Energy Data 2015

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I. Energy and the Economy

Table 1 China key energy and economic indices

	1990	2000	2005	2010	2011	2012	2013	2014
Population (millions)	1143.33	1267.43	1307.56	1339.20	1347.35	1354.04	1360.72	1367.82
Urban population (%)	26.4	36.2	43.0	49.7	51.3	52.6	53.7	54.8
GDP growth rate (%)	3.8	8.4	11.3	10.6	9.5	7.7	7.7	7.3
GDP (100 million Chinese yuan)	18668	99215	184937	401513	472882	519470	588019	636139
Economic structure Primary industry (%)	27.1	15.1	12.1	10.1	10.0	10.1	9.4	9.2
Secondary industry (%)	41.3	45.9	47.4	46.7	46.6	45.3	43.7	42.7
Tertiary industry (%)	31.6	39.0	40.5	43.2	43.4	44.6	46.9	48.1
GDP per capita (USD)	344	949	1808	4425	5359	6093	6695	7571
Primary energy consumption (Mtce)	987.0	1469.6	2613.7	3606.5	3870.4	4021.4	4169.1	4260.0
Dependence on crude oil imports (%)	-18.4	26.4	36.4	54.5	56.5	56.4	57.6	59.3
Urban per capita disposable income (Chinese yuan)	1510	6280	10493	19109	21810	24565	26955	28844
Rural per capita net income (Chinese yuan)	686	2253	3255	5919	6977	7917	8896	10489
Private vehicles (in units of 10,000)	551.4	1608.9	3159.7	7801.8	9356.3	10933.1	12670.1	15447
Energy consumption per capita (Kgce)	864	1160	1999	2693	2873	2970	3064	3114
Per capita domestic electricity consumption (kWh)	42	132	217	381	418	461	500	508
Energy industry fixed-asset investments (100 million Chinese yuan)	847	2840	10206	20899	22989	25500	29009	31725
Electricity production (TWh)	621.2	1355.6	2500.3	4207.1	4713.0	4987.6	5431.6	5649.6
Steel output (Mt)	66.4	128.5	353.2	637.2	685.3	723.9	813.1	822.7
Cement output (Mt)	209.7	597.0	1068.9	1881.9	2099.3	2209.8	2419.2	2476.1
Exports (USD 100 million)	620.9	2492.0	7619.5	5777.5	18986.0	20487.1	22093.7	23427.8
Imports (USD 100 million)	533.5	2250.9	6599.5	3962.4	17434.6	18184.1	19503.2	19603.9
SO_2 emissions (Mt)	15.02	19.95	25.49	21.85	22.18	21.18	20.44	19.74
Chinese yuan/USD exchange rate	4.7832	8.2785	8.1943	6.7695	6.5488	6.3125	6.1932	6.1428

Notes: 1. GDP is calculated at current prices and the growth rate is calculated at constant price.

2. Energy industry fixed-asset investments include the coal mining and washing industries, the petroleum and natural gas extraction industry, the petroleum processing and coking industries, the electric power and hot water production and supply industries, and the gas production and supply industries. Before 1990 they were state-owned, and 2000-2014 they were urban fixed-asset investments.

Sources: National Bureau of Statistics of the People's Republic of China (NBS); General Administration of Customs; China Electricity Council; Ministry of Environmental Protection.

Table 2 China key indices by region (2014)

Region	Population (millions)	GDP (100 million Chinese yuan)	Tertiary industry (%)	Total energy consumption (10,000 tce)	Per capita GDP (Chinese yuan)	Energy consumption per capita (Kgce)	Steel output (10,000t)	Electricity production (100 million kWh)
National total	1367.82	636139	48.1	416913	46508	3114	82270	56496
Beijing	21.52	21331	77.9	6724	99995	3179	2.1	364
Tianjin	15.17	15723	49.6	7882	105202	5196	2287	626
Hebei	73.84	29421	37.2	29664	39984	4045	18530	2500
Shanxi	36.48	12759	44.1	19761	35064	5444	4325	2647
Inner Mongolia	25.05	17770	39.5	17681	71044	7078	1662	3858
Liaoning	43.91	28627	34.2	21721	65201	4948	6511	1648
Jilin	27.52	13804	36.2	8645	50162	3142	1265	772
Heilongjiang	38.33	15039	46.0	11853	39226	3091	476	881
Shanghai	24.26	23561	64.8	11346	97343	4698	1775	792
Jiangsu	79.60	65088	46.7	29205	81874	3679	10196	4348
Zhejiang	55.08	40154	47.9	18640	72967	3390	1748	2885
Anhui	60.83	20849	34.8	11696	34427	1940	2451	2034
Fujian	38.06	24056	39.6	11190	63472	2965	1821	1873
Jiangxi	45.42	15709	35.9	7583	34661	1677	2235	873
Shandong	97.89	59427	43.5	35358	60879	3633	6411	3691
Henan	94.36	34939	36.8	21900	37073	2327	2882	2730
Bubei	58.16	27367	41.5	15730	47124	2713	3056	2382
Hunan	67.37	27049	42.4	14919	40287	2230	1918	1314
Guangdong	107.24	67792	49.1	28480	63452	2676	1710	3948
Guangxi	47.54	15673	37.8	9100	33090	1928	2084	1310
Hainan	9.03	3501	51.9	1720	38924	1922	22.4	245
Chongqing	29.91	14265	46.8	8049	47859	2710	786	676
Sichuan	81.40	28537	36.7	19212	35128	2370	2243	3079
Guizhou	35.08	9251	49.6	9299	26393	2655	552	1748
Yunnan	47.14	12815	43.1	10072	27264	2149	1689	2550
Tibet	3.18	921	53.4	-	29252	-	-	32
Shaanxi	37.75	17690	36.4	10610	46929	2819	1038	1621
Gansu	25.91	6835	44.0	7287	26427	2822	1074	1241
Qinghai	5.83	2301	37.1	3768	39633	6519	144	580
Ningxia	6.62	2752	43.3	4781	41834	7310	162	1157
Xinjiang	22.98	9264	41.0	13632	40607	6021	1213	2091

Note: Total energy consumption and energy consumption per capita data are from 2013.
Sources: NBS, China Statistical Abstract 2015, China Statistics Press, May 2015; China Energy Statistical Yearbook 2014, China Statistics Press, August 2015.

Table 3 Global comparison of key energy and economic indices (2014)

	China	US	EU	Japan	Russia	India	OECD	World
Population (millions)	1367.8	323.9	507.4	127.5	143.7	1283.0	1248.9	7283.6
Per capita GDP (USD)	7571	54630	36451	36194	14382	1267	34494	10613
Per capita fossil fuel recoverable reserves								
Coal (t)	175	733	110	2.7	1093	47	308	139
Oil (t)	2.51	18.22	1.58	0.05	98.12	0.62	29.78	33.05
Natural gas (m^3)	3615	30256	2956	164	226822	1091	15614	25880
Per capita primary energy consumption (Kgce)	2807	10138	4010	5110	6779	710	6290	2536
Per capita oil consumption(t)	380	2581	1169	1545	1030	141	1627	578
Per capita electricity production (kWh)	4130	13267	6390	8323	7406	860	8618	3277
Per capita steel output (t)	601	273	333	868	492	67	408	228
Vehicle ownership (per 1,000 people)	81	801	514	595	317	24	578	163
Per capita CO_2 emissions (t)	6.83	18.77	7.30	10.53	11.54	1.72	11.02	4.85

Note: 1. China's fossil fuel recoverable reserves data are from China's Ministry of Land and Resources; the world total is a revision based on data from the BP Statistical Review of World Energy.

2. Data on vehicle ownership is from 2012.

Sources: NBS; IEA; World Bank; IMF; BP Statistical Review of World Energy, June 2015; IEEJ, Handbook of Energy and Economic Statistics in Japan, 2015 version; World Steel Association.

Table 4 China per capita GDP in top 10 regions (2014) (Unit: USD)

1. Shenzhen	25241
2. Taiwan	23442
3. Suzhou	21176
4. Guangzhou	21040
5. Tianjin	17013
6. Shanghai	16278
7. Beijing	15191
8. Jiangsu	13141
9. Zhejiang	11685
10. Inner Mongolia	11565

Table 5 China urbanization and energy consumption

	2000	2005	2010	2011	2012	2013	2014
Urban population (millions)	459.1	562.1	665.6	690.8	711.8	731.1	749.16
Urbanization rate (%)	36.2	43.0	49.7	51.3	52.6	53.7	54.8
Number of cities at prefecture level and above		286	287	288	289	290	
population ＞4 million		13	14	14	14	14	
population 2-4 million		25	30	31	31	33	
population 1-2 million		75	81	82	82	86	
Urban per capita disposable income (Chinese yuan)	6280	10493	19109	21810	24565	26955	28844
Urban per capita housing area (m^2)	20.3	26.1	31.6	32.7	32.9		
Urban private car ownership (100 households)	0.5	3.4	13.1	18.6	21.5	22.3	25.7
Urban air conditioner ownership (100 households)	30.8	80.7	112.1	122.0	126.8	102.2	107.4
Urban refrigerator ownership (100 households)	80.1	90.7	96.6	97.2	98.5	89.2	91.7
Urban centralized heating area (100 million m^2)	11.1	25.2	43.6	45.6	51.8	57.2	61.1
Urban per capita electricity consumption (kWh)	217	306	445	464	500	528	525

Sources: NBS; China Electricity Council.

Table 6 Economic and energy consumption divide (regional/urban-rural/rich-poor)

Economy			
Overall per capita GDP (USD) (2014)	National average: 7571	Max: Shenzhen 25241	Min: Guizhou 4297
Urban per capita disposable income /Chinese yuan (2014)	National average: 28844	Max: Shanghai 48841	Min: Gansu 21804
Rural per capita disposable income /Chinese yuan (2014)	National average: 10489	Max: Shanghai 21192	Min: Gansu 6277
Energy consumption			
Regional			
Energy consumption per capita /Kgce (2013)	National average: 3114	Max: Ningxia 7310	Min: Jiangxi 1677
Per capita electricity consumption /kWh (2014)	National average: 4078	Max: Ningxia 12899	Min: Tibet 1079
Per capita residential electricity consumption /kWh (2014)	National average: 508	Max: Beijing 793	Min: Tibet 220
Urban and rural			
Final energy consumption per capita /Kgce (2010)	National average: 1.58	Urban: 2.91	Rural: 0.79 (1.01)
Per capita electricity consumption /kWh (2014)	National average: 4078	Urban: Suzhou 11959	Rural: Hainan 258
Per capita residential electricity consumption /kWh (2014)	National average: 508	Urban: Shenzhen 1662	Rural: Qinghai 290
Rich and poor			
2014 urban per capita disposable income (Chinese yuan)	20% highest income households: 61615		20% lowest income households: 11219
2014 urban and rural per capita disposable income (Chinese yuan)	20% highest income households: 50968		20% lowest income households: 4747
2014 home computer ownership (100 households)	National average: Urban: 76.2 Rural: 23.5	Max: Shanghai1 44.4	Min: Tibetan rural areas 0.54*
2014 air conditioner ownership (100 households)	National average: Urban: 107.4 Rural: 34.2	Max: Dongguan 272.0*	Min: Gansu rural areas 0.28*
2014 private car ownership (100 households)	National average: Urban: 25.7 Rural: 11.0	Max: Dongguan 80 *	Min: Households in hardship 3.2*
Residential electricity consumption per household /kWh/month	National average: 106	Max: 500m^2 luxury real estate average: 20000	Min: impoverished areas: **1.1**

Note: 1.* Figures are from 2012.

2. Rural final energy consumption per capita (2010) :1.01 in the brackets includes the direct combustion of biomass energy.

3. Shenzhen per capita residential electricity consumption refers to Futian district only (with a population of 1.357 million).

4. Impoverished areas include 21 provinces (or autonomous regions), and monthly electricity consumption is the average of 970,000 households.

Sources: NBS; China Agriculture Yearbook; China Electricity Council; Shenzhen and Dongguan statistics bureaus; Investigation of Electricity Available for Each Household, *State Grid*, 2007, No.12.

Table 7 China coefficient of elasticity in energy and electricity consumption

Year	Growth of energy consumption (%)	Growth of electricity consumpmtion (%)	GDP growth (%)	Energy consumption elasticity coefficient	Electricity consumption elasticity coefficient
1990	1.8	6.2	3.8	0.47	1.63
1991	5.1	9.2	9.2	0.55	1.00
1992	5.2	11.5	14.2	0.37	0.81
1993	6.3	11.0	14.0	0.45	0.79
1994	5.8	9.9	13.1	0.44	0.76
1995	6.9	8.2	10.9	0.63	0.75
1996	3.1	7.4	10.0	0.31	0.74
1997	0.5	4.8	9.3	0.06	0.52
1998	0.2	2.8	7.8	0.03	0.36
1999	3.2	6.1	7.6	0.42	0.80
2000	4.5	9.5	8.4	0.54	1.13
2001	5.8	9.3	8.3	0.70	1.12
2002	9.0	11.8	9.1	0.99	1.30
2003	16.2	15.6	10.0	1.60	1.56
2004	16.8	15.4	10.1	1.66	1.52
2005	13.5	13.5	11.3	1.19	1.19
2006	9.6	14.6	12.7	0.76	1.15
2007	8.7	14.4	14.2	0.61	1.01
2008	2.9	5.6	9.6	0.30	0.58
2009	4.8	7.2	9.2	0.52	0.78
2010	7.3	13.2	10.6	0.69	1.25
2011	7.3	12.1	9.5	0.77	1.31
2012	3.9	5.9	7.7	0.51	0.77
2013	3.7	8.9	7.7	0.48	1.16
2014	2.2	3.8	7.3	0.30	0.51

Source: NBS.

Table 8 China economic and industrial structural changes **Unit: %**

	1980	1990	1995	2000	2005	2009	2010	2011	2012	2013	2014
Economic structure											
Primary industry	30.2	27.1	19.9	15.1	12.1	10.3	10.1	10.0	10.1	9.4	9.2
Secondary industry	48.2	41.3	47.2	45.9	47.4	46.3	46.7	46.6	45.3	43.7	42.7
Tertiary industry	21.6	31.6	32.9	39.0	40.5	43.4	43.2	43.4	44.6	46.9	48.1
Industry											
Light industry	47.1	49.4	47.3	39.8	31.4	29.5	28.6	28.4	28.5		
Heavy industry	52.9	50.6	52.7	60.2	68.6	70.5	71.4	71.6	71.5		

Note: China stopped dividing industry into “light” and “heavy” after 2013.
Source: NBS.

Table 9 Global economic structure (2012) **Unit: %**

	Primary industry	Secondary industry	Tertiary industry
US	1.2	19.1	79.7
China	9.7	46.6	43.7
Germany	0.8	28.1	71.1
Britain	0.7	21.1	78.2
France	1.9	18.3	79.8
Italy	2	23.9	74.1
Japan	1.2	27.5	71.3
Russia	4.4	37.6	58.0
India	17	18	65.0
Brazil	5.4	27.4	61.2
World	5.9	30.5	63.6

Note: Production value is calculated according to purchasing power parity.
Source: IMF.

Table 10 China energy-intensive goods production (2014)

Product	Output	China's global share (%)
Crude steel	822.7 Mt	49.6
Electrolytic aluminum	27.52 Mt	65
Cement	2476 Mt	60
Sheet glass	793 million weight cases	50
Architectural ceramics	10.23 billion m^2	65
Yarn	33.79 Mt	40
Chemical fiber	43.90 Mt	70
Vehicles	23.725 million	27.5
Household air conditioners	144.63 million	75
Refrigerators	87.96 million	50
Color TV sets	141.29 million	50
Washing machines	71.14 million	50
Microwave ovens	77.5 million	75
Mobile phones	1.627 billion	77
Solar water heaters	52.4 million m^2	76
Photovoltaic cells	33 GW	73
Energy saving bulbs	4.37 billion	80

Sources: NBS; Ministry of Industry and Information; China Building Material Industry Association; China Ceramics Industry Association; China Chemical Fiber Association; China Household Electrical Appliances Association; Chinese Solar Energy Society; China Association of Lighting Industry; United Nations Industrial Development Organization.

Table 11 China energy-intensive materials and equipment production

	1990	2000	2005	2010	2011	2012	2013	2014
Energy-intensive materials								
Crude steel (Mt)	66.4	128.5	353.2	637.2	685.3	723.9	813.1	822.7
Cement (Mt)	209.7	597.0	1068.9	1881.9	2099.3	2209.8	2419.2	2476.1
Electrolytic aluminum (Mt)	0.85	2.79	7.79	15.77	19.61	23.14	25.44	27.52
Ethylene (Mt)	1.57	4.70	7.56	14.21	15.28	14.87	15.99	16.97
Agricultural fertilizer (Mt)	18.80	31.86	51.78	63.38	66.26	68.32	70.26	68.87
Energy-intensive equipment (millions)								
Vehicles	0.51	2.07	5.71	18.27	18.42	19.28	21.12	23.73
Household refrigerators	4.63	12.79	29.87	72.96	86.99	84.27	92.61	87.96
Color TV sets	10.33	39.36	82.83	118.30	122.31	128.23	127.76	141.29
Household air conditioners	0.24	18.27	67.65	108.88	139.30	124.0	130.6	144.63

Source: NBS.

Table 12 Urban living standards in China's most affluent cities and Tokyo (2014)

	Beijing	Shanghai	Shenzhen	Dongguan	Tokyo (Japan)
Permanent resident population (10,000)	2152	2426	1078	832	1332
Per capita disposable income (USD)	7148	7767	7710	7523	16930
Per capita indoor area (m^2)	35	32	28	32	35
Durable consumer goods ownership					
Private cars (per 100 households)	63	36	75	80	46
Air conditioners (per 100 households)	178.7	207.1	167	272	264.3
Color TV sets (per 100 households)	141.2	192.3	128	187	225.9
Computers (per 100 households)	112.1	144.4	119	123	128.1

Note: 1. Private car data in Beijing, Shanghai and Dongguan refers only to urban households.
2. Data on air conditioners, color TVs and computers in Shenzhen and Dongguan is from 2011.
3. Data on air conditioners, color TVs and computers in Japan is the country average from 2012.

Source: China Statistical Yearbook 2014; Beijing, Shanghai, Shenzhen and Dongguan statistics bureaus; IEEJ, Handbook of Energy and Economic Statistics in Japan, 2014; per capita income of the people in Tokyo, Statistical Bureau of the Ministry of Internal Affairs and Communications; per capita living space of people in Tokyo, 2013 Japan's population census of the Ministry of International Affairs and Communications; Number of private cars per 100 households in Tokyo, Automobile Inspection & Registration Information Association.

Table 13 China urban and rural living standards and energy consumption

	2000	2010	2011	2012	2013	2014
Per capita GDP (USD)	949	4425	5375	6093	6995	7571
Urban per capita disposable income of urban residents (Chinese yuan)	6280	19109	21810	24565	26955	28844
Rural per capita net income of households (Chinese yuan)	2253	5919	6977	7917	8896	10489
Engel's coefficient, urban households (%)	39.4	35.7	36.3	36.2	35.0	
Engel's coefficient, rural households (%)	49.1	41.1	40.4	39.3	37.7	
Per capita living space (m^2)						
Urban (gross floor area)	20.3	31.6	32.7	32.9		
Rural (indoor living space)	24.9	34.1	36.2	37.1	38.1	
Ownership of energy-intensive appliances (per 100 households) Indoor air conditioners						
Urban	30.8	112.1	122.0	126.8	102.2	107.4
Rural	1.3	16.0	22.6	25.4	29.8	34.2
Refrigerators						
Urban	80.1	96.6	97.2	98.5	89.2	91.1
Rural	12.3	45.2	61.5	67.3	72.9	77.6
Color TVs						
Urban	116.6	137.4	135.2	136.1	118.6	122.0
Rural	48.7	111.8	115.5	116.9	112.9	115.6
Home computers						
Urban	9.7	71.2	81.9	87.0	71.5	76.2
Rural	0.5	10.4	18.0	21.4	20.0	23.5
Private cars						
Urban	0.5	13.1	18.6	21.5	22.3	25.7
Rural	-	-	-	-	9.9	11.0
Energy consumption per capita (KgCE)	1160	2693	2873	2970	3063	3114
Residential electricity consumption per capita (kWh)	132	381	418	461	500	508
Urban	217	445	464	500	528	525
Rural	84	316	368	415	465	485

Sources: NBS; China Electricity Council.

Table 14 China rural electrification and poverty standards

	1978	2000	2005	2010	2011	2012	2013	2014
Rural population (millions)	790.14	808.37	745.44	674.15	656.56	642.22	629.61	618.66
Poverty standard Chinese yuan /person	100	625	683	1274	2300	2300	2300	2300
People living below the poverty line (millions)	250.0	32.1	23.7	26.9	122.4	99.0	82.5	70.2
People without access to electricity (millions)	450.0	35.0	13.0	5.3	5.0	3.87	1.23	0.2
Domestic electricity consumption per capita (kWh)	8*	84	149	316	368	415	465	485

Note: 1. According to the World Bank poverty level of USD1.25/day, there were 180 million people in China living below the poverty line in 2013.

2. *1980 data.

Sources: NBS; China Electricity Council; National Energy Administration; State Electricity Regulatory Commission.

II. Primary Energy Supply

Table 15 Global fossil fuel recoverable reserves and reserves-to-production ratio (2014)

Coal (100 million t)		Oil (100 million t)		Natural gas (trillion m^3)	
China	2400(63)	Venezuela	466(＞100)	Russia	32.6(56.4)
US	2322(256)	Saudi Arabia	367(63.6)	Iran	34.0(＞100)
Russia	1570(441)	Canada	279(＞100)	Qatar	24.5(＞100)
Australia	764(155)	Iran	217(＞100)	Turkmenistan	17.5(＞100)
India	606(94)	Iraq	202(＞100)	US	9.8(13.4)
Germany	405(218)	Russia	141(26.1)	Saudi Arabia	8.2(75.4)
Ukraine	339(384)	Kuwait	140(＞100)	UAE	6.1(＞100)
Kazakhstan	336(309)	UAE	130(72.2)	Venezuela	5.6(＞100)
South Africa	302(116)	Libya	63(＞100)	Nigeria	5.1(＞100)
Indonesia	280(61)	US	59(11.4)	China	4.9(38.0)
World	10170(125)	Nigeria	50(43.0)	Algeria	4.5(54.1)
		Kazakhstan	39(48.3)	Australia	3.7(67.6)
		China	34(16.3)	Iraq	3.6(＞100)
		Qatar	27(35.5)	Indonesia	2.9(39.2)
		Brazil	23(18.9)	Egypt	1.8(37.9)
		Angola	17(20.3)		
		Mexico	15(10.6)		
		OPEC	1705(91.1)		
		World	2407(57.0)	World	188.5(54.5)

Note: 1. Recoverable reserves are the amount that can be extracted from proven reserves.

2. China's recoverable coal reserves as calculated by BP in 2014 were 114.5 billion tons (BP uses 1992 data). Data on recoverable reverses of coal, oil and natural gas come from China's Ministry of Land and Resources. The world total is a revision based on BP data.

3. The US' recoverable coal reserves come from the National Mining Association.

4. Reserves-to-production ratios are given in parentheses.

Sources: BP Statistical Review of World Energy, June 2015; Ministry of Land and Resources.

Table 16 Recoverable reserves of shale gas Unit: trillion m3

China	31.22
Argentina	22.46
Algeria	19.80
US	18.62
Canada	16.04
Mexico	15.26
Australia	12.24
South Africa	8.65

Source: EIA, 2014-06.

Table 17 China Coal, oil and natural gas resouces and reserves

Coal
China has 3,231.7 billion tons of coal resources (to a depth of 1,500m). Proven reserves are 1.4 trillion tons, and by the end of 2014 there were technologically recoverable reserves of 239.99 billion tons.
Oil
Crude oil: China has 93.9 billion tons of oil resources, of which 24.58 billion tons is proven. By the end of 2014 , it had technologically recoverable reserves of 3.433 billion tons.
Oil sands: China has 60 billion tons of oil sands resources, of which 2.3 billions tons is proven.
Oil Shale: China has 243.2 billion tons of technologically recoverable reserves of oil shale, which 12 billion tons is recycable.
Natural gas
Conventional natural gas: China has 54.6 trillion m^3 of conventional natural gas resources, of which 33.8 trillion m^3 is proven resources. At the end of 2014, accumulated proven reserves were 12.78 trillion m^3, and remaining technologically recoverable reserves were 4.95 trillion m^3.
CBM: China has 37 trillion m^3 in coal-bed methane resources, with proven resources of 11 trillion m^3. In 2014, accumulated proven reserves were 226 billion m^3, and remaining technologically recoverable reserves were 90 billion m^3.
Shale gas: China has 134.4 trillion m3 in shale gas resources, with proven resources of 25.1 trillion m3. In 2014, proven reserves were 106.8 billion m3, and technologically recoverable reserves were 26.7 billion m3.

Source: Ministry of Land and Resources.

Table 18 China energy output by source

Year	Raw coal (Mt)	Crude oil (Mt)	Natural gas (100 million m^3)	Electric energy production (TWh)	Hydropower (TWh)
1990	1080	138.3	153.0	621.2	126.7
1991	1087	141.0	160.7	677.5	124.7
1992	1116	142.1	157.9	753.9	130.7
1993	1150	145.2	167.7	839.5	151.8
1994	1240	146.1	175.6	928.1	167.4
1995	1361	150.1	179.5	1007.0	190.6
1996	1397	157.3	201.1	1081.3	188.0
1997	1388	160.7	227.0	1135.6	196.0
1998	1332	161.0	232.8	1167.0	198.9
1999	1364	160.0	252.0	1239.3	196.6
2000	1384	163.0	272.0	1355.6	222.4
2001	1472	164.0	303.3	1480.8	277.4
2002	1550	167.0	326.6	1654.0	288.0
2003	1835	169.6	350.2	1910.6	283.7
2004	2123	175.87	414.6	2203.3	353.5
2005	2365	181.35	493.2	2500.3	397.0
2006	2570	184.77	585.5	2865.7	435.8
2007	2760	186.32	692.4	3281.6	485.3
2008	2903	190.43	803.0	3495.76	637.0
2009	3115	189.49	852.7	3714.65	615.6
2010	3428	202.41	957.9	4207.16	722.17
2011	3764	202.88	1053.4	4713.02	698.95
2012	3945	207.48	1106.1	4987.60	872.10
2013	3974	209.92	1208.6	5431.64	920.29
2014	3874	211.43	1301.6	5649.58	1064.34

Source: NBS.

Table 19 Global oil, natural gas and coal production

Oil (Mt)					
	2010	2011	2012	2013	2014
Saudi Arabia	473.8	526.0	549.8	538.4	543.4
Russia	511.8	518.5	526.2	531.0	534.1
US	332.9	345.7	394.1	448.5	519.9
China	202.4	202.9	207.5	209.9	211.4
Canada	160.3	170.4	182.6	194.4	209.8
Iran	208.8	208.2	177.1	165.8	169.2
UAE	133.3	151.3	154.7	165.7	167.3
Iraq	121.5	136.7	152.5	153.2	160.3
Kuwait	122.5	139.7	153.7	151.5	150.8
Venezuela	146.7	141.5	136.6	137.9	139.5
Mexico	145.6	144.5	143.9	141.8	137.1
Brazil	111.4	114.2	112.2	109.8	122.1
Nigeria	121.3	118.2	116.2	110.7	113.5
Norway	98.9	93.8	87.2	83.2	85.6
Angola	90.5	83.8	86.9	87.3	83.0
World	3979.3	4010.6	4119.8	4126.6	4220.6
OPEC	1667.2	1704.4	1776.3	1734.4	1729.6

Natural gas (100 million m^3)					
	2010	2011	2012	2013	2014
US	6035	6485	6812	6891	7283
Russia	5889	6070	5923	6047	5787
Qatar	1167	1453	1508	1565	1772
Iran	1462	1518	1656	1640	1726
Canada	1599	1597	1561	1561	1620
China	949	1027	1070	1171	1302
Norway	1077	1017	1147	1087	1088
Saudi Arabia	877	993	993	1000	1082
Algeria	804	827	815	815	833
Indonesia	857	815	771	721	734
Turkmenistan	424	595	623	623	693
Malaysia	626	622	616	672	664
Mexico	576	583	569	582	581
UAE	513	523	543	546	578
Uzbekistan	596	570	569	569	573
Netherlands	705	642	639	687	558
World	32026	33157	33802	34088	34606

Coal (Mt)					
	2010	2011	2012	2013	2014
China	3428	3764	3945	3974	3874
US	983.7	992.8	928	950	907
India	573.8	588.5	606	619	644
Australia	424	416	431	471	491
Indonesia	305.9	324.9	386	449	458
Russia	321.6	333.5	355	355	358
South Africa	254.3	255.1	260	256	261
Germany	182.3	188.6	196	190	186
Poland	133.2	139.2	144	143	137
Kazakhstan	110.8	115.9	116	114	109
World	7254.6	7659.4	7865	8231	8165

Note: Coal production includes hard coal and brown coal. Brown coal production (Mt) in 2012: China 510, Germany 185, Russia 77, US 72, Australia 71, Turkey 68, Poland 64, and India 47.
Sources: BP Statistical Review of World Energy; NBS; DOE/EIA.

Table 20 China and world production of coal, oil, natural gas and electricity

	China				World			
	Coal (Mt)	Oil (Mt)	Natural gas (100 million m^3)	Electricity production (TWh)	Coal (Mt)	Oil (Mt)	Natural gas (100 million m^3)	Electric production (TWh)
1950	43	0.2	0.07	4.6	1853	539	1851	959
1960	397	5.2	10.4	59.4	2658	1087	4889	2358
1970	354	30.7	28.7	115.9	2959	2275	10400	5069
1980	620	106.0	142.7	300.6	3775	2974	15256	8247
1990	1080	138.3	153.0	621.2	4738	3164	19912	11774
2000	1384	163.0	272.0	1355.6	4693	3612	24323	15380
2005	2365	181.4	493.2	2500.3	6036	3897	27798	18312
2006	2570	184.8	585.8	2865.7	6443	3910	28802	19026
2007	2760	186.3	692.4	3281.6	6511	3901	29547	19908
2008	2903	195.1	803.0	3495.8	6795	3935	30608	20342
2009	3115	189.5	852.7	3714.7	6881	3831	29759	20136
2010	3428	202.4	948.5	4207.2	7255	3978	32026	21325
2011	3764	202.9	1026.9	4713.0	7659	4011	33157	22051
2012	3945	205.7	1070.4	5021.0	7865	4120	33802	22504
2013	3974	209.9	1170.5	5397.6	8231	4127	34088	23127
2014	3874	211.4	1301.6	5649.6	8165	4221	34606	23867

Sources: NBS; UN World Energy Supplies; BP Statistical Review of World Energy; Energy Encyclopedia, Encyclopedia of China Publishing House, 1997, Beijing.

Table 21 China energy production by source and world ranking

	1990	2000	2005	2010	2011	2012	2013	2014
Primary energy (MTCE)	1039.2	1350.5	2162.2	2969.2	3179.9	3318.5	3400.0	3600.0
Ranking	3	3	2	1	1	1	1	1
Coal (Mt)	1080	1384	2365	3428	3764	3945	3974	3874
Ranking	1	1	1	1	1	1	1	1
Crude oil (Mt)	138.3	163.0	181.4	202.4	202.9	205.7	209.9	211.4
Ranking	5	5	6	5	5	4	4	4
Natural gas (100 million m^3)	153.0	272.0	493.2	948.5	1026.9	1070.4	1170.5	1301.6
Ranking	20	19	13	7	6	7	6	6
Hydroelectric power (TWh)	126.7	222.4	397.0	722.2	699.0	782.1	920.3	1064.3
Ranking	4	4	1	1	1	1	1	1
Electric power (TWh)	621.2	1355.6	2500.3	4207.2	4713.0	5021.0	5397.6	5649.6
Ranking	4	2	2	2	1	1	1	1

Sources: NBS; BP Statistical Review of World Energy.

Table 22 World 10 largest oil companies (2014)

	Crude oil output (Mt)	Natural gas output (100 million m^3)
1. Saudi Aramco	470.0	1138
2. National Iranian Oil Company	177.9	1664
3. China National Petroleum Corporation	160.5	1039
4. Exxon Mobil Corporation	110.1	1223
5. Petroleo De Venezuela, S.A.	150.8	477
6. Royal Dutch Shell	77.1	994
7. British Petroleum Company	100.7	730
8. Gazprom	71.4	5024
9. Rosneft Oil	168.4	396
10. Chevron Corporation	86.6	537

Note: Ranking was calculated according to six indices: petroleum reserves, petroleum output, natural gas reverses, natural gas output, petroleum refinery distillation capacity, and oil product sales.
Source: US Petroleum Intelligence Weekly.

Table 23 China crude oil output of 10 biggest oil and gas fields **Unit: 10,000 t**

	2013	2014
1. Daqing	4000	4000
2. Shengli	2770	2787
3. Changqing	2432	2505
4. Bohai	2574	2019
5. Yanchang	1254	1277
6. Xinjiang	1160	1180
7. Liaohe	1001	1021
8. Southwest	737	736
9. Tarim	500	590
10. Jilin	527	493

Source: *International Petroleum Economics*, 2015, No.4.

Table 24 Global crude oil refining capacity (2014)

Country	Number of refineries	Annual crude oil refining capacity (Mt)
US	123	901.2
China	200	702.0
Russia	40	275.0
Japan	28	223.3
India	23	232.1
Italy	14	102.3
South Korea	6	148.4
Germany	15	109.4
Saudi Arabia	8	124.8
Canada	17	100.4
Brazil	13	95.9
Mexico	6	77.0
Britain	8	70.1
France	9	70.3
Singapore	3	67.2
China Taiwan	4	65.5
Spain	9	71.4
Venezuela	5	64.1
Netherlands	6	59.7
World total	787	4744.5

Note: Data on China's petroleum refinery distillation capacity and number of refineries are sourced from China's petrochemical industry; the world total has been revised from the Chinese data.
Source: *Oil & Gas Journal*, December 1, 2014. The translation in Chinese was published in *International Petroleum Economics*, 2015, No.5.

Table 25 World 10 biggest oil refineries

Company	Crude oil processing capacity (10,000 t)				
	2010	2011	2012	2013	2014
Exxon Mobil Corporation	28915	28940	28288	27945	27328
China Petrochemical Corporation	19855	19855	19855	19855	29784*
Royal Dutch Shell Group	22546	20971	20971	20546	20923
China National Petroleum Corporation	13075	13375	13375	13375	18144
British Petroleum Company	16625	16611	16611	14295	14295*
Saudi Aramaco	12165	12258	12258	14258	14178
Valero Energy	13083	13883	13883	13883	13848
Petroleo De Venezuela, S.A.	13390	13390	13390	13390	13390
ConocoPhillips	13891	12841	12521	12571	12616
Chevron Corporation	13778	12798	12920	12698	12310

* Domestic statistics.

Source: Oil & Gas Journal, 2014-12-01.The translation in Chinese was published in the *International Petroleum Economics*, 2015, No.1-2.

