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TECHNICAL NOTE

PERFORMANCE TRACKING OF CHINA'S CLIMATE ACTIONS

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EXECUTIVE SUMMARY

The Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) establishes the goal to limit the increase in the global average temperature to well below 2°C relative to preindustrial levels and to pursue efforts to limit the temperature increase to 1.5°C. As part of the common effort, China submitted its Intended Nationally Determined Contributions (INDC), titled *Enhanced Actions on Climate Change*, to the UNFCCC secretariat. With the Paris Agreement coming into effect on November 4, 2016, the document (hereinafter referred to as "NDC") took legal effect. China must now take practical measures to achieve the goals it set forth in its NDC. Main goals include reducing carbon dioxide (CO_2) emissions per unit of gross domestic product (GDP) (known as "carbon intensity"), peaking its emissions around 2030, increasing its share of non–fossil fuels in primary energy consumption, and greatly expanding forest cover.

To show China's progress in combatting climate change, World Resources Institute (WRI) has developed an open data platform, *Performance Tracking of China's Climate Actions 1.0* ("the platform"). The platform tracks the country's progress in its climate change mitigation goals, improves data availability, supports decision-making, and facilitates experience sharing. The platform focuses on the main action goals of the NDC and presents the latest information as well as the development path for each goal since 2005 in graphic

CONTENTS

Technical notes document the research or analytical methodology underpinning a publication, interactive application, or tool.

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form. The platform also tracks China's progress in its goals related to CO_2 emissions, non–fossil fuel consumption, and forest cover established in the *12th and 13th Five-Year Plans*.

All data in the platform is public data or is calculated based on public data. Carbon dioxide emissions data are calculated based on open energy consumption data and include only emissions from fossil fuel combustion. The outcomes of WRI calculations may differ by 1–2 percent from National Inventory data and are for reference only; they do not represent official information. WRI will continue to improve data sources and corresponding calculation methods as it further develops the platform. We also will incorporate more topics and functions. For example, we will add a blog to publish in-depth analysis of issues related to climate change.

According to our analysis of data for the period 2010–2015, the rate of decrease in China's carbon intensity of GDP, the proportion of non–fossil fuels used in primary energy consumption, the forest stock volume, and the forest coverage rate all progressed to meet the 2015 goals set in the *12th Five-Year Plan*. Going forward, we will continue to track the NDC goals for 2030. Furthermore, our analysis indicates that, if the slowdown in China's GDP growth rate accelerates (that is, GDP grows more slowly between 2017 and 2030 than it did in the previous decade), CO_2 emissions could peak earlier and the inflection point could be achieved by 2030.

This technical note is a supporting document for the WRI platform. It elaborates upon the methodology and data sources used to track each goal and analyze the tracking results to better assist readers in understanding the contents of the platform. The objective of the platform is to provide useful data and information to help the country, provinces, and cities of China reach their emissions peak at an earlier date, with a lower overall peak level.

