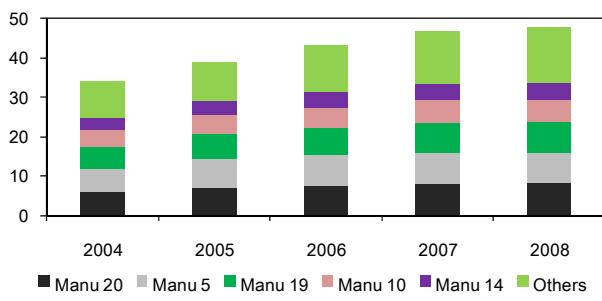
(b) Tianjin



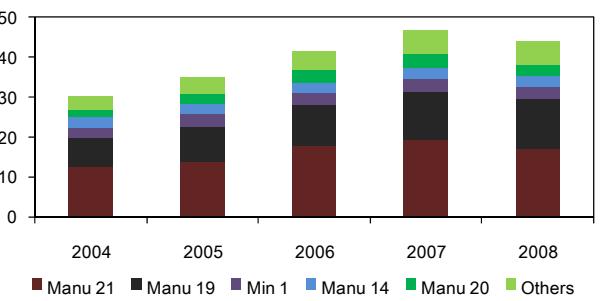
(c) Wuxi



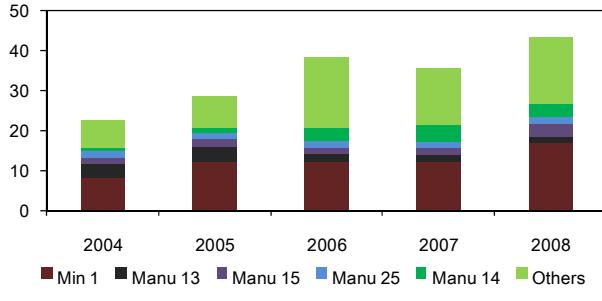
(d) Chongqing



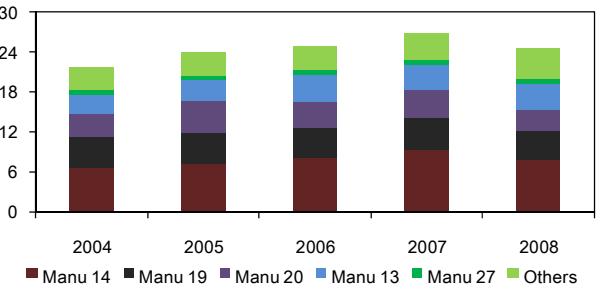
(e) Hangzhou



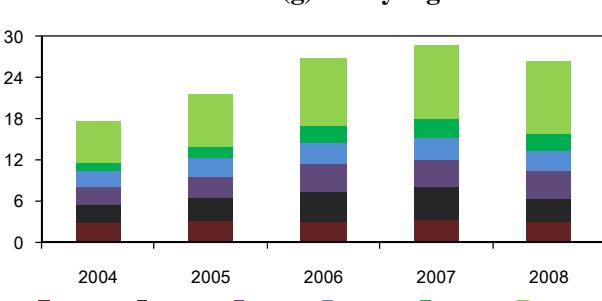
(f) Zhengzhou



(g) Shenyang



(h) Nanjing



(i) Guangzhou

Fig. S4. Carbon emission structures of industrial energy consumptions for the cities in China, million tons. (The abbreviations of each industrial subsector are shown in the following table)

Min 1	Mining and Washing of Coal
Min 2	Extraction of Petroleum and Natural Gas
Min 3	Mining and Processing of Ferrous Metal Ores
Min 4	Mining and Processing of Non-Ferrous Metal Ores
Min 5	Mining and Processing of Non-metal Ores
Min 6	Mining of Other Ores
Manu 1	Processing of Food from Agricultural Products
Manu 2	Manufacture of Foods
Manu 3	Manufacture of Beverages
Manu 4	Manufacture of Tobacco
Manu 5	Manufacture of Textile
Manu 6	Manufacture of Textile Wearing Apparel, Footware and Caps
Manu 7	Manufacture of Leather, Fur, Feather and Related Products
Manu 8	Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products
Manu 9	Manufacture of Furniture
Manu 10	Manufacture of Paper and Paper Products
Manu 11	Printing, Reproduction of Recording Media
Manu 12	Manufacture of Articles For Culture, Education and Sport Activities
Manu 13	Processing of Petroleum, Coking, Processing of Nuclear Fuel
Manu 14	Manufacture of Raw Chemical Materials and Chemical Products
Manu 15	Manufacture of Medicines
Manu 16	Manufacture of Chemical Fibres
Manu 17	Manufacture of Rubber
Manu 18	Manufacture of Plastics
Manu 19	Manufacture of Non-metallic Mineral Products
Manu 20	Smelting and Pressing of Ferrous Metals
Manu 21	Smelting and Pressing of Non-ferrous Metals
Manu 22	Manufacture of Metal Products
Manu 23	Manufacture of General Purpose Machinery
Manu 24	Manufacture of Special Purpose Machinery
Manu 25	Manufacture of Transport Equipment
Manu 26	Manufacture of Electrical Machinery and Equipment
Manu 27	Manufacture of Communication Equipment, Computers and Other Electronic Equipment
Manu 28	Manufacture of Measuring Instruments and Machinery for Cultural Activity and Office Work
Manu 29	Manufacture of Artwork and Other Manufacturing
Manu 30	Recycling and Disposal of Waste
Other 1	Production and Supply of Gas
Other 2	Production and Supply of Water
Other 3	Construction

References

- [1] Beijing Municipal Statistics Bureau (BMSB). 2005-2009. Beijing Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [2] Chongqing Municipal Statistics Bureau (CMSB). 2005-2009. Chongqing Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [3] Guangzhou Municipal Statistics Bureau (GMSB). 2005-2009. Guangzhou Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [4] Hangzhou Municipal Statistics Bureau (HMSB). 2005-2009. Hangzhou Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [5] Lanzhou Municipal Statistics Bureau (LMSB). 2005-2009. Lanzhou Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [6] Nanjing Municipal Statistics Bureau (NMSB). 2005-2009. Nanjing Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [7] Shanghai Municipal Statistics Bureau (SMSB). 2005-2009 a. Shanghai Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [8] Shenyang Municipal Statistics Bureau (SMSB). 2005-2009 b. Shenyang Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [9] Tianjin Municipal Statistics Bureau (TMSB). 2005-2009. Tianjin Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [10] Wuhan Municipal Statistics Bureau (WMSB). 2005-2009 a. Wuhan Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [11] Wuxi Municipal Statistics Bureau (WMSB). 2005-2009 b. Wuxi Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [12] Zhengzhou Municipal Statistics Bureau (ZMSB). 2005-2009. Zhengzhou Statistical Yearbook 2004-2008; China Statistics Press: Beijing, China.
- [13] Kennedy, C.; Steinberger, J.; Casson, B.; Hansen, Y.; Hillman, T.; Havránek, M.; Pataki, D.; Phdungsilp, A.; Ramaswami, A.; Mendez, G. Greenhouse gas emissions from global cities. *Environ. Sci. Technol.* 2009, 43, 7297-7302
- [14] BP Global, 2010. BP Statistical Review of World Energy. Available at <<http://www.bp.com/statisticalreview>>.