Table 26 Global oil refineries with annual refining capacity over 20 Mt (2014) Unit: 10,000t/year

Ranking	Company	Location	Refining capacity
1	Judibana Paraguana Refining Center	Judibana, Venezuela	4700
2	SK Group	Ulsan, South Korea	4200
3	GS Caltex Corporation	Yeosu, South Korea	3925
4	S-Oil Corporation	South Korea	3345
5	Reliance Petroleum	Jamnagar, India	3300
6	ExxonMobil Jurong Island Refinery	Jurong Island, Pulau Ayer Chawan, Singapore	2963
7	Reliance Petroleum	Jamnagar, India	2900
8	Baytown Refinery (ExxonMobil)	Baytown, TX, US	2803
9	Saudi Aramco	Ras Tanura, Saudi Arabia	2750
10	Formosa Petrochemical Corporation	Mailao, Taiwan, China	2700
11	Marathon Oil Corporation	Garville, LA, US	2610
12	Baton Rouge Refinery (ExxonMobil)	Baton Rouge, LA, US	2510
13	Kuwait National Petroleum Company	Mina Al Ahmadi, Kuwait	2330
14	Shell Eastern Petroleum	Bukom Island, Singapore	2310
15	Sinopec Zhenhai Refining & Chemical Company	Zhenhai, Zhejiang, China	2300
16	Marathon Oil Corporation	Galveston, TX, US	2200
17	PetroChina Dalian Petrochemical Company	Dalian, China	2050
18	Citgo Petroleum Corp.	Lake Charles, LA, US	2020
19	Shell Pernis Refinery	Pernis, Netherlands	2020
20	Saudi Aramco	Rabigh, Saudi Arabia	2000
21	SAMREF	Yanbu, Saudi Arabia	2000
22	SATORP	Al Jubayl, Saudi Arabia	2000

Source: Oil & Gas Journal, 2014-12-01, the translation in Chinese was published *in the International Petroleum Economics*, 2015, No.1-2.

Table 27 China major fuels crude refining volume and production Unit: Mt

	2000	2010	2011	2012	2013	2014
Crude refining volume	210.8	426.8	451.1	463.3	478.6	503.0
Production of major fuels						
Gasoline, kerosene and diesel	117.05	252.08	266.94	283.57	296.12	316.83
Gasoline	41.32	76.76	81.37	89.80	98.33	110.29
Kerosene	8.78	17.08	18.75	21.56	25.06	30.01
Diesel	70.73	158.25	166.82	172.21	172.73	176.53
Fuel oil	20.54	25.37	23.02	23.61	25.57	25.42

Sources: NBS; CPCIF.

Table 28 China raw coal production Unit: Mt

1980	620	1997	1388
1981	622	1998	1332
1982	666	1999	1364
1983	715	2000	1384
1984	789	2001	1472
1985	872	2002	1550
1986	894	2003	1835
1987	928	2004	2123
1988	980	2005	2365
1989	1054	2006	2570
1990	1080	2007	2760
1991	1087	2008	2903
1992	1116	2009	3115
1993	1150	2010	3428
1994	1240	2011	3764
1995	1361	2012	3945
1996	1397	2013	3974
		2014	3874

Source: NBS.

Table 29 China 10 largest coal-producing provinces/regions raw coal production Unit: Mt

	2010	2011	2012	2013	2014
1. Shanxi	741.0	872.3	913.9	963	977
2. Inner Mongolia	786.7	979.0	1061.9	1031	908
3. Shaanxi	356.4	405.0	427.5	493	515
4. Guizhou	159.6	156.0	181.1	191	185
5. Shandong	148.9	154.0	145.0	140	148
6. Xinjiang	103.1	120.0	139.2	147	143
7. Henan	212.8	232.0	147.2	153	135
8. Anhui	131.5	130.0	147.1	140	130
9. Hebei	102.0	93.0	93.8	92	82
10. Heilongjiang	97.1	98.2	91.3	80	69

Source: China National Coal Association.

Table 30 China 10 largest coal companies coal production (2014) Unit: 10,000t

1. Shenhua	47351
2. China Coal Energy	18304
3. Datong Coal	16754
4. Shandong Energy	13926
5. Shaanxi Coal and Chemical Industry Group	12712
6. Shanxi Coking Coal Group	10700
7. Yankuang Group	10212
8. Jizhong Energy Resources	10200
9. Henan Energy and Chemical Industry Group	10186
10. Lu'an Mining	9018
Total	159363

Source: China National Coal Association.

Table 31 China coal industry key indicators

	1990	2000	2005	2010	2011	2012	2013	2014
Raw coal output (Mt)	1080	1384	2365	3428	3764	3945	3974	3874
Surface mining (%)	3.0	4.5	5.0	10.0	11.0	12.0	12.0	12.0
Raw coal preparation (%)	17.1	24.3	31.9	50.9	52.0	56.0	60.0	62.5
Coal mines (10,000 mines)	7.01	3.32	2.48	1.50	1.40	1.20	1.25	1.10
Coal consumption (Mt)	1376.8	1410.5	2433.8	3490.1	3889.6	4117.3	4244.3	4121.2
Coal consumed for electricity generation	438.0	566.8	1050.2	1497.3	1709.5	1810.9	1898.5	1880.5
Export volume (Mt)	17.29	58.84	71.68	19.03	14.66	9.26	7.51	5.74
Import volume (Mt)	2.00	2.02	26.17	164.78	182.4	288.51	327.08	291.22
Year-end inventory (Mt)	184.1	142.4	139.7	217.2	253.0	280.0	290.0	300.0
Average pithead coal price in key state-owned key coal mines (Chinese yuan/t)	61.67	139.69	291.06	441.0	467.5	459.5	450.8	401.2
Accident death toll (no. of persons)	7301	5816	5938	2433	1973	1384	1067	931
Accident death rate (no. of persons/Mt)	6.76	4.20	2.51	0.71	0.52	0.35	0.27	0.24

Sources: NBS; China National Coal Association; China Coal Processing & Utilization Association; China Electricity Council.

Table 32 US coal industry key indicators

	2010	2011	2012	2013	2014
Coal output (Mt)	983.5	993.7	927.8	949.6	906.7
Recoverable reserves (100 million t)	2353.8	2353.7	2336.9	2331.0	2322.0
Coal consumption (Mt)	953.5	909.8	807.2	861.7	831.6
Percentage used in electrictiy production (%)	92.8	92.6	92.6	92.2	92.9
Strip mining (%)	69.0	69.0	66.3	65.3	65.3
Coal mines	1285	1285	1229	1061	—
Mines	525	525	488	424	—
Strip mines	760	760	719	637	—
Number of employees (10,000 people)	13.55	14.23	13.77	12.33	11.55
Average coal mining production costs (USD/t)	39.26	46.02	44.04	44.38	—
Coal price to consumers for power (USD/t)					
Power plants	49.98	52.54	52.38	51.36	—
Coking plants	169.34	202.80	210.09	173.09	—
Productivity of coal mines (t/people/h)	5.09	5.03	4.71	5.03	—
Productivity of mines	2.90	2.62	2.58	2.78	—
Producutivity of strip mines	8.94	9.19	8.14	9.40	—
Accident death toll (no.of persons)	48	21	20	20	16
Accident death rate (no. of persons/Mt)	0.049	0.021	0.022	0.021	0.018

Source: National Mining Association.

Table 33 Coal mine accident and death rates in major coal-mining countries

	2000	2005	2010	2011	2012	2013	2014
China							
Coal output (Mt)	1384	2365	2428	3764	3945	3974	3874
Death toll (no. of persons)	5816	5938	2433	1973	1384	1067	931
Death rate (no. of persons/ Mt)	4.20	2.51	0.71	0.52	0.351	0.268	0.240
US							
Coal output (Mt)	975.6	1026.5	983.7	993.7	927.8	949.6	906.7
Death toll (no. of persons)	38	22	48	21	20	20	16
Death rate (no. of persons/Mt)	0.039	0.021	0.049	0.021	0.022	0.021	0.018
India							
Coal output (Mt)	334.6	468.4	5738	588.5			644.0
Death toll (no. of persons)	117	117	93	63			46
Death rate (no. of persons/Mt)	0.35	0.25	0.16	0.11			0.07
Australia							
Coal output (Mt)	306.8	298.5	424.0	415.5	431.0		
Death toll (no. of persons)	1	1	0	0	6		
Death rate (no. of persons/Mt)	0.003	0.003	0	0	0.014		
Russia							
Coal output (Mt)	240.3	298.5	323.2	337.4	355.2		
Death toll (no. of persons)	113	125	142	46	36		
Death rate (no. of persons/Mt)	0.47	0.42	0.44	0.14	0.10		
South Africa							
Coal output (Mt)	224.2	244.4	254.3		260.0		
Death toll (no. of persons)	31	15	33		18		
Death rate (no. of people/Mt)	0.138	0.61	0.130		0.069		

Sources: State Administration of Work Safety; [US] National Mining Association; [Russia] *Coal*; Safety Course for the Coal Mining Foremen, 2012.

Table 34 China coalbed methane output **Unit: 100 million m3**

	Underground Drainage	Ground Drainage
2005	23	—
2007	44	3.2
2008	50	5.0
2009	64.5	10.1
2010	73.5	14.5
2011	92.0	23.0
2012	99.4	25.7
2013	108.9	29.2
2014	133.0	37.0

Note: CBM utilization volume in 2014 was 7.7 billion m^3.
Sources: China National Coal Association; National Energy Administration.

Table 35 China energy industry fixed investment **Unit: 100 million Chinese yuan**

	2000	2010	2011	2012	2013	2014
National	26221.8	243797.8	302396.1	364854.1	435747.4	502004.9
Energy industry	2839.6	20899.3	22714.8	25499.8	29008.9	31724.9
Coal mining and washing	198.9	3888.1	4907.3	5370.2	5212.6	4682.1
Oil and gas extraction	335.6	2716.8	2691.1	3076.5	3820.6	4023.0
Oil processing, coking and nuclear fuel processing	94.8	2029.6	2268.5	2500.5	3039.1	3239.8
Electricity, heating generation and supply	2130.3	11356.4	11603.5	12947.9	14726.4	17538.2
Fuel gas production and supply	60.0	908.4	1244.4	1604.7	2210.2	2241.8

Note: Data from 2000 refers to the fixed asset investment of state-owned businesses; between 2005 and 2014, it refers to urban fixed assets investments.
Source: NBS.

III. Electricity

Table 36 Global electricity generation **Unit: TWh**

Country	2000	2005	2010	2011	2012	2013	2014
China	1356	2500.3	4207.2	4713.0	4937.8	5397.6	5649.6
US	3991	4257.4	4325.9	4302.9	4256.1	4267.1	4297.3
India	565	689.6	922.2	1006.2	1053.9	1053.9	1102.9
Japan	1082	1153.1	1145.3	1104.2	1101.5	1094.0	1061.2
Russia	878	954.1	1036.8	1051.6	1066.4	1045.0	1064.1
Canada	599	614.9	629.9	609.8	610.2	629.9	608.2
Germany	564	620.3	621.0	618.0	617.6	606.1	614.0
Brazil	349	402.9	484.8	501.3	553.7	583.6	582.3
France	541	575.4	573.2	564.3	560.5	553.8	555.7
World	15380	18311.6	21325.1	22050.9	22504.3	23127.0	23867.0

Source: BP Statistical Review of World Energy, June 2015.

Table 37 Global hydroelectric capacity **Unit: TWh**

Country	2005	2010	2011	2012	2013	2014
China	397.0	722.2	699.0	860.9	911.6	1064.3
Canada	362.2	349.4	374.9	378.4	389.8	377.1
Brazil	336.2	401.3	426.4	415.8	383.7	367.8
US	273.1	261.8	312.2	278.1	270.6	260.0
Russia	173.8	167.6	166.8	166.3	180.4	172.9
Norway	136.6	117.5	121.4	142.1	128.5	136.0
India	96.8	110.0	131.1	115.3	131.1	130.2
Japan	76.3	90.6	85.4	80.5	81.6	87.1
Venezuela	77.9	76.6	82.7	81.8	83.6	82.3
Sweden	72.8	66.4	66.4	78.3	61.2	64.2
France	51.9	62.9	45.3	58.1	68.2	62.5
Italy	36.1	51.0	45.8	41.4	51.0	56.8
World	2913.7	3441.2	3496.7	3667.8	3791.0	3867.6

Source: BP Statistical Review of World Energy, June 2015.

Table 38 China 10 biggest hydropower stations

Name	River	Location	Installed capacity/ 10,000 KW	Finished
Three Gorges	Yangtze	Yichang in Hubei	2240, 32×70	2009, the last unit was put into operation in 2012
Baihetan	Jinsha	Sichuan/Yunnan	1600, 8×100×2 shores	The first batch of units will be put into operation in 2018, it is scheduled to be finished in 2022
Xiluodu	Jinsha	Sichuan/Yunnan	1386, 9×77×2 shores	2015
Wudongde	Jinsha	Sichuan/Yunnan	1020，6×85×2 shores	It is scheduled to be put into operation in 2020
Jinping	Yalong	Sichuan	840, one-stage, two-stage, 14×60	2014
Xiangjiaba	Jinsha	Yunnan/Sichuan	784, 8×80+3×48	2014
Longtan	Lancang	Guangxi	630, 9×70	2009
Nuozhadu	Lancang	Yunnan	585, 9×65	2014
Xiaowan	Lancang	Yunhnan	420, 6×70	2010
Laxiwa	Yellow	Qinghai	Phase I 350, 5×70	2010

Table 39 China installed power capacity and electricity generation

	1990	2000	2005	2010	2011	2012	2013	2014
Electricity generation capacity by year end /GW	137.89	319.32	517.48	962.19	1062.53	1144.91	1257.68	1366.17
Hydropower	36.05	79.35	117.39	213.40	232.98	248.90	280.44	303.29
Thermal power	101.84	237.54	391.37	706.63	768.34	819.17	870.09	917.38
Nuclear power	—	2.10	6.84	10.82	12.57	12.57	14.66	20.31
Wind power				31.07	46.23	60.83	76.52	95.81
Electricity generation/TWh	621.32	1386.5	2474.7	4207.2	4713.0	4937.8	5397.59	5649.58
Hydropower	126.35	243.1	401.0	722.2	694.0	860.9	911.64	1064.34
Thermal power	494.97	1107.9	2018.0	3331.9	3843.9	3910.8	4235.87	4233.73
Nuclear power	—	16.7	52.3	73.9	87.2	98.3	111.5	132.54
Wind power				50.1	74.1	103.0	138.3	156.30

Note: 1. In 2014, hydroelectric installed capacity pumped storage was 21.83GW; thermal installed capacity (coal) was 831.42GW and gas was 51.63GW.

2. Data on wind energy is on-grid wind energy; accumulated installed capacity in 2014 was 114.76GW.

Sources: NBS; China Electricity Council.

Table 40 China electric power transmission line length above 220kV Unit: km

Voltage class (kV)	2000	2005	2010	2012	2013	2014
1000	—	—	1006	1006	1298	2122
±800	—	—	3334	5466	6904	10132
750	—	141	6685	7201	9825	10935
500	25910	62866	135180	133276	140173	141265
330	8524	13059	20338	21294	22640	23886
220	122597	177617	277988	291642	304885	313655

Source: SGCC.

Table 41 China 10 biggest power companies (2014)

	Installed capacity (10,000 kW)	Electricity generation (100 million kWh)
1. Huanneng	15149	6355
2. Guodian	12518	5013
3. Datang	12048	4968
4. Huadian	12254	4893
5. China Power Investment Corporation	9667	3806
6. Shenhua	6685	3229
7. Three Gorges	5003	2005
8. China Resources Power	3652	1625
9. Yudean	2695	1206
10. Zheneng	2727	1148

Source: China Electricity Council.

Table 42 China power industry key indicators

	2000	2005	2010	2011	2012	2013	2014
Coal consumption for power supply (gce/kWh)	392	370	333	329	325	321	319
Coal consumption for power generation (gce/kWh)	363	343	312	308	305	302	300
Power station power consumption rate (%)	6.28	5.87	5.43	5.39	5.10	5.05	4.83
Thermal power	7.31	6.80	6.33	6.23	6.08	6.01	5.84
Line loss factor (%)	7.70	7.21	6.53	6.52	6.74	6.68	6.64
Utilization hour for generating equipment	4517	5425	4650	4730	4579	4521	4318
Hydropower	3258	3664	3404	3019	3591	3359	3669
Thermal power	4848	5865	5031	5305	4982	5021	4739

Source: China Electricity Council.

IV. New Energy and Renewable Energy

Table 43 China renewable energy resources

Hydropower		Installed capacity (GW)	Annual generating capacity (TWh)
	Theoretical reserves	694.40	6,082.9
	Technically developable resources	541.64	2,474.0
	Economically developable resources	401.80	1,753.4
	Small hydropower (50MW) developable resources	128.03	535.0
Biomass		Resources (2014)	Production in 2020
	Straw	800Mt	Biogas 80bn m^3
	Firewood and forestry residues	210Mt	Power generation 30GW, 131 TWh Molding fuel 50Mt Bioethanol 10Mt
	Livestock manure	3.8bn t	Biodiesel 12Mt
	Urban domestic garbage	160Mt	
Solar			Development potential 2,200GW
Wind		Resources Onshore: 4,350GW at height of 10m	Development potential Onshore: 2,560GW at height of 50m; 3,050GW at height of 70m Offshore: 190GW at depth of 5 - 25 m
Geothermal energy	Underground hot water High temperature geotherm	6.7 bn m^3/a = 32.83Mtec/a 6GW	
Ocean energy		Resources 2,500GW, including tidal energy of 1,100GW	Development potential 50GW, including tidal energy of 22GW

Table 44 China renewable energy development and utilization

		2000	2005	2010	2011	2012	2013	2014
Hydropower	GW	79.4	117.4	213.4	230.5	248.9	280.0	301.8
	TWh	243.1	397.0	722.2	699.0	860.9	911.6	1064.3
	Mtce	88.2	136.2	225.3	215.3	262.6	276.2	319.3
Small hydropower	GW	24.8	38.5	59.0	62.1	65.0	68.0	70.0
	TWh	80.0	120.9	202.3	175.7	217.3	227.3	233.7
	Mtce	29.0	41.5	63.1	54.1	66.3	68.9	70.1
Solar energy	MTCE	3.1	9.6	22.6	27.3	32.5	44.5	55.6
Photovoltaic power generation	10,000kW	1.8	7.0	122.0	374.0	492.0	1745.0	2805.0
	100MkWh	0.19	0.74	12.9	40.0	52.5	238.8	250.0
	MTCE	0.01	0.03	0.40	1.23	1.60	7.24	7.50
Water heaters	10,000 m^2	2600	8000	18500	21740	25770	31000	41400
	MTCE	3.1	9.6	22.2	26.1	30.9	37.2	48.1
Wind power generation	GW	0.34	1.22	4478	62.36	75.32	91.41	114.61
	TWh	0.5	2.0	72.2	100.0	124.3	159.8	200.3
	MTCE	0.2	0.7	22.5	30.0	37.9	48.4	60.1
Biomass energy	MTCE	2.9	10.1	21.7	23.4	24.9	24.9	26.8
Rural biogas	100Mm^3	23	86	145	150	156	158	160
	MTCE	1.6	6.1	10.4	10.8	11.1	11.3	11.4
Biomass and garbage power generation	GW	0.8	2.0	6.7	7.7	8.7	9.0	9.4
	TWh	3.5	8.7	29.0	33.5	38.0	38.3	40.2
	MTCE	1.3	3.0	9.0	10.3	11.6	11.6	12.1
Ethanol	Mt	—	1.02	1.80	1.77	1.66	1.70	2.16
	MTCE	—	1.0	1.7	1.7	1.5	1.6	2.0
Biodiesel	Mt	—	—	0.4	0.4	0.5	1.0	0.88
	MTCE	—	—	0.6	0.6	0.7	1.4	1.3
Geothermal utilization	MTCE	0.7	1.2	6.7	7.4	9.7	14.4	17.6
Total		86.3	199.0	286.3	318.6	353.5	412.1	479.4

Note: 1. Small hydropower refers to stations with installed capacity of less than 50MW.

2. In 2014 photovoltaic utilization hours came to 1,350 and wind utilization hours was 1905.

3. Energy provided by solar water heaters was 120kgce/m^2/a.

4. In 2013, rural areas had 2.26 million solar stoves, providing 1.21MTCE/a of energy and there were 24.5 million m^2 of solar houses, providing 0.76 MTCE /heating season.

5. The methane calorific value was 5,000kcal/ m^3=0.714 kgce/ m^3; the bioethanol calorific value was 6,530kcal/kg=0.933kgce/kg; the biodiesel calorific value was 10,000kcal/kg=1.429kgce/kg.

6. Geothermal energy ground source heat pumps generated 25 kgce/m^2 of energy and geothermal heating

generated 28 kgce/m^2.

7. Renewable energy power generation was converted to standard coal equivalent using coal consumed in thermal power generation for the same year, the gross coal consumption rate (kWh/gce) in 2000, 2005, 2010, 2011, 2012, 2013 and 2014 was 363, 343, 312, 308, 305, 302 and 305 respectively.

Sources: National Bureau of Statistics; China Energy Statistical Yearbook 2014; National Development and Reform Commission; National Energy Bureau; Ministry of Water Resources; Ministry of Agriculture; Ministry of Housing and Urban-Rural Development; Ministry of Land and Resources; China Electricity Council; Chinese Solar Energy Society; China Association of Rural Energy Industry (CAREI); China Association of Resource Comprehensive Utilization; China Wind Energy Association; Building Energy Conservation Research Center of Tsinghua University.

Table 45 China buildings renewable energy

	2010		2012		2013		2014	
	Quantity	Standard coal quantity (MTCE)	Quantity	Standard coal quantity (MTCE)	Quantity	Standard coal quantity (MTCE)	Quantity	Standard coal quantity (MTCE)
Direct combustion of biomass energy	150 MTCE	150	128	128	117	117	107	107
New energy								
Solar water heaters	185 M m^2	22.2	257.7 M m^2	30.7	310 M m^2	36.9	414 M m^2	48.1
Photovoltaic power generation	320GWh	0.1	1560GWh	0.5	1875GWh	0.6	675GWh	0.7
Ground source heat pumps	227 M m^2	5.7	300 M m^2	7.5	330 M m^2	8.3	360 M m^2	9.0
Geothermal space heating	35 M m^2	1.0	80 M m^2	2.2	220 M m^2	6.1	310 M m^2	8.6
Rural biogas	14.5 BN m^3	10.4	15 BN m^3	11.1	15.8 BN m^3	11.3	16 BN m^3	11.4
Subtotal		39.4		52.0		63.2		77.8
Total		189.4		180.0		180.2		184.8

Note: 1. Biomass energy for direct combustion includes straw and firewood.

2. Solar water heaters provided 120kgce/m^2/a of energy, geothermal heating, 28kgce/m^2/heating season and ground source heat pump 25kgce/m^2/ heating season.

3. Power generation capacity was converted into standard coal equivalent according to the annual gross coal consumption rate of thermal power generation.

Sources: National Bureau of Statistics; National Development and Reform Commission; National Energy Bureau; Department of Education, Science & Technology, Ministry of Agriculture; Chinese Academy of Agricultural Engineering; Building Energy Conservation Research Center of Tsinghua University; Guangdong Academy of Sciences; Ministry of Housing and Urban-Rural Development; Solar Thermal Utilization Specialty Committee of CAREI; Energy Saving Professional Committee of CAREI; Chinese Solar Energy Society; Ministry of Land and Resources; Geothermal China Energy Society, China Energy Research Society (CERS).

Table 46 Global renewable energy development and utilization

	2000	2010	2011	2012	2013	2014	World's top consumers (2014)
Primary energy consumption (MTCE)	12942.1	17301.1	17726.1	17980.1	18295.9	18440.6	China (4260)
Renewable energy							
Hydropower (TWh)	2653.7	3441.2	3496.7	3667.8	3791.0	3867.6	China (1064.3)
Biomass energy (MTCE)	1035	1334	1358	—	—	—	China (117)
Geothermal power generation (MW)	7974	11055	11225	11446	12546	13500	US (3400)
Wind power generation (GW)	17.4	197.0	238.0	283.0	318.1	369.5	China (114.61)
PV cell output (GW)	0.3	27. 4	27.1	33	40.3	45.3	China (33.0)

Note: Biomass energy is the amount consumed by direct combustion.
Sources: National Bureau of Statistics of China; BP Statistical Review of World Energy, June 2015; The IEA, Coal Information 2014; OECD/IEA, Energy Balances of the OECD Countries; OECD/IEA. Energy Balances of Non-OECD Countries; Earth Policy Institute. Global Wind Energy Council; World Watch Institute; Chinese Solar Energy Society; Solar buzz; Emerging Energy Association.

Table 47 Global renewable energy supply (2013)

	Cumulative installed wind power capacity at year end (MW)	Cumulative installed photovoltaic power capacity at year end (MW)	Cumulative installed geothermal power capacity at year end (MW)	Biofuel production (KTOE)
US	61292	12022	3442	28440
Brazil	3445	-	-	15783
Britain	10976	2892	-	449
Germany	34316	35948	17	2615
France	8120	4632	17	1936
Italy	8448	17600	876	292
Spain	22898	4828	-	674
China	91460	18300	27	1680
Japan	2722	13643	503	-
Philippines	-	-	1868	-
India	20226	2291	-	321
Australia	3489	3255	2	416
World	319907	139637	11709	65348

Note: Biofuels include fuel ethanol and biodiesel.
Source: BP Statistical Review of World Energy.

Table 48 Global renewable energy generation **Unit: Mtoe**

	2005	2010	2011	2012	2013	2014
US	20.6	38.9	45.0	50.6	58.6	65.0
China	1.1	13.1	24.7	33.8	46.1	53.1
Germany	9.6	18.9	24.0	27.5	29.3	31.7
Spain	5.6	12.5	12.6	15.0	16.3	16.0
Brazil	4.2	7.3	9.0	10.1	11.9	15.4
Italy	3.1	5.8	8.4	11.4	13.4	14.8
India	2.3	7.6	9.2	11.0	12.5	13.9
Britain	2.7	5.0	6.6	8.1	11.1	13.2
Japan	6.5	7.2	7.5	8.2	9.5	11.6
France	1.1	3.4	4.3	5.5	5.9	6.5
EU	34.1	68.5	82.5	97.7	109.7	118.7
OECD	69.1	128.1	150.2	173.4	196.3	215.9
World	84.6	168.0	204.9	242.9	283.0	316.9

Note: 1. Renewable energy generation includes wind, geothermal, solar, biomass and waste combustion.
2.A thermal power station conversion efficiency of 38% was used.
3. 1Mtoe=4400GWh.
Source: BP Statistical Review of World Energy.

Table 49 Global combustible biomass and waste consumption **Unit: Mtoe**

	1990	2000	2005	2010	2011	2012
China	200	204	205	214	216	216
India	133	150	160	177	181	185
US	62.3	73.2	75.8	89.3	91.5	88.6
Brazil	48.6	49.3	63.3	81.6	77.9	78.1
Indonesia	43.5	49.1	50.4	52.2	53.8	54.1
Germany	4.8	7.9	14.6	25.6	26.6	28.0
Thailand	14.7	14.6	17.2	22.6	21.8	23.4
Vietnam	12.5	14.2	14.8	14.7	14.9	15.0
France	11.0	10.8	11.8	15.5	14.1	15.4
Canada	8.2	11.7	12.1	12.0	12.3	12.4
Japan	5.0	5.9	6.8	9.7	10.1	10.2
Mexico	8.6	8.9	8.9	8.4	8.3	8.4
Russia	12.2	6.9	6.9	6.9	7.1	7.4
Philippines	11.3	8.1	7.2	6.9	6.9	7.0
Africa	19.5	256	292	328	341	352
OECD	147	183	205	264	267	276
EU	46	66	85	126	129	137
World	909	1029	1128	1288	1314	1343

Sources: IEA, Energy Balances of OECD Countries; Energy Balances of Non-OECD Countries.

Table 50 Global biofuel production **Unit: 1000 toe**

	2000	2005	2010	2011	2012	2013	2014
US	2991	7478	25568	28518	27360	28462	30056
Brazil	5212	7835	15575	13197	13547	15783	16656
Argentina	9	9	1790	2397	2468	1970	2577
EU	744	3133	11141	10196	10841	11197	11606
China	—	622	1479	1673	1931	2016	2083
Indonesia	—	9	718	1104	1388	1740	2444
OECD	3841	10779	37928	39952	39376	40967	43034
World	9177	19701	59465	60888	61658	65928	70792

Note: Biofuels include bioethanol and biodiesel.
Source: BP Statistical Review of World Energy, June 2015.

V. Energy Consumption

Table 51 Global primary energy consumption and mix (2014)

	Primary energy consumption Mtoe	Consumption by fuel (%)					
		Oil	Natural gas	Coal	Nuclear power	Hydropower	Renewable energy
China	2972.1	17.5	5.6	66.0	1.0	8.1	1.8
US	2298.7	36.4	30.2	19.7	8.3	2.6	2.8
Russia	681.9	21.7	54.0	12.5	6.0	5.8	-
India	637.8	28.3	7.2	56.5	1.2	4.6	2.2
Japan	456.1	43.2	22.2	27.7	-	4.3	2.5
Canada	332.7	31.0	28.2	6.4	7.2	25.7	1.5
Germany	311.0	35.9	20.5	24.9	7.1	1.5	10.2
Brazil	296.0	48.1	12.1	5.2	1.2	28.2	5.2
South Korea	273.2	39.5	15.7	31.0	13.0	0.3	0.4
France	237.5	32.4	13.6	3.8	41.5	6.0	2.7
Iran	252.0	37.0	60.8	0.4	0.4	1.3	-
Saudi Arabia	239.5	59.3	40.7	-	-	-	-
Mexico	191.4	44.5	40.3	7.5	1.2	4.5	1.9
Britain	187.9	36.9	31.9	15.7	7.7	0.7	7.0
Indonesia	174.8	42.3	19.7	34.8	-	1.9	1.3
Italy	148.9	38.0	34.3	9.1	-	8.7	9.9
Spain	133.0	44.7	17.8	9.0	4.8	6.7	12.0
South Africa	126.7	23.0	2.9	70.6	2.8	0.2	0.5
Turkey	125.3	27.0	34.9	28.6	-	7.3	2.2
EU	1611.4	36.8	21.6	16.7	12.3	5.2	7.4
OECD	5498.8	36.9	26.1	19.1	8.2	5.7	3.9
World	12928.4	32.6	23.7	30.0	4.4	6.8	2.5

Note: 1. Renewable energy refers to power generation from wind, geothermal, solar, biomass and waste combustion.

2. A thermal power station conversion efficiency of 38% was used for hydropower and renewable energy.

Source: BP Statistical Review of World Energy, June 2015.

Table 52 Global growth rates in energy and oil consumption Unit: %

	Primary energy						Oil					
	2005	2010	2011	2012	2013	2014	2005	2010	2011	2012	2013	2014
China	10.5	11.3	8.7	7.7	4.4	2.6	2.8	12.8	5.0	5.3	3.5	3.3
US	0.1	3.4	-0.7	-2.5	2.6	1.2	0.3	1.7	-1.2	-2.0	1.7	0.5
EU	-2.7	3.7	-3.8	-0.8	-0.6	-3.9	0.8	-1.2	-2.7	-4.3	-2.2	-1.5
Japan	1.0	6.0	-5.1	-0.6	-0.8	-0.3	1.6	0.9	0.3	6.6	-4.1	-5.2
Russia	0.1	4.0	3.3	-0.3	0	-1.2	-0.5	4.8	6.9	2.8	2.8	0.9
India	2.4	5.7	4.5	5.4	3.8	7.6	-0.5	1.8	4.9	5.3	0.9	3.0
OECD	0.8	3.6	-1.0	-0.9	0.9	-0.9	0.7	0.8	-0.8	-1.1	-0.6	-1.2
World	3.0	5.6	2.4	2.1	2.0	0.9	1.3	3.0	1.1	1.2	1.1	0.8

Source: BP Statistical Review of World Energy.

Table 53 China primary energy consumption and mix

Year	Total energy consumption (10,000 tce)	Share (total energy consumption =100)			
		Coal	Oil	Natural gas	Hydro, nuclear and wind
1978	57144	70.7	22.7	3.2	3.4
1980	60275	72.2	20.7	3.1	4.0
1985	76682	75.8	17.1	2.2	4.9
1990	98703	76.2	16.6	2.1	5.1
1991	103783	76.1	17.1	2.0	4.8
1992	109170	75.7	17.5	1.9	4.9
1993	115993	74.7	18.2	1.9	5.2
1994	122737	75.0	17.4	1.9	5.7
1995	131176	74.6	17.5	1.8	6.1
1996	135192	73.5	18.7	1.8	6.0
1997	135909	71.4	20.4	1.8	6.4
1998	136184	70.9	20.8	1.8	6.5
1999	140569	70.6	21.5	2.0	5.9
2000	146946	68.5	22.0	2.2	7.3
2001	155547	68.0	21.2	2.4	8.4
2002	169577	68.5	21.0	2.3	8.2
2003	197083	70.2	20.1	2.3	7.4
2004	230281	70.2	19.9	2.3	7.6
2005	261369	72.4	17.8	2.4	7.4
2006	286467	72.4	17.5	2.7	7.4
2007	311442	72.5	17.0	3.0	7.5
2008	320611	71.5	16.7	3.4	8.4
2009	336126	71.6	16.4	3.5	8.5
2010	360648	69.2	17.4	4.0	9.4
2011	387043	70.2	16.8	4.6	8.4
2012	402138	68.5	17.0	4.8	9.7
2013	416913	67.4	17.1	5.3	10.2
2014	426000	66.0	17.1	5.7	11.2

Source: National Bureau of Statistics.

Table 54 China final energy consumption and mix by sector

	2000		2005		2010		2011		2012	
	MTCE	%	MTCE	%	MTCE	%	MTCE	%	MTCE	%
Agriculture	40.2	4.6	57.5	4.0	78.7	3.2	90.4	3.4	95.5	3.4
Industry	525.8	60.3	905.7	62.7	1610.9	67.5	1748.3	65.8	1808.1	65.0
Transportation	134.8	15.5	198.7	13.7	330.2	13.3	393.5	14.8	424.0	15.2
Construction	170.9	19.6	283.3	19.6	368.0	15.4	426.7	16.0	454.0	16.4
Total	871.7	100.0	1445.2	100.0	2387.8	100.0	2658.9	100.0	2781.6	100.0

Note: This table is based on China's energy balance sheet, but calculated according to internationally-agreed definitions of energy balance and methodology. Electricity is converted to standard coal equivalent by heat value equivalent. Final energy consumption is calculated by subtracting losses from processing, conversion and storage (the intermediate links) and the energy consumption of the energy industry itself from the primary energy consumption. Losses from thermal power, power generation, transmission, coal transport by rail, coal feeding, coking and oil refining comprised 25.4% of primary energy consumption in 2013. The energy industry's energy consumption was calculated by adding the energy consumption of the coal mining and washing industry, the oil and natural gas mining industry, oil processing, coking and nuclear fuel processing industries, the power production and supply industries and the gas production and supply industry, and then deducting 95% of gasoline and 35% of diesel consumption, representing 7.2% of primary energy consumption in 2013. The final energy consumption in China's energy balance sheet did not deduct the energy consumption from the energy industry.