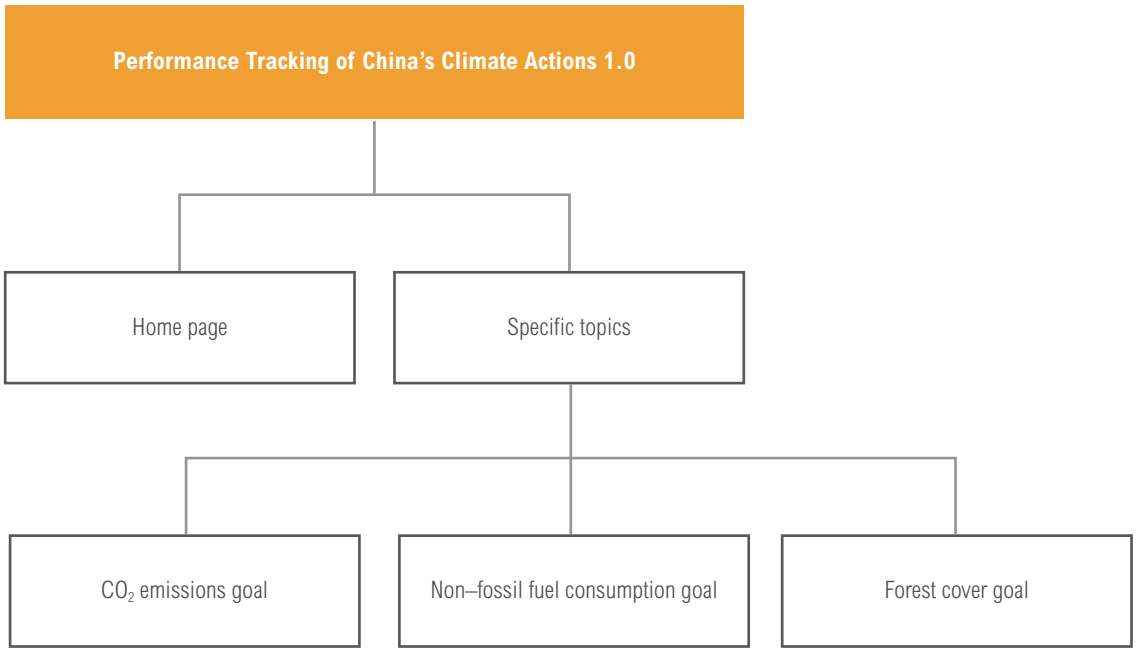
RESEARCH BACKGROUND

On June 30, 2015, China submitted *Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions* (INDC) to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). On November 4, 2016, the Paris Agreement came into force, and contracting parties were to begin taking appropriate mitigation measures to achieve the objectives set out in the agreement. The Paris Agreement stipulates that each contracting party may adjust their existing INDC from time to time to strengthen their contribution. It also stipulates that each nation shall report their contribution every five years. In addition, it encourages parties other than developed countries to report relevant "indicative quantitative and qualitative information" every two years.

To show China's progress in combatting climate change, as well as the country's corresponding contribution to achieving the goal of keeping the average global temperature rise to well below 2°C above preindustrial levels by the end of this century, and to pursue efforts to limit the temperature increase to 1.5°C, World Resources Institute (WRI) has developed an open data platform called *Performance Tracking of China's Climate Actions 1.0* ("the platform"). The platform tracks China's progress on meeting its goals to mitigate climate change, helping to improve data availability, support decision-making, and facilitate experience sharing. The platform focuses on the main action goals of the NDC and presents the latest status and development path of each goal in graphic form. See Figure 1 for the framework of the platform:

This technical note serves as a supporting document for the platform and mainly describes the data sources and methodologies under the special topics of the platform to give readers a better understanding of the contents of the platform. Chapter 2 reviews the main targets related to climate change in detail. Chapters 3 through 6 describe the tracking of each target, including methodologies, data descriptions, and results analysis. Chapter 7 summarizes the limitations of this study as well as plans for further improvements. It should be noted that under the special topic of the carbon emission goal, the platform currently only shows the Chinese government's public data (2005 and 2012). In this note, WRI provides the time series data and correlation analysis since 2005 based on its calculations, which complements information other

Figure 1 | **Framework of the Platform**



Source: WRI China.

than the national public data. The difference between China's official data and WRI calculations is modest; the latter are provided for reference and do not represent the official information.

CHINA'S CLIMATE ACTIONS

In submitting its Intended Nationally Determined Contributions (NDC), China made a further set of commitments to the international community beyond those it made in 2009, with targets now set for both 2020 and 2030. Considering these two international commitments, this note focuses on tracking the following targets:

- **Carbon dioxide (CO_2) emissions intensity target:** Cut CO_2 emissions per unit of gross domestic product (GDP) by 40–45 percent of 2005 levels by 2020; cut CO_2 emissions per unit of GDP by 60–65 percent of 2005 levels by 2030.
- **CO_2 emissions peak target:** China's CO_2 emissions to peak around 2030; China will strive to achieve this target as early as possible.
- **Non–fossil fuel consumption target:** By 2020, non–fossil fuel consumption to account for about 15 percent of primary energy consumption; by 2030, non–fossil fuel consumption to account for about 20 percent of primary energy consumption.
- **Forest cover target:** By 2020, raise forest area by 40 million hectares compared with that in 2005 and raise the forest stock volume by 1.3 billion cubic meters compared with that in 2005. By 2030, raise the forest stock volume by 4.5 billion cubic meters compared with that in 2005.

China also established targets regarding CO_2 emissions, non–fossil fuel consumption, and forest cover in the *12th and 13th Five-Year Plans*. This note also will look at China's performance during the *12th* and *13th Five-Year Plan* periods.