The consumption of agricultural diesel oil, residential coal and transport gasoline and diesel oil was low. In 2013, agricultural diesel oil consumption in China's energy balance sheet was 13.36 Mt; whereas the China Petroleum and Chemical Industry Federation (CPCIF) and the China Association of Rural Energy Industry (CAREI) reported it 2.5 times larger at about 34.0 Mt. In 2013, residential coal consumption in China's energy balance sheet was 92.9 Mt, whereas CAREI, Department of Education, Science & Technology of Ministry of Agriculture, and the Construction Market Governance Research Center (SCRC) at Tsinghua University reported it again 2.5 times larger at around 230 Mt.

China's energy balance sheet only reports data on oil consumed by vehicles used by the transportation industry, and did not include oil consumed by other sectors and private vehicles. In 2013, gasoline consumed by other sectors and private vehicles accounted for 52% of gasoline consumption used in transportation. The World Bank developed a formula to calculate China's transportation industry's actual energy consumption; this formula uses data from China's energy balance sheet, 95% of gasoline and 35% of diesel consumed by the industrial sector and construction industry, commerce (wholesale, retail, accommodation and catering), other industries (finance, real estate, business and residential services, geological surveying, information transmission, computer services and software, warehousing and postal services, scientific research and technology services, education, culture, sports and entertainment, water conservancy management, environment and public facilities management, health, social security and social welfare, public management and social organization and national defense) and 100% of oil used in agricultural consumption and 100% of gasoline and 95% of diesel oil used by private individuals.

Table 55 Global fossil fuel consumption

Coal (Mtoe)			Oil (Mt)			Gas (100 million m^3)		
	2013	2014		2013	2014		2013	2014
China	1961.2	1962.4	US	832.1	836.1	US	7399	7594
US	454.6	453.4	China	503.5	520.3	Russia	4135	4092
India	324.3	360.2	Japan	207.5	196.8	China	1676	1855
Japan	128.6	126.5	India	175.2	180.7	Iran	1622	1702
South Africa	88.7	89.4	Russia	146.8	148.1	Japan	1169	1125
Russia	90.5	85.2	Saudi Arabia	132.4	142.0	Saudi Arabia	1030	1082
South Korea	81.9	84.8	Brazil	135.2	142.5	Canada	1035	1042
Germany	81.7	77.4	Germany	113.4	111.5	Mexico	827	858
Poland	55.8	52.9	South Korea	108.3	108.0	Germany	837	709
Australia	44.9	43.8	Canada	103.5	103.0	UAE	683	693
World	3867.0	3881.8	Iran	95.1	93.2	Britain	731	667
			Mexico	89.7	85.2	Italy	642	568
			France	79.3	76.9	Thailand	523	527
			Britain	69.3	69.3	India	515	506
			Singapore	64.7	66.2	World	33810	33930
			Spain	59.0	59.5			
			World	4179.1	4211.1			

Source: BP Statistical Review of World Energy, June 2015.

Table 56 Global final energy consumption by sector (2012)

	Overall consumption (Mtoe)	Sector consumption (Mtoe)			
		Industry	Transport	Civil / commercial / agricultural	Non-energy use
China	1702	810（47.6）	238（14.0）	518（30.0）	136（8.0）
US	1433	248（17.3）	597（41.7）	483（33.7）	104（7.3）
EU	1140	264（23.2）	307（26.9）	470（41.2）	99（8.7）
Japan	309	82（26.5）	74（23.9）	115（37.2）	38（12.3）
Russia	462	144（31.2）	94（20.3）	157（34.0）	67（14.9）
India	512	168（32.8）	74（14.5）	234（45.7）	36（7.0）
OECD	3582	793（22.1）	1184（33.1）	1273（35.5）	332（9.3）
World total	8979	2541（28.3）	2507（27.9）	3123（34.8）	809（9.0）

Note: Proportions are shown in brackets.
Sources: IEA, Energy Balances of OECD Countries; Energy Balances of Non-OECD Countries.

Table 57 Consumption of oil products by type (2014) Unit: 1,000 barrels/day

	Total	Light distillates oil	Middle distillates	Fuel oil	Others
US	19035	9164	5604	256	4012
China	11056	3545	4136	537	2837
EU	12527	2680	6684	828	2336
Japan	4298	1570	1321	537	871
World total	92086	30131	33903	7976	20076

Note: Light distillates consist of aviation and motor gasolines and light distillate feedstock (LDF); middle distillates consist of jet and heating kerosines and gas and diesel oils; fuel oil includes marine bunkers and crude oil used directly as fuel; others include refinery gas, LPG, solvents, lubricants, petroleum coke, bitumen, wax and other refined products and refinery fuel and loss.
Source: BP Statistical Review of World Energy, June 2015.

Table 58 China oil product consumption by type Unit: Mt

	2000	2005	2010	2011	2012	2013	2014
Gasoline	35.05	48.53	68.86	73.96	81.41	88.33	95.44
Diesel	67.74	109.73	146.34	156.35	169.66	172.54	176.18
Kerosene	8.70	10.77	17.44	18.16	19.57	21.33	23.41
Fuel oil	38.73	42.42	37.58	36.63	36.83	37.69	33.84

Note: Fuel oil for 2013-2014 is the apparent consumption.
Sources: National Bureau of Statistics; China Petroleum and Chemical Industry Federation; CNPC Economics & Technology Research Institute.

Table 59 China natural gas consumption

	2000		2010		2012		2013		2014	
	100 million m^3	%	100 million m^3	%	100 million m^3	%	100 million m^3	%	100 million m^3	%
Power generation	8.1	3.3	192.4	17.9	260	17.6	302	18.0	352	19.3
Chemicals	88.7	36.2	187.3	17.4	212	14.4	218	13.0	264	14.5
Industry	106.0	43.2	381.3	35.4	425	28.8	469	28.0	480	26.4
Transportation	5.8	2.4	79.7	7.4	136	9.2	188	11.2	224	12.3
Construction	36.4	14.9	235.1	21.9	442	29.9	499	29.8	500	27.5
Total	245.0	100.0	1075.8	100.0	1476	100.0	1676	100.0	1820	100.0

Sources: National Bureau of Statistics; gas use industry.

Table 60 China coal consumption by sector **Unit: Mt**

	2000	2005	2010	2011	2012	2013	2014
Thermal power	574	1126	1757	2006	1974	2029	1960
Steel	151	319	458	589	594	629	620
Building materials	239	343	504	548	542	576	570
Chemical industry	88	129	161	177	192	209	230
Total coal consumption	1411	2434	3490	3890	4117	4244	4121

Note: Thermal power coal consumption includes coal used for heat supply by power plants.
Sources: China Coal Transportation & Sale Society (CCTS); China National Coal Association (CNCA); National Bureau of Statistics.

Table 61 Global electricity share in final energy consumption **Unit: %**

	1990	2000	2005	2010	2011	2012
China	5.9	10.9	14.7	19.4	20.3	20.9
US	17.5	19.5	20.4	21.5	21.7	22.4
Japan	21.5	23.6	24.3	26.7	25.8	25.7
Germany	16.2	18.0	18.8	19.8	20.7	20.5
Britain	17.1	18.8	20.2	20.6	21.9	21.4
France	18.2	20.3	21.5	23.5	23.7	24.1
Italy	16.1	18.2	18.7	19.8	20.5	20.8
Canada	22.6	21.8	21.7	21.8	21.5	20.8
Australia	16.7	21.4	22.5	23.6	23.3	22.7
Russia	11.5	12.6	13.7	14.3	13.7	13.8
Mexico	10.2	14.2	15.3	15.7	16.7	16.9
South Korea	12.5	17.8	21.9	24.5	25.1	24.9
India	7.4	10.2	11.6	13.2	14.0	14.6
EU	16.5	18.6	19.4	20.3	20.9	21.1
OECD	17.7	19.7	20.6	21.9	22.1	22.3
World	13.3	15.4	16.4	17.6	17.9	18.1

Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

Table 62 China electricity consumption per capita and residential electricity consumption per capita by region

Region	Electricity consumption per capita (kWh)		Residential electricity consumption per capita (kWh)	
	2014	2013	2014	2013
Nationwide	4078	3936	508	500
Beijing	4392	4365	793	751
Tianjin	5315	5369	523	521
Hebei	4504	4447	477	468
Shanxi	5009	5061	421	395
Inner Mongolia	9661	8749	482	448
Liaoning	4644	4576	488	484
Jilin	2427	2377	369	358
Heilongjiang	2242	2204	427	415
Shanghai	5656	5884	718	855
Jiangsu	6305	6251	625	690
Zhejiang	6372	6293	765	802
Anhui	2617	2543	387	423
Fujian	4897	4522	910	827
Jiangxi	2247	2099	373	365
Shandong	4327	4206	482	471
Henan	3098	3081	411	467
Hubei	2852	2815	451	469
Hunan	2131	2135	446	422
Guangdong	4900	4549	759	670
Guangxi	2762	2633	509	450
Hainan	2802	2604	489	410
Chongqing	2910	2750	458	476
Sichuan	2480	2409	399	382
Guizhou	3349	3224	546	500
Yunnan	3254	3124	434	392
Tibet	1079	989	220	346
Shaanxi	3252	3066	471	438
Gansu	4235	4160	283	268
Qinghai	12458	11751	371	336
Ningxia	12899	12470	350	306
Xinjiang	8331	6848	321	301

Source: China Electricity Council.

Table 63 China terminal power consumption by sector Unit: TWh

	2000	2005	2010	2011	2012	2013	2014
Total	1158.49	2168.57	3663.93	4139.65	4345.83	4693.69	4883.10(100.0)
Agriculture	70.89	87.64	97.65	110.29	100.25	102.69	101.34(2.1)
Industry	791.35	1546.10	2609.05	2968.35	3053.51	3150.19	3276.83(67.1)
Transportation	19.60	43.03	62.92	84.84	91.42	100.09	92.58(1.9)
Residential	167.18	282.48	509.40	562.01	622.77	678.92	693.61(14.2)
Commercial	40.17	75.23	129.20	150.31	169.29	187.69	199.56(4.1)
Others	69.28	134.09	255.71	263.85	308.60	474.15	519.18(10.1)

Note: 1. Terminal power consumption = power generation capacity - (power consumption of power plant + line loss).

2. Industry includes the construction industry.

Source: China Electricity Council; National Bureau of Statistics.

Table 64 China manufacturing industry energy consumption (2014)

	Unit product energy consumption	2014 production	2014 energy consumption (MTCE)
Steel	913 kgce/t	822.7 Mt	751.1
Electrolytic aluminum	13596 kWh/t	27.52 Mt	112.2
Copper smelting	420 kgce/t	7.64 Mt	3.2
Cement	124 kgce/t	2476 Mt	307.0
Architectural pottery	7.0 kgce/m^2	10.23 BN m^2	71.6
Wall materials	454 kgce/10,000 block standard bricks	1.198 TN standard bricks	54.4
Sheet glass	15.0 kgce/ weight case	793 M weight cases	11.9
Oil refining	97 kgce/t	503 Mt (process load)	48.8
Ethylene	860 kgce/t	16.97 Mt	14.6
Synthetic ammonia	1540 kgce/t	56.99 Mt	87.8
Caustic soda	949 kgce/t	30.59 Mt	29.0
Soda ash	336 kgce/t	25.14 Mt	8.4
Tourmaline	3272 kWh/t	25.48 Mt	25.0
Paper and cardboard	340kgce/t	118.0 Mt	40.1
Total			1565.1

Note: 1. The comprehensive energy consumption of products is industrywide. Wall materials energy consumption is a weighted average of clay solid bricks and new wall materials.

2. Product energy consumption is converted into standard coal equivalent according to gross coal consumption rate.

3. The energy consumption of the 14 products of six industries shown in the above table accounts for about 70% of the energy consumption of the manufacturing industry.

Sources: National Bureau of Statistics; National Development and Reform Commission; Ministry of Industry and Information; China Iron and Steel Association; China Nonferrous Metals Industry Association; China Electricity Council; China Building Materials Industry Association; China Petroleum and Chemical Industry Federation;

China Chemical Energy Conservation Technology Association; China Ceramics Industry Association; China Carbide Industry Association; China Paper Association.

Table 65 China transportation line length **Unit: 10,000 km**

	2000	2010	2011	2012	2013	2014
Railways	6.87	9.12	9.32	9.76	10.31	11.18
Roads	140.3	400.8	410.6	423.8	435.62	446.39
Highways	1.63	7.41	8.49	9.62	10.44	11.19
Inland waterways	11.93	12.42	12.46	12.50	12.59	12.63
Civil aviation	150.3	276.5	349.1	328.0	410.6	463.7
Oil and gas pipelines	2.47	7.85	8.33	9.01	9.85	10.63

Sources: National Bureau of Statistics, China Statistical Yearbook 2015.

Table 66 China traffic, turn-over, and transport mode ownership

	2000	2010	2011	2012	2013	2014
Traffic						
Passenger (100 million people)	147.9	327.0	352.6	380.4	212.3	220.9
Railways	10.5	16.8	18.6	18.9	21.1	23.6
Highways	134.7	305.3	328.6	355.7	185.3	190.8
Waterways	1.9	2.2	2.4	2.6	2.4	2.6
Civil aviation	0.7	2.7	2.9	3.2	3.5	3.9
Freight (100 million t)	135.87	324.18	396.70	410.04	409.89	438.11
Railways	17.86	36.43	39.33	39.04	39.67	38.13
Highways	103.88	244.81	282.01	318.85	307.66	333.28
Waterways	12.24	37.89	42.60	45.87	55.97	59.83
Civil aviation	0.02	0.56	0.56	0.55	0.56	0.59
Turnover						
Passenger (100 million people-km)	12261	27894	30984	33383	27572	30096
Railways	4533	8762	9612	9812	10596	11605
Highways	6657	15021	16760	18468	11251	12084
Waterways	101	72	75	77	68	74
Civil aviation	971	4039	4537	5026	5657	6333
Freight (100 million t-km)	43321	141837	159324	173771	168014	185398
Railway	13770	27644	29466	29187	29174	27530
Highway	6129	43390	51375	59535	55738	61017
Waterway	23734	68428	75424	81708	79436	92775
Civil aviation	50	179	174	164	170	186
Non-military vehicles (10,000)	1608.9	7801.8	9356.3	10933.1	12670.1	14598.1*
Private cars	365.1	4989.5	6237.5	7637.9	9198.2	10945.4
Rail	15253	19431	20721	20797	20835	21096
Non-military boats (10,000)	18.50	15.56	15.80	15.83	15.53	15.50
Non-military aircraft	982	2405	3191	3589	4004	4168

Note: * Excludes 9.72 million agricultural three-wheeled vehicles and low-speed trucks.
Sources: National Bureau of Statistics, China Statistical Yearbook 2015.

Table 67 China transport sector energy consumption

	2005	2008	2009	2010	2011	2012	2013
Highways							
Gasoline (Mt)	46.08	58.15	60.35	67.5	72.1	85.1	95.5
Diesel (Mt)	54.60	69.80	72.20	77.9	88.2	96.9	106.0
Railways							
Diesel (Mt)	5.61	5.87	5.25	6.72	6.85	6.94	6.81
Electricity (100 million kWh)	198.1	271.1	275.4	307.0	354.4	394.3	428.4
Waterways							
Diesel (Mt)	5.02	6.23	7.40	7.75	8.19	8.9	9.2
Fuel oil (Mt)	7.08	9.86	12.80	14.70	15.35	16.9	17.6
Civil aviation							
Kerosene (Mt)	9.52	11.75	13.14	16.01	18.0	18.4	19.8

Note: Gasoline consumption from railway transportation does not include alternative fuel. In 2013, 16.7 million t of alternative fuel was consumed, of which, compressed natural gas and liquefied natural gas came to 13.02 million t; fuel ethanol, 1.67 million t; biodiesel, 0.17 million t; methyl alcohol, 0.33 million t; coal oil, 1.17 million t; and electric vehicles consumed an equivalent energy of 0.33 million t of oil.

Sources: National Bureau of Statistics; National Development and Reform Commission; National Railway Administration; China Association of Automobile Manufacturers; Chinese Automotive Technology & Research Center; CNPC Economics &Technology Research Institute, Oil-gas industry from home and abroad development report in 2013; Characteristics of China's oil market in 2012 and prospects for 2013 by Gong Jinshuang, *International Petroleum Economics*, 2013, No.1-2, 70-76; Current status and prospects of China's refining industry by Jin Yun and Zhu He, *International Petroleum Economics,* 2013, No.5, 24-34; Recent years' changes in China's bunker oil market and suggestions for future development by Tian Ming, *International Petroleum Economics,* 2013, No.1-2, 155-161; China Electricity Council; China's 2013 oil product market and 2014 supply/demand outlook by Chen Jianduo, Dong Shanshan, Wang Mengxi and Ding Shaoheng, *International Petroleum Economics*, 2014, No.3, 82-92.

Table 68 China alternative fuel consumption **Unit: 10,000 t**

	2010	2011	2012	2013	2014
Natural gas	305	555	700	1302	1300
Fuel ethanol	182	182	200	167	216
Biodiesel	1	5	50	17	88
Fuel methanol	220	50	45	33	150
Coal oil	40	80	70	117	120
Electric vehicles	5	14	30	33	98
Total	753	886	1095	1670	1972

Note: Natural gas includes compressed natural gas (5.4 million t in 2011) and liquefied natural gas (0.15 milion t in 2011). In 2013, natural gas was substituted by liquefied petroleum gas. 1t liquefied natural gas is equivalent to 725 m^3 natural gas; while 1t liquefied petroleum gas equals 800 m^3 natural gas.
Sources: China's 2013 oil product market and 2014 supply/demand outlook by Chen Jianduo, et al., *International Petroleum Economics*, 2014, No.3, 82-92; Characteristics of China's refined products market in 2010 and supply and demand forecast for 2011 by Ding Shaoheng, et al., *International Petroleum Economics*, 2011, No.4, 40-49; Development of China's refining industry during the 13th Five-Year Plan by Jin Yun and Zhu He, *International Petroleum Economics,* 2015, No.5, 14-21; China Association of Automobile Manufacturers.

Table 69 China residential and public building construction **Unit: 100 million m2**

	Residential			Public buildings	Total
	Urban	Rural	Total		
2000	93	201	294	32	326
2005	156	221	377	57	434
2010	218	229	447	101	548
2011	226	238	464	105	569
2012	234	238	472	108	580

Note: Total floor space in 2013 was 3.5 billion m^2, of which, the residential area was 1.93 billionm^2; floor space in 2014 was 2.57 billionm^2 with a residential area of 1.08 billionm^2 .
Sources: National Bureau of Statistics; Building Energy Conservation Research Center of Tsinghua University.

Table 70 China agricultural and rural energy indicators

	2000	2010	2011	2012	2013	2014
Total power of agricultural machinery (10,000 kW)	52574	92786	97735	102559	103907	107600
Effective irrigation area (10,000 ha)	5382.0	6034.8	6168.2	6303.6	6335.1	6572.3
Water-saving irrigation area (10,000 ha)	1640	2731	2918	3122	2713	
Consumption of chemical fertilizers (10,000 t)	4145	5562	5704	5839	5912	5996
Installed capacity of small rural hydropower plants (10,000 kW)	698.5	5924.0	6212.3	6568.6	7119.0	7332.0
Rural electricity consumption (100 million kWh)	2421.3	6632.3	7139.6	8104.9	8549.5	8884.4

Source: National Bureau of Statistics.

Table 71 China household electric appliance penetration rate Unit: per 100 households

	2000		2010		2011		2012		2013		2014	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Air conditioners	30.8	1.3	112.1	16.0	122.0	22.6	126.8	25.4	102.2	29.8	107.4	34.2
Refrigerators	80.1	12.3	96.6	45.2	97.2	61.5	98.5	67.3	89.2	72.9	91.1	77.6
Color TVs Rice cookers	116.6	48.7	137.4	111.8	135.2	115.5	136.1	116.9	118.6	112.9	122.0	115.6
Kitchen ventilators	54.1	2.8		11.1	87.6	13.2		14.7	66.1	12.4	68.2	13.9
Water heaters	49.1		84.8		89.1		90.1	10	80.3	43.6	83.0	48.2
Washing machines	90.5	28.6	96.9	57.3	97.1	62.6	98.0	67.2	88.4	71.2	90.7	74.8
Microwave ovens	17.6		59.0		60.7		62.2		50.6	14.1	52.6	14.7
Home computers	9.7	0.5	71.2	10.4	81.9	18.0	87.0	21.4	71.5	20.0	76.2	23.5
Fixed-line telephones		26.4	80.9	60.8	69.6	43.1	68.4	42.2	48.6	32.6	55.5	38.9
Mobile telephones	19.5	4.3	188.9	136.5	205.3	179.7	212.6	197.8	206.1	199.5	216.6	215.0
Private cars	0.5		13.1		18.6		21.5		22.3	9.9	25.7	11.0

Source: National Bureau of Statistics.

Table 72 China household electric applicance energy consumption (2014)

	Number (100 million)		Electricity consumption (100 million kWhs)	
	Households	Society	Households	Society
Air conditioners	3.46	5.32	1868	2874
Refrigerators	3.94	4.38	1150	1279
Color TVs	5.49	6.10	1153	1848
Rice cookers	4.61	4.61	449	449
Electric fans	6.11	8.73	121	173
Electric shower water heaters	1.50	1.66	713	789
Kitchen ventilators	2.04	2.27	247	275
Microwave ovens	1.66	1.84	75	83
Washing machines	3.85	4.28	154	171
Total			5930	7941

Note: 1. The number of households was calculated by multiplying the total number of households in the whole country by the penetration rate of the appliance. In 2014, there were 460.5 million households in the whole country.

2. The penetration rate of electric rice cookers, 100%; air conditioners, 65%; electric fans, 70%; all the other appliances, 90%.

3. Average power and annual utilization hours per appliance: Air conditioners, 1,200W, 450h; color TVs, 120W, 1050h; electric cookers, 650W,150h; electric fans, 55W, 360h; electric shower water heaters, 2,500W, 190 h; kitchen ventilators, 220W, 550 h; microwave ovens, 750W, 60 h; washing machines, 400W, 100 h; refrigerators had an average daily power consumption of 0.8kWh .

Sources: National Bureau of Statistics; Zhiyan Enterprise Consultant Company, the analysis and development prospects of electric cookers in China in 2014-2019; Average power and annual utilization hours of household appliances compiled by Wang Qingyi, energy data in 2012.

Table 73 Japan household electric appliance penetration rate Unit: per 100 households

	1990	2000	2005	2009	2010	2011	2012	2013
Air conditioners	114.0	207.6	255.3	263.1	259.9	268.0	264.3	275.8
Refrigerators	126.5	121.4						
Microwave ovens	71.0	98.8						
Washing machines	108.0	108.6						
Clothes dryers	15.0	21.9		30.8				
Dishwashers	—	—	—	30.5				
Color TVs	196.4	226.2	250.3	243.0	239.6	232.4	225.9	208.1
DVD players	—	21.9	90.8	119.9	133.1	140.4	144.1	121.5
Home computers	11.2	48.6	104.1	118.2	122.9	129.9	128.1	131.2

Note: *2003.
Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

Table 74 US household electricity consumption

	2013	2012
Population (millions)	317.8	315.1
Households (millions)	114.33	113.93
Housing area (m^2/household)	155.8	155.1
Energy end-use per household (kgce/household)	3914	3593
Household energy consumption (TWh)		
Lighting	161.3	175.0
Space heating	109.4	79.3
Space cooling	184.8	232.4
Water heating	123.0	123.0
Fridges	101.1	103.9
Freezers	21.9	21.9
Color TVs and set top boxes	90.2	90.2
Washing machines	8.2	8.2
Clothes dryers	54.7	54.7
Cooking	30.1	30.1
Dishwashers	24.6	27.3
Personal computers and related equipment	32.8	32.8
Stove fans and circulative pump for boiler	35.5	24.6
Others	313.1	278.9
Total	1412.7	1282.2
Household electricity use per capita (kWh)	4445	4069

Note: Others include small appliances, heater blocks and other electric motors.
Source: DOE/EIA, Annual Energy Outlook 2015.

Table 75 China public institutions energy consumption

2000	61.18 Mtce
2005	104.84 Mtce
2010	150.51 Mtce
2011	168.43Mtce
2012	184.1 Mtce
2013	197.6Mtce
Including: Electricity	339.76 TWh
Gasoline	18.19 Mt
Electricity consumption of rural residents	312.94 TWh
Energy consumption per capita of administrative bodies was about 8 times higher than that of urban residents; electricity consumption per capita of administrative bodies was 11 times higher.	

Note: Public institutions refer to government agencies, social organizations and public utilities that rely on government funding.

Sources: National Bureau of Statistics; China Electricity Council; Ministry of Housing and Urban-Rural Development.

VI. Energy Efficiency and Energy Conservation

Table 76 China energy-saving and rates (1980-2014)

	Primary energy consumption (MTCE)	Energy consumption per 10,000 Chinese yuan GDP (tce)	Rate of energy consumption reduction per Chinese yuan 10,000 GDP (%)	Energy saving (MTCE)
1980	602.8	13.20		
1981	594.5	12.37	6.3	37.8
1982	620.7	11.84	4.3	22.5
1983	660.4	11.36	4.1	22.3
1984	709.0	10.59	6.8	41.1
1985	766.8	10.10	4.6	37.9
6th Five-Year Plan period				161.6
	808.5	9.78	3.2	17.3
	866.3	9.39	4.0	24.7
	930.0	9.06	3.5	34.1
	970.0	0.07	+1.1	-4.9
	987.0	8.90(5.32)	1.8	28.9
7th Five-Year Plan period				100.1
	1037.8	5.12	3.8	41.0
	1091.7	4.72	7.8	93.4
	1159.9	4.40	6.8	116.6
	1227.4	4.12	6.4	75.1
	1311.8	3.97	3.6	44.6
8th Five-Year Plan period				370.7
	1351.9	3.69	7.1	59.6
	1359.1	3.40	7.9	74.0
	1361.8	3.16	7.1	159.7
	1405.7	3.03	4.1	117.0
	1469.6	2.89(1.47)	4.6	139.7
9th Five-Year Plan period				550.0
	1555.5	1.44	2.0	44.1
	1695.8	1.44	0	0
	1970.8	1.52	+5.6	-109.3
	2320.8	1.61	+5.9	-144.6
	2613.7	1.64(1.41)	+1.9	-55.8
10th Five-year Plan period				-265.6
	2864.7	1.37	2.8	87.1
	3114.4	1.30	5.1	187.6

	3206.1	1.22	6.2	253.4
	3361.3	1.17	4.1	172.8
	3606.5	1.14(0.88)	2.6	122.7
11th Five-Year Plan period				823.6
	3870.4	0.86	2.3	96.8
	4120.4	0.83	3.5	160.2
	4169.1	0.80	3.6	176.4
	4260	0.762	4.80	214.8

Notes: The GDPs for 1980-1990, 1990-2000, 2000-2005, 2005-2010, and 2010-2014 were calculated according to comparable prices in 1980, 1990, 2000, 2005 and 2010.
Sources: National Bureau of Statistics; National Development and Reform Commission.

Table 77 China energy saving (2014) **Unit: MTCE**

	Energy saving in 2014 compared with 2013	%
Technology energy saving	85.2	39.7
Industry	30.5	14.2
Transportation	14.7	6.8
Construction	40.0	18.6
Structural energy saving	129.5	60.3
Total energy saving	214.8	100.0

Notes: 1. In industrial energy saving, manufacturing contributed 22.0 MTCE and power generation, 8.47 MTCE.

2. In construction energy saving, new buildings by following energy-saving design standards and existing residential energy-saving technology retrofitting contributed 12.57 MTCE; renewable energy applications in construction added 14.6 MTCE, including the use of solar water heaters, photovoltaic power generation, ground source heat pumps, geothermal heating and biogas in rural areas. New electricity saving lamps contributed 12.8 MTCE.

Table 78 China manufacturing industry energy saving (2014)

	Product energy consumption						Production in 2014	Energy saving (MTCE) in 2014 compared with 2013
	Unit	2010	2011	2012	2013	2014		
Steel	kgce/t	950	942	940	923	913	822.7 Mt	8.23
Electrolytic aluminum	kWh/t	13979	13913	13844	13740	13596	27.52 Mt	1.19
Copper	kgce/t	500	497	451	436	420	7.64Mt	0.12
Cement	kgce/t	134	129	127	125	124	2476 Mt	2.48
Architectural ceramics	kgce/m^2	7.7	7.4	7.3	7.1	7.0	10.23 billion m^2	1.02
Wall materials	kgce/10,000 standard bricks	468	454	449	449	454	1,198 billion standard bricks	+0.60
Sheet glass	kgce/weight case	16.9	16.5	16.0	15.0	15.0	793 million weight cases	0
Oil refining	kgce/t	100	97	93	94	97	503 Mt (processing amount)	+1.51
Ethylene	kgce/t	950	895	893	879	860	16.97 Mt	0.32
Synthetic ammonia	kgce/t	1587	1568	1552	1532	1540	56.99 Mt	+0.46
Caustic soda	kgce/t	1006	1060	986	972	949	30.59 Mt	0.70
Sodium carbonate	kgce/t	385	384	376	337	336	25.14 Mt	0.03
Calcium carbide	kWh/t	3340	3450	3360	3423	3272	25.48 Mt	1.15
Paper and cardboard	kgce/t	390	380	364	362	340	118.0 Mt	1.53
Total								15.40
Total of manufactural industry								22.00

Note: 1. In product energy consumption, electricity consumption was converted into standard coal equivalent by coal consumption in power generation.

2. Each product's energy consumption is the average of the whole industry.

3. In this table, the 14 products listed came from six industries whose energy consumption accounted for 70% of the aggregate consumption in manufacturing in 2014.

Sources: National Bureau of Statistics, 2015 China Statistical Abstract, China Statistical Yearbook 2014; National Development and Reform Commission; Ministry of Industry and Information Technology; China Electricity Council; China Iron and Steel Industry Association; China Nonferrous Metals Industry Association; China Building Materials Industry Association; China Cement Association; China Ceramics Industrial Association; China Petroleum and Chemical Industry Federation; China Chemical Energy Conservation Technology Association; China Soda Industry Association; China Carbide Industry Association; China Paper Association.

Table 79 China transportation energy saving (2014)

	Unit workload energy consumption (kgce/10,000 conversion t-km)						Workload in 2014 (100 million conversion t-km)	Energy saving (10,000 tce) in 2014 compared with 2013
	2005	2010	2011	2012	2013	2014		
Highways	556	500	492	485	462	446	62337	997
Railways	55.9	49.6	47.8	47.4	46.6	45.4	39135	47
Waterways	50.8	47.2	44.8	43.2	41.1	35.9	91955	478
Civil aviation	6190	5578	5296	5147	5063	5147	673	+57
Total								1465

Note: 1. Electrified rail electricity consumption was calculated to standard coal equivalent by coal consumption in power generation.

2. Gasoline consumed by highway transportation includes alternative automobile fuel. Alternative automobile fuel consumed in 2010 was 7.53 Mt; in 2011 it was 8.86 Mt; in 2012 it was 10.95 Mt; in 2013 it was 16.70 Mt; and in 2014 it was 19.72 Mt.

Sources: National Bureau of Statistics; State Railway Administration; Ministry of Transport; China Electricity Council; China Association of Automobile Manufacturers; China Automotive Technology & Research Center; CNPC Economics & Technology Research Institute; Development of China's refining industry during the 13th Five-Year Plan by Jin Yun and Zhu He, *International Petroleum Economics*, 2015, No.5, 14-21; Characteristics of China's oil market in 2012 and prospects for 2013 by Gong Jinshuang, *International Petroleum Economics*, 2013, No.1-2, 70-76; China's fuel oil market in 2012 and prospects for 2013 by Wei Jian, Xiong Guoyue and Liu Ruiming, *International Petroleum Economics*, 2013, No.1-2, 162-167; Recent years' changes in China's bunker oil market and suggestions for future development by Tian Ming, *International Petroleum Economics*, 2013, No.1-2, 155-161; Statistical Bulletin of Transportation Industry Development in 2014; Statistical Bulletin of China Civil Aviation in 2014.

Table 80 China construction energy saving (2014) **Unit: MTCE**

	2011	2012	2013	2014
New buildings	13.00	10.00	13.00	10.65
Existing residential buildings	1.45	2.42	2.46	1.92
Lighting	11.70	11.10	13.10	12.80
Renewable energy applications	5.80	7.20	11.20	14.60
Total	31.95	30.72	39.76	39.97

Notes: 1. In new buildings, applying standards to energy saving design created energy saving capacity.

2. In existing residential buildings, energy saving was achieved through improvements to energy saving technology in the north.

3. Energy saving from lighting was achieved by the replacement of incandescent bulbs with energy-saving lighting..

4. Renewable energy applications include solar water heaters, photovoltaic power generation, ground source heat pumps, geothermal heating and biogas in rural areas.

Sources: Ministry of Housing and Urban-Rural Development; National Development and Reform Commission; Ministry of Land and Resources; Ministry of Agriculture; China Association of Rural Energy Industry; China Association of Solar Energy.

Table 81 Energy consumption per GDP (2014) **Unit: tce/million USD**

Britain	91.1
Italy	99.0
Germany	115.1
France	119.2
EU	124.5
Japan	141.1
US	188.5
China	409.0
India	444.6
World	238.9

Sources: GDP, IMF, April 14, 2015; energy consumption, BP Statistical Review of World Energy, June 2015.

Table 82 China physical energy efficiency **Unit: %**

	2000	2005	2010	2012	2013
1. Exploitation efficiency	33.0	33.3	35.9	36.0	36.2
2. Intermediate link efficiency	68.5	70.8	70.6	69.7	68.6
3. End-user utilization efficiency					
Agriculture	32.0	33.0	34.0	35.0	36.0
Industry	46.0	47.3	50.5	52.6	53.2
Transportation	28.9	29.2	29.1	31.6	33.0
Residential and commercial use	66.0	68.4	74.2	76.1	76.4
Total	46.7	48.3	51.0	52.5	53.7
4. Energy efficiency (2×3)	32.0	34.2	36.0	36.6	36.8
5. Overall efficiency of energy system (1×4)	10.6	11.4	12.9	13.2	13.3

Notes: 1. This table was calculated according to internationally-accepted definitions of energy balance.
2. Intermediate link refers to energy processing, conversion, storage and transportation;

Table 83 Energy-intensive product energy consumption

	China						Global leading level
	2000	2010	2011	2012	2013	2014	
Coal mining and washing							
Full energy consumption (kgce/t)	38.2	32.7	32.5	31.8	30.2		
Electricity consumption (kWh/t)	29	24.0	24.0	23.4	24.1	24.3	17.0
Petroleum and natural gas exploitation							
Comprehensive energy consumption (kgce/toe)	208	141	132	126	121	125	105
Electricity consumption (kWh/toe)	172	121	127	121	123	132	90
Coal consumption in power generation (gce/kWh)	363	312	308	305	302	300	292
Coal consumption in electricity supply to power plants (gce/kWh)	392	333	329	325	321	319	302
Full energy consumption for steel (kgce/t)							
Whole industry	1475	950	942	940	923	913	
Large and medium-sized enterprises	906	701	695	694	682	674	
Comparable energy consumption for steel (kgce/t)	784	681	675	674	662	654	610
AC power consumption for electrolytic aluminum (kWh/t)	15418	13979	13913	13844	13740	13596	12900
Full energy consumption for copper smelting (kgce/t)	1227	500	497	451	436	420	360
Full energy consumption for cement (kgce/t)	172	134	129	127	125	124	118
Full energy consumption for wall materials (kgce/10,000 standard bricks)	763	468	454	449	449	454	300
Full energy consumption for building ceramics (kgce/m^2)	8.6	7.7	7.4	7.3	7.1	7.0	3.4
Full energy consumption for sheet glass (kgce/weight case)	25.0	16.9	16.5	16.0	15.0	7.1	13.0
Full energy consumption for crude oil processing (kgce/t)	118	100	97	93	94	97	73
Full energy consumption for ethylene (kgce/t)	1125	950	895	893	879	860	629
Full energy consumption for synthetic ammonia (kgce/t)	1699	1587	1568	1552	1532	1540	990
Full energy consumption for caustic soda (kgce/t)	1439	1006	1060	986	972	949	910
Full energy consumption for sodium carbonate (kgce/t)	406	385	384	376	337	336	310
Electricity consumption for calcium carbide (kWh/t)	3475	3340	3450	3360	3423	3272	3000
Full energy consumption for paper and cardboard (kgce/t)							
Whole industry	912	390	380	366	353	340	
Pulp companies	1540	1200	1170	1128	1087	1050	580
Electricity consumption for chemical fibers (kWh/t)	2276	967	951	878	849	801	800

Note: 1. Global leading level is an average of the leading nations.