Based on the targets outlined in Table 1, this note reviews China's performance on each target since 2005, including CO_2 emissions (excluding other greenhouse gases), non–fossil fuel consumption, and forest cover. The platform also will track and update

Table 1 | **Summary of China's Main Climate Action Targets**

	2030 NDC Target	2020 Target	*13th Five-Year Plan* Target	*12th Five-Year Plan* Target
CO_2 Emissions per unit of GDP	Reduce by 60–65 percent from 2005 levels	Reduce by 40–45 percent from 2005 levels	Reduce by 18 percent from 2015 levels	Reduce by 17 percent by from 2010 levels
Non–Fossil Fuel Consumption Share of Primary Energy Consumption	Reach 20 percent by 2030	Reach 15 percent by 2020	Reach 15 percent by 2020	Reach 11.4 percent by 2015
Forest Cover	—	Increase by 40 million hectares from 2005 levels	—	—
Forest Growing Stock	Raise by 4.5 billion cubic meters compared with 2005	Raise by 1.3 billion cubic meters compared with 2005	Reach 16.5 billion cubic meters by 2020	Reach 14.3 billion cubic meters by 2015
Forest Coverage Rate	—	—	Reach 23.04 percent by 2020	Reach 21.66 percent by 2015

Source: Data from NDC, 12th Five-Year Plan and 13th Five-Year Plan, aggregated by WRI China.

the performance on a regular basis as data becomes available in relevant yearbooks.

CO_2 EMISSIONS INTENSITY TARGET TRACKING

Methodology

CO_2 emissions intensity measures the level of CO_2 emissions per unit of GDP. The platform tracks the rate of decrease compared with targets in the NDC and other areas. The calculation is as follows:

Formula 1:

$$\text{Rate of decline of } CO_2 \text{ emissions per unit of GDP}_{Tracking\ year} = 1 - \frac{CO_2 \text{ emissions per unit of GDP}_{Tracking\ year}}{CO_2 \text{ emissions per unit of GDP}_{Base\ year}} \times 100\%$$

The tracking year is the year to be measured; the base year is the reference year for comparison.

CO_2 emissions per unit of GDP are calculated as follows:

Formula 2:

$$CO_2 \text{ emissions per unit of GDP}_{Tracking\ year} = CO_2 \text{ emissions}_{Tracking\ year} \div \text{GDP (2005 constant price)}_{Tracking\ year}$$

For CO_2 emissions, official data are to be used whenever available. Otherwise, the data may be calculated as follows:

Formula 3:

$$CO_2 \text{ emissions} = \sum_{ij} \text{Activity level}_{ij} \times \text{Emission factor}_{ij}$$

Where i refers to industry, and j refers to energy category. The activity level is fossil fuel consumption by industry and by energy category. See the energy balance sheet (Table 2) and "Energy Consumption" part under Section 3.2 for detailed categories of industry and energy. Emission factor refers to the CO_2 emissions from each ton of fossil fuel combustion.

Emission factor is calculated as follows:

Formula 4:

$$\text{Emission factor}_j = \text{Average low calorific value}_j \times \text{Carbon content factor}_j \times \text{Carbon oxidation factor}_j \times \text{Mass conversion coefficient of carbon to carbon dioxide}(44/12)$$

For energy varieties where the average low calorific value cannot be obtained directly, use the following formula:

Formula 5:

$$\text{Average low calorific value}_j = \text{Calorific value per unit standard coal} \times \text{Standard coal coefficient}_j$$

For detailed notes to the parameters, see "Emission Factor" under Section 3.2 and Table 3.

Because the NDC target is based on 2005 emissions levels, a price factor will be deducted from GDP data, which will be converted to a constant 2005 price, to reflect actual GDP growth and CO_2 emissions per unit of GDP, which is converted to the 2005 constant price. The conversion is as follows:

Formula 6:

$$\text{GDP (constant 2005 price)}_{Tracking\ year} = GDP_{2005} \div \text{GDP Index}_{2005} \times \text{GDP Index}_{Tracking\ year}$$

GDP index is the gross domestic product index with 1978 as the base year for comparison (1978 = 100).

Data Description

The most critical information in tracking progress on the CO_2 emissions intensity target is CO_2 emissions data. However, data sources and the scope of data vary among different research institutions, which may lead to differences in calculation results. Therefore, this section lists the basic data used by WRI when calculating China's CO_2 emissions for reference.