2. For full energy consumption in China and overseas for all years, electricity consumption was converted to standard coal equivalent.

3. The US is the world's leading nation in mining and washing coal. In 2013, strip mines made up 66% of all active mines in the US, the percentage in China was 12%; electricity consumption per ton of coal in strip mining made up about 20% of mining's total in the US.

4. The international leading level for electricity consumption of the oil and gas exploitation industry is an estimated value from Shell and British Petroleum Company.

5. The gross coal consumption rate and net coal consumption rate in China was calculated from generators above 6MW; the international figure is the average of Japan's top nine power companies. In 2010, in China, coal made up 94.3% of all thermal power stations, oil, 0.5%; and gas, 2.3%. In Japan those ratios were 38.0%, 14.0% and 43.4%.

6. The comparable energy consumption for steel in China is from large- and medium-sized enterprises, whose production accounted for 80.2% of the whole country in 2014. The international figure here comes from Japan.

7. The full energy consumption for cement is split into the heat consumption of clinker and full electricity consumption for cement. Electricity consumption was calculated as standard coal equivalent. Here, the international figure comes from Japan. In 2010, China's clinker heat consumption was 115kgce/t while Japan's was 96kgce/t. Full electricity consumption was 89kWh/t in China and 78kWh/t in Japan.

8. The international leading level of full energy consumption for wall materials was the US.

9. Most ethylene in China is manufactured from naphtha. In the Middle East, classified as an international advanced leading country here, ethylene is manufactured from ethane.

10. Full energy consumption for caustic soda was calculated from the weighted average of energy consumption from the diaphragm process and ion exchange membrane.

11. Full energy consumption for synthetic ammonia was calculated from the average value of large-, medium- and small-sized enterprises with coal, oil and gas as raw materials. In 2012, 76% used coal and 22% used natural gas. The US, which uses natural gas for 98% of ammonia production is the international ;eading level country in the table.

Sources: National Bureau of Statistics; Ministry of Industry and Information Technology; China National Coal Association; China Electricity Council; China Iron and Steel Industry Association; China Nonferrous Metals Industry Association; China Building Materials Industry Association; China Ceramics Industrial Association; China Chemical Energy Conservation Technology Association; China Petroleum and Petrochemical Engineering Institute (CPPEI); China Paper Association; China Chemical Fibers Association; Institute of Energy Economics, Japan; Handbook of Energy and Economic Statistics, 2015 version; Iron and Steel Institute of Japan; South Korea Iron and Steel Association; Japan Cement Association; Japan Institute of Energy; IEA, Energy Statistics of OECD Countries.

Table 84 Global energy consumption of energy-intensive industries

	2010	2011	2012	2013	2014	International advanced level	
						2005	2014
Coal consumption in thermal power generation (gce/kWh)	333	329	325	321	319	288	275
Comparable energy consumption for steel (kgce/t)	681	675	674	662	654	610	610
AC power consumption for electrolytic aluminum (kWh/t)	13979	13913	13844	13740	13596	14100	12900
Full energy consumption for cement (kgce/t)	134	129	127	125	124	127	118
Full energy consumption for ethylene (kgce/t)	950	895	893	879	860	629	629

Note: 1. Electricity consumption was calculated to standard coal equivalent.

2. International leading level is the average value of leading countries (that is those that are the most energy-efficient). Italy is the lading country for coal consumption in thermal power generation; Japan is the leading country for comparable energy consumption for steel and full energy consumption for cement. The Middle East qualifies for full energy consumption for ethylene.

3. In 2010, in China, coal made up 94.3% of all thermal power stations, oil, 0.5%; and gas, 2.3%. In Italy, those percentages were: 17.5%, 9.9% and 70.9%.

4. The comparable energy consumption for steel in China is from large- and medium-sized enterprises. Their production accounted for 80.2% of the national total in 2014.

Sources: National Bureau of Statistics; China Electricity Council; China Iron and Steel Industry Association; China Nonferrous Metals Industry Association; China Building Materials Industry Association; China Petroleum and Chemical Industry Federation; Institute of Energy Economics, Japan; Statistical Handbook of Japan Energy and Economy (2015 version); Japan Electric Power Information Center; Statistics of Overseas Electric Utility in 2012; Iron and Steel Institute of Japan; Japan Cement Association.

Table 85 China electricity consumption of electricity-intensive products and processes

	Electricity consumption						2014 production
	Unit	2010	2011	2012	2013	2014	
Coal mining and washing	kWh/t	24.0	24.0	23.4	24.1	24.3	3870Mt
Petroleum and natural gas exploitation	kWh/toe	121	127	121	123	132	328.6 Mtoe
Steel	kWh/t	467	475	475	467	470	822.7 Mt
AC power consumption for electrolytic aluminum	kWh/t	13979	13913	13844	13740	13596	27.52 Mt
Cement	kWh/t	89.7	89.0	88.4	87.0	85.5	2476 Mt
Sheet glass	kWh/weight case	7.1	6.7	6.6	6.2	6.2	790 million weight case
Synthetic ammonia	kWh/t	1116	1090	1010	1035	1043	56.99 Mt
Caustic soda	kWh/t	2203	2336	2359	2326	2280	30.59 Mt
Calcium carbide	kWh/t	3340	3450	3360	3423	3272	25.48 Mt
Paper and cardboard	kWh/t	545	527	511	521	536	118.0 Mt
Chemical fibers	kWh/t	967	951	878	849	801	43.9 Mt

Note: 1,111 m^3 natural gas = 1 toe.

Sources: National Bureau of Statistics; Ministry of Industry and Information Technology; China National Coal Association; China Electricity Council; China Iron and Steel Industry Association; China Nonferrous Metals Industry Association; China Building Materials Industry Association; China Chemical Energy Conservation Technology Association; China Paper Association; China Chemical Fibers Association.

Table 86 Japan gross heat consumption rate and net heat consumption rate of thermal power plants

	Power generation		Power supply	
	Efficiency (%)	Heat consumption (gce/kWh)	Efficiency (%)	Heat consumption (gce/kWh)
1980	38.08	323.0	36.25	339.3
1985	38.21	321.9	36.31	338.7
1990	38.78	317.2	37.05	332.0
1995	39.00	315.0	37.21	330.6
2000	40.59	303.0	38.87	316.4
2005	40.90	300.7	39.21	313.7
2010	41.86	293.8	40.21	305.9
2011	41.74	294.7	40.21	305.9
2012	41.81	294.2	40.30	305.2
2013	40.30	291.5	40.67	302.4

Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

Table 87 Industry centralization of energy-intensive industries: comparison between China and the world (2013)

	China	Foreign countries
Iron-smelting blast furnaces	1,480 furnaces, 480,000 t pig iron per furnace	28 furnaces, 3.01 million t pig iron per furnace (Japan)
Cement	4,300 enterprises, annual output 560,000 million t per factory	Annual output 2.30 million t per factory (Japan), 5.6 million t annual output per factory (Thailand)
Bricks and tiles	70,000 enterprises, annual output 14 million standard bricks per factory	Annual output of 80-220 million standard bricks per factory in leading enterprises
Oil refining	150 refineries, annual processing capacity 3.83 million t per refinery	6 refineries, annual processing capacity 24.65 million t per refinery (South Korea)
Ethylene	32 sets of equipment, annual output 524,800 t per set	13 sets of equipment, annual output 834,000 t per set (Saudi Arabia)
Papermaking	2,400 enterprises, output 48,000 t per factory	Average annual output 300,000 t per factory in developed countries

Sources: China Iron and Steel Industry Association; China Building Materials Industry Association; China Brick & Tile Industry Association; China Petroleum and Chemical Industry Federation; China Paper Association; Iron and Steel Institute of Japan; *Oil & Gas Journal*, December 3, 2013.

Table 88 China Production capacity utilization rate of energy-intensive industries (2014)

	Output	Capacity	Production capacity utilization rate (%)
Coal	3874Mt	5500Mt	70.4
Coke	467.9 Mt	668 Mt	70.0
Steel	822.7 Mt	1160 Mt	70.9
Electrolytic aluminum	27.52Mt	35.0 Mt	78.6
Cement	2476 Mt	3600 Mt	68.8
Sheet glass	793 million weight cases	1350 million weight cases	58.7
Oil refining	503.0 Mt	650.5 Mt	77.3
Ethylene	16.97 Mt	23.1Mt	73.5
Synthetic ammonia	56.99 Mt	74.0 Mt	77.0
Caustic soda	30.59 Mt	40.8Mt	75.0
Sodium carbonate	25.14 Mt	33.0 Mt	76.2
Methanol	37. 41Mt	68.0Mt	55.0
Calcium carbide	25.48 Mt	41.0 Mt	62.1
Photovoltaic cell modules	35.0 GW	48.0 GW	72.9

Note: Oil refining refers to crude oil processing.
Sources: Ministry of Industry and Information Technology; National Bureau of Statistics; National Development and Reform Commission; China National Coal Association; China Coking Industry Association; China Iron and Steel Industry Association; China Building Materials Industry Association; China Petroleum and Chemical Industry Federation; China Fertilizer Association.

Table 89 China industrial outdated capacity eliminated

	Eliminated					Output in 2014
	2006～2010	2011	2012	2013	2014	
Coal	450.0 Mt	24.6 Mt	97.8 Mt	200.0 Mt	108 Mt	3874 Mt
Coke	10.38 Mt	19.35 Mt	24.93 Mt	14.05 Mt	12.0 Mt	467.9 Mt
Thermal power generation	72.1 GW	3.46 GW	5.51 GW	4.47 GW	3.3 GW	915.7 GW
Iron smelting	111.7 Mt	31.22 Mt	28.46 Mt	25.3 Mt	120.0 Mt	711.6Mt
Steel smelting	68.6 Mt	27.94 Mt	9.37 Mt	19.7 Mt	90.0 Mt	822.7 Mt
Electrolytic aluminum	0.80 Mt	0.62 Mt	0.27 Mt	0.27 Mt	0.57 Mt	27.52 Mt
Cement	403 Mt	153 Mt	220 Mt	114 Mt	81Mt	2476 Mt
Sheet glass	152 million weight cases	29 million weight cases	59 million weight cases	60million weight cases	38 million weight cases	793 million weight cases
Calcium carbide	4.0 Mt	1.53 Mt	1.32 Mt	1.13 Mt	1.92 Mt	25.48 Mt
Paper	10.3 Mt	8.2 Mt	8.8 Mt	4.55 Mt	4.92 Mt	108.0 Mt

Sources: Ministry of Industry and Information Technology; National Bureau of Statistics; China National Coal Association; China Electricity Council; China Iron and Steel Industry Association; China Building Materials Industry Association; China Carbide Industry Association; China Paper Association.

Table 90 China energy saving through product structure adjustments

1. Coal	By increasing the proportion of coal washed. Washing removes 50%-70% ash and 60%-70% inorganic sulfur. Coal firing uses 10% less coal when it is washed. The proportion of raw coal washed in China rose from 31.9% in 2005 to 62.5% in 2014. In 2014, 2.42 billion t of raw coal was washed, saving 240 million t and saving 476 million t in CO_2 emissions .
2. Steel	(1) Reinforced steel output in China in 2014 reached 215 Mt. By replacing 100 Mt ordinary steel bars with a tensile strength of 335MPa with high-tensile steel bars with a tensile strength of 400MPa or above, annual steel bar consumption was cut by 10 Mt; saving 16 Mt of iron ore and 9.5 Mtce of energy. In 2014, the ratio of reinforced steel with a tensile strength of 400MPa or above had reached 80% of total output. (2) By lowering the iron-steel ratio. The iron-steel ratio is the proportion of pig-iron output to crude steel output. This largely depends on the amount of recycled scrap steel that is used. The iron-steel ratio was 0.86 in 2014. In 2012, the iron and steel industry recycled 88.6 Mt of scrap steel. Comprehensive energy consumption of recycling scrap steel is only 19% of the energy consumption per ton of steel in large- and medium-sized enterprises.
3. Non-ferrous metals	By producing a higher proportion of regenerated metal. In 2014, regenerated non-ferrous metal output nationwide reached 11.53 Mt, in which, the output of regenerated copper, aluminum, lead and zinc was 2.95 Mt, 5.65 Mt, 1.60 Mt and 1.33 Mt respectively, accounting for 37.1%, 23.2%, 37.9% and 22.8% of the total output. The comprehensive energy consumption of secondary copper, aluminum and lead was 18%, 45% and 27% of primary metal. Compared with primary metal, secondary non-ferrous metal production saves 64.8 billion kWh in electricity consumption, 1.84 billion m^3 in water consumption and reduces the discharge of solid waste by 1.52 billion t.
4. Building materials	(1) By improving the proportion of high strength cement. High strength cement is cement with a grade of 42.5 or above. Grade 42.5 cement has a tensile strength of 42.5MPa when hardened. The proportion of high-grade cement output was 50% in 2014. Replacing 32.5 grade cement with high-grade cement will reduce cement used by 15%.

	(2) By encouraging the use of unpackaged cement. Unpackaged cement is cement that has been premixed with mortar and is directly transported to construction sites in special purpose vehicles. Compared with bagged cement, 10,000 tons of unpackaged cement can save 330m^3 in quality wood (which is used for manufacturing the bags), saving 450 kg in damaged and worn paper bags and saving 237tce. In 2014, the proportion of unpackaged cement used was 57.6%. (3) By encouraging the use of new-type wall materials. New-type wall materials is a sintered product made from industrial waste residue as the main raw material. Compared with solid clay bricks, new-type wall materials can lower energy consumption by 40% during production; and save 30% in energy for heating when used in construction. In 2005, 44% of wall materials were new-type wall materials in China, and this rose to 63% in 2013. During the 11th Five-Year Plan period, 25 million tce energy was saved by eliminating the use of solid clad bricks and replacing them with new-type wall materials; 1.5 billion t industrial waste residue was utilized in producing new-type wall materials. Further, over 3 million *mu* in farmland was saved from damage caused by brick-making and disposing of solid waste, and the shuttering of clay brick factories. (4) By encouraging the use of low-e glass. This energy saving glass is produced by adding a thin metal film, such as silver, copper or tin to the glass. It reflects solar heat and prevents the loss of heat from inside the room, saving more than 50% in energy consumption. At present, the penetration rate in the US and Europe has reached 85%. In 2013, the production of low-e glass in China was about 140 million m^2.
5. Fertilizer	By encouraging controlled release fertilizers. In 2012, China used 58.39 Mt of chemical fertilizers. The effective utilization ratio was just 30% in China, 52% in the US, and 68% in Europe. Controlled release fertilizer releases the fertilizer according to the need of the crops and the nature of the soil. It can greatly improve the utilization rate, saving 15%-25% in fertilizer use and reducing pollution. In 2013, China produced 3.68 Mt of controlled release fertilizer; in 2014, it was being used on 31 crops in 25 provinces and regions. This type of fertilizer has shown to give a 10.4% increase in corn yields, and a 10%-20% increase in potato, grape, and watermelon yields.
6. Vehicles	(1) By encouraging the use of energy-saving vehicles. In 2014, there were 13.146 million energy-saving automobiles with engine displacement under 1.6 litres, saving up to 3.66 Mt in fuel. The market share of vehicles with small displacement engines was 67% in China in 2014. (2) By encouraging the use of cars in rural areas, encouraging energy-saving cars, and discouraging the use of agricultural vehicles. China currently has about 12 million three-wheeled vehicles and low-speed freight vehicles, consuming 3.3 Mt in diesel oil every year. Agricultural vehicles consume 10%-20% more fuel than energy saving vehicles and produce significantly more pollution. China offers subsidies to encourage people to replace three-wheeled and low-speed freight vehicles with light-duty trucks and minibuses (under 1.3 litres). From March 2009 to September 2010, 3.06 million vehicles were sold in rural areas..
7. Lighting	By encouraging the use of energy-saving bulbs. These bulbs use mercury vapor to activate trichromatic phosphor on the inner wall of the tube to produce light. Their use can save up to 70% in electricity consumption. China offered subsidies from June 2009 to June 2011 to encourage the uptake of 520 million energy-saving lights, saving 18.1 billion kWh and 90.8 billion kWh within their service time. In 2012, 840 million energy-saving lights were sold, saving 29.2 billion kWh in electricity each year. Between 2001 and 2013, the output of energy-saving bulbs rose from 660 million to 4.45 billion and the ratio of energy-saving bulbs to incandescent lights switched from 1:3.5 to 1:0.96.
8. Air conditioners	By encouraging the use of energy-saving air conditioners. Energy-saving air conditioners are ranked level 1 or level 2 in energy efficiency. In China, domestic air conditioners are the most energy intensive household appliance. In 2012, China had 550 million air conditioners, which consumed 297.5 billion kWh that year. From June 2009 to June 2011, China subsidized the purchase of 50 million energy-efficient air conditioners, saving 14.7 billion kWh in electricity consumption. The market share of energy-saving air conditioners rose from 5% to 70% over the same period. China no longer produces level 3, level 4 and level 5 air conditioners. In 2014, the output of variable frequency air conditioners accounted for 57.5% of all air conditioners. Compared with constant frequency air conditioners, variable frequency machines can save up to 30% in energy consumption.

Table 91 Japan transportation unit energy consumption

	1990	2000	2005	2010	2011	2012	2013
Passenger traffic (kcal/person-km)							
Private vehicles	497	582	599	571	561	524	484
Commercial vehicles	1524	1271	1301	1647	1652	1648	1637
Buses	139	158	170	189	191	193	210
Railways	48	50	49	51	48	47	48
Waterways	267	484	433	481	486	471	
Aviation	550	435	473	543	447	383	459
Freight transport							
Vehicles	922	851	778	970	1027	1141	1148
Railways	59	60	60	61	60	59	61
Waterways	148	218	232	180	188	185	146
Aviation	5178	5301	5179	4942	5014	4898	4782

Note: Average caloric value of gasoline is 8,266 kcal/liter, diesel 9,006 kcal/liter, and jet fuel, 8,767 kcal/liter.
Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

Table 92 Japan passenger vehicles fuel economy

	Car ownership (10,000)		Sales volume of new vehicles (10,000)		Fuel economy (km/liter)			
					Cars		New vehicles	
	Passenger vehicles	Minicars	Passenger vehicles	Minicars	Total	Excluding minicars	Total	Excluding minicars
2000	3379	1008	426	127	12.8	11.8	13.8	12.6
2005	4010	1435	476	142	13.5	12.4	15.3	14.1
2010	3759	1800	388	121	14.7	13.3	17.8	16.8
2011	3710	1859	401	128	15.0	13.5	18.3	17.1
2012	3618	1935	444	157	15.3	13.8	19.4	17.8
2013	3502	2023	484	182	15.6	14.0	19.9	18.3

Note: 1. Passenger vehicles refers to cars that use gasoline. 2. Minicars have an engine displacement less than 0.66 liters.
Source: The Institute of Energy Economics, Japan, Handbook of Japan's & World Energy & Economic Statistics, 2015.

Table 93 Japan household appliances energy efficiency

Refrigerators (kWh/liter/year, based on revised standards)	
2005	1.5
2010	0.7
2011	0.6
2012	0.6
2013	0.6

Air conditioners (cooling and heating, wall-mounted,, 2.8 kW energy-saving, electricity consumption (kWh)).

	Cooling time	Heating time	Total
1995 type	412	1080	1492
2000 type	262	755	1017
2005 type	227	692	919
2008 type	214	644	858
2009 type	212	637	849
2010 type			872
2011 type			845
2012 type			846
2013 type			844

Color TV sets (32 inches, annual electricity consumption (kWh))	
1997 type	235
2000 type	220
2005 type	200
2010 type	88
2011 type	77
2012 type	69
2013 type	66

Note: 1997 type, 2000 type and 2005 type use CRT (cathode-ray tube) screens, 2010 type, 2011 type and 2012 type use LED (lighting emitting diode) screens.

Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

Table 94 Japan energy consumption per household by category and use (2013)

Unit: 1,000kcal/household

	Heating	Refrigeration	Hot water	Cooking	Power, etc	Total	Proportion (%)
Electricity	377	223	347	206	3281	4433	48.8
Fuel gas	411	-	1025	284	-	1719	18.9
LPG	83	-	663	282	-	1028	11.3
Kerosene	1432	-	405	-	-	1836	20.2
Coal	-	-	9	1	-	11	0.1
Solar energy	-	-	53	-	-	53	0.6
Total	2302	223	2502	773	3281	9081	100.0
Proportion (%)	25.4	2.5	27.5	8.5	36.1	100.0	

Note: 1. There are an average 3.05 people per household.
2. Coal includes briquette coal, firewood and charcoal.
Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

Table 95 Japan commercial building area and energy consumption (2013)

	Floor area ($10^6 m^2$)	Energy consumption (10^{10}kcal)
Office buildings	484	8796
Department stores and supermarkets	22.5	731
Wholesale and retail	450	7919
Restaurants	65.6	3375
Schools	365	3314
Hotels and inns	91.7	4169
Hospitals	112.2	4478
Theaters and entertainment venues	35.6	1343
Others	219	6508
Total	1845	40634

Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economics Statistics, 2015.

Table 96 Japan commercial building unit area energy consumption by category and use (2013)

Unit: 10^3kcal/m^2

	Space heating	Space cooling	Water heating	Cooking	Power	Total	Shares (%)
Electricity	3.5	10.4	1.6	2.5	111.1	129.2	58.7
Fuel gas	9.0	12.9	13.6	17.1	-	52.8	24.0
Oil products	20.8	1.1	9.8	-	-	31.6	14.3
Coal	0.5	-	2.1	0.7	-	3.3	1.5
Solar & geothermal energy	0.6	1.6	1.3	-	-	3.4	1.5
Total	34.4	26.0	28.4	20.3	111.1	220.2	100.0
Proportion (%)	15.6	11.8	12.9	9.2	50.5	100.0	

Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economics Statistics, 2015.

Table 97 China energy-saving service industry

In 2013, China had 4,852 ESCOs (Energy Service Companies) in contract energy management (CEM) employing 508,000 people. In 2014, the value of the energy-saving service industry was 265.04 billion Chinese yuan, up 23.0% from 2013. In 2014, the investment value for Energy Performance Contracting reached 95.88 billion Chinese yuan, up 29.2% from 2013 and the amount of energy was 29.962 million tce.

Source: EMCA ESCO Committee of China Energy Conservation Association

Table 98 Chinese government energy-saving procurement

Government procurement in China refers to purchasing by government bodies at all levels with public funds. A large proportion of goods procured by governmental agencies are energy consuming, so the choices government bodies make can play a big role in stimulating the energy-saving product market and also play a part in leading the way to improving energy conservation and emissions reduction. In July 2007, China established a system that made it mandatory for government bodies to buy energy-saving products; the list of approved products was drawn up by the Ministry of Finance and the National Development and Reform Commission. The list is based on energy-saving performance, technological level, and market maturity. The list explicitly stipulates those product categories that are prioritised and those that are mandatory. The list currently includes 15,000 energy-saving products, including air conditioners, lighting, computers, monitors, printers, photocopiers, and government vehicles. Mandatory products include air conditioners, lighting, TVs, electric water heaters, computers, monitors, urinals, and water nozzles. In 2014, government procurement spending was 1.73 trillion Chinese yuan, accounting for 11.4% of government spending and 2.7% of GDP. The total spent on energy-saving products was 210 billion Chinese yuan, accounting for 87.1% of money spent on these product categories; environmentally-friendly products worth 176.24 billion Chinese yuan were purchased, accounting for 75.3% of these product categories. Compared with 2013, the government spent 5.6% more on energy-saving products and 14.2% more on green products in 2014.

VII. The Energy Trade

Table 99 China energy imports and exports

	2000	2005	2008	2009	2010	2011	2012	2013	2014
Crude oil (Mt)									
Exports	10.44	8.07	3.73	5.18	3.04	2.52	2.44	1.62	0.60
Imports	70.27	127.08	178.89	203.79	239.31	252.55	271.09	282.14	308.36
Petroleum products (Mt)									
Exports	10.30	16.88	20.12	27.92	30.44	30.52	28.44	32.78	12.71
Imports	24.32	41.45	45.63	47.70	47.84	52.12	52.91	56.48	46.55
Natural gas (100 million m^3)									
Exports	31.4	29.7	32.5	32.1	40.3	31.4	28.5	27.1	25.1
Imports			46.4	76.3	164.7	307.1	398.9	518.2	583.5
Coal (Mt)									
Exports	58.84	71.68	45.43	22.40	19.03	14.66	9.26	7.51	5.74
Imports	2.02	26.17	40.40	125.83	164.78	222.30	288.51	327.08	291.22

Note: 1. Natural gas exports in 2014 refers to LNG; for imports, pipeline natural gas made up 31.31 billion m^3 and LNG, 27.04 billion m^3.

2. From 2011 to 2014, coal imports included brown coal. In 2014, China imported 64.01Mt of brown coal.

Source: General Administration of Customs of the People's Republic of China.

Table 100 China energy dependence upon foreign trade

Crude oil

China imported 70.27 Mt of crude oil in 2000, its external dependence was 26.4%. In 2014, imports reached 308.31 Mt; and it exported 0.60 Mt (making net imports 307.76 Mt). It consumed 519.0 Mt of crude oil, making external dependence 59.3%.

Natural gas

In 2000, China exported 3.14 billion m^3 of natural gas. In 2008, it imported 4.64 billion m^3 and exported 3.25 billion m^3, making it a net importer of natural gas (1.39 billion m^3). In 2014, China imported 58.35 billion m^3 of natural gas (pipeline gas and LNG), 2.51 billion m^3 was exported and 182 billion m^3 was consumed. Net imports were 55.78 billion m^3, making external dependence 30.6%.

Coal

In 2000, China exported 58.84Mt of coal and imported just 2.02Mt. In 2009, China exported 129.83Mt of coal and imported 22.40Mt, turning it into a net exporter of coal. In recent years, coal imports have risen sharply because the price of coal imports fell lower than domestically-produced coal and China enjoyed zero tariffs. In 2014, imports reached 291.22Mt, exports were 5.74Mt, meaning net imports were 285.48Mt. It consumed 4121Mt, making external dependence 6.9%。

Table 101 Global oil trade (2014) **Unit: Mt**

	Imports		Exports	
	Crude oil	Oil products	Crude oil	Oil products
US	365.4	90.1	16.9	179.9
Canada	29.9	26.9	148.6	26.3
Mexico	-	30.6	56.5	7.4
Central and South America	22.2	85.5	164.0	30.4
Europe	446.9	173.5	11.6	98.6
Former Soviet Union	0.1	6.4	294.8	144.1
Middle East	11.4	43.2	850.1	128.6
North Africa	9.7	24.9	62.1	24.6
West Africa	0.2	18.6	213.9	6.5
Eastern and Southern Africa	11.0	18.1	9.3	0.7
Australia	26.4	23.6	12.0	3.3
China	309.2	63.7	0.4	25.8
India	189.7	19.9	-	61.3
Japan	168.6	45.5	-	13.3
Singapore	45.6	102.4	0.3	71.3
Other Asia-Pacific countries	240.3	138.7	35.7	89.5
World total	1876.4	911.5	1876.4	911.5

Note: Bunkers are not included as exports, into-area movements are excluded.
Source: BP Statistical Review of World Energy, June 2015.

Table 102 China petroleum imports and exports **Unit: 10,000 t**

		2008	2009	2010	2011	2012	2013	2014
Total crude oil and petroleum products	Imports	22451.8	25148.4	28715.5	30586.9	32651.8	33862.4	35490.5
	Exports	2384.9	3310.2	3348.2	3310.8	3090.2	3439.9	3444.1
	Net imported	20066.9	21838.2	25367.3	27276.1	29561.6	30422.5	32046.3
Crude oil	Imports	17889.3	20378.9	23931.1	25254.9	27109.1	28214.4	30835.7
	Exports	373.3	518.4	304.2	252.2	243.5	162.0	60.0
	Net imported	17516.0	19860.5	23626.9	25002.7	26865.6	28052.4	30775.7
Petroleum products	Imports	4562.5	4769.5	4784.4	5332.0	5291.1	5648.0	4654.6
	Exports	2011.6	2791.8	3044.0	3058.6	2846.7	3277.9	3384.1
	Net imported	2550.9	1977.7	1740.4	2273.4	2695.5	2370.1	1270.5
Gasoline	Imports	198.7	4.4	0	0	0.5	0	3.4
	Exports	203.6	494.3	517.1	406	292.2	468.8	498.4
	Net imported	-4.9	-489.9	-517.1	-406.0	-291.7	-468.8	-495.0
Kerosene	Imports	647.8	576.2	486.8	614.9	620.7	668.9	391.4
	Exports	533.2	594.5	604.8	656.6	745.1	917.5	1051.1
	Net imported	114.6	-18.3	-118.0	-41.6	-124.4	-249.0	-659.7
Diesel	Imports	624.8	183.7	179.9	244.1	94.7	26.7	47.0
	Exports	62.9	450.7	467.3	203.1	186.2	278.2	400.0
	Net imported	561.9	-267.0	-287.4	40.9	-91.5	-251.5	-353.0
Fuel oil	Imports	2160.1	2400.4	2301.4	2675.0	2680.8	2346.7	1782.6
	Exports	724.6	862.5	989.5	1233.9	1163.6	1135.0	940.2
	Net imported	1435.5	1573.9	1311.9	1441.4	1517.1	1211.7	842.4

Note: Crude oil and petroleum products include gasoline, diesel, kerosene, fuel oil, naphtha, lubricants, liquid paraffin, petroleum asphalt, petroleum coke and non-liquid paraffin.
Source: General Administration of Customs.

Table 103 China crude oil imports by source **Unit: 10,000 t**

Source region/country	2008	2009	2010	2011	2012	2013	2014
Middle East	8962.1	9746.1	11275.6	13004.3	13498.4	14654.2	16058.0
Saudi Arabia	3636.8	4195.3	4463.0	5027.8	5390.1	5389.9	4966.2
Oman	1458.5	1163.8	1586.8	1815.3	1957.4	2548.2	2974.3
Iraq	186.0	716.3	1123.8	1377.4	1568.5	2351.4	2858.0
Iran	2132.2	2314.7	2132.0	2775.7	2201.0	2144.1	2746.1
UAE	457.9	330.7	528.5	637.5	874.4	1027.6	1165.2
Kuwait	589.6	707.6	983.4	954.2	1049.2	934.7	1062.0
Africa	5395.5	6141.8	7085.3	6014.7	6469.9	6423.9	6804.1
Angola	2989.4	3217.3	3938.2	3115.0	4015.6	4001.3	4065.0
Sudan	1049.9	1219.1	1259.9	1298.9	290.6	595.3	821.7
Congo	437.1	409.0	504.8	563.1	536.6	707.8	705.2
Libya	319.0	634.5	737.3	259.2	730.7	239.5	96.6
Asia-Pacific	506.4	961.8	880.1	863.7	775.1	644.0	600.9
Australia	89.7	156.5	287.0	408.0	371.6	302.6	272.6
Vietnam	-	-	68.3	74.5	64.7	148.3	148.3
Mongolia	-	-	28.7	45.8	61.3	103.1	103.1
Others	3025.3	3528.4	4686.8	5495.3	6365.7	6492.3	7372.7
Russia	1163.8	1530.4	1524.5	1972.5	2433.0	2444.6	3310.8
Venezuela	646.7	526.7	755.0	1151.8	1529.0	1574.8	1378.8
Brazil	302.2	406.0	804.8	671.0	607.1	524.1	700.2
Kazakhstan	567.1	600.6	1005.4	1121.1	1070.4	1189.1	568.6
Total imports	17889.3	20378.9	23931.1	25378.0	27109.1	28214.4	30835.7
OPEC	11275.1	13183.2	15102.7	15782.9	17898.2	18036.0	18738.2

Source: General Administration of Customs.

Table 104 China petroleum imports and exports **Unit: USD100 million**

	2000	2010	2011	2012	2013	2014
Crude oil						
Imports	148.6065	1353.0716	1967.8800	2206.6592	2195.4864	2281.3844
Ratio (%)	2.80	9.59	11.29	12.14	11.26	11.64
Exports	21.1895	16.4481	19.0568	22.2603	14.6257	4.9043
Ratio (%)	0.85	0.11	0.10	0.11	0.07	0.03
Refined oil products						
Imports	36.5713	224.6763	327.7997	329.9300	317.0028	233.7095
Ratio (%)	1.62	1.59	1.88	1.81	1.63	1.00
Exports	21.0718	170.2797	207.6604	213.2889	245.1032	254.0221
Ratio (%)	0.85	1.10	1.09	1.04	1.11	1.08

Note: Ratio means to the proportion of total imports and exports.
Source: General Administration of Customs.

Table 105 Global coal trade (2013) **Unit: Mt**

Exports	
Australia	358
Indonesia	426
Russia	143
US	107
Columbia	77
South Africa	77
World	1420
Imports	
China	327
Japan	186
South Korea	183
EU	171
India	152
World	1420

Table 106 Global natural gas trade (2014) **Unit: 100 million m^3**

	Pipeline	LNG	Total
Exports			
Russia	1874	145	2019
Qatar	201	1034	1235
Norway	1011	53	1064
Canada	746	-	746
Algeria	235	173	498
Malaysia	127	339	466
Netherlands	441	-	441
US	423	4	427
Turkmenistan	416	-	416
Australia	-	316	316
Indonesia	95	217	312
World	6639	3333	9972
Imports			
Japan	-	1206	1206
Germany	850	-	850
US	746	17	763
China	313	271	584
Italy	469	45	514
South Korea	-	511	511
Turkey	411	73	484
Britain	329	113	442
France	274	71	345
Spain	154	155	309
Belgium	268	29	297
Russia	242	-	242
Canada	218	6	224
Ukraine	175	-	175
World	6639	3333	9972

Source: BP Statistical Review of World Energy, June 2015.