Energy Consumption

In 2014, China adjusted its energy data. All energy data used in this note are the adjusted data. The energy balance data for 2005–2013 are derived from the *China Energy Statistical Yearbook* 2014, while the energy balance data for 2014 and 2015 are from the *China Energy Statistical Yearbook 2015* and the *China Energy Statistical Yearbook* 2016, respectively.

To facilitate the analysis of industry structure and energy structure in the follow-up study, this technical note uses the sum of emissions by subsector and by energy type to calculate total emissions. Activity level data used to calculate emissions are the data from the energy balance table in the national statistical yearbook. Taking the 2015 data as an example, the yellow highlighted areas in Table 2 are the energy consumption data used to calculate the emissions. Among these, blast furnace gases and converter gases are mainly from energy recycling activities in the steel industry. To avoid repeating calculations, we do not calculate emissions from these two gases. The energy consumption of "non-energy use" under the industry category is used as raw materials and basic materials directly without combustion. Therefore, this part is deducted when calculating emissions.

Emission Factor

See Formula 4 for the calculation of the emission factor. Table 3 lists each parameter value required for the calculation of the emission factor and the emission factor values calculated based on these parameters.

(1) The average low calorific value: For energy varieties superscripted with 1, we take the average low calorific value by directly referring to *2005 Research on China's Greenhouse Gas Inventories;* in other cases, the average low calorific value is calculated by Formula 5. The calorific value of 29,307 kJ/kgce is derived from the national standard *General Principles for Calculation of Comprehensive Energy Consumption* (GB/T2589-2008). The conversion factors from physical unit to coal equivalent is calculated based on the physical quantity and standard quantity of 2015 energy balance or derived from data in the *China Energy Statistical Yearbook* 2016.

(2) Carbon content factor and carbon oxidation factor: For energy varieties superscripted with 2, we take the values by directly referring to *2005 Research on China's Greenhouse Gas Inventories,* among which, the values of raw coal, cleaned coal, and other washed coal are obtained by weighted average; in other cases, values are derived from *Guidelines for the Compilation of Provincial Greenhouse Gas Inventories* (Trial) and *2006*

Table 2 | **China Energy Balance Sheet (Physical Quantity), 2015**

Item	Coal Total	Raw Coal	Cleaned Coal	Other Washed Coal	Brique-ttes	Gangue	Coke	Coke Oven Gas	Blast Furnace Gas	Conver-ter Gas	Other Gas	Other Coking Products	Petroleum Products Total	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Naphtha	Lubricants	Paraffin Waxes	White Spirit	Bitumen Asphalt	Petroleum Coke	LPG	Refinery Gas	Other Petroleum Products	Natural Gas	LNG	Heat	Electricity	Other Energy
	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(108 cu.m)	(108 cu.m)	(108 cu.m)	(108 cu.m)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^8 cu.m)	(10^4 tons)	(10^{10} kJ)	(10^8 kW•h)	(10^4 tce)
I. Total Primary Energy Supply	397073.75	396371.63	614.85	99.26	-11.99		-803.63						55188.00	54093.50	-718.52	-926.01	-654.27	669.77	632.72	20.72	-53.86	-7.06	441.89	361.84	1073.80		253.48	1654.29	1961.87		15179.41	5751.10
1. Indigenous Production	374654.16	374654.16											214.58	21455.58														1346.10			15303.85	5751.10
Hydro Power																															11302.70	
Nuclear Power																															1707.89	
Wind Power																															1857.66	
2. Import	20406.48	20401.30			5.18		0.38						38824.29	33548.28	17.03	348.45	42.80	1540.40	664.72	32.56	8.49	2.21	470.59	588.76	1243.95		316.05	340.64	1961.87		62.10	
3. Domestic Airplanes & Ships Refueling in Abroad													924.33			367.93	28.65	527.75														
4. Export (–)	533.80	519.73			14.07		964.82						4373.46	286.56	589.29	1237.33	716.25	1051.69		11.84	62.35	0.42	28.70	241.92	144.15		2.96	32.45			186.54	
5. Oversea Airplanes & Ships Refueling in China (–)													754.69			389.29	15.00	350.40														
6. Stock Change	2546.91	1835.90	614.85	99.26	-3.10		160.81						-888.05	-623.80	-146.26	-15.77	5.53	3.71	-32.00			-8.85		15.00	-26.00		-59.61					
II. Input (–) & Output (+) of Transformation	-284818.72	-302290.15	5261.27	10284.23	1925.93	-11.50	44538.75	590.74	5520.91	360.31	153.19	1074.33	-2626.94	-53218.37	12103.01	3658.62	17928.02	1424.73	3934.63	113.58	161.33	147.26	2007.80	1613.62	2552.12	1570.69	3376.02	-430.66	345.57	401604.52	42841.88	-223.42
1. Thermal Power	-179318.38	-176643.54	-31.82	-2643.02		-2709.60	-5.92	-169.63	-1465.75	-113.46	-2.80		-265.54	-12.46	-0.17	-0.01	-22.36	-31.52						-136.27		-50.42	-12.34	-291.59	-163.12	-59452.63	42841.88	-1058.97
2. Heating Supply	-24095.38	-23370.24	-56.03	-669.11		-725.34	-276.03	-60.85	-620.23	-45.40	-0.51		-493.21	-6.69	-0.07	-0.02	-6.22	-165.13						-150.51	-3.27	-131.71	-29.61	-61.70	-9.84	399029.66		-310.67
3. Coal Washing	-18337.66	-93395.97	59304.68	15753.63		3423.44																										
4. Coking	-60643.56	-6891.22	-53674.91	-77.43			44633.92	817.32				1183.11																				
5. Petroleum Refineries	-697.03	-518.32	-149.89	-10.82								-121.43	7133.09	-53199.22	12103.56	3658.62	18007.89	3963.01	4585.04	117.17	161.35	147.26	2016.52	1900.40	2934.42	1853.65	8883.42	-3.75				-38.86
# Petroleum Products Input (–)													-9001.28		-0.31		-51.29	-2341.63	-650.41	-3.59	-0.02		-8.72	-0.20	-379.03	-100.83	-5465.45					