Table 107 China trade in main energy-intensive products

	2000	2005	2010	2011	2012	2013	2014
Imports							
Steel products (10,000 t)	1596	2582	1643	1558	1366	1408	1443
Copper and copper alloy (10,000 t)	81	142	338	329	398	384	422
Aluminum and aluminum alloy (10,000 t)	91	64	36	33	64	48	35
Fertilizer (10,000 t)	1189	1397	718	795	843	793	959
Paper pulp (10,000 t)	335	759	1137	1445	1646	1685	1796
Synthetic fibric for textile (10,000 t)	100	84	37	35	33	38	34
Exports							
Cement (10,000 t)	605	2216	1616	1061	1200	1454	1391
Sheet glass (10,000 m^2)	5592	19925	17398	18726	17632	19506	21896
Steel products (10,000 t)	621	2052	4256	4888	5573	6233	9378
Copper products (10,000 t)	14	46	51	50	49	49	51
Aluminum products (10,000 t)	13	71	218	300	283	307	367
Zinc and zinc products (10,000 t)	59	15	4	5	0.8	0.5	13.3
Paper and cardboard (10,000 t)	65	167	380	450	471	565	630

VIII. Energy Prices and Taxes

Table 108 China energy price indices (year-on-year)

	Coal and coal products retail price	Petroleum and petroleum products retail price	Fuel retail price	Purchase price of enterprises' electricity fuel	Factory price			
					Coal	Petroleum and natural gas	Electricity	Fuel gas
2000			117.7	115.4	98.1	144.3	102.4	
2001			102.4	100.2	106.5	99.1	102.3	
2002			102.0	100.1	111.6	95.2	100.8	
2003	102.2	111.2	109.3	107.4	103.8	119.1	100.9	
2004	119.2	110.6	112.4	109.7	116.8	119.6	102.4	
2005	121.5	113.6	115.4	115.0	123.2	129.9	104.2	104.0
2006	107.2	113.6	112.4	111.9	105.0	122.0	102.8	106.8
2007	104.9	104.1	104.2	104.3	103.8	102.0	102.2	104.8
2008	127.0	113.4	116.0	120.6	128.7	122.1	101.9	105.9
2009	106.8	89.1	92.7	89.2	101.9	66.0	102.4	100.5
2010	107.0	113.9	112.3	116.3	110.0	137.8	102.0	105.4
2011	110.4	111.3	111.1	110.8	110.2	124.5	101.6	109.4
2012	101.7	103.2	102.9	100.9	97.0	99.6	103.7	102.0
2013	98.5	100.2	99.9	96.6	88.7	96.5	100.2	102.1
2014	97.0	99.6	99.2	97.1	89.0	96.8	100.2	103.5

Source: National Bureau of Statistics.

Table 109 Crude oil spot price on international markets **Unit: USD/barrel**

Year	Dubai	Brent	Nigeria Forcados	West Texas Intermediate Crude Oil
1991	16.63	20.00	20.11	21.54
1992	17.16	19.32	19.61	20.57
1993	14.95	16.97	17.41	18.45
1994	14.74	15.82	16.25	17.21
1995	16.10	17.02	17.26	18.42
1996	18.52	20.67	21.16	22.16
1997	18.23	19.09	19.33	20.61
1998	12.21	12.72	12.62	14.39
1999	17.25	17.97	18.00	19.31
2000	26.20	28.50	28.42	30.37
2001	22.81	24.44	24.23	25.93
2002	23.74	25.02	25.04	26.16
2003	26.78	28.83	28.66	31.07
2004	33.64	38.27	38.13	41.49
2005	49.35	54.52	55.69	56.59
2006	61.50	65.14	67.07	66.02
2007	68.19	72.39	74.48	72.20
2008	94.34	97.26	101.43	100.06
2009	61.39	61.67	63.35	61.92
2010	78.06	79.50	81.05	79.45
2011	106.18	111.26	113.65	95.04
2012	109.08	111.67	114.21	94.13
2013	105.47	108.66	111.95	97.99
2014	97.07	98.95	101.35	93.28

Source: BP Statistical Review of World Energy, June 2015.

Table 110 Gasoline retail price (March 25, 2015) **Unit: RMB/liter**

Venezuela	0.12	Indonesia	4.41	France	9.56
Libya	0.75	Canada	5.84	Britain	10.37
Saudi Arabia	0.99	China	6.06	Norway	11.49
Turkmenistan	1.37	Australia	6.08	Italy	11.55
Kuwait	1.49	India	6.30	Netherlands	11.55
Iran	1.61	Japan	7.20		
Malaysia	3.35	South Korea	8.82		
Russia	3.54	Germany	9.38		
US	3.97				

Table 111 China urban gasoline retail price **Unit: RMB/t**

	January 2010	June 2010	February 2011	March 2012	May 2013	February 2014	May 2015
Beijing	8612	8893	9280	10380	9420	9735	8237
Shenyang	8326	8422	8835	9935	8975	9530	8448
Shanghai	8777	8872	9260	10360	9400	9715	8170
Wuhan	8353	8448	8860	9960	9000	9555	7920
Guangzhou	8655	8507	8915	10015	9055	9610	8197
Chengdu	8560	8655	9035	10135	9195	9150	8250
Xi'an	8327	8406	8820	9920	8960	9515	8170

Note: Gasoline refers to 90# gasoline that meets China's national standards (Beijing, Shanghai and Guangzhou implement local standards).

Table 112 Natural gas prices on international markets (CIF) **Unit: USD /million BTU (CIF)**

Year	LNG, Japan	Natural gas			Crude oil, OECD average CIF
		Germany imports	US imports	Canada imports	
1990	3.64	2.78	1.64	1.05	3.82
1995	3.46	23.9	1.69	0.89	2.96
2000	4.72	2.89	4.23	3.75	4.83
2001	4.64	3.66	4.07	3.61	4.08
2002	4.27	3.23	3.33	2.57	4.17
2003	4.77	4.06	5.63	4.83	4.89
2004	5.18	4.32	5.85	5.03	6.27
2005	6.05	5.88	8.80	7.26	8.74
2006	7.14	7.85	6.76	5.83	10.66
2007	7.73	8.03	6.95	6.17	11.95
2008	12.55	11.56	8.85	7.99	16.76
2009	9.06	8.52	3.89	3.38	10.41
2010	10.91	8.01	4.39	3.69	13.47
2011	14.73	10.48	4.01	3.47	18.56
2012	16.75	11.93	2.76	2.27	18.82
2013	16.17	10.73	3.71	2.93	18.25
2014	16.33	9.11	4.35	3.87	16.80

Note: 1 million BTU=28 m^3 of natural gas.
Source: BP Statistical Review of World Energy, June 2015.

Table 113 End-user natural gas price in selected countries **Unit: USD /toe**

	2005	2010	2011	2012	2013	2014
US						
Industry	361.3	230.4	218.2	165.8	198.8	232.7
Electricity generation	362.1	223.8	208.5	150.7	190.7	224.5
Residential use	546.8	477.5	470.6	456.4	440.0	536.0
Canada						
Industry	323.4	177.9	199.2	153.8	177.3	203.7*
Electricity generation	248.1	227.2	205.2	168.8	207.4	—
Residential use	467.7	478.6	479.6	444.0	436.9	646.6*
Britain						
Industry	332.0	365.3	459.2	496.8	541.3	517.6
Electricity generation	238.4	291.6	396.5	437.3	464.5	350.6*
Residential use	502.3	731.3	870.3	932.6	977.4	1078.1
Germany						
Industry	—	666.9	753.9	832.0	747.0	—
Residential use	—	1069.7	1276.2	1272.7	1147.5	—
France						
Industry	366.9	538.3	665.7	660.8	669.8	635.2
Residential use	656.1	960.3	1121.2	1082.4	1158.3	1155.8
Japan						
Industry	446.1	705.2	909.6	995.1	931.0	—
Residential use	1384.0	1836.8	2140.1	2192.1	1887.9	—
South Korea						
Industry	435.9	678.1	776.7	837.2	1016.7	—
Residential use	586.5	728.3	840.4	894.0	979.5	—
OECD average						
Industry	362.1	358.5	382.4	360.9	394.1	320.2*
Residential use	639.1	757.1	766.8	797.4	800.8	821.0

Note: 1. 1 toe=1111 m^3 natural gas.
2. *Q1-3, 2014.
Sources: IEA, Prices and Taxes. The translation is published in *International Petroleum Economics*, 2015, No.6.

Table 114 China urban natural gas prices for residential use (May 2014) **Unit: RMB/m^3**

Beijing	2.28
Hohhot	1.20
Shenyang	3.30
Daqing	1.65
Shanghai	2.50
Fuzhou	3.65
Xiamen	4.00
Wuhan	2.53
Guangzhou	3.45
Chengdu	1.89
Chongqing	1.72
Xining	1.10
Xi'an	1.98
Lanzhou	1.70
Urumchi	1.37

Table 115 Global coal prices **Unit: USD/t**

Year	Northwestern Europe market price	Japan coking coal import CIF price	Japan steam coal import CIF price
1990	43.48	60.54	50.81
1995	44.50	54.47	47.58
1996	41.25	56.68	49.54
1997	38.92	55.51	45.53
1998	32.00	50.76	40.51
1999	28.79	42.83	35.74
2000	35.98	39.69	34.58
2001	39.03	41.33	37.96
2002	31.65	42.01	36.90
2003	43.60	41.57	34.74
2004	72.08	60.96	51.34
2005	60.54	89.33	62.91
2006	64.11	93.46	63.04
2007	88.79	88.24	69.86
2008	147.67	179.03	122.81
2009	70.66	167.82	110.11
2010	92.50	158.95	105.19
2011	121.52	229.12	136.21
2012	92.50	191.46	133.61
2013	81.69	140.45	111.16
2014	75.38	114.41	97.65

Source: BP Statistical Review of World Energy, June 2015.

Table 116 China key state-owned mines ex-mine price **Unit: Chinese yuan/t**

Year	Average selling price of commercial coal
1997	166.34
1998	160.20
1999	142.74
2000	140.19
2001	150.99
2002	167.39
2003	175.66
2004	206.43
2005	291.06
2006	301.55
2007	330.08
2008	463.12
2009	418.0
2010	441.0
2011	467.5
2012	459.5
2013	450.8
2014	401.2

Sources: China National Coal Association; National Bureau of Statistics.

Table 117 China coal price along route (5500kcal/kg steam coal) **Unit: Chinese yuan/t**

	July 2011	end 2012	June 2014
Ex-mine price, Datong, Shanxi	520	500	370
Settlement price, Qinhuangdao Port and Datong	840	635	525
Market price, Guangzhou Port	980	710	592
Market price, coal imports, Guangzhou Port	935	680	585

Notes: 1. Ex-mine price includes tax.
2. Coal import data in 2011 was from Indonesia; data in 2012 and 2014 was from Australia.

Table 118 End-user electricity price in selected countries (2013) **Unit: US censt/kWh**

	Industrial	Residential
US	6.8	12.1
Japan	17.4	24.2
Germany	16.9	38.8
France	12.6	19.1
Britain	14.0	23.0
Italy	32.2	30.6
Canada	8.8*	10.5*
Sweden	9.0	23.4

Note: * data is from 2012.
Source: IEA, Energy Prices and Taxes.

IX. Energy Science and Technology

Table 119 China R&D expenditure in energy and energy-intensive industries

Unit: 100 million Chinese yuan

	2010	2011	2012	2013	2014
Industry total	4015.4	5993.8	7200.6	8318.4	9254.3
Coal mining and washing	108.7	145.1	157.9	156.6	151.5
Petroleum and natural gas exploitation	88.1	82.1	86.2	80.7	84.4
Petroleum processing, coking and nuclear fuel processing	43.8	62.5	81.6	89.3	106.6
Production and supply of electric power and heating	31.9	42.8	46.8	58.4	61.9
Steel	402.1	512.6	627.8	633.0	642.0
Non-ferrous metals	118.9	190.2	271.2	301.1	330.6
Building materials	81.3	139.7	163.6	215.0	246.5
Chemical products	247.5	469.9	553.6	660.4	746.5
Chemical fibers	41.0	58.8	63.4	66.8	75.0
Food, beverages and tobacco	98.8	147.5	186.7	203.4	232.4
Textile and apparel	101.2	165.0	193.6	227.8	251.9
Paper and paper products	36.7	55.9	75.8	87.8	91.4
Transportaiton equipment	582.2	785.3	913.4	1052.3	1213.3
Electrical machinery and apparatus	425.1	624.0	704.2	815.4	922.9
Communications equipment, computers and other electronic equipment	686.3	941.1	1064.7	1252.5	1392.5
General and special machinery manufacture	472.2	772.3	899.5	1060.2	1161.5

Note: 2010 data was from large- and medium-sized enterprises; 2011-2014 data was from enterprises above designated size (that is with annual income of 20 million Chinese yuan and above).
Source: National Bureau of Statistics.

Table 120 US Department of Energy R&D funding **Unit: USD million**

	Appropriation in 2014	Application in 2015
Energy projects		
Energy efficiency and renewable energy	1900.6	2316.7
Electricity delivery and energy reliability	147.2	180.0
Nuclear energy	888.4	863.4
Fossil fuel energy		
Clean coal technology	0	-6.6
Fossil fuel energy R&D	561.9	475.5
Naval petroleum and oil shale reserves	20.0	20.0
Strategic petroleum reserves	189.4	205.0
Northeast home heating oil reserves	8.0	1.6
Total	779.3	711.0
Uranium enrichment research and demonstration fund	598.6	531.0
Energy Information Administration	117.0	122.5
Non-defense environmental cleanup	231.7	226.2
Science	5066.4	5111.2
Advanced Research Projects Agency-Energy	280.0	325.0
Departmental Administration	126.4	129.1
Inspector General	42.1	39.9
Innovative technology loan guarantee program	20.0	7.0
Advanced technology vehicles manufacturing loan program	6.0	4.0
Total	10203.8	10582.9

Notes: Science projects includes funding for basic science, high energy physics, biological and environmental research, nuclear physics, supercomputers, fusion energy, and others. In 2013, these seven areas were allocated funds of USD1.657 billion, USD777 million, USD625 million, USD527 million, USD456 million, USD498 million and USD410 million respectively; a total of USD 4.992 billion.
Source: US Department of Energy, Budget by Appropriation 2015.

Table 121 China energy technology more advanced than US

China has seven energy technologies that are more advanced than in the US. They are: ultra-high voltage power transmission, high speed rail, ultra supercritical thermal power generation, nuclear power, new energy vehicles, renewable energy and supercomputers (Steven Chu, former secretary of energy with the US Department of Energy, December 2010)

Ultra-high transmission line: In 2009 China completed a 639km long 1,000 kV ultra-high AC transmission line from Shanxi-Jingzhou. Since then, China has completed three ±800 kV ultra-high DC transmission pilot projects: Fulong Sichuan-Shanghai, Yunnan-Guangdong, and Jinping-Suzhou. On July 5, 2014, the Yibin-Jinhua ±800 kV ultra-high DC transmission project was put into operation, with 8 GW transmission capacity and a

length of 1,653 km. These four ultra-high DC transmission lines have a transmission capacity of 26.96 GW and a total length of 7,119 km. On June 30, 2015, China launched the 2,383 km ±800 kV ultra-high DC 8 GW transmission capacity project between Jiuquan and Hunan.

High speed rail: By October 2015, China had built 17,000 km of high speed rail, accounting for 55% of the world total. Some 9,600 km of this rail can support trains at speeds above 300 km/h (60% of the world total). In 2014, China launched the CRH-380 series electric high speed train, with a top speed of 380 km/h, the fastest in the world.

Ultra supercritical thermal power generation: By 2014, China had 68 ultra supercritical units with a million kW in operation, more than the sum of all other countries. The average coal consumption at the Shanghai Waigaoqiao No.3 Power Generation Company's unit is 279.39 gce/kWh, with 44% net efficiency.

Nuclear power: By the end of 2014, China had 22 nuclear power plants in commercial operation with a gross installed capacity of 20.31 GW. There were another 27 reactors under construction with a gross installed capacity of 29.53 GW. In 2015, eight new reactors will be added, with a gross installed capacity of 6.62 GW. Based on foreign technology, China designed the CAP-1400 (1400MW) pressurized water reactor unit and started its construction in Rongcheng, Shandong in 2013.

Renewable energy: In 2014, China used 479.4 Mtce of renewable energy, up 4.6 times from 2000. Renewable energy in China includes: hydropower generation at 1064.3 TWh; photovoltaic power generation at 25.0 TWh; wind power generation at 200.3 TWh; biomass and waste power generation at 40.2 TWh; 414 million m^2 (48.1 Mtce) of solar water heaters, geothermy (ground source heat pump and geothermal heating) 17.6 Mtce; and rural biogas of 16 billion m^3 (11.4 Mtce). Wind power installed capacity in 2014 was 94 times that of 2005 and photovoltaic power generation installed capacity in 2014 was 401 times higher than that in 2005. Newly-added renewable energy installed capacity passed newly-added fossil fuel installed capacity in 2013 for the first time. That year, newly-added renewable energy installed capacity was 63.87 million kW, or 62.3% of the total.

Supercomputers: China's Tianhe-2 supercomputer has a peak computation speed of 54.9 petaflops and a continuous computation speed of 33.9 petaflops. On the Top 500 list of most powerful computers, from July 13, 2015, Tianhe-2 has won for five successive years.

Table 122 China clean coal technology

Coal preparation	Raw coal preparation rate in 2014 was 62.5% and 242 Mt raw coal was washed.
Briquette coal	Annual production and sales for residential use was more than 40 Mt.
Coal water slurry	Capacity in 2014 was 130 Mt, of which 30 Mt was for fuel and 100 Mt was for gasification material.
Ultra supercritical thermal power units	In 2014, China had 68 1,000 MW ultra supercritical power units in operation.
Circulating fluidized bed boilers	In 2014, there were 3,000 boilers with a total capacity of 100 GW. Among them, 65 had a capacity of 300 MW and 600 MW supercritical CFBC have been built.
Integrated gasification combined-cycle, IGCC	A 250 MW demonstration plant went into operation in Tianjin in 2012.
Power plant air pollution reduction	By 2014, China had built 755 GW fuel gas desulphurization systems, which accounted for 91.5% of coal power installed capacity. China had also built 660 GW denitration systems, accounting for 80% of coal power installed capacity.
Coal chemical industry	In 2014, China used coal to manufacture 970 million m^3 of synthetic natural gas; 24.31 Mt of methanol; 2.37 Mt of olefin, and 1.2 Mt of oil.

Sources: China Coal Processing & Utilization Association; Coal Industry Clean Coal Engineering Technology Research Center; China Electricity Council; China Petroleum and Chemical Industry Federation.

Table 123 China energy-intensive industry energy-saving technologies

	2000	2010	2011	2012	2013	2014	Energy-saving technology
Coal							
Raw coal washing rate (%)	24.3	50.9	52.0	56.0	60.0	62.5	Washing reduces coal consumption by 10%. In 2014, emissions of SO_2 were cut by 11.1 Mt and CO_2 by 476 Mt.
10-million-ton coal mine	1	35	39	43	50	53	The production efficiency of a 10-million-ton mine is now on a par with the global leading countries.
Electricitiy generation industry							
Proportion of 300 MW and above 300 MW units in thermal power installed capacity (%)	42.7	72.7	72.9	73.6	76.3	77.7	100 MW plants consumed 380−500 gce/kWh while 300 MW and above consumed 290−340 gce/kWh.
Million kw ultra-supercritical units	0	33	39	59	63	70	
Steel							
Pulverized coal injection in blast furnace (kg/t)	118	149	148	150	149	146	Coal injection reduces energy consumption by 90 kgce/t.
Continuous casting ratio	82.5	99.47	99.50	99.55	99.63	99.71	Processing 1 t steel billet saves 200 kgce in energy.
Penetration rate of coke dry quenching (%)	6	80	85	90	90		Processing 1Mt red coke saves 100,000 tce in energy.
Penetration rate of TRT (%)	50	100	100	100	100	100	Power generating capacity per ton of iron was 30kWh.
Electrolytic aluminum							
Proportion of large capacity preroaster in output (%)	52	90	95	95	95	95	Large scale prebaked cell over 160kA uses 9% less power than self-baking cell.
Chemical industry							
Proportion of caustic soda production by ion exchange membrane (%)	24.9	76.0	81.1	85.1	87.1	87.6	Ion exchange membranes saved 123 kWh more for per ton of caustic soda compared with diaphragms.
Petrochemical industry							
10-million-ton refinery number	4	20	20	21	22	25	Energy consumption per ton was 22% lower than the industry average
Proportion of new dry technique for cement production in cement output (%)	12	80	89	92	93	93	Heat consumption of large-scale new dry process was 40% lower than mechanical shaft kiln
Bulk cement rate (%)	28	48.1	51.8	54.2	55.9	57.6	Compared with bagged cement, 100 million t unbagged cement saved 3.3 million m^3 in wood, avoiding the 4.5% rate of bag damage, or 2.37 million tce.
Proportion of floating shaping output in sheet glass output (%)	57	85	89	90	90	93	Comprehensive energy consumption in the float process is 16% lower thanthe Fourcault process
Proportion of new-type wall materials in wall materials output (%)	28	55	61	63	63		Energy consumption in manufacturing new-type wall materials is 40% lower than solid clay bricks.

Note: Penetration rate of coke dry quenching is the proportion of coke dry quenching processing capacity in total

coke output; TRT popularizing rate is the proportion of blast furnaces above 1,000 m^3 that have installed TRT.
Sources: China Coal Processing & Utilization Association; China Electricity Council; China Iron and Steel Industry Association; China Non-ferrous Metals Industry Association; China Building Materials Industry Association; China Building Glass and Industrial Glass Association.

Table 124 China, US coal industry major indicators (2014)

	China	US
Raw coal production (Mt)	3874	1154
Coal exports (Mt)	5.74	143.71
Coal imports (Mt)	291.22	11.31
Coal consumption (Mt)	4121	831.6
Percentage of coal used in power generation (%)	46	93
Percentage of production in strip mines (%)	12.0	65.3
Average mine exploitation depth (m)	456	90
Average ex-mine coal price (USD/t)	72.8*	44.4*
Coal mines in operation	11000	1061*
Coal industry employees (10,000 people)	611	11.55
Raw coal production efficiency	5.80t/miner*	5.87t/h
Coal miners average wage	9527USD/year*	82058USD/year
Death toll from mining accidents	931	16
Death rate from mining accidents (person/Mt)	0.24	0.015

Note: 1. The percentage of commercial coal from raw coal was 86% in the US.
2. Average mine exploitation depth in China is from large- and medium-sized mines.
3. Average ex-mine price and raw coal production efficiency in China is from key state-owned coal mines.
4. Power generation data from China includes coal used for heating.
5. In 2014, the average USD:RMB exchange rate was 1:6.1428.
6. *is for 2013.
Sources: National Bureau of Statistics; China National Coal Association; DOE/EIA; National Mining Association.

X. Energy and Environment

Table 125 China principal pollutant emissions

Year	SO2(Mt)	NOx (Mt)	Smoke dust (Mt)	Industrial dust (Mt)	Waste water (100 million m^3)	Chemical oxygen demand(COD) (Mt)
1995	23.70		17.44	17.31	415.3	
2000	19.95		11.65	10.92	415.2	14.45
2001	19.48		10.70	9.91	432.9	14.05
2002	19.27		10.13	9.41	439.5	13.67
2003	21.59		10.48	10.21	460.0	13.34
2004	22.55		10.95	9.05	482.4	13.39
2005	25.49		11.82	9.11	523.0	14.14
2006	25.89	15.24	10.89	8.08	536.8	14.28
2007	24.68	16.40	9.87	6.99	556.8	13.82
2008	23.21	16.25	9.02	5.85	572.0	13.21
2009	22.14	16.93	8.47	5.24	589.2	12.78
2010	21.85	18.52	8.29	4.49	617.3	12.38
2011	22.18	24.04		12.97	659.2	25.00
2012	21.18	23.38		12.36	684.6	24.24
2013	20.44	22.27		12.78	695.4	23.53
2014	19.74	20.78		17.41	716.2	22.95

Note: In 2011, China changed the way it measured indicators such as chemical oxygen demand, thus post 2011 data cannot be compared with data collected before 2011.
Source: Ministry of Environmental Protection.

Table 126 China coal production environmental damage (2014)

Coal gangue: In 2014, output was about 780 Mt, with approximately 4200 Mt stockpiled in the country, occupying 12,000 hectares of land. Installed capacity passed 30 GW by using 40 Mtce of washed coal gangue and coal slurry. More than 100 billion standard bricks were made using coal gangue. In 2014, 7.2 billion m^3 of wastewater was discharged from coal mines, with a utilization rate of 67.5%.

Ground subsidence: By 2014, coal mining-related ground subsidence had reached 1.4 million hectares. The land reclamation rate in 2014 was 62%.

Methane emissions: In 2014, about 36 billion m^3 of methane was emitted from coal mining activities. Of this, gas drainage was 17 billion m^3 and exploitation was 7.7 billion m^3.

Sources: China National Coal Association; China Coal Processing & Utilization Association; National Energy Administration.

Table 127 China limits on sulfur in gasoline and diesel **Unit: ppm**

	National I standard	National II standard	National III standard	National IV standard	National V standard
Gasoline					
Threshold value	800	500	150	50	10
Time of implementation	2000	2005	2010	2014	2018
Diesel					
Threshold value	2000	500	350	50	10
Time of implementation	2000	2003	2013	2015	2018

Notes 1. The deadline for reaching national V standard was brought forward to January 1, 2017.

2. The 15 ppm for gasoline standard was introduced in 2010 in the US; in Japan a 10 ppm standard was introduced in 2006 and the EU's 10 ppm standard was set in 2010.

Source: Current status of Chinese gasoline and diesel standards and challenges in improving oil quality by Gong Huiming, *International Petroleum Economics*, 2013, No.5, 53-57.

Table 128 China thermal power plant emission standards, GB 13223-2011

Air pollution emission concentration limits (mg/m3)

	Smoke dust	SO_2	NO_x	Mercury and its compounds
2004 standard	50	400	450	—
2015 standard	30	Existing boiler 200 New boiler 100	100	0.03
EU 2001 standard	20	184	135	
USA 2005 standard	30	200	200	

Thermal power plants in operation before 2012 in China adopted the new standard from July 1, 2014. The new standard is expected to cut SO_2 emissions by 6.18 Mt and NO_x emissions by 5.8 Mt by 2015 annually.

Table 129 China boiler emission standards, GB 13221-2014

Air pollution emission concentration limits (mg/m3)

	Particulate matter (PM)	SO_2	NO_x	Mercury and its compounds
Coal-fired boiler				
In-use	80	400	400	0.05
New	50	300	300	0.05
Oil-burning boiler				
In-use	60	300	400	
New	30	200	250	
Gas-fired boiler				
In-use	30	100	400	
New	20	50	200	

Boilers in operation before July 1, 2014 adopted these standards. From October 1, 2015, steam boilers with steam capacity above 10 t/h and hot-water boilers above 7 MW adopted these standards; from July 1, 2016, steam boilers with steam capacity below 10 t/h and hot-water boilers below 7 MW adopted these standards.

Because of these standards, 80% of coal-fired industrial boilers are likely to either be shut down or upgraded. It is estimated that RMB321-407 billion Chinese yuan will be needed to upgrade these industrial boilers. Once these standards have been met, it will cut emissions of particulates by 660,000 t PM and 3.14 Mt of SO_2.

Table 130 China cement industry emission standards, GB 4915-2013

Standards were first issued in 1985, and amended in 1996, 2004 and 2013.
Emission standard of air pollutants for cement industry, GB 4915-2013. *Standard for pollution control on co-processing of solid wastes in cement kiln*, GB 30485-2013.

In 2012, PM emissions from the cement industry made up 15%-20% of total PM emissions, NO_x accounted for 8%-10% of total emissions and SO_2 accounted for 3%-4% of total emissions.

Air pollution emission concentration limits (mg/m^3)

	PM	SO_2	NO_x (here, NO_2)	Fluoride (by perfluoro volume)	Mercury and its compounds	Ammonia
Cement kiln and other ventilation equipment	30	200	400	5	0.05	10*
	（20）	（100）	（320）	（3）	（0.05）	（8）*
Dryer, drying and grinding mill, coal grinding mill and clinker cooler	30	600**	400**	—	—	—
	（20）	（400）**	（300）**	—	—	—
Crusher, mill, packing machine, and other ventilation equipment	20	—	—	—	—	—
	（10）	—	—	—	—	—

Note: Bracketed data refers to special limits set for enterprises in key regions. Deadlines and area were set by the State Council administrative department in charge of environmental protection or the provincial government.

* These limits allow for using ammonium hydroxide, urea, etc. as a reducing agent so as to prevent nitric oxide emissions.

**These limits allowed using an independent heat source with drying equipment.

In 2013, PM emissions limits were reduced to 30 mg/m^3 for thermal equipment such as cement kilns (from 50 mg/m^3) and 20 mg/m^3 for ventilation equipment such as cement grinding mills (from 30 mg/m^3). In 2004, NO_x emissions limits were reduced to 400 mg/m^3 from 800 mg/m^3. There had been no limits to ammonia and mercury emissions earlier.

Standard for pollution control on co-processing of solid wastes in cement kiln, controls hydrogen chloride, hydrogen fluoride, heavy metal and dioxin emissions.

New enterprises adopted these standards from March 1, 2014 and existing enterprises adopted them from July 1, 2015.

The implementation of these new standards meant that the environmentally-friendly investment rate for dust extraction and denitration for cement enterprises has reached 10%-12%; operational costs for environmental protection facilities rose by 12%-15% /t for cement compared with before the standards were adopted.

Table 131 Global CO2 emissions

	Emissions (Mt-CO_2)						Percentage from coal-fired factilities in 2014 (%)	Per capita emissions in 2014 (t-CO_2)
	2000	2010	2011	2012	2013	2014		
China	4723	8138	9042	9240	9517	9347	79.1	6.83
US	6077	6129	6018	5788	5933	6079	29.5	18.77
India	1048	1683	1798	1824	1931	2202	64.8	1.72
Russia	1612	1629	1676	1705	1715	1658	20.4	11.54
Japan	1321	1314	1307	1410	1398	1343	37.3	10.53
Germany	888	834	802	815	810	799	38.4	9.70
South Korea	500	717	738	764	768	769	43.7	15.84
Saudi Arabia	567	611	625	620	632	621	13.5	18.53
Iran	349	563	601	616	617	665	0	23.19
Canada	390	585	597	609	631	651	0.7	9.79
World	25193	33420	34380	35041	35317	35309	44.6	4.85

Note: 1. China's fossil fuel consumption is from the National Bureau of Statistics, other countries' data are from BP.

2. China's CO_2 emission coefficient for coal is 2.71t-CO_2/tce (3.87t-CO_2/toe), petroleum is 2.13t-CO_2/tce (3.04t-CO_2/toe), and natural gas is 1.65t-CO_2/tce (2.36t-CO_2/toe) in China. Foreign countries and the world emission coefficient is from the International Energy Agency (IEA): coal is 3.96t-CO_2/toe, petroleum 3.07t-CO_2/toe and natural gas 2.35t-CO_2/toe.

3. The International Energy Agency does not include CO_2 emissions from fossil fuel from non-energy generation sources. As such, global CO_2 emissions in 2014 were 32.3 billion t.

Table 132 US CO2 emissions **Unit: Mt-CO_2**

	2012	2013
Residential	1044	1105
Commercial	933	968
Industrial	1476	1486
Transportation	1819	1845
Total	5272	5405
Electricity generation	2035	2053
Including:		
Petroleum	2240	2272
Natural gas	1363	1399
Coal	1657	1722
Others	12	12

Note: 1. CO_2 emission in electricity generation is shared by each end-user sector of electricity.
2. Oil used in transportation includes an annual 90-126 Mt of international bunker fuel (civilian and military use).
3. Natural gas used in transportation includes pipeline fuel gas, automobile gas, train gas and bunker gas.
4. Electricity includes power plants and combined heat and power generation.
5. Others include CO_2 emissions from geothermy and urban waste.

Source: DOE/EIA, Annual Energy Outlook 2015.

Table 133 Japan CO2 emissions **Unit: Mt-CO_2**

	2000	2010	2011	2012	2013
Electricity generation	389.2	462.2	526.6	571.8	579.1
Self-use	49.6	70.6	60.8	64.9	72.5
End-user energy consumption	730.9	604.5	585.0	576.6	583.8
Industry	340.8	260.5	224.7	246.1	256.7
Transportation	251.9	230.7	226.0	222.6	222.4
Residential use	74.3	69.2	67.9	65.8	63.5
Commercial use	63.9	44.2	66.4	42.1	41.2
Total	1169.7	1137.3	1172.3	1213.4	1235.4

Note: CO_2 emissions are from burning fossil fuels.

Source: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2014.

Table 134 China energy, electricity air pollution and CO2 emission coefficient (2014)

Air pollution	
Energy (kg/tce)	
SO_2	
Total consumption of primary energy	4.63
Fossil fuel energy consumption	5.22
NO_x	
Total consumption of primary energy	4.88
Fossil fuel energy consumption	5.49
Smoke dust and industrial dust	
Total consumption of primary energy	4.09
Fossil fuel energy consumption	4.60
Electricity (g/kWh)	
SO_2	
Total electricity generation	1.10
Thermal power	1.46
NO_x	
Total energy generation	1.10
Thermal power	1.46
Smoke dust	
Total energy generation	0.17
Thermal power	0.23
CO_2	
Energy (t-CO_2/tce)	
Coal	2.71
Petroleum	2.13
Natural gas	1.65
Primary energy consumption	2.19
Fossil fuel energy	2.47
Electricity (g-CO_2/kWh)	
Total energy generation	556
Thermal power	741

Note: * Data is from 2013.

Sources: National Bureau of Statistics; Ministry of Environmental Protection; Energy Research Institute of the National Development and Reform Commission; China Electricity Council; the First National General Survey Bulletin for Pollution Sources, the Ministry of Agriculture, February 6, 2010.

Table 135 China energy end-user CO2 emission coefficient

End-user	CO_2 emission coefficient
Coal	2.71 t- CO_2/tce
Coke	3.14 t- CO_2/tce
Coke oven gas	2.41 t- CO_2/tce
Blast furnace gas	5.81 t- CO_2/tce
Converter gas	8.43 t- CO_2/tce
Petroleum products	2.07 t- CO_2/tce
Natural gas	1.65 t- CO_2/tce
Heating power	2.62 t- CO_2/tce
Electricity (2014)	
Thermal power	0.741 kg- CO_2/kWh
Total electricity consumption	0.556 kg- CO_2/kWh

Table 136 Global fossil fuel energy CO2 emission coefficient

	t-CO_2/toe	t-C/toe		t-CO_2/toe	t-C/toe
Coal	3.96	1.080	Crude diesel	3.10	0.846
Crude oil	3.07	0.837	Fuel oil	3.24	0.883
Gasoline	2.90	0.791	LPG	2.64	0.720
Naphtha	3.07	0.837	Other petroleum products	3.07	0.837
Jet fuel	2.99	0.816	Natural gas	2.35	0.641
Kerosene	3.01	0.821			

Sources: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2014.

Table 137 Japan CO2 fossil fuel energy emission coefficient (2013) **Unit: t-CO_2/toe**

Coal	
Imported coking coal	3.7651
Imported steam coal	3.7482
Domestic steam coal	3.6438
Imported anthracite	3.9784
Coal products	
Coke	4.6384
Coal tar	3.2079
Briquette coal	3.9784
Coke oven gas	1.6776
Blast furnace gas	4.0113
Converter gas, electric furnace gas	6.4035
Crude oil	
Crude oil	2.9209
Natural gas liquid	2.8073
Petroleum products	
Naphtha	2.8672
Gasoline	2.8810
Jet fuel	2.8549
Kerosene	2.8718
Crude diesel	2.8840
Fuel oil A	2.9654
Fuel oil B	3.0959
Lubricating oil	3.0744
Other heavy oils	3.1358
Petroleum coke	3.7605
Refinery gas	2.2164
LPG	2.5141
Natural gas	
Imported LNG	2.1028
Domestic natural gas	2.1442
Urban gas	2.1181

Sources: The Institute of Energy Economics, Japan, Handbook of Energy and Economic Statistics, 2015.

1. Intelligent coal mining

Intelligent coal mining uses Information and Communications Technologies to monitor and remote control the main production processes and equipment used in coalmines. The first intelligent coal mining pilot, the Shaanxi Huangling Mining (Group) Co., Ltd's No.1 mine, was opened in 2014, and is considered a breakthrough in coal mining technology. By May 2015, this mine had produced 1.9 million t of coal, saving more than RMB5 million in labor costs and resulting in a zero-death rate. A number of intelligent coal mining tech solutions have been developed for many kinds of geological environments. They are currently being applied in 15 mining areas in China and involve a number of companies, including Shenhua Group, Shaanxi Coal and Chemical Industry Group, Jizhong Energy Group and Yangquan Coal Industry Group.

2. Coal mining circular economy parks

Coal mining circular economy parks are industrial parks that employ circular economy principles and are based on coal mining. They use a variety of set-ups, such as coal - electricity - building materials; coal - electricity - chemicals - building materials; coal - coke - chemicals; coal - oil (coal liquefaction) - chemicals; coal - electricity – aluminum; and coal - electricity - silicon (polysilicon production). The mines make use of environmentally-friendly technologies, resources recycling, harmless waste treatment, mine gas drainage and utilization, evacuation and recycling of combustible gas and toxic or harmful gases, and land reclamation of areas suffering land subsidence. Some coal mines have been able to stop the practice of dumping of coal gangue, mine water and wastewater emissions. At the Wutongzhuang mine in Fengfeng Mining District, which produces an annual 4 million t of coal, all gangue is used to fill the gob area while the mine water is injected into a rock layer after being treated; mine water (19 ℃) and return air with afterheat produce the same energy as five heating boilers and 2,080 air conditioners.

The Tashan Circular Economy Park with two coal mines in Datong, Shanxi employs low-carbon technologies. The mines have an annual output capacity of 20Mt and 10Mt; the mining recovery rate is above 90% when extremely thick coal seams are exploited. The washed raw coal is supplied to the air-cooling pithead power plants. The middling is supplied to the power plant (550m^2 central heating supply) and methanol plant (where methanol is made from the gasification of coal). Robots are used to convert gangue into bricks, with an annual output of 240 million standard bricks. Flyash is used as the raw material in the cement plant. All solid waste is utilized. The associated kaolin from the coal seam is processed into 6,250 mesh kaolin powder. Sewage is treated and then recycled so that the park has near zero emissions. China's largest timber forest base has been planted in the mining area and covers 420,000mu (0.0667 hectares). These techniques have tripled park output while raw coal production consumes 0.002tce/t in energy.

3. Coal preparation

Coal preparation removes 50%−70% of ash and 60%−70% of inorganic sulfur from coal. This can improve thermal efficiency so the 10% less coal is needed for coal-fired equipment. Raw coal in developed countries is washed during coal preparation. China washed 2.42 billion t of raw coal in 2014, or 62.5% of all coal mined, saving 240 million t in coal consumption and reducing CO_2 emissions by 476 million t. Unit investment and unit cost of coal preparation is only 1/10th that of flue gas desulfurization in power plants.

4. Coal storage and mixture

Large-scale storage, processing, coal blending and transfer facilities are often built at distributing centers along rivers or the coast to blend coal from different coal mines or of various quality into coal that meets specific needs (such as for power generation, coking and export) to improve efficiency and guarantee a stable supply. This can save 5%-8% of coal used in power plants. The annual processing capacity of existing, under construction or planned 10 million-ton plus coal storage and mixture centers exceeds 300 million t, of which five are 50 million-ton centers. The mixture center in Caofeidian has been digitalized. All solid waste is reused at coal blending centers that have coal preparation facilities.

5. Coal water slurry (CWS)

Coal water slurry is a type of oil-substituted fuel made of approximately 70% pulverized coal (250-300μm), about 30% water, and around 1% dispersing agent (to guarantee its mobility) and stabilizer. About 2 t of coal water slurry can replace 1 t of fuel oil. CWS is low-ash (＜8%) and low-sulfur (＜0.5%) and produces 65% less SO_2 and 85% less particulate matter when it is burned compared with raw coal. It burns at lower temperatures (100-200℃ lower) than that of coal and less NO_x is generated. CWS development has picked up speed in China in the past few years. Production capacity reached 130 million t in 2013, 30 million t of which was used as fuel in industrial boilers, kilns and power plants and 100 million t was used as raw material in gasification. Thermal efficiency of CWS in industrial boilers is more than 83%, 10%−20% higher than that of traditional coal-fired industrial boilers, reducing coal consumption by more than 15%. When used as a fuel for kilns during gasification, 10-20% less coal needs to be used.

6. Synthetic gas from coal

Coal can be used to produce synthetic gas with a calorific value equivalent to that of natural gas. Feed coal is smashed and then undergoes pressurized gasification with oxygen as the gasifying agent, to produce a gas with calorific value 11.2−13.0MJ/m^3, the H_2/CO mix is adjusted through conversion after cooling, removing H_2S and CO_2 through purification, followed by methanation and hydrogenation under the action of a catalyst. The calorific value of coal gas is 35−37MJ/m^3.

Its energy conversion efficiency and pollution emissions are improved compared with other conversion technologies. The energy conversion efficiency of synthetic natural gas from coal is 50%-52%; in power generation it is 40%-42%, while for methanol from coal, it is 42%, and for coal to liquid oil it is 32% (indirect liquefaction) and 38% (direct conversion). The water consumption per unit calorific value (t/GJ) of synthetic natural gas from coal is 0.18, coal to liquid 0.38 and methanol from coal is 0.78. It generates much less SO_2, particulate matter and CO from combustion, however, CO_2 emitted during the life cycle is twice that of natural gas, and phenolic wastewater is also discharged during production. Compared with directly burning coal, industrial use ends up using 10%-20% less coal, and domestic use ends up using 20%-30% less coal.

Synthetic natural gas is transported via pipelines and is easy to use. It is widely used in power generation and as an industrial fuel, as a raw material in chemical manufacturing, as a fuel for vehicles, and as a fuel for domestic use. It can supplement conventional natural gas, liquefied natural gas and liquefied petroleum gas supplies. Developing the sector is important for increasing natural gas supply and promoting energy conservation and emissions reduction in China.

The production capacity in China of synthetic natural gas from coal was 3.1 billion m^3 and output was 970 million m^3 in 2014.

7. Tertiary oil recovery

Tertiary oil recovery is a process that injects steam, polymers and other chemical agents, natural gas or carbon dioxide into oil reservoirs to enhance oil recovery. Injecting steam reduces the viscosity of crude oil; injecting polymers improves the mobility ratio of underground oil in water; adding surface-active agents into water decreases the interfacial surface tension of oil and water; injecting natural gas or carbon dioxide dissolves or dilutes crude oil and improves its mobility. The current average recovery rate for the world's oil fields is about 35%, a percentage that can be increased to more than 50% through tertiary oil recovery. China's Daqing oil fields uses tertiary oil recovery by polymer flooding and this has raised crude oil output by more than 10 million t every year since 2002, reaching 14.59 million t in 2014.

8. Coal bed methane mining

Coal bed methane is an unconventional natural gas found in coal seams and is more than 90% methane. It is a potent greenhouse gas (as well as a clean form of energy) and it poses a danger during coal mining because it may explode. The world's total resources of coal bed methane are 260 trillion m^3, of which 36.8 trillion m^3 are in China. This is equivalent to the total resources of onshore conventional natural gas. Coal bed methane is mined underground or at ground level by drilling. It is important to extract coal bed methane to prevent coal mine accidents and also to boost China's clean energy supply to reduce greenhouse gas emissions. The US produced 60 billion m^3 of coal bed methane in 2012. China produced 17 billion m^3 in 2014, 13.3 billion m^3 of which was extracted underground and 3.7 billion m^3 from above ground. Some 7.7 billion m^3 of coal bed methane was used that year.

9. Shale gas mining

Drilling is conducted at a proven gas field and air flow is induced to cause shale gas to spurt out of the mouth of the well from a certain stratum.

Shale gas is an unconventional natural gas found in shale. The world's resources of shale gas is estimated to be 456 trillion m^3. Proven recoverable reserves in the US are 14 trillion m^3. Horizontal drilling and hydraulic fracturing technologies are used to overcome technical obstacles in shale gas mining, increasing output from 11 billion m^3 in 2000 to 272.7 billion m^3 in 2014. China's recoverable resources of shale gas are 36 trillion m^3; the largest in the world. In 2014, output was 1.33 billion m^3.

10. High-efficiency and low-emission industrial boilers

This refers to small- and medium-sized industrial boilers with an hourly evaporation rate of less than 75 t, including industrial steam boilers, heating hot-water boilers for civilian use, CHP boilers and waste heat boilers. China had 460,000 coal-fired industrial boilers in 2014, which consumed an annual 730 million t of coal. The average operating efficiency was 60%−65%, which is 10−20% below that of the leading global level. China's industrial boilers discharge 7.18 million t of SO_2, 2.17 million t of NO_x, 1.6 million t of dust and about 90 million t of waste residue every year, the second largest source of pollution after coal-fired power plants. More than 100 million t of coal can be saved if efficiency can be raised to 80% from its current 65%. China has developed high-efficiency and low-emission coal-fired industrial boilers with a thermal efficiency of 87%-90%.

11. Decoupling coal-fired industrial boilers

When coal is treated to low-temperature reduction-nitridation, and then to high-temperature oxidation combustion, pyrolytic gas is generated, which encourages combustibles to burn fully and inhibits the generation of NO_X. This method uses 20%-30% less coal compared with traditional coal-fired boilers, and produces about the same amount of pollution as gas-fired boilers, cutting NO_X emissions by 30%-45%. China succeeded in launching several centralized heating demonstration pilots using small- and medium-sized boilers in 2015. Distributed coal-fired heating is still used to provide heating for at least 200 million people in rural and suburban areas, a key source of smog-causing pollution. This new technology can have a significant impact in reducing air pollution.

12. Ultra supercritical coal-fired units

These are thermal power units where the steam pressure in the boiler can reach 30MPa. In 2010, China had 33 x 1,000MW ultra supercritical units in service; in 2011 that figure was 39; 59 in 2012 and 70 in 2014. Average coal consumption used to supply power is 288 gce/kWh, 31 gce/kWh less than that of thermal power. This means that using ultra-supercritical units in 2014 saved 10.28 million tce of energy. The average coal consumption used to supply power for Shanghai's Waigaoqiao No.3 Power Generation Co., Ltd. was 279.39 gce/kWh, and net efficiency was 44%. It is estimated that by 2020, ultra-supercritical units will be producing 500GW of energy in China.

13. Integrated gasification combined-cycle (IGCC)

IGCC uses fuel gas produced via coal gasification to drive gas turbines to generate power. Burn boilers use residual gas to produce steam to drive turbines for power generation. Sulfur and nitrogen are removed before combustion through the gasification of coal; and thermal efficiency is improved by the use of combined-cycle technology. When using coal with a sulfur content as high as 3.5%, IGCC power stations emit less 70% less SO_2, 60% less NO_x and 60% less solid waste compared with flue gas desulfurization in pulverized coal furnaces. The generating efficiency of the new generation of IGCC generators can be as high as 45%.

More than 10 IGCC power plants have been built around the world. The largest IGCC unit is the Martin Power Plant in Florida with a capacity of 2*385MW. China's first IGCC pilot began operations in Tianjin in 2012 with an installed capacity of 250MW, including pollutant recycling, carbon sequestration, utilization and storage. It uses two-stage dry pulverized coal pressurized gasification technology. It can remove up to 90% of sulfur from emissions and produces near zero emissions of pollutants and CO_2. China has invested RMB13,800 per KW into research in this area to improve the technology.

14. Circulation fluidized bed boilers (CFBB)

A fluidized bed boiler uses coal and adsorbent limestone in a combustion chamber bed, blasting from the bottom of the boiler to suspend the bed for fluidized combustion. Fluidization improves the efficiency of combustion and the sulfur fixation in the limestone reduces SO_2 emissions. The lower combustion temperature ($830-900^0$C) significantly reduces NO_x emissions. The circulation fluidized bed boiler uses high-speed jets of air to achieve auxiliary combustion of solid particles and their return to the combustor. It uses about 10% less coal than conventional boilers and reduces SO_2 and NO_x emissions by about 90% compared with power stations using pulverized coal furnaces and flue gas desulfurization devices.

China uses more CFBBs than any other country. In 2014, China had 3,000 x 35−1,025 t/h CFBBs in 2014 with a total capacity of 100GW, and 65 x 300MW units. Baima Power Plant in Sichuan is using 600MW supercritical CFBB units.

15. Third generation nuclear reactors

First generation nuclear reactors were built by the former Soviet Union and the US in the 1950s. Second generation nuclear reactors were developed in the 1960s and include pressurized water reactors, boiling-water reactors and heavy water reactors. Third generation nuclear reactors are equipped with passive safety systems to reduce the likelihood of accidents and generally have a lifetime service of about 60 years. Availability rate is more than 87% and they take on average about 42-54 months to build. The mature third generation nuclear reactors are the AP-1000, built by the US and Europe's ERP. China is building four AP-1000 pressurized water reactor units in Sanmen County in Zhejiang, and Haiyang in Shandong, the first set of third generation nuclear reactors in the world. China is planning to build CAP-1400 (1,400MW) pressurized water reactors, based on AP-1000 technology.

China's self-developed Hualong No.1 1,000 MW nuclear power plant uses advanced active and passive design concepts, and enlarges the assembly cores from 157 to 177, boosting power generation by 5%-10%. They are being developed with safety as a priority. Hualong No.1 pilot and Fuqing Nuclear Power Plant's No.5 and 6 units began operation on May 7, 2015 in Fujian. The technology will be exported to Pakistan and Argentina.

16. Fast breeder reactors (FBR)

These employ high-energy and high-speed neutrons from nuclear fission to start a chain reaction. Generally liquid metal sodium is used as a coolant without the use of a moderator. The fuel, uranium 235 or 238, is

converted to plutonium 239 after absorbing neutrons. Plutonium 239 releases more neutrons during fission, converting more uranium 238 into plutonium 239. Ten uranium 235 or plutonium 239 atomic nuclei can generate 12-16 plutonium 239 atomic nuclei; 10 will maintain the fission process, while 2-6 can form new nuclear fuel; the fact that the reactor produces new nuclear fuel has led to its name as a "breeder" reactor. FBRs increases the utilization rate of uranium resources from less than 1% in pressurized water reactors to over 60%. They separate radioactive sodium from cooling returned water, improving safety.

China's first sodium-cooled fast neutron experimental reactor was operated at full power for 72 hours on December 15, 2015. China became the eighth country in the world to use FBRs. The Fujian Xiapu Nuclear Power Plant is building a pilot FBR with a capacity of 600MW.

17. Distributed energy

This refers to the installation of small-scale generators at or near end users. This means that power transmission and distribution is not required. End users can control energy generation and power supply is highly reliable. It can supply both heating and power, or cooling, heating and power and improves energy efficiency. The main energy sources used are natural gas, hydropower, solar energy, wind energy and other renewable sources. In the United States, it is mainly used in hospitals, factories, for Internet servers, military bases and other places that require uninterrupted power supply, and is integrated with micro-grids and smart grids. In China, the installed capacity of distributed photovoltaic power generation was 4.67 million KW in 2014, rising to 5.71 million KW by June 2015. By the end of 2014, 104 distributed natural gas power generation projects were under construction or had been finished with a total installed capacity of 3.8 million KW. Combined cooling, heating and power supply from natural gas services 5 million m^2 of buildings in 10 universities in Guangzhou Higher Education Mega Center. 74,000 small hydropower stations were built in 2014 with a total installed capacity of 73 million KW, generating 220 billion KWh of electricity.

18. Intelligent power plants

These are full life-cycle digital smart thermal power plants, whose operations are controlled online. China's first clean and energy-saving intelligent power plant was put into operation at Huadian in Laizhou, Shandong in 2012. It employs two ultra supercritical 1,000MW units, generating 800kWh of electricity per year.

19. Ultra-high voltage (UHV) transmission lines

China defines ultra-high as ±800kV DC and 1,000kV AC (highest for equipment is 1100kV) for grid transmission. UHV transmission over long distance and with high voltage reduces energy losses. The transmission power of AC 1,000kV is up to 4−5GW, 4−5 times that of 500kV, and theoretical line loss is only 1/4 of that of 500kV.

The Jindongnan-Nanyang-Jingzhou 1,000kV UHV AC transmission pilot was started on January 6, 2009. It is the world's highest voltage UHV transmission project and the technology is homegrown. The Sichuan-Shanghai ±800kV UHV DC transmission pilot was finished on November 13, 2009 with a transmission power of 6.4GW and 2,000 km of lines. The Yunnan-Guangdong ±800kV UHV DC transmission pilot was launched on December 28, 2009, with a rated transmission power of 5GW and 1,373 km of lines. The Yibin-Jinhua ±800kV UHV transmission pilot was launched on July 5, 2014, with a transmission capacity of 8GW and 1,653 km of lines. The Jiuquan-Hunan ±800kV UHV transmission pilot was launched on June 3, 2015, with 2,383 km of lines and a transmission capacity of 8GW. By June 2015, 21,000 km of UHV transmission lines had been built or were under construction in China, able to transmit 330 billion KWh of electricity.

20. Smart grids

Smart grids use advanced communications, information and control technologies to improve energy efficiency and allow renewable sources to be incorporated into the national grid (solving issues of supply and demand). In 2013, China became the largest smart grid market in the world with an investment of US$4.3 billion and 62 million smart meters. By 2020, smart grids in China are expected to save more than 400Mtce of energy and reduce CO_2 emissions by 1,100Mt.

21. Coal moisture control (CMC)

CMC technology dries coal for coking, reducing moisture content to 5%−6% before it is used in a furnace. New technology uses a fluidized bed of flue gas to dry the coal. Japan is using this technology in 17 large coke ovens. Production capacity has been increased by 11%, decreasing the heat rate by 15% and making coke size more uniform.

China's iron and steel industry routinely uses CMC technology. In 2012, China had 17 such devices with a coking capacity of 9.53 million t.

22. Coke dry quenching (CDQ)

About 1,500Nm^3 of circulating nitrogen is needed to quench 1 ton of red coke, and usually the coke has to be cooled below the temperature of 250℃. 500-600 kg of steam could be recycled in CDQ compared with wet quenching. It can also save up to 40 kgce per ton of red coke, reducing pollution emissions, and improving coke

quality. By 2013, 90% of large- and medium-sized enterprises were using CDQ in China's iron and steel industry.

23. Coke-oven gas utilization

Coke-oven gas usually contains hydrogen and methane with a calorific value of 21MJ/m^3. It can be used as gas for urban use. Coke-oven gas has been used to produce methanol, liquefied natural gas and synthetic natural gas in China. In 2013, the production capacity of methanol from coke-oven gas was 11.37 million t, or one fifth of the country's total. The first device producing natural gas from coke-oven gas was built in Hejin, Shanxi. Another project in Ordos, Inner Mongolia has an annual output of 120 million m^3 of synthetic natural gas produced from coke-oven gas.

24. Pulverized coal injection (in blast furnaces)

This is a technology that replaces coke with coal in blast furnaces. Fine-grained anthracite is directly injected into the center of the furnace, and coke is replaced with pulverized coal (bituminous coal or mixed anthracite) to provide the heat needed during iron-making and to act as a reductant. It is an important energy-saving technology for blast furnace smelting. More hydrogen is released when pulverized coal undergoes gasification compared with coke, enhancing the reducing capacity, penetrability and diffusivity capacity of coal gas and helping ore reduction and improving the blast furnace's operation. Replacing coke with 1 t of coal cuts energy consumption by 90 kg/t. In 2014, 146 kg coal was used for every ton of iron manufactured.

25. Sintering waste heat generation

This process uses the waste heat generated during sintering in steel production to generate power. Sintering allows iron ore that cannot be directly added into the blast furnace to be used for iron-making, improving the smelting performance. The sintering process consumes a huge amount of energy, second only the blast furnace itself and represents 9%−12% of the iron and steel industry's total energy consumption. Sintering waste heat generation produces steam from the waste heat boiler or heat pipe plant after purification of flue gas. This steam is then used to generate power via turbines. Waste heat from 1 t of sinter can generate 20 kWh of electricity, reducing 8 kgce of energy needed to produce one ton of steel. By 2012, 100 sintering waste heat boilers were saving 1.9 million tce of energy per year in China's iron and steel industry.

26. Circulative process (steel complexes)

This refers to the new generation steel industry which links steel production, energy conversion, waste use and other advanced technologies within a circulative process. China has six large iron and steel companies that are using this approach to manufacture 300Mt of high-quality steel every year while generating 210TWh of electricity, reducing energy consumption for each ton of steel to below 640 kgce and reducing emissions to 100Mt of CO_2. One of these companies is Shougang Caofeidian Jingtang Iron & Steel Plant, which started operations at the end of 2010. It manufactures 9.7Mt of steel per year.

27. Energy management systems for steel companies

These use computerized systems to ensure optimized energy supply during production and real-time monitoring of energy consumption. In 2014, China had 50 iron and steel companies that were using energy management systems, cutting energy consumption by 5%−7%.

28. High-strength low-alloy steel

Baosteel is producing high strength cold-rolled steel sheets and hot-dip galvanized sheets for use in the car industry. These steel sheets are lightweight, reducing energy demand and boosting safety. Baosteel made 215 million t of steel bars in 2014, 80% of which were high strength rebars of 400MPa and above. This method saves more than 17 million t of rebar or more than 27 million t of iron ore and 15 million tce of energy every year.

29. Large capacity preroaster (electrolytic aluminum production)

The electrolytic reduction stage of producing aluminum consumes more energy than any other stage of the production process – including the mining of bauxite, its processing, and smelting. This technology electrolyzes the mixture of Alumina and cryolite producing molten aluminum at the cathode, and CO_2 and CO at the anode. The molten aluminum is cast into ingots after purification. Large capacity preroasters generally have a current intensity above 140kA. Compared with 60kA roasters, the power consumption per ton of aluminum in 300kA large preroasters can save more than 2,000kWh. China completely stopped using roasters in 2007. By 2013, the percentage of production held by preroasters 160kA and over was 95%.

30. Closed carbide furnaces

Closed carbide furnaces can reduce flue gas emissions by more than 90% compared with open furnaces. A large closed carbide furnace requires 400kWh less than an open furnace. The flue gas can be directly used in the boiler or for drying raw materials after dedusting and decoking, or as a fuel to heat the lime. In 2014, the percentage of production from closed carbide furnaces in China was 60%.

31. Regenerated metal

Recycling scrap metal consumes less energy than making metal from ore. Scrap copper that is pure can be

recycled by smelting it in an electric induction furnace; copper compounds can be recycled in a reverberatory furnace using electrolytic refining technology, while a single-chamber reverberatory furnace is used for scrap aluminum.

In 2014, China recycled 11.53 million t of non-ferrous metals of which 2.95 million t was copper, 5.65 million t was aluminum, 1.6 million t was lead, and 1.33 million t was zinc, representing 37.1% of total copper production, 23.2% of total aluminum production, 37.9% of lead production and 22.8% of zinc production. Recycled copper consumes 18% of the energy used to make copper from ore; aluminum, 45% and lead, 27%. In 2012, China saved 64.8b kWh of electricity by recycling non-ferrous metals.

China used 88.6 million t of steel scrap in 2014. Scrap steel consumes just 22% of the energy per ton of steel consumed by large- and medium-sized steel companies making steel from ore, saving 47Mtce of energy.

32. Second generation new drying technique (cement production)

This is also known as outside predecomposition calciner. Suspension preheater kilns, a technology introduced in the 1970s in cement manufacture, replaced the rotary kiln with drying and preheating processes to make sure decomposition occurs in the decomposing furnace, significantly reducing the energy needed for the reaction in the kiln. A decomposing furnace is installed at the rear of the kiln and equipped with a fluidized bed combustor, making heating much more efficient. Such technology reduces heat consumption by about half while significantly raising output. Outside predecomposition calciners producing 2,000, 4,000, 5,000, 8,000 and 12,000 t daily are operating currently in China. In 2013, 93% of cement in China was produced using this technology.

Second generation technology uses a high solid-gas ratio. During the preheating stage, flue gas at high temperature flows out from cyclone preheaters at the base, increasing the solid-gas ratio to more than 2.0 from less than 1.0 for first generation technology. This also improves thermal efficiency, boosts output, and means lower temperatures can be used and less waste gas is produced. External circulation allows the materials to stay in the furnace for longer, improving decomposition. It's a much simpler process, with less investment required, better heat stability, higher output, and it saves energy and produces less pollution. It uses 15% less heat, 22% less energy, but the daily production is 44% greater and SO_2 emissions are 78% lower. China now has more than 10 production lines using this second generation technology.

33. Net waste heat generation

This technology generates energy from the waste heat of dry cement kilns. Waste heat boilers are installed at the front and rear of kilns to recycle the waste heat. The boiler at the rear generates superheated steam that is used in a turbine to generate power. The boiler at the front generates superheated steam if it is equipped with a regenerative system; otherwise it generates saturated steam and superheated water for the boiler at the rear. A 2,000 t a day system can generate about 16.2m kWh of electricity every year with an installed capacity of 3,000 kW. China has been recycling waste heat from dry cement kilns in 700 new dry cement production lines since 2012 with an installed capacity of 5.8 million kW, generating 35b kWh of electricity annually.

34. High-grade cement

High-grade cement is cement that is grade 42.5 and above. In 2014, 50% of cement produced in China was high-strength cement of grade 42.5 (cement with compressive strength of 42.5MPa when a 7.07×7.07×7.07cm test tube prepared with cement and standard sand at the ratio of 1:3 completely hardens). The remainder was of grade 32.5. Replacing low-grade cement with high-grade cement means 15% less cement needs to be used.

35. Ecological cement

Ecological cement is cement that contains industrial residue or ash from urban waste incineration and sewage sludge. It consumes less energy and resources and produces less pollution. More than 40 kinds of solid waste, including flyash and coal refuse, are used in ecological cement in China. In 2012, the production of ecological cement used 800 million t of solid waste and made up 36.2% of total cement output.

36. Unpackaged Cement

This describes the practice of transporting loose cement in a special vehicle from the factory to the construction site. Transporting 100 million t of cement in this way saves two billion paper bags, equivalent to 3.3 million m^3 of wood, 120 million m^3 of water and 800,000 t of coal used for paper bag production. It also reduces losses from damages to the cement from paper bag residue; saving 5 million t of cement, which means the total energy savings comes to 2.37 million tce. In 2013, China transported 1.349 billion t of unpackaged cement, 55.9% of all cement used, saving 30.99 million tce of coal, reducing dust emissions by 13.56 million t, and saving RMB60.7 billion. In 2014, unpackaged cement made up 57.6% of all cement produced in China.

37. Ultra high performance concrete

Ultra high performance concrete is concrete reinforced with steel fiber instead of rebar. Compared with normal cement, its compressive strength is 6−8 times higher, rupture strength is 10 times higher and fire resistance is 100 times higher. It can be very thin and comes in various colors and shapes when high strength is needed.

Using ultra high performance concrete C110-137 can save 30-70% in cement volume and 15-25% in steel

consumption in China compared with the commonly used C40-60 concrete. Lafarge has patented the technology for this kind of cement and China has established production lines.

38. New-type wall materials

These are materials that replace the use of traditional clay bricks. There are 20 types with three different classes, including hollow bricks, aerated concrete blocks, sintered products using industrial residue (coal refuse, flyash and other waste) and sludge (sand) as the main raw materials; lightweight boards, using polystyrene foam plastic, rock wool, glass wool, and gypsum etc. Compared with clay bricks, new-type wall materials are lightweight and consume less energy. Their manufacture consumes 40% less energy than that used to make clay bricks. The application of new-type wall materials in buildings can reduce energy consumption for heating by 30% or more. In 2013, new-type wall materials accounted for 63% of all bricks made in China.

39. Advanced brick production technique

This describes brick production that is efficient, automated and energy saving. Hydraulic vibration molding creates bricks or building blocks of uniform compactness and high strength. Coal refuse, flyash, and slag can be used as the main raw materials to produce bricks without the need for sintering with the use of a vacuum extruder. A single machine using this technology can produce more than 60 million standard bricks every year. It is fully automated and produces standard bricks, perforated bricks, hollow blocks and many other products.

40. Thinner ceramic tiles

Regular ceramic tiles are 9-12 mm thick. China has shuttered more than 90% of ceramic enterprises to save energy and reduce pollution. Making ceramic tiles thinner can help to conserve energy and reduce pollution emissions. In 2015, China began making 4.7 mm thick ceramic tiles, saving 5-6 million t of coal and 20 million t of raw materials. In 2014, China made 10.23 billion m^2 of ceramic tiles.

41. Caustic soda production technique by ion exchange membranes

This technology is used to manufacture high-purity caustic soda, chlorine and hydrogen with the use of an ion exchange membrane. Sodium chloride is hydrated, refined and then electrolyzed. The use of the membrane produces soda at very high purity, chlorine is released from the anode and hydrogen from the cathode. This method consumes 28% less energy than the diaphragm method, and it also needs 25% less investment because it is a much more efficient method, needs much less space, and produces less pollution. In 2014, 87.5% of China's caustic soda used the ion exchange membrane method.

42. Refining-chemical integration

This method describes refining oil and producing chemicals at one location. It does not require the use of storage vehicles for transportation and each stage of the process is connected at the plant by pipes. The raw materials used are gaseous fuels that are desulfurized and purified; and any waste heat is recycled. This method uses less energy and produces less pollution. China opened its first plant in Quanzhou in November 2009. The production capacity of oil refineries was expanded to 12 million t from 4m t, producing 800,000 t of ethylene, 650,000 t of propyl ethylene, 400,000 t of polypropylene and 1 million t of arene every year. In 2014, China had 14 refineries that were equipped with ethylene units among 22 x 10 million-ton oil refineries. They produced 489.4Mt of oil (69.7% of total produced), and 11.99Mt of ethylene (58.7% of total produced).

43. Chemical industrial parks

In these parks, raw materials, intermediate products, finished products, by-products and waste are shared around the plants, optimizing the use of resources. China currently has more than 1,000 chemical industrial parks; 200 at provincial levels. The Shanghai Chemical Industrial Park consumes 1.2 tce of energy (1/2 the industry average) and 33 t of water (1/5 of the industry average) for every RMB10,000 of output value produced. Required investment is also only about half.

44. Green manufacturing

This uses technology that helps to manufacture energy-saving products and improve the utilization ratio of steel, and includes net forming, rapid manufacturing, hot working process simulation and optimization technologies, etc. Net forming is a technology for manufacturing parts that can be used as mechanical components without reprocessing or with little processing after forming. Rapid manufacturing directly or indirectly acts on materials driven by product model to reduce and even eradicate the use of dies to rapidly manufacture prototypes, parts and dies of any complicated shapes. Utilization ratio of steel in mechanical industry is 60%-70% in China. International advanced level is 90%-95%. The potential for saving steel is huge.

45. Green papermaking

Shandong Quanlin Group has developed a technology to make unbleached paper (used for food packaging) from straw. The paper is completely biodegradable and is exported to 20 countries.

It is unbleached so it contains no brighteners or dioxins. Compared with traditional bleaching, it uses 20-30 t less water, 20% less energy per ton of pulp, and costs are 50% lower. Processes include materialization, composite aeration, anaerobic, aerobiotic, deep decolorization and constructed wetlands; indices of drainage meet and exceed

international wood pulp environmental standards. Biological humic acid is extracted from black liquor of pulp to produce 400,000t of organic fertilizer.

46. Intelligent manufacturing

Intelligent manufacturing is a combination of manufacturing and information technology, connecting industrial robots to the internet of things, artificial intelligence, cloud computing, big data and other new technologies. On average, efficiency levels are 20% higher, production costs are 20% lower, and energy consumption and pollution emissions 10% lower.

The automobile, aviation, electronic goods, metal processing, steel, building materials, petrochemicals, textiles, food and beverages have all adopted intelligent manufacturing techniques in China. In 2015, China launched more than 30 pilots using this technology.

47. Industrial robots

Industrial robots can be programmed to do long repetitive and dangerous work that used to be performed by people. Industrial robots can be considered to be environmentally-friendly because their use means less energy consumption and improved efficiency. Fully-automatic spray systems use 15% less energy, for example. China was using 56,000 new industrial robots in 2014, an increase of 54%, which makes China the country with the fastest-growing number of industrial robots in the world. The inventory is 200,000, and it reached 300,000 in 2015.

48. Remanufacturing techniques

In this technology waste machinery is repaired, reassembled and reused on a large scale. Remanufactured equipment can be as good as or even better than new machinery. The cost of repair is on average just half the cost of buying new equipment and consumes 60% less energy and 70% less materials. The automobile, machinery, household appliances, and office equipment manufacturing industries have adopted this technique. In the US, the annual sales volume is more than US$100 billion. China has rapidly adopted this technology, and has developed plasma and high-speed arc spraying, nano brush electroplating, and other key technologies with proprietary intellectual property rights. They have been applied to the remanufacturing of auto parts, aircraft blades, numerically-controlled machine tools, Steyr engines, components of large chemical plant installations and others, creating a total capacity of 230,000 in car engines, gearboxes, diverters, and generators. In China, 20 million kW in obsolete motors was remanufactured between 2013 and 2015.

49. Comprehensive utilization of coal refuse

Coal refuse is mainly used in power generation, the manufacture of building materials, road building, land reclamation and filling in areas of subsidence. In 2013, China produced 750 million t of coal refuse, and the utilization rate was 64%. Of the the 480 million t of coal refuse, 150 million t (32%) was used to generate 160 billion KWh of electricity, 56 million t (12%) was used to make building materials; 260 million t (56%) was used in road building, reclamation and repairing areas of subsidence.

50. Comprehensive utilization of flyash

China produced 580 million t of flyash in 2013, with a utilization rate of 69%. Of the 400 million t of flyash, 176 million t (44%,) was used for cement production; 112 million t (28%) for wall materials; and 64 million t (16%) for concrete. A smaller percentage, 5% went into building roads; 3% was used in agriculture; and 4% was used in mineral extraction.

51. Trace irrigation

This is an underwater irrigation method that automatically regulates the supply of water to ensure water is concentrated around a crop's roots, maintaining soil moisture to reduce loss through evaporation. The results of five year's of testing has shown that this irrigation technique needs 50% less water than using the best irrigation droppers.

52. Controlled release fertilizers using contained membranes

In this process the fertilizer, decided by the needs of the crop and soil characteristics, is applied through a controlled release mechanism and contained membranes. This has improved the uptake of nutrients, meaning 15%-25% less fertilizer needs to be applied, reducing pollution.