Table 2 | **China Energy Balance Sheet (Physical Quantity), 2015**

Item	Coal Total	Raw Coal	Cleaned Coal	Other Washed Coal	Brique-ttes	Gangue	Coke	Coke Oven Gas	Blast Furnace Gas	Conver-ter Gas	Other Gas	Other Coking Products	Petroleum Products Total	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Naphtha	Lubricants	Paraffin Waxes	White Spirit	Bitumen Asphalt	Petroleum Coke	LPG	Refinery Gas	Other Petroleum Products	Natural Gas	LNG	Heat	Electricity	Other Energy
	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(108 cu.m)	(108 cu.m)	(108 cu.m)	(108 cu.m)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^4 tons)	(10^8 cu.m)	(10^4 tons)	(10^{10} kJ)	(10^8 kW•h)	(10^4 tce)
6. Gas Works	-1270.45	-1132.67	-130.76	-7.02			188.62	3.90			156.50	21.87																3.24				
# Coke Input (–)							-1.84					-9.22																				
7. Natural Gas Liquefaction																												-76.86	518.53			
8. Briquettes	-474.26	-338.19		-2062.00	1925.93																											
9. Recovery of Energy									7606.89	519.17																			64327.92	62027.49		1185.08
III. Loss													87.56	87.22											0.34			20.38	13.00	4875.29	2987.86	
IV. Total Final Consumption	112195.35	94027.49	5854.30	10408.35	1905.21		43774.95	588.51	5522.55	356.90	153.09	1077.23	52445.68	782.69	11367.91	2663.71	17280.44	2123.73	4573.66	133.80	108.20	142.00	2451.09	1975.82	3578.56	1576.01	3688.06	1209.66	2296.70	396778.72	55032.12	5526.78
1. Agriculture, Forestry, Animal Husbandry, and Fishery Industry	2625.00	2581.03		43.97			49.49						1733.41		231.33	1.10	1492.88	0.94							7.16			0.95		106.70	1039.83	492.73
2. Industry	90831.25	74393.53	5837.17	9281.06	1319.49		43639.19	566.70	5522.55	356.90	86.29	1077.23	16229.74	782.69	476.53	21.16	1436.50	594.75	4573.66	133.80	108.20	142.00	68.79	1975.82	731.57	1576.01	3608.26	559.36	2040.00	280611.96	38562.13	1231.53
# Non-Energy Use	9451.26	8354.15	663.69	433.43			1745.83	14.53				392.67	8254.95	135.66	9.33	1.94	27.50	131.74	4249.48	116.67	105.54	136.46	39.58	1351.11	233.99	34.20	1681.75	96.94	182.17			
3. Construction	878.06	851.29	8.09	18.68			6.68						3507.50		408.57	12.50	555.71	53.51					2382.30		15.10		79.80	2.16		903.67	698.67	35.65
4. Transport, Storage, and Post	491.60	460.97	9.04	21.59			3.02						20513.75		5306.59	2504.88	11162.80	1439.49							99.98			190.65	256.70	2809.72	1125.61	1171.85
5. Wholesale, Retail Trade and Hotel, Restaurants	3863.65	3767.18		62.08	34.39		40.06	0.91			6.14		615.70		243.29	11.68	257.74	18.95							84.04			51.29		6113.91	2122.04	92.52
6. Others	4158.66	4043.84		102.25	12.57		5.35	1.18					3683.34		2108.47	83.27	1384.15	16.08							91.36			45.44		12391.77	3918.63	298.37
7. Residential consumption	9347.13	7929.65		878.72	538.77		31.16	19.72			60.66		6162.25		2593.11	29.13	990.66								2549.35			359.81		93840.97	7565.21	2204.13
Urban	1361.50	990.12		203.44	167.94		9.17	19.72			60.46		4305.58		1804.08	3.74	549.70								1948.06			358.38		93840.97	4103.94	249.53
Rural	7985.63	6939.53		675.28	370.82		21.99				0.20		1856.67		789.03	25.39	440.96								601.29			1.43			3461.27	1954.60
V. Statistical Difference	59.68	53.99	21.82	-24.86	8.73	-11.50	-39.83	2.23	-1.64	3.41	0.10	-2.90	27.82	5.22	16.58	68.90	-6.69	-29.23	-6.31	0.50	-0.73	-1.80	-1.40	-0.36	47.02	-5.32	-58.56	-6.41	-2.26	-49.49	1.31	0.90
VI. Total Energy Consumption	397014.07	396317.64	59897.71	15877.75	1905.21	3434.94	44058.74	818.99	7608.53	515.76	156.40	1207.88	55160.18	54088.28	11368.46	2663.71	17360.31	4662.01	5224.07	137.39	108.22	142.00	2459.81	2262.60	3961.20	1858.97	9195.46	1589.14	2482.66	461106.64	58019.98	6935.28

Source: Data from China Energy Statistical Yearbook 2016.