This technique was used to produce 3.68 million t of crops in China in 2013, more than 50% of the world total. It has been used over an area of 69.25 million mu of land growing more than 30 types of crops and saving RMB50−100 per mu. It has helped to boost corn output by 10.4%, and the output of potatoes, grapes and watermelons by 10%-20%.

53. Soil analysis in fertilizer application

This is a method where the soil type is first analyzed to arrive at the best fertilizer mix according to the needs of the soil; it also guides farmers how to fertilize. This can improve the soil quality, improve its ability to hold moisture, reduce fertilizer quantity, boost crop yields and reduce disease. In 2012 in China this system was used

on over 500 million mu of farmland, saving 1.5 million t of fertilizer and 4 million t of coal. By 2014 the area using this method reached 1.4 billion mu.

54. Comprehensive utilization of straw

In 2013, 830 million t of straw was collected in China, of which 640 million t (77%) was used. Other than as fuel for rural residents, straw can also be used as a fertilizer, animal feed, factory fuel, for pulping and papermaking, and as a base material for planting edible mushrooms. In 2012, 26% was used as fertilizer, 28% for animal feed; 14% as factory fuel, 4% in pulping and papermaking and 3% for growing mushrooms for a total of l 610 million t of straw.

55. Energy-saving buildings

These employ various technologies and design features to reduce energy consumption in buildings. (1) Building envelope. Outer walls and roof uses composite thermal insulation; wall materials utilize aerated concrete, perforated bricks, expanded perlite, rock wool, polystyrene, polyurethane foaming plastic and so on while windows are made from materials that have a low heat conductivity coefficient such as coated hollow glass with low emissivity. This kind of approach can reduce energy needed for heating or cooling by more than 50%. (2) Heating and air conditioning. Combined gas heating, power and cooling systems are used; efficient boilers, two-pipe systems and regulating devices can also be used for heating, and a meter is installed by the household to keep track of units used. This can save up to 30%−35% in energy. (3) Efficient gas and electric water heaters. These use about 15% less energy. Heat-pump water heaters save up to 50% in energy consumption compared with resistance water heaters. (4) Lighting. Incandescent bulbs can be replaced with compact fluorescent lighting, which uses 70% less energy; slim-line fluorescent lighting can save another 10%. The use of natural light and distribution lighting systems can save 50% in energy. (5) Computer control systems. These manage heating, air conditioning, ventilation, lighting, etc and can help to reduce energy consumption by 10%. (6) Renewable energy. Passive solar housing saves 30kgce of energy per m^2 during the heating season; solar water heaters save 120 kgce of energy per m^2 (collector area) annually; advanced solar buildings are equipped with photovoltaic cells, heat pumps, control systems, high performance thermal insulation materials, and heat storage materials, and use 85% less energy; geothermal energy to heat water can save 40 kg of coal per m^2 in a heating season; ground source heat pump heating and air conditioning cuts energy use by 30% and more.

56. Green buildings

Green buildings are those that use as little resources (energy, land, water and materials) as possible in their life cycle, and provide people with healthy, adaptive, and efficient space that harmonizes with nature. They can be environmentally friendly in the sense they are sustainable and reduce pollution. They are also called sustainable buildings, ecological buildings, energy-saving and environmentally friendly buildings.

According to China's *Evaluation Standards for Green Buildings*, implemented on January 1, 2015, green buildings are classified according to three grades: one-star, two-star and three-star.

In 2014, China built 170 million m^2 of green buildings and that increased to more than 1 billion m^2 in 2015.

The Tianjin Vanke Jinlu Garden Community Service Center was the first building to be awarded three stars in China. It uses a range of technologies such as LED lighting, solar water heating systems, ground source heat pumps, adjustable a shading louver system, bidirectional air flow systems, heat recovery systems, a CO_2 monitoring system, a humidity control system, light pipes, roof planting and vertical greening.

57. Passive house

Passive houses use technologies such as energy-saving designs, building envelope, and building materials, to fully recycle the interior heat and renewable energy to create a comfortable living environment. Compared with conventional houses, they can save up to 80% in energy.

In Qinhuangdao, a Sino-German passive low-energy building project was constructed in 2014. It has six stories and covers an area of 1,200 m^2. It is China's most energy-efficient residential building.

The main technologies it uses are: 220 mm graphite-polystyrene boards and extruded polystyrene boards as insulation in the outer walls and roof; energy-saving doors and windows; three-layer hollow low-E window glass; composite frames using aluminum and wood for the doors; adjustable external shutters on rollers which are automatically controlled by the intensity of the sunlight; natural ventilation; solar water heaters with a collector area of 305 m^2 and 8 m^3 insulation water tanks; air pre-cooling (heating) technology; lighting in the underground garage is supplied by natural light; photovoltaic power generation; roof-top 20 KW photovoltaic cells; heat recovery technology; frequency conversion technology is used in the main air conditioner; ground source heat pumps; monitoring of energy consumption; real-time monitoring of indoor air quality and automatic control technologies for fresh air; and energy consumption simulation analysis technology.

58. Prefabricated housing

This method plans prefabrication in the factory, and assembles the houses on site. It uses less materials, energy and land, resists earthquakes and reduces construction site waste. The industry is relatively mature in

China, and steel, high-strength pre-stressed concrete and lightweight building materials are usually used. Compared with conventional methods for house building, prefabricated housing uses 30% less materials, 70% less energy and 20% less land. Construction time is usually reduced by 80%, and construction waste is cut by 90%. The industrialization rate of housing construction is 60% in Europe and the US, 70% in Japan and about 20% in China. In 2014, real estate giant Vanke built 14.74 million m^2 of industrialized buildings; the industrialization rate of Grand, another real estate company, was over 85%, with more than 10 million m^2 of industrialized buildings finished.

59. Low-E glass

This is glass coated with one or more layers of thin film composed of silver, copper, tin or other metals or their compounds. It is characterized by having a relatively high transmissivity for visible light, but reflects over 80% of infrared emitted from inside to keep heat indoors. It also has good thermal insulation properties for blocking thermal radiation. Many residential buildings in Dongguan, Guangdong, use this glass technology, which has helped to cut power consumption by 60%. In Europe and the US, almost 85% of windows are of this type. In 2013, China made 140 million m^2 of this energy-saving glass.

The greater the number of layers of silver the more energy-saving the glass is; with single layer glass cutting energy consumption by 50%, double layer by 60% and triple layer by 70%. The latter is now being used in China.

60. Phase change materials (PCM)

PCMs are a kind of bio-gel sealant for walls and ceilings, typically 1.25 cm thick. They solidify at night-time and melt in the day-time, thus these materials are able to store and release large amounts of energy, reducing the energy consumption used for cooling by 98%.

61. Three-dimensional greening

In summer, the internal temperature in buildings with three-dimensional greening is 3-5℃ lower than those without. This helps to reduce air conditioning energy demands by 30% or above. Shanghai planned to increase the area of three-dimensional greening by 1.5 million m^2 during the 12^{th} Five Year Plan, and Beijing planned to expand roof-top gardening area by 1 million m^2.

62. Heat Pump Water Heaters

Also called fourth generation water heaters, these absorb the low-temperature heat from the surrounding air and compress it into high-temperature heat. It is a very efficient way to heat water, and is four times as efficient as electrical water heaters and three times as efficient as gas boilers, while consuming just 1/3 – 1/4 of the electricity of electric water heaters. If heat pump water heaters replace 50% of currently-used electric water heaters, electricity saved annually could reach 15 billion kWh.

63. Maglev central air-conditioning

These types of air conditioners use permanent magnets and electromagnets to suspend the movement of the compressor so as to eliminate energy loss through friction. They use 50% less energy than regular air conditioners. China could save 32 billion kWh of electricity a year if maglev central air conditioners were installed in all of its offices and commercial buildings.

64. Advanced solid fuel stoves and cooking stoves

It is estimated that households in China are using more than 100 million coal-fired stoves, burning an average of 210 million t of coal annually. These kinds of stoves are inefficient and are highly polluting. Thermal efficiency is only 20%−25%. Coal-saving stoves have a thermal efficiency of about 40%. Traditional firewood stoves are just 10%−15% while that of firewood-saving stoves is over 30%, which is still very low. China has developed coal and firewood stoves with a thermal efficiency above 70%.

The use of low-efficiency solid fuels in Chinese households may cause serious health and environmental problems. According to a WHO report, 420,000 people in China die every year from diseases related to indoor pollution from solid fuel stoves. UNEP has also pointed out that the black carbon released from the burning of biomass and coal in conventional stoves, brick kiln, and diesel engines (about 40% of the total black carbon emissions in China) is the second major factor that causes climate change. Using low-efficiency firewood also destroys forests and aggravates water and soil loss.

65. Rural biogas

Biogas is a combustible gas produced from biomass (fecal matter and other organic waste) under anaerobic conditions. It is about 60%−70% methane and has a calorific value of about 5,500 kcal/m^3.

In 2014, 43 million households in China were using rural biogas (including central gas supply), benefiting about 165 million people. A total production of 16 billion m^3 of biogas was achieved, which helped to make 440 million t organic fertilizer. If the 16 million t of biogas replaced firewood used in households, an equivalent of 144

million mu of forest land could be saved.

66. Ground source heat pumps

A ground source heat pump is an underground heat exchanger pumping system using shallow geothermal energy in soil, sandstone and underground water. Vertical pipes are used for the heat exchanger and they tend not to go deeper than 50−100 m. The coefficient of heat supply can reach 3-4. These heat pumps use 20%−50% less energy than coal-fired boilers during heating and 10%−20% less energy when used to cool water. The sector has developed rapidly in China. In 2014, 360 million m^2 of building area was heated by ground source heat pumps.

67. Smart heating grids

Smart heating grids use urban waste heat from the metro system, and sewers, etc. The heat is recycled with the use of heat pumps and supplied to users through pipelines and heat exchangers forming an urban heat grid. Urban heating grids have been built in Norway, Finland, Canada, Denmark and Sweden.

68. Compact fluorescent lamps (CFL)

CFLs are often called energy-saving lights. They have an average luminous efficiency of 80 lumen per watt and last for about 5,000−10,000 hours.. Luminous efficiency is about 5−7 times higher than incandescent lighting; they use 70−75% less electricity, and last 8−10 times longer. They are ideal substitutes for incandescent lighting due to their high luminous efficiency, better color rendering index, smaller size, and convenience of use.

CFL uses a low voltage mercury vapor discharge lamp. The tube is made with special glass with a filament painted with electron powder at either end. The tube also contains mercury and inert gases and the inside of the glass is painted with trichromatic phosphor. The principle of light emission is basically the same as that of fluorescent lamps.

CFL are used in homes, hotels, shopping malls, schools, offices and public buildings. China is the largest producer and exporter of CFLs, with 4.45 billion made in 2013, 80% of the world total.

69. Light emitting diodes (LED)

LEDs use semiconductors as the light source. They have a high luminous efficiency of up to 110 lumen per watt. They typically use 80% less power than incandescent lamps and 50% less than CFLs. They can last more than 50,000 h, 50 times that of incandescent lamps. They do not emit any harmful radiation or contain any hazardous chemicals such as mercury or xenon. 90% of the electrical energy is converted into visible light, with little heat produced. While in incandescent lamps, 80% of the electrical energy is converted into thermal energy. LEDs need only low voltage and are safe to use. Their drawbacks include strobe flicker problems, over-brightness and they are relatively expensive.

LEDs were initially developed in red, yellow, green, and blue, which were mainly used for indication lights for electrical instruments. Gradually they were also used in traffic signals, car lights, and large screens, etc. White LEDs were introduced in 1998. Currently, 6−7 W white LED lamps are equipped with 100 x 0.06-0.07W single-tube LEDs, which can replace 45W incandescent lamps. China's LED industry has exploded in recent years with 389.87 billion LED bulbs produced in 2014.

70. Intelligent lighting

This is lighting that is controlled remotely and often features energy-saving devices. It can include devices to regulate the level of indoor lighting, timer controls, and automatic delays, etc. The energy-saving aspect can be seen in devices that monitor natural light to adjust artificial lighting levels, and these can typically save 30% in energy consumption. Control systems prevent voltage fluctuations and other technologies to help to prolong the life of bulbs by up to 2 to 4 times. China has already introduced intelligent lighting devices.

71. Smart household appliances

Microprocessors, sensors and network communication technologies are used in smart household appliances. They can monitor the environment and adjust accordingly; receive orders from remote control inside or outside house; and be linked to other devices to achieve smart appliances (for example, central air conditioners, ventilation systems, sound systems, lighting, curtains and security systems).

In January 2015, Changhong launched the first smart TV CHiQ in China. It remembers the users' preferences. Meiling has launched a CHiQ refrigerator with cloud image recognition, as well as a CHiQ air conditioner capable of monitoring human body status.

Smart appliances communicate through wireless technology instead of generic cabling, which conserves energy and is more environmentally friendly.

72. Cloud TVs

This describes a technology that links cloud computing with TV sets so that content can be pulled from the Internet and watched on the TV and the user can also remotely control devices around the home such as refrigerators, washing machines, and other appliances. Cloud TVs can interact with computers and cell phones to share videos, audios and other form of information, as well as hosting social media, helping with office work,

offering entertainment, healthcare and education. China has several types of cloud TVs on the market.

73. Intelligent residential communities (IRC)

This is an approach that uses the "three networks" (telecommunications, broadcasting and the Internet) to transmit data in residential communities. With only one converter, residents can surf the Internet, watch TV, make phone calls, and also smartly monitor water, electricity and gas meters so that the data can be analyzed. Typically IRCs can save a single community up to 25-30% in energy consumption. China has built several IRC pilot projects.

74. Smart cities

This new approach to urban development uses all aspects of new generation information technology to build a new type of "smart" city with the goal of improving the quality of people's lives. It allows urban services to be interactive which reduces resource demands and costs.

China launched its first 90 pilot smart cities in December 2012, a second batch of 103 in August 2013, and a third batch of 84 in April 2015. Currently there are 277 pilots in total. The duration of smart city pilots is 3-5 years, and the evaluation has three levels: one star, two stars, and three stars.

75. Pure electric vehicles

These are electric cars that only use rechargeable batteries as their power source, compared with hybrid cars that can also use conventional fuel. The batteries are typically the lead-acid type. Hydrogen-nickel batteries and lithium ion batteries have a better capacity and endurance. The battery is generally connected with the vehicle via an AC plug. Currently the technology is quite expensive and it is not mature. More charging stations are needed. In 2012, Tesla came out with a new safer battery with a better mileage. Around 45,000 pure electric vehicles were owned in China in 2013. The sales volume of pure electric vehicles in China was 45,000 in 2014 in China, and it reached 30,000 in the first half of 2015. In 2014, the inventory of New Energy Vehicles in China was more than 120,000.

76. Hybrid electric vehicles

Hybrid electric vehicles have both conventional internal combustion engines and an electric motor. The two power sources work separately or together to reduce overall fuel consumption and emission of exhaust gases. When the vehicle is starting or travelling at low speeds, only the electric motor is used; at higher speeds or speeding up, both the combustion engine and the electric motor work together; at high speeds, the battery supplies energy for air conditioning, music and radio, headlights and taillights; when decelerating and braking, the electric motor acts as a generator to charge the battery. Generally hybrid electric vehicles use 15-25% less fuel than conventional cars. When compared with pure electric vehicles, they have better power performance, driving range and are more convenient. The technology used in the Toyota Prius hybrid electric vehicle is relatively mature. By April 2012, 4 million vehicles had been sold in 80 countries; of which 1.5 million had been sold in the US. In 2013, Volkswagen launched its XL1 hybrid electric vehicle, which runs on only 0.9 l of fuel per 100 km. China's hybrid electric vehicle technology is not yet mature. Cars are costly to maintain and there is a high failure rate. In 2013, 14,000 hybrid electric vehicles were owned in China. In 2014, sales volume was 30,000, up 8.8 times year-on-year. In the first half of 2015, the sales volume was 21,000. China now has the largest market for new energy vehicles in the world.

77. Low speed electric vehicles (LSV)

Low speed electric vehicles are 4-wheel vehicles that have a maximum speed of 80km/h and a driving range of less than 80 km according to a definition in *Battery Electric Passenger Cars Specifications* in 2012.

LSVs are considered to be safer than electric bicycles and motorbikes. Their main selling points are low price (RMB20,000-30,000) and convenience. Their power ratings are 4-10KW, and battery capacity is 3-12KW. Most batteries are the lead-acid variety. Middle and high-end LSVs use lithium ion batteries that charge in 6-12 h, operate at speeds of 40-80 km/h with a maximum driving range of 80-150 km. The market for LSVs is huge, and they sell well in rural areas and in third and fourth-tier cities. In 2014, sales volume reached 400,000 and was expected to reach 600,000 in 2015. Unified provisions on production, sale, driving, etc. should be launched as soon as possible.

78. Aluminum trailers

These are trailers made from aluminum instead of steel. There are about 3 million trailers in China. Gasoline consumption is only 25% that of trucks. Aluminum trailers are lighter than steel trailers (usually by about 3 t) and thus consume less fuel: when the trailer weight falls by 10%, fuel consumption falls by 8%-10%. One aluminum trailer can save 5,175 l of oil annually (with a traveling distance of 150,000 km) compared with steel trailers, equivalent to 12.93 t of CO_2 emissions. The market for these trailers has just opened in China. If they can be applied in China at 70% of the rate in developed countries, 7.66 million t of oil and 22 million t of CO_2 could be saved annually, equivalent to a saving of RMB178 billion.

79. Electric bicycles

Electric bicycles are bicycles assisted by battery power. They are quiet, clean, and fairly cheap to maintain, which makes them good substitutes for mopeds. China has a huge market for electric bicycles. In 2000, there were only about 50,000, but by 2014 there were 193 million. Currently, 90% of electric bicycles in China use lead-acid batteries, weighing 4-5 kg; the remaining 10% use lithium batteries, which typically last 3 times as long as lead-acid batteries. National standards rule that the total weight of an electric bicycle should be less than 40 kg and that the maximum speed should be less than 20 km/h. In 2012, there were 103 million motorcycles in China. If electric bicycles replaced all these, China could save 1.48 million t of gasoline per year.

80. Green transportation

This describes a transportation system that is designed to reduce pollution, alleviate traffic congestion and use resources wisely. The common measures include better urban planning and traffic demand management, developing public transport, using energy-saving and clean energy vehicles, and promoting walking and cycling. Private cars consume five times more fuel per 100 passengers than buses, and emit 15 times more harmful gases in urban areas. In Beijing, the proportion of public transit has risen from 29.8% in 2005 to 49.8% in 2014.

81. Intelligent transportation systems (ITS)

An ITS is a system which uses information and communication technologies for all areas of road transport from infrastructure to public transport scheduling to increase safety and improve efficiency. Advanced ITS can increase the efficiency of transport by 80%-100%, reduce traffic congestion by 60%, cut traffic accidents by 30%-70%, and cut oil consumption and CO_2 emissions by 15%−30%.

China has applied ITS technology to various aspects of its transportation sector including information acquisition and release, public transport, parking management, and electronic toll collection (ETC). By July 2015, China had built 8,883 special lanes for ETC serving 15.08 million users, and saving 4,446 l of oil every year. Vehicles typically emit 50% less carbon emissions with ETC. The traffic capacity of ETC lanes is four times higher than regular lanes.

82. Car networking

This technology uses devices on board the vehicle to collect and disseminate information with the aim of creating a smoother transport system, which also leads to better energy conservation, emissions reduction and road safety. The technology is used with ITS, intelligent parking management, ETC, and vehicle information acquisition. By 2014, more than 7 million vehicles had installed onboard devices.

83. Micron dry dust suppression technique

This is a new kind of dust suppression technology. The molecule of water for dust-fall is smashed into particles of 1-10μm via sonic boom to wrap breathable dust particles (PM2.5，PM10) with water mist particles to make them fall. It can be widely used during grinding, screening, handling, transporting or storing materials from mines, harbors, factories and construction sites. China has a number of different ranges of onboard mist sprayers.

84. High-speed rail

The German Aviation and Space Technology Research Institute (Deutschen Zentrums für Luft- und Raumfahrt) found that the per capita energy consumption per km for high-speed rail at a speed of 300 km/h is equivalent to 2.85 l of gasoline; cars at 150 km/h consume 6 l; airbuses consume 7.7 l. The key energy-saving features include: being lightweight; having a streamlined shape to reduce air resistance, and a kinetic energy recovery system.

In 2014, China launched the CRH-380 Electric Multiple Unit which has a maximum commercial operating speed of 380 km/h.

85. Permanent magnet synchronous traction systems for high-speed trains

These use motors with a constant rotor speed and AC frequency; the energy is generated by permanent magnets to avoid excitation loss.

CSR Zhuzhou Institute Co., Ltd. has developed a system for high-speed rail. Compared with traditional asynchronous motors, a 690 KW permanent magnet motor uses 10% less energy.

86. Magnetically levitated trains (Maglev)

Magnetically levitated trains use magnets to levitate and propel the train forward. This ensures that the only frictional force opposing forward motion is air resistance.

The world's first commercially operated magnetically levitated train started business in Shanghai in January 2003. The track was 30 km long and the train ran at a speed of 430 km/h.

On April 21, 2015, Central Japan Railway Company's maglev 7-carraige trains set the world record with a speed of 603 km/h.

China South Locomotive & Rolling Stock Corporation Limited (CSR) began producing low-speed maglev trains with a maximum speed of 100 km/h and a passenger capacity of 60 people in January 2012. And in April

2015, Beijing began to build a low-speed maglev train line.

87. The Internet of Ships

Inland navigation is integrated with the internet of things to make an intelligent inland navigation network connecting humans and ships, ships and ships, ships and goods, and ships and the shore – it facilitates intelligent identification, positioning, tracking, monitoring, and management, etc.

In 2014, the Internet of ships was launched in Hangzhou, Jiaxing and Huzhou in Zhejiang, Wuxi, Taizhou and Zhenjiang in Jiangsu and other pilot cities. Technologies used include radio frequency identification (RFID), convenient lockage system (water ETC), OBU, global positioning system (GPS), and automatic identification systems (AIS terminal).

88. Bio-jet fuel

Animal fats, vegetable oils and other organic residue can be used to make bio-jet fuel. Animal fats and vegetable oil, including waste cooking oil, can reduce life-cycle CO_2 emissions by about 35% compared with conventional aviation fuels. Sinopec has developed the No.1 bio-jet fuel from waste cooking oil (gutter oil) combined with regular aviation fuel at a ratio of 1:1. On March 21, 2015, a Hainan Airlines Boeing 737-800 flew from Shanghai to Beijing on this biofuel. It was the first commercial passenger flight to use this kind of biofuel.

The International Air Transport Association predicts that by 2020, bio-jet fuels will compose 30% of all aviation fuel. Currently, the main hurdle is that the production costs are 2-3 times higher than regular aviation fuels.

89. Friction reducing agents for pipes

These are chemical agents that reduce turbulence in pipelines so that the liquid can flow more easily. At present, polymers are used. Adding traces of friction reducing agents allows oil to move more smoothly, faster, and safer and it also reduces energy. Turbulence is reduced by about 40%, which means 30% more oil can be delivered in the same time frame.

90. High efficiency motors

These describe motors which are significantly more efficient that the standard motor. Efficiency can be enhanced with better design, materials and technology. For example, better efficiency is given by using cold-rolled silicon steel sheets rather than hot-rolled. In 2011, China had around 1 billion small- and medium-sized motors, consuming about 2,000 billion kWh of electricity a year, which is roughly 50% of the total consumption. However, the average efficiency of small- and medium-sized motors in China is 5% lower than the global average, and system efficiency is 10-20% lower.

91. Information and communication technologies (ICT)

Rapid advances have been made in information and communication technologies and have been widely applied to many different fields. ICT applications can significantly help in energy conservation and emission reduction.

The International Data Corporation estimated that ICT could be applied in China to reduce CO_2 emissions by 1.4 billion t and save 550 million tce of energy by 2020. This alone would fulfill the goal that China set to cut carbon intensity by 40% in 2020 from 2005 levels. ICT is used in smart grids, intelligent buildings, intelligent logistics, energy-saving vehicles, industrial energy saving, intelligent motors, and in communications.

92. 3-D printing

Successive layers are produced until the entire object is finished from a virtual design. It can be used to manufacture parts for automobiles, electronics, aerospace, iron and steel, ships and in other high-end manufacturing industries. The technology is capable of creating seamless connections with high precision and strength. The stability and strength of joints is far greater than that achieved by welding and reinforcement. 3D printing also has applications in medicine and the military. Large industrial 3D printers can print titanium alloy products.

93.Cloud computing

Cloud computer is a relatively new Internet technology; simply it is the remote management of data – in other words using a network of remote servers to store and process data rather than on a local server or personal computer. Once connected to the Internet, you can access all the services of connected computers, including supercomputers. For example, China's Tianhe-1 supercomputer is the fastest supercomputer in the world. Each "cloud" can have hundreds of thousands of, or even millions of computers. Cloud computing does not lose data, but it raises new challenges for data security, since the user may not have exclusive control over data stored.

China has embraced the key technologies of cloud computing. Major cloud platforms, calculation capability and data processing capability are at global leading levels. It is widely used in medicine, manufacturing, energy, finance, transportation, telecommunications, government affairs, education, and scientific research. In 2014, China's cloud computing industry was worth RMB 650 billion, up 55% from the previous year.

Cloud computing encourages innovation, and reduces costs, particularly for small- and medium-sized

enterprises, and promotes innovation.

94. Big data

Big data refers to the collection, analysis, and use of a huge amount of text, images, video and audio that is passed through networks. It has become a major source of new knowledge and is the technology with the biggest potential in the IT industry. China is one of the countries with the fastest development in big data, and is being used in energy development, smart cities, intelligent transportation, e-commerce, communications, medical treatment, education, gaming, tourism, clothing, real estate, banking, securities, insurance, food safety, weather, and maritime affairs. In April 2015, China was running 19,636 big data projects.

95. New type semiconductor chips

The new generation of semiconductor chip uses gallium nitride, while the typical integrated semiconductor chip uses gallium arsenide.

On March 26, 2015, Chongqing University of Posts and Telecommunications launched its first commercial system-in-package chip, the CY2420S, showing China is at the forefront of this kind of technology. These kinds of chips are controlled by the Internet; they consume relatively little energy and are very stable. Production line speed is 50% higher while energy consumption is reduced by around half.

China imported 90% of the chips it used in 2014, costing US$286.5 billion, which exceeded money spent on oil imports (US$251.5 billion), making chip imports the top import for China that year.

96. Nano powder coal activator

The nano powder activates the energy in coal and prolongs combustion. The combustion of coal at high temperature generates hydrogen, acetylene and carbon monoxide. Hydrogen and acetylene are high quality combustible gases under the action of oxygen. The nano powder activator helps carbon monoxide to form new combustibles, greatly prolonging combustion and thus reducing overall coal consumption. Using 0.4 kg of nano powder activator from the United States or Japan can save over 5 t of coal.

97. Upgrades in vehicle fuel quality

One of the key sources of air pollution in cities in China is exhaust emission from vehicles, and according to a report by China's Ministry of Environmental Protection in 2015, 31.1 % of PM2.5 emissions came from cars in Beijing and in Shenzhen, that percentage was 41.0%.

China has consistently upgraded vehicle emissions standards. In 2000, the "National 1" standard on sulfur content in gasoline stipulated a maximum of 800 ppm; "National 2" in 2005 lowered that to 500 ppm; "National 3" in 2010 brought it down to 150 ppm; "National 4" in 2014 made it 50 ppm while "National 5", a standard set for 2017 is 10 ppm. Japan began limiting sulfur content in fuel in 2006 and the EU in 2010.

"National 5" standard will reduce emissions by 10-15% and NO_x emissions by 25% compared with "National 4".

98. Energy efficiency labels

China currently classifies five levels of energy efficiency for appliances such as refrigerators, air conditioners and others. Level 1 is the highest energy efficiency rating and Level 5 the lowest. China introduced this labeling system in March 2005. By March 2015, 1.8 billion household appliances and nearly 10 billion lights, among others had been sold with energy efficiency labeling. It is estimated this has saved 441.9 billion KWh of electricity over that decade.

99. Emission standards for air pollution on high emission industries

Emission standards for thermal power plants, GB 13223-2011, was implemented in 2011. These include maximum dust emissions at 30 mg/m^3 from 50mg/m^3 in 2004; SO_2 emissions to 200 mg/m^3 (in existing boilers) and 100 mg/m^3 (in new boilers) from 400 mg/m^3 in 2004; and NO_x emissions at 100 mg/m^3 from 450 mg/m^3 in 2004. US standards put maximum emissions of dust at 30 mg/m^3; SO_2 at 200 mg/m^3; and NO_x at 200 mg/m^3. It is expected that China's new standards would have reduced SO_2 emissions by 6.18 million t and NO_x emissions by 5.8 million t in 2015.

Emission standards for boilers, GB 13221-2014, came into force for existing boilers in 2014, for new boilers above 10 t/h on October 1, 2015 and for new boilers below 10t/h on July 1, 2016. Maximum PM emissions for coal-fired boilers in service is set at 80 mg/m^3 and new boilers at 50 mg/m^3; SO_2 emissions are capped at 400 mg/m^3 for existing boilers and 300 mg/m^3 for new ones; NO_x emissions are set at 400 mg/m^3 for existing boilers and for new boilers, 300 mg/m^3; mercury and mercury compounds are capped at 0.05 mg/m^3. Once the new standard is implemented, 80% of industrial boilers will be upgraded or phased out. This will cost about RMB321-401 billion. These standards are expected to cut PM emissions by 660,000 t and SO_2 emissions by 3.14 t in 2015.

Emission standards for the cement industry, GB 4915-2013, came into force for existing enterprises on March 1, 2014 and for new enterprises on July 1, 2015. PM emissions are limited to 30 mg/m^3 (existing) and 20 mg/m^3 (new) from 50 mg/m^3 (cement kiln and other thermal equipment) and 30 mg/m^3 (cement mill and other ventilation equipment); NO_x emissions are limited to 400 mg/m^3 from 800 $mg/m^{3,}$ while limits on emissions of

ammonia were added (10 mg/m^3) and mercury (0.05 mg/m^3). Proportion of investment on dedusting, denitration and other environmental protection of cement enterprises will reach 10%-12%. The new standards will mean an extra RMB12-15 per ton of cement.

The emission standard for the ceramics industry is GB 25464-2010. In December 12, 2014, the Ministry of Environmental Protection published a partly revised list of the standards. The PM emissions standard was unchanged at 30 mg/m^3; SO_2 emissions were reduced to 50 mg/m^3 from 100 mg/m^3; and NO_x emissions were brought down to 180 mg/m^3 from 240 mg/m^3. The new standard means that many ceramics plants in Foshan and Guangdong, which make 60% of China's ceramic products, will need to close down.

100. Carbon capture and sequestration (CCS)

CCS is a technology that can capture up to 90% of the CO_2 produced by the burning of fossil fuels. The gas is often sequestered by pumping it underground and can be used to improve oil and gas recovery. By storing the gas under a coal seam, the recovery of coal bed methane can be made more efficient. Because CCS reduces CO_2 emissions from industrial sources and coal-fired power plants, it is expected to become a key technology for reducing greenhouse gas emissions.

In 2014, there were 22 CCS projects worldwide, 13 of which were running and nine were under construction. Most of those in service are in the US and Canada. China has also been focusing on CCS; it ranked second in the world in 2014.

The CO_2 capture project at Shidongkou Power Plant in Shanghai owned by Huaneng was finished in 2010. It is the world's largest CO_2 capture pilot project, annually producing 100,000 t of CO_2 of 99.9% purity. In 2012, Shenhua began a 100,000 t/a CCS project. CO_2 captured from the direct liquefaction of coal was injected into a 1,000-3,000 m alkaline water layer for sequestration. It sequestered more than 40,000 t of CO_2 by 2014.

Global energy statistics

1. Highest recoverable coal reserves

China: 240 billion t (end 2014), 23.6% of total world reserves

2. Highest recoverable oil reserves

Venezuela: 46.6 billion t (end 2014), 17.5% of total world reserves

3. Highest recoverable natural gas reserves

Russia: 32.6 trillion m^3 (end 2014), 17.3% of total world reserves

4. Highest recoverable shale gas reserves

China: 31.22 trillion m^3 (2013)

5. Largest coal field

Powder River Coal Basin, US: sub-bituminous coal proved reserves 122.4 billion t, predictive reserves 700 billion t

6. Largest oil field

Onshore: Ghawar Oil Field, Saudi Arabia: discovered in 1948, recoverable reserves 11.5 billion t

Offshore: Baleeira Oil Field, Brazil: recoverable reserves 8−12 billion barrels

7. Largest gas field

Onshore: Urengoy Gas Field, Russia: proved reserves 8.06 trillion m^3

Offshore: North Gas Field, Qatar: proved reserves 2.7 trillion m^3

8. Most economically exploitable hydropower resources

China: 401.8 GW, 1,753.4 TWh

9. Largest primary energy output

China: 3.6 billion tce (2014)

10. Largest crude oil output

Saudi Arabia: 538.4 Mt (2014), 12.9% of total world output

11. Largest crude oil processing capacity

US: 901.2 Mt/a (2014)

12. Largest coal output

China: 3,870 Mt (2014), 47.4% of total world output

13. Largest coke output

China: 476.9 Mt (2014), over 60% of total world output

14. Largest natural gas output

US: 728.3 billion m^3 (2014), 21.0% of total world output

15. Largest coal bed methane output

US: 60 billion m^3 (2012)

16. Largest shale gas output

US: 272.7 billion m^3 (2014), 37.4% of world output

17. Largest generating capacity

China: 5,649.6 TWh (2014), 23.7% of world total

18. Largest hydroelectric power generation

China: 1,064.3 TWh (2014), 27.5% of world total

19. Largest number of small hydro plants

China: 73 GW, 220 TWh (2014)

20. Largest share of energy from hydropower

Norway: 95% of gross generation (2012)

21. 100% renewable energy

Iceland: 16.89 TWh (2011), 73.2% hydropower; 26.8% geothermal power

22. Most nuclear power reactors

US: 100 reactors, 99 GW (2014)

23. Largest share of energy from nuclear power

France: 73.3% (2014)

24. Most nuclear power plants

China: 28 reactors under construction, 31,635 MW in March 2014, 42.2 % of the world's total capacity under construction

25. Largest uranium output

Kazakhstan: 22,45 1t (2013), 37.8% of world total

26. Largest geothermal power installed capacity

US: 3.4 GW (2014)

27. Largest wind power installed capacity

China: 114.61 GW (2014)

28. Largest photovoltaic cell output

China: 35 GW (2014)

29. Largest photovoltaic power generation

Germany: 38.2 GW, 32.8 TWh (2014)

30. Most biomass energy consumed

China: 110 Mtce (2014)

31. Largest biogas output

China: 16 billion m^3 (2014)

32. Largest biomass power installed capacity

US: 13.6 GW (2013)

33. Largest biofuel output

US: 30.06 Mtoe (2014)

34. Highest number of solar water heaters

China: collector area of 414 million m^2 (2014)

35. Highest number of solar cookers

China 2.26 million (2013)

36. Highest geothermal consumption

China: 17.6 Mtce (2014)

37. Largest oil company

Saudi Aramco: crude oil output 543.4 Mt, natural gas output 108.2 billion m^3 (2014)

38. Largest natural gas company

Gazprom: output 443.9 billion m^3 (2014)

39. Largest coal company

Coal India Limited: output 492 Mt (2013)

40. Largest power company

China Huaneng: installed capacity 151.49 million kW, generating capacity 646.1 billion kWh (2014)

41. Top coal mine output

Powder River (US): output 454 Mt (2013)

42. Largest mine

Daliuta Mine (Shenmu-Dongsheng, China): raw coal output 37.93 million t (2013)

43. Largest open-pit coal mine

North Antelope Rochelle mine (Wyoming, US): output 97.68 million t (2012)

44. Largest coal-fired power plant

Taichung Power Plant (Taiwan, China): installed capacity 5,780 MW

45. Largest oil-fired power plant

Kagoshima Power Plant (Japan): installed capacity 4,400 MW, 4×600 MW and 2×1,000 MW supercritical units

46. Largest gas-fired power plant

Futtsu power plant (Japan): LNG installed capacity 5,040 MW (2014)

47. Largest hydropower station
Three Gorges hydropower station (China): installed capacity 22.4 GW, generating capacity 98.8 billion kWh (2014)
48. Largest nuclear power plant under construction
Yangjiang nuclear power plant (China): installed capacity 6,500 MW, 6 units, of which three came on line March 10, 2015
49. Largest nuclear power reactor
China: 1,750 MW, Taishan Nuclear Power Plant (operational August 2013)
50. Largest geothermal power plant
The Geysers (US): installed capacity 1,000 MW (2014), max 2,043 MW (1988)
51. Largest wind power plant
Onshore: Alta Wind Energy Center (California, US): installed capacity 1,020 MW (2014), expanding to 1,550 MW
Offshore: London Array (UK): 630 MW, completed February 2012
52. Largest wind turbine
Denmark: V-164-8.0, 8 MW, tower height 140 m, swept area 21,000 m^2, tested January 2014
53. Largest photovoltaic plant
Golmud Photovoltaic Plant (Qinghai, China): 1,100 MW
54. Largest solar thermal plant
Ivanpah (US): installed capacity 392 MW, completed February 2014
55. Highest voltage UHV transmission line
Shanxi-Nanyang-Jingmen UHV AC transmission demonstration project (China): 1,000 kV, 640 km long, completed November 2009
56. Largest primary energy consumption
China: 4,260 Mtce (2014), 23% of world total
57. Largest oil consumption
US: 836.1 Mt (2014), 19.9% of world total
58. Largest oil refinery
Paraguana (Venezuela): annual processing capacity 47 Mt (2014)
59. Largest strategic oil reserves
US: 696 million barrels (2014)
60. Largest coal consumption
China: 4121 Mt (2014), 50.6% of world total
61. Largest natural gas consumption
US: 759.4 billion m^3 (2014), 22.4% of world total
62. Largest share of coal in primary energy consumption
South Africa: 70.6% (2014)
63. Largest share of oil in primary energy consumption
Singapore: 87.0% (2014)
64. Largest share of natural gas in primary energy consumption
Uzbekistan: 85.6% (2014)
65. Largest share of nuclear power in primary energy consumption
France: 41.5% (2014)
66. Largest proportion of hydropower in primary energy consumption
Norway: 66.2% (2014)
67. Largest per capita energy consumption
Iceland: 25.63 tce (2011)
68. Largest population without electricity
India: 306 million people (2012)

69. Longest length of high-speed rail
China: nearly 17,000 km (October 2015), 55% of world total
70. The fastest high-speed rail
China: CRH-380, maximum commercial operating speed 380 km/h (2014)
71. Rail line transporting the most coal
Datong-Qinhuangdao (China): 450.2 Mt (2014)
72. Largest number of electric bicycles
China: 200 million (2014)
73. Largest oil exporter
Saudi Arabia: 2.51 billion barrels (2014)
74. Largest oil importer
US: 365.4 Mt of crude oil, 90.1 Mt of oil products (2014)
75. Largest oil tanker
Knock Nevls (Singapore): net weight 564,763 t, manufactured by Sumitomo Heavy Industries (Japan)
76. Largest coal exporter
Indonesia: 379 Mt (2014)
77. Largest coal importer
China: 291.2 Mt (2014)
78. Largest natural gas exporter
Russia: 201.9 billion m^3 (2014), 187.4 billion m^3 by pipeline, 28.2% of world total
79. Largest LNG importer
Japan: 120.6 billion m^3 (2014), 36.2% of world trade volume
80. Largest exporter of LNG
Qatar: 103.4 billion m^3 (2014), 31.0% of world trade volume
81. The longest gas pipeline
China-Central Asia gas pipeline (Turkmenistan – Kazakhstan – Uzbekistan – China) + second West-East gas pipeline (in China from Xinjiang – Guangdong): nearly 10,000 km, transmitting 30 billion m^3 of gas annually, put into operation December 2009
82. Largest excavator for open pit mine
WK-75 of Taiyuan Heavy Industry (China): bucket capacity of 75m^3, manufactured in 2012
83. Largest mine truck
Liebherr's T282B (US): dead weight 224 t, carrying capacity 400 t, 3650HP diesel engine
84. Country with most efficient mines
US: 2.78 t/h (2013)
85. Lowest coal mining accident death rate
Australia: zero deaths (2008 and 2010)
86. Highest coal mining accident death rate
China: 931 (2014)
87. Most serious power outage
India: 13:00 July 31, 2012, affecting 670 million people (43% of the population) in the north, northeast and east, lasting 15 hours.
88. Largest number of 1,000 MW ultra-supercritical generating units
China: 68 (2014)
89. Largest circulating fluidized bed boilers installed capacity
China: 3,000 CFBC of 35−1,025t/h, total capacity 100 GW (2014)
90. Largest coal waste generating capacity
China: 104.2 billion kWh (2013)
91. Largest coal water slurry producer and user
China: annual production capacity 130 Mt (2013)

92. Largest number of compact fluorescent lamps
    China: 4.45 billion (2013), 80% of world total
93. Lowest energy consumption per unit of output value
    UK: 91.1 tce/US$1 million of GDP (2014)
94. Lowest thermal power plant heat consumption
    Italy: 275 gce/kWh (2011)
95. Lowest comparable energy consumption (steel)
    Japan: 610 kgce/t (2010)
96. Lowest comprehensive energy consumption (cement)
    Japan: 118 kgce/t (2010)
97. Highest government investment in R&D in energy
    US Department of Energy: US$12.76 billion (2014)
98. Cheapest gasoline
    Venezuela: US$ 0.019/liter (March 2015)
99. Highest sulfur dioxide emissions
    China: 19.74 Mt (2014)
100. Highest carbon dioxide emissions
    China: 9347 Mt (2014)

Energy Terms

1. Energy consumption per unit of GDP

Also known as energy intensity, this refers to energy consumed for every unit of GDP. It is usually expressed by oil equivalent (or coal equivalent)/t (or kg)/RMB10,000 ($10,000). It reflects the degree of economic dependence on energy and is affected by a series of factors including economic structure, technological level, energy structure, and population.

There are some problems using energy intensity as an index of performance for regions or countries in an international comparison. First, energy is often underestimated or overestimated because the GDP of any given year would include energy consumption from the previous year and that year's energy consumption will contribute to the GDP of the following year. Second, there is a great deal of difference between different regions in terms of development, economic structure, resources, and exchange rate.

2. Energy consumption per unit industrial value added

This refers to the amount of energy consumed for each unit of industrial value added. Industrial value added is the final output of industrial companies' production activities expressed in monetary forms in the reporting period. Industrial value added = total industrial output – industrial intermediate output – value added tax payable.

In China's Energy Balance Sheet (by sector), energy consumption is calculated from primary energy without deducting losses from energy processing, conversion, storage and transportation nor does it deduct the gasoline and diesel consumed in transport, so the calculated energy saved from the reduction of industrial value added is typically under-estimated. The calculation from some agencies has higher energy saved from industrial value added than from the reduction of national energy intensity.

3. Physical energy efficiency

This refers to energy efficiency in activities such as mining, energy processing, conversion, storage, transportation and utilization. It has three parts (processing and conversion, storage and transportation, and end-use).

Mining efficiency

This is the recovery rate or ratio: that is the calorific value of output mined to the calorific value of the reserves available.

Processing and conversion efficiency

This is the ratio of the effective energy input to the total energy input in processing and conversion, the difference of which is the loss in processing and conversion and energy consumed. "Processing" refers to the refining of coal, oil, natural gas or uranium ore. Conversion refers to the process of changing primary energy into secondary energy, including coking, power generation, heat production, gasification, and liquefaction.

Storage and transportation efficiency

This measures the loss of energy during transportation, distribution and storage; it generally excludes energy consumption of the procedure itself but includes energy consumed by transformers in power transmission lines and pipeline delivery pumps.

End-use efficiency

This refers to the ratio of energy consumed by end users to the energy input at the beginning.

Total efficiency of energy system

This is the product of multiplying mining efficiency, processing and conversion efficiency, storage and transportation efficiency, and end-use efficiency. "Energy efficiency" usually refers to the multiplier of the latter three efficiencies.

The energy efficiency of China (processing and conversion, storage and transportation, end-use) in 2013 was 36.8%

4. Energy saving rate

This is the ratio of energy saved to energy consumed of a baseline period; it is generally calculated using energy saved per unit of GDP or per unit industrial value added, or energy saved per unit product. In 2014, China's energy saving rate per RMB10,000 GDP was 4.8%.

5. Final consumption of energy

According to the internationally accepted definition of energy balance, the final consumption of energy is calculated from the primary energy consumed minus the energy used by the energy sector (split into five industries in China: coal mining and washing; oil and natural gas extraction; oil processing and coking; electricity, heat production and supply; and, gas production and supply) and losses from processing, conversion and transportation of primary energy (losses from thermal power generation, coal preparation, oil processing and

coking, and power transmission). In China's Energy Balance Sheet, two sets of data are listed for final energy consumption using two calculation methods: coal equivalent method and the calorific value method. Losses from power generation and energy consumption from the energy sector are not deducted when the coal equivalent calculation method is used. However, calorific value calculation method deducts the losses from power generation, but not the energy. In 2013, the final consumption of energy was 2,781.6 Mtce in China, which was 65.3% of primary energy consumption.

6. Biomass fuel consumption

According to the International Energy Agency, this is also called combustible renewable energy, which refers to the fuel consumed from burning firewood, straw and other biomass energy sources directly. In 2014, China's biomass fuel consumption reached 140 Mtce, ranking third after coal and oil. From this, 110 Mtce was used for cooking and heating by rural residents and 30 Mtce was used in the processing of agricultural products.

7. Energy consumption statistics by factory method

The "Factory method" is still used in calculating energy consumption statistics by sector in China. It calculates the energy consumed on an industrial factories' level rather than on an industrial activities' level. Therefore, oil consumed by vehicles only includes oil consumed by the transportation sector, while oil consumed by agriculture, industry, buildings, services and private cars is calculated in corresponding gasoline and diesel consumption in every industry or sector. In 2013, in China, gasoline consumption for other sectors and private cars was about 52% of total consumption. Another item that differs greatly with actual consumption in the Energy Balance Sheet is the energy consumption from the building materials industry, as only energy for enterprises in the industry is calculated while building materials are also produced in large quantities in other industries, the energy consumption of which accounted for 27% of total consumption in 2013.

8. Electrification level

The electrification level is the degree of dependence in socio-economic development on electricity. It is generally measured by two indicators: the percentage of generating electricity in total primary energy consumption, which reflects the status of electricity in the energy system and the percentage of electricity in the total energy consumption, which measures the electricity consumption level of various users, and gives an indication of the importance of electricity in socio-economic development. Other important indicators include electricity consumption per unit GDP, per capita electricity consumption, and per capita domestic electricity consumption, etc.

In 2000, China's electrification level (by final energy consumption) was 15.9%; rising to 20.9% in 2012. The average level of Organization for Economic Cooperation and Development countries is 22.3%. In 2014, per capita electricity consumption in China was 4,078 kWh and per capita domestic electricity consumption was 508 kWh.

9. Energy consumption elasticity

This is the ratio of the primary energy consumption growth rate to the GDP growth rate in a certain country or region. It reflects the interactive relationship between energy and economic growth. GDP and energy consumption are both integrated indicators, which vary considerably in a single country over time and between countries because they relate to economic structure, resources, technological level, population size, climate and even diplomatic relations. Since the first oil crisis, countries have diversified the sources and types of energy, made progress on energy conservation, globalization has become more entrenched and electrification has advanced. All these have distorted the relationship between energy consumption and the economy from close correlation to almost no correlation. For that reason, elasticity of energy consumption should not be used to forecast energy demand.

10. Energy price elasticity

Energy price elasticity measures the percentage of energy demand reduction from a price increase of 1%. Short-term and long-term price elasticities are calculated according to energy type and use (industrial, transportation and residential) to forecast energy demand, help energy conservation efforts, and analyze the influence of changes in energy price on economies. Between 1953 and 2005, China's energy price elasticity was 0.37.

11. Energy demand income elasticity

This is the percentage increase in energy demand when per capita income rises by 1%. It is a key variable in forecasting energy demand. Energy demand income elasticity in China between 1981 and 2002 was 0.44, 0.78 in Japan and 0.84 in India.

12. Heavy chemicals industry

Before 2013, China divided industry into heavy and light industries. Heavy industries are those that provide the means of production for the main national economic sectors such as extractive, raw materials and processing. A combination of the heavy and chemical industries is called the heavy chemicals industry.

But after 2013, China no longer made this distinction. Instead it divided industry into mining, manufacturing,

electricity, heating, gas and water production and supply.

13. High technology industry

The *Statistical Classification Catalogue of High Technology Industries* from the National Bureau of Statistics lists high technology industries as aerospace manufacturing, electronic and communication equipment manufacturing, computer and office equipment manufacturing, medicine and medical equipment manufacturing and instrument manufacturing.

14. Top-grade equipment manufacturing

This is one of China's strategic emerging industries which includes aerospace equipment, space infrastructure, satellites and their applications, urban mass transit, marine engineering, and intelligent manufacturing.

15. Industrial enterprises above a designated size

This refers to industrial enterprises with an annual main income over RMB20 million (RMB5 million before 2011).

16. Medium-, small- and mini-sized industrial enterprises

Medium-sized industrial enterprises must employ more than 300 employees (but less than 2,000), have a sales volume of over RMB30 million (but less than RMB300 million) and total assets of more than RMB40 million (but less than RMB400 million). Mini-sized enterprises were added starting from July 4, 2011; they are defined as employing less than 20 employees and having an annual income below RMB3 million. Small-sized enterprises lie between medium- and mini-sized.

17. Industrial concentration level

This is an index that measures the scale and structure of enterprises in a certain sector. It is calculated using the proportion of big-, medium- and small-sized enterprises, or the top 5 or top 10 enterprises in the sector's annual average output. In China's energy-intensive sector, the energy consumption per unit product of small enterprises is 30% higher than that of large-sized enterprises. Industrial concentration has a big impact on energy efficiency.

18. Remaining recoverable reserves

This refers to the amount of coal, oil and natural gas reserves that can be exploited by a certain date. According to the national standards set out in *Solid Mineral Resources and the Classification of Reserves* issued in 1999 (in line with the ***United Nations International Framework. Classification*** *for* ***Reserves/Resources - Solid Fuels*** *and* ***Mineral*** *Commodities)* , recoverable reserves refer to the amount of resources that can be exploited from proved reserves under present economic and production conditions. It is calculated by multiplying proved reserves by the recovery ratio. As technological advances are made the recoverable reserves will increase. Proved reserves are defined as the amount of resources that can be exploited using existing technology and as regards local conditions. In 2014, China had 3.43 billion tons of remaining recoverable reserves of oil.

19. Raw coal and salable coal

Raw coal is coal once gangue (including impurities such as pyritic sulfur) has been removed. Gross coal refers to coal before any processing has taken place once it has been mined. Salable coal is washed and screened (where impurities such as ash and sulfur are removed) raw coal. Coal production in China is a measure of raw coal, whereas other countries use salable coal. In 2014, the proportion of salable coal in raw coal was 86% in the US, 81% in Australia and 76% in Poland. In the same year, coal production in China was 3,974 Mt (raw coal) or 3,320 Mt (salable coal).

20. Comprehensive energy consumption per unit product

This refers to the amount of energy consumed per unit product; it includes primary energy, secondary energy and energy consumed during energy generation. The latter two are calculated using coal equivalent. The unit of comprehensive energy consumption is usually standard coal equivalent /kilogram .

The comprehensive energy consumption simply shows how much energy a particular enterprise consumes; however, different products or the same product manufactured using different technologies can consume vastly different amounts and kinds of energy. For example some products rely on coal, others will use other sources of energy from the electricity supply. Thus the real benefits of energy-saving efforts are not from this indicator. For that reason it is recommended to separately calculate electricity and fuel consumption per unit product.

Since 2006, China started using a calorific value calculation method to replace coal equivalent method for comprehensive energy consumptions. Other countries use the coal equivalent method. In China in 2012, the comprehensive energy consumption of large- and medium-sized iron and steel enterprises was 602.7 kgce/t (using the calorific value method), which was lower than the global advanced level of 610 kgce/t (using the coal equivalent method). In 2012, the comprehensive energy consumption for China's steel industry was 674 kgce/t in China (using the coal equivalent method), 11% higher than the global advanced level.

21. Gross coal consumption rate

Coal consumption or heat consumption in electricity generation refers to the amount of standard coal equivalent (calculated by calorific value) consumed per kilowatt generated. This will depend on the energy mix and unit capacity. Consumption rate is relatively low in oil-fired and gas-fired power plants. In China in 2010, coal consumption in electricity generation was 312 gce/kWh and 333 gce/kWh for electricity supply. Coal made up 94.3% of thermoelectric power plants; oil, 0.5% and gas, 2.3%. In Italy, one of the leading countries in this area, coal consumption in electricity supply was 275 gce/kWh with coal making up 17.5%; oil, 9.9%; and gas, 70.9% of thermoelectric power generation.

22. Loss factor of electricity transmission

This is the loss of power during transmission and distribution in a defined period of time. According to domestic statistics, in rural areas, most electricity is sold in bulk, thus the losses from low voltage distribution (which are about 12%) are not included in national statistics. The actual loss factor is much higher than reported (6.64% in 2014).

23. Comparable energy consumption of steel

Chinese methods of calculating comprehensive energy consumption in the production of steel are different from internationally-accepted methods. International calculations usually include the main procedures, such as sintering, puddling, casting, and metal rolling, but in China auxiliary processes are also included, such as refractory material, carbon, coking and machine maintenance. In order to compare, the comprehensive energy consumption calculated by international method is called comparable energy consumption.

In 2013, the comparable energy consumption of steel in China was 662 kgce/t, 9% higher than the leading global level of 610 kgce/t.

24. Energy consumption per unit energy factor for petroleum refining

Energy factors are a measure of processing in oil refineries. A higher processing means a higher unit energy consumption, so unit energy consumption is not a comparable indicator. It is international practice to use the energy consumption per unit energy factor as a comparable indicator. Energy factors are calculated from unit energy consumption and the composition of the oil refining equipment. According to *The Norm of Energy Consumption Per Unit Product for Petroleum Refining* (GB-30251-2013) implemented on September 1, 2014 in China, energy consumption per unit energy factor for current oil refineries should be no more than 11.5 kgoe/t, unit comprehensive energy consumption for newly-established enterprises should be no more than 63 kgoe/t and energy consumption per unit energy factor should be no more than 8 kgoe/t.

25. Product physical energy efficiency

This is the ratio of effective energy consumption during the production process to the energy supplied at the beginning. Product physical energy efficiency = theoretical energy (or electricity) consumption of the product / actual energy (or electricity) consumption. For example, the comparable energy consumption of steel was 681 kgce/t in 2010 in China, whilst the theoretical energy consumption was 440 kgce/t and energy efficiency, 65%. The same data for production of electrolytic aluminum was 13,979 kWh/t, 6,330 kWh and 45%.

26. High-grade cement

High-grade cement is graded higher than 42.5 (42.5R, 52.5R, 62.5, 62.5R). 42.5 cement represents a ratio of 1:3 for cement to sand and compressive strength of the test cubic (7.07×7.07×7.07cm) is 42.5MPa when it is fully hardened. Replacing low-grade (32.5) with high-grade cement means 15% less cement needs to be used. In 2013, the proportion of high-grade cement production in China was 40%.

27. Sheet glass weight-box

This is a unit of measurement for sheet glass. One weight case is 50 kg of sheet glass, 2 mm-thick and with a volume of 10 m^2.

28. Standard brics

This is a unit of measurement for bricks. The dimensions of a standard brick is 240×115×53 mm including a 10 mm-thick brickwork joint, and a length:width: thickness ratio 4:2:1.

29. Conversion t-km

Conversion t-km = freight t-km + passenger kilometers×conversion coefficient. Conversion coefficient of railway passenger transportation is 1 t per person; highway passenger transportation is 0.1 t per person; sea passenger transportation is 1 t per person; domestic route civil aviation passenger transport is 72 kg per person; and international routes 75 kg per person.

30. Product raw material mix

This describes the percentage of raw materials in the output of a product. The composition will have a significant impact on energy consumption. For example, unit product energy consumption of synthetic ammonia from coal is 30% higher than that of natural gas. In 2013, coal was 76% of the raw materials used to produce

synthetic ammonia, while the proportion for natural gas was 21%. Comprehensive energy consumption was 1,532 kgce/t. In the US, natural gas made up 98% of the raw materials used in synthetic ammonia production and the comprehensive energy consumption was 990 kgce/t.

31. Heating Degree Day (HDD)

This is defined as the number of degrees that a day's average temperature outdoors is below the standard base temperature – 18℃ is used internationally. It is an average outdoor temperature index to calculate and evaluate the energy needed for heating or cooling. For those days with an average temperature below standard base temperature, HDD will be calculated. For example, the heating degree day is 21 (18-(-3)=21) if daily average temperature is -3℃. Accumulated weekly or monthly figures are also used.

HDD are higher in Chinese cities compared with European and North American cities at similar latitudes. The average HDD for Harbin (45.7°N) is 5,578; Changchun (43.6°N) is 5,172; Shenyang (41.8° N) is 4,291; and it is 3,076 in Beijing (39.8°N). While in Berlin, Germany (52.5°N) it is 3,420 and it is 2,924 in Vancouver, Canada (49.2°N). This indicates that the winter in China is much colder, therefore buildings' energy-saving practices and how to improve the comfort level of buildings are more important issues to address.

32. Energy efficiency ratio (EER)

This measures the cooling efficiency of air conditioners under a given condition and national regulations; and is a ratio of the cooling capacity to the effective power input; the unit is W/W.

33. External costs

These describe the environmental and social costs from manufacturing and the price paid to guarantee energy supply. The environmental cost of coal is the damage it causes to the environment and public health during mining, processing, storage, transportation and burning. This includes air, water, soil pollution and the associated damage to land, water resources, ecosystems, buildings, and human health.

34. Differential electricity pricing

In China, energy-intensive industries (electrolytic aluminum, ferroalloy, calcium carbide, caustic soda, cement, iron and steel, yellow phosphorus and zinc smelting) are charged different rates for electricity. Normal electricity price is charged to "permitting category" industries and "encouraging category" industries, while RMB0.2 per kWh is added to "limiting category" industries, and RMB0.3 per kWh is added to "phasing-out category" industries. In 2014, the "phasing out category" surcharge was raised to RMB0.4 per kWh.

35. Staggered electricity prices (residential)

In this mechanism the price per KW is raised for higher electricity usage to encourage domestic consumers to use less energy, thereby reducing emissions. China rolled out trials of this pricing mechanism across the country in July 2012. Under this system 80% of households did not end up paying a higher price because their power consumption was not high enough. The bars were set at different amounts for different locations; for example in Shanghai it was 260 KWh, in Beijing, 240 KWh, Sichuan 180 KWh and Shaanxi, 150kWh.

36. Range pole electricity pricing

This pricing system accelerates market-oriented reforms. Based on the price during the operational period, China uses unified pricing based on the average cost for new electricity projects in a certain area or province.

37. Renewable energy electricity price

This refers to the higher cost of renewable energy over fossil fuel generated power. This additional part of price for renewable resources has increased from RMB0.004 per per kWh to RMB0.008 per per kWh since December 1st, 2011. Since September 5, 2013, it was raised up to RMB0.015 per per kWh.

38. Two-part price system for space heating

In China, the cost of centralized heating is calculated in two parts. The first is related to the investment needed for the construction, maintenance and management of the heating system, and the second part is related to the heat used and operational costs. Since the heating system is constructed based on the maximum heating load that can be supplied, which needs to be operated no matter the households use it or not, or how much they use, therefore the first part is fixed and shared by all household users.

39. Energy consumption subsidies

The International Energy Agency (IEA) calculates this using the price difference method, which measures the difference between end users and the base price.

Energy consumption subsidies usually include the following items: (1) trading measures: quotas, technical restrictions and tariffs; (2) regulations: price controls, demand assurance (for example in giving preference to the use of domestic coal in electricity generation) mandatory distribution rate; (3) taxes: mining fees, tariffs, income tax; (4) credit: low-interest loans; (5) direct fiscal appropriation: subsidies for producers and consumers; (6) risk transfer: limit to financial liabilities; (7) government subsidies and investment into energy infrastructure and research and development.

According to the IEA study, China paid out USD25 billion in energy subsidies in 2005 and the average subsidy rate for all kinds of energy was 11%. Without subsidies, China would have consumed 14% less energy. In 2010, subsidies came to USD21 billion.

International Organizations

Organization for Economic Cooperation and Development (OECD)

In 1948, 18 European countries formed the Organization for European Economic Cooperation (OEEC) to carry out the Marshall Plan. Just over a decade later, the OEEC, joined by the US and Canada, launched the Organization for Economic Cooperation and Development (OECD) in September 1961 with its headquarters in Paris. Currently, the OECD has 34 member states: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, South Korea, Luxembourg, Mexico, Holland, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, UK, US, Chile, Estonia, Israel and Slovenia. The last four countries joined in 2010. By 2014, the population of OECD countries reached 1.25 billion with a combined GDP of US$43.08 trillion.

The goals of the OECD are to promote sustainable economic development and jobs creation in member countries, improve living standards and maintain financial stability and to assist healthy economic growth in both member and non-member states.

International Energy Agency (IEA)

The International Energy Agency (IEA) was established after the first oil crisis in 1973, under a US initiative in November 1974, with its headquarters in Paris. It is an international body responsible for overseeing the the global energy sector under the OECD framework. Its aims are: (1) to prevent the disruption of oil supplies; (2) guide global energy policy; (3) maintain data on the international oil market; (4) promote the development of alternative energy resources and improve energy utilization.

The 29 member countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, South Korea, Luxembourg, Holland, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, UK and US.

European Union (EU)

The EU came out of the European Community and was established in November 1993. Initially it was 12 member states: France, Germany, Italy, Holland, Belgium, Luxembourg, UK, Denmark, Ireland, Greece, Spain and Portugal. Sweden, Finland and Austria joined in January 1995; Poland, Czech Republic, Hungary, Slovakia, Slovenia, Lithuania, Latvia, Estonia, Malta and Cyprus joined in May 2004; Bulgaria and Romania joined in January 2007; and Croatia joined in July 2013,. There are currently 28 member countries, covering an area of 4.6 million square kilometers. In 2014, the population of all EU countries was 507 million with a combined GDP of US$ 17.6 trillion.

On January 1, 2002, the Euro became the official currency for 12 member states (currently 19 countries have adopted the Euro). Its headquarters are in Brussels.

World Energy Council (WEC)

The World Energy Council (WEC) grew out of the World Power Conference in 1924. It was renamed the World Energy Conference in 1968 and became the World Energy Council in 1990. It now has 98 members. Its mission is to research and provide suggestions on energy-related issues for public and energy policy makers. It focuses on the following issues: energy and the environment, energy resources, energy and the public, economics, efficiency and conservation. Its main goal is the promotion of energy development that is both sustainable and beneficial to society.

Its headquarters are in London and in 1985, China joined the WEC Executive Council.

Organization of Petroleum Exporting Countries (OPEC)

In September 1960, Iraq, Iran, Kuwait, Saudi Arabia and Venezuela established the Organization of Petroleum Exporting Countries in Baghdad following a meeting to discuss western oil companies. Its headquarters are in Vienna. There are 12 member states: the five founding nations, Iraq, Iran, Kuwait, Saudi Arabia, Venezuela, and Algeria, Angola, Ecuador, Libya, Nigeria, Qatar and The United Arab Emirates.

OPEC's mission is to coordinate and unify oil policies among its member states and to safeguard their

common interests. By the end of 2014, recoverable reserves of petroleum in OPEC members were 170.5 billion tons, or 71.6% of the world total. In 2014, oil production reached 1,729.6 Mt (41.0% of the world total).

Units

1. Energy

tce	Tons of standard coal (tons of coal equivalent). Standard coal is used as a measure of energy based on the coal equivalent value. 1kgce=7000kcal=29307kJ
Mtce	Million tons of coal equivalent
kgce	Kilogram of coal equivalent
gce	Gram of coal equivalent
toe	Tons of oil equivalent. It is used as a measure of energy based on the oil equivalent value. 1kgoe=10000kcal=41816kJ
Btu	British thermal unit, 1Btu=252cal=1055J
kcal	Kilocalorie
Mt	Million tons
st	Short ton, 1st=2000Ib=907.185kg
MW	Thousand kilowatts (megawatt)
GW	Million kilowatts (gigawatt)
TW	Billion kilowatts (terawatt)
kWh	kilowatt hour
GWh	gigawatt hour
TWh	terawatt hour

2. Conversions

(1) China

Items	Average lower calorific value	Conversion factor of standard coal
Raw coal	20908 kJ(5000 kcal)/kg	0.7143 kgce/kg
Cleaned Washed coal	26344 kJ(6300 kcal)/kg	0.9000 kgce/kg
Other washed coal		
Middling	8363 kJ(2000 kcal)/kg	02857 kgce/kg

Slimes	8363kJ(2000-3000 kcal)/kg	02857-0.4286 kgce/kg
Coke	28435 kJ/(6800 kcal)/kg	0.9714 kgce/kg
Crude oil	41816 kJ/(10000 kcal)/kg	1.4286 kgce/kg
Fuel oil	41816 kJ/(10000 kcal)/kg	1.4286 kgce/kg
Gasoline	43070 kJ/(10300 kcal)/kg	1.4714 kgce/kg
Kerosene	43070 kJ/(10300 kcal)/kg	1.4714 kgce/kg
Diesel	42652 kJ/(10200 kcal)/kg	1.4571 kgce/kg
Liquefied petroleum ga, LPG	50179 kJ/(12000 kcal)/kg	1.7143 kgce/kg
Refinery gas)	45998 kJ/(11000 kcal)/kg	1.5714 kgce/kg
Natural gas	38931 kJ/(9310 kcal)/m^3	1.3300 kgce/m^3
Coke oven gas	16726-17981 kJ/(4000~4300 kcal)/m^3	0.5714-0.6143 kgce/m^3
Other coal gas		
By furnace	5227 kJ/(1250 kcal)/m^3	0 1786 kgce/m^3
By heavy oil catalytic cracking	19235 kJ/(4600 kcal)/m^3	0.6571 kgce/m^3
By heavy oil thermal cracking	35544 kJ/(8500 kcal)/m^3	1.2143 kgce/m^3
Coke gas	16308 kJ/(3900 kcal)/m^3	0.5571 kgce/m^3
By pressure gasification	15054 kJ/(3600 kcal)/m^3	0.5143 kgce/m^3
Water coal gas	10454 kJ/(2500 kcal)/m^3	0.3571 kgce/m^3
Coal tar	33453 kJ/(8000 kcal)/kg	1.1429 kgce/m^3
Benzene	41816 kJ/(10000 kcal)/kg	1.4286 kgce/m^3
Heat (in caloritic value)		0.03412 kgce/MJ (0.14286 kgce/1000 kcal)
Power (heat value equivalent)	3596 kJ/(860 kcal)/kW·h	0.1229 kgce/kW·h
(equal in heat value)	Calculated by consumption of standard coal for thermal power generation	
Biomass energy		
Night soill	18817 kJ/(4500 kcal)/kg	0.643 kgce/kg
Cow dung	13799 kJ/(3300 kcal)/kg	0.471 kgce/kg
Pig dung	12545 kJ/(3000 kcal)/kg	0.429 kgce/kg
Sheep, donkey, horse and mule dung	15472 kJ/(3700 kcal)/kg	0.529 kgce/kg
Poultry manure	18817 kJ/(4500 kcal)/kg	0.643 kgce/kg

Soybean stalk, cotton stalks	15890 kJ/(3800 kcal)/kg	0.543 kgce/kg
Paddy straw	12545 kJ/(3000 kcal)/kg	0.429 kgce/kg
Wheat straw	14635 kJ/(3500 kcal)/kg	0.500 kgce/kg
Maize stalks	15472 kJ/(3700 kcal)/kg	0.529 kgce/kg
Fire weed	13799 kJ/(3300 kcal)/kg	0.471 kgce/kg
Leaves	14635 kJ/(3500 kcal)/kg	0.500 kgce/kg
Firewood	16726 kJ/(4000 kcal)/kg	0.571 kgce/kg
Biogas	20908 kJ/(5000 kcal)/kg	0.714 kgce/m3

(2) British Petroleum Company

Crude oil conversion factors

	Tonnes	Kiloliters	Barrels	US gallons	Tonnes/year
Tonnes =	1	1.165	7.33	308	—
Kiloliters =	0.858	1	6.2898	264	—
Barrels =	0.136	0.159	1	42	—
US gallons	0.00325	0.0038	0.0238	1	—
barrels/day =	—	—	—	—	49.8*

*Based on worldwide average gravity.

Petroleum products

	Barrels to tonnes	Tonnes to barrels	Kiloliters to tonnes	Tonnes to kiloliters
LPG	0.086	11.6	0.542	1.844
Gasoline	0.118	8.5	0.740	1.351
Kerosene	0.128	7.8	0.806	1.240
Gas oil/ diesel	0.133	7.5	0.839	1.192
Fuel oil	0.149	6.7	0.939	1.065

Natural gas (NG) and liquefied natural gas (LNG)

	1 billion cubic meters of NG	1 billion cubic feet of NG	1 million tonnes of oil equivalent	1 million tonnes of LNG	1 trillion British thermal unit	1 million barrels of oil equivalent
1 billion cubic meters of NG =	1	35.3	0.90	0.73	36	6.29

1 billion cubic feet of NG =	0.028	1	0.026	0.021	1.03	0.18
1 million tonnes of oil equivalent =	1.111	39.2	1	0.805	40.4	7.33
1 million tonnes of LNG =	1.38	48.7	1.23	1	52.0	8.68
1 trillion British thermal unit =	0.028	0.98	0.025	0.02	1	0.17
1 million barrels of oil equivalent =	0.16	5.61	0.14	0.12	5.8	1

Calorific equivalents

One tonne of oil equivalent equals approximately:	
Heat units	10 million kilocalories
	42 gigajoules
	40 million British thermal units
Solid fuel	1.5 tonnes of hard coal
	3 tonnes of lignite
Gas fuel	See NG and LNG table
Electricity	12 megawatt-hours
1 million tonnes of oil or oil equivalent produces about 4,400GW of electricity in a modern power plant.	

Source: BP Statistical Review of World Energy, June 2015.