Table 3 | CO_2 Emission Factor and Correlation Coefficient

Energy Type	Average Low Calorific Value		Carbon Content Factor (Ton Carbon/TJ)	Carbon Oxidation Factor	Calorific Value per Unit of Standard Coal (kJ/kgce)	Conversion Factor from Physical Unit to Coal Equivalent		CO_2 Emission Factor (Calculation Result)	
Raw Coal[2]	20,934	kJ/kg	26.37	92%	29,307	0.7143	kgce/kg	1.864	tons of CO_2/ton
Cleaned Coal[1,2]	26,344	kJ/kg	25.41	87%				2.142	tons of CO_2/ton
Other Washed Coal[1,2]	15,373	kJ/kg	25.41	89%				1.257	tons of CO_2/ton
Briquettes[1,2]	17,460	kJ/kg	33.56	90%				1.933	tons of CO_2/ton
Gangue[3]								0.915	tons of CO_2/ton
Coke[2]	28,469	kJ/kg	29.42	96%	29,307	0.9714	kgce/kg	2.954	tons of CO_2/ton
Coke Oven Gas[2]	16,746	kJ/m3	13.58	99%	29,307	0.5714	kgce/m3	8.252	tons of CO_2/10,000 m^3
Other Gas[2]	5,234	kJ/m3	12.20	99%	29,307	0.1786	kgce/m3	2.303	tons of CO_2/10,000 m^3
Other Coking Products	33,820	kJ/kg	22.00	93%	29,307	1.1540	kgce/kg	2.537	tons of CO_2/ton
Crude Oil[1,2]	42,620	kJ/kg	20.08	98%				3.074	tons of CO_2/ton
Gasoline[1,2]	44,800	kJ/kg	18.90	98%				3.042	tons of CO_2/ton
Kerosene[1,2]	44,750	kJ/kg	19.60	98%				3.168	tons of CO_2/ton
Diesel Oil[1,2]	43,330	kJ/kg	20.20	98%				3.147	tons of CO_2/ton
Fuel Oil[1,2]	40,190	kJ/kg	21.10	98%				3.055	tons of CO_2/ton
Naphtha[1]	45,010	kJ/kg	20.00	98%				3.235	tons of CO_2/ton
Lubricants	41,449	kJ/kg	20.00	98%	29,307	1.4143	kgce/kg	2.979	tons of CO_2/ton
Paraffin Waxes	39,998	kJ/kg	20.00	98%	29,307	1.3648	kgce/kg	2.932	tons of CO_2/ton
White Spirit	42,999	kJ/kg	20.00	98%	29,307	1.4672	kgce/kg	3.152	tons of CO_2/ton
Bitumen Asphalt	38,392	kJ/kg	22.00	98%	29,307	1.3100	kgce/kg	3.035	tons of CO_2/ton
Petroleum Coke	30,772	kJ/kg	27.50	98%	29,307	1.0500	kgce/kg	3.041	tons of CO_2/ton
LPG[1,2]	47,310	kJ/kg	17.20	99%				2.951	tons of CO_2/ton
Refinery Gas1,2	46,050	kJ/kg	18.20	99%				3.043	tons of CO_2/ton
Other Petroleum Products2	38,978	kJ/kg	20.00	98%	29,307	1.3300	kgce/kg	2.801	tons of CO_2/ton
Natural Gas[1,2]	38,931	kJ/m3	15.32	99%				21.655	tons of CO_2/10,000 m^3
LNG [1]	41,868	kJ/kg	17.20	98%				2.588	tons of CO_2/ton
Other Energy						1.0000	kgce/kg	2.770	tons of CO_2/ton

Source: Based on raw data from Research on China's Greenhouse Gas Inventories (2005), General Principles for Calculation of Comprehensive Energy Consumption, China Energy Statistical Yearbook (2016), Guidelines for the Compilation of Provincial Greenhouse Gas Inventories (Trial), Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (2006) and Guidelines for the Calculation Tool of Greenhouse Gas Emissions from Energy Consumption 2.1 (Song et al. 2013), modified by WRI China.

Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories.

In addition, the emission factor of gangue (superscripted with 3) is derived by taking reference from *Guidelines for the Calculation Tool of Greenhouse Gas Emissions from Energy Consumption 2.1* (Song et al. 2013). However, the emission factor of gangue provided by the guidelines is 2.86 tons of CO_2/ton, which requires the carbon content of the gangue to be above 78 percent, but the carbon content of the gangue is generally no more than 30 percent. Therefore, the emission factor of gangue shall be adjusted downward to 0.915 tons of CO_2/ton.

CO_2 Emissions

Since 2005, the Chinese government has published two lists of greenhouse gas emissions, namely, *The 2005 Greenhouse Gas Inventories* (see Table 4) released via *The Second National Communication on Climate Change of the People's Republic of China* (hereinafter referred to as *The Second National Communication*) in 2012; and *The 2012 Greenhouse Gas Inventories* (see Table 5) released via *The First Biennial Update Report on Climate Change of the People's Republic of China* (hereinafter referred to as *The First Biennial Update Report*) in 2016. See Box 1 for an analysis of national greenhouse gas inventories.

Table 4 | **China's Greenhouse Gas Inventories, 2005 (100 million tons of CO_2 equivalent)**

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Energy	54.04	3.24	0.40	–	–	–	57.69
Industrial Processes	5.69	0.00	0.34	1.49	0.06	0.10	7.68
Agriculture	–	5.29	2.91	–	–	–	8.20
Waste	0.03	0.80	0.28	–	–	–	1.11
Land-Use Change and Forestry (LUCF)	–4.22	0.01	0.00	–	–	–	–4.21
Total (excluding LUCF)	59.76	9.33	3.94	1.49	0.06	0.10	74.67
Total (including LUCF)	55.54	9.33	3.94	1.49	0.06	0.10	70.46

Source: Data from The Second National Communication.

Table 5 | **China's Greenhouse Gas Inventories, 2012 (100 million tons of CO_2 equivalent)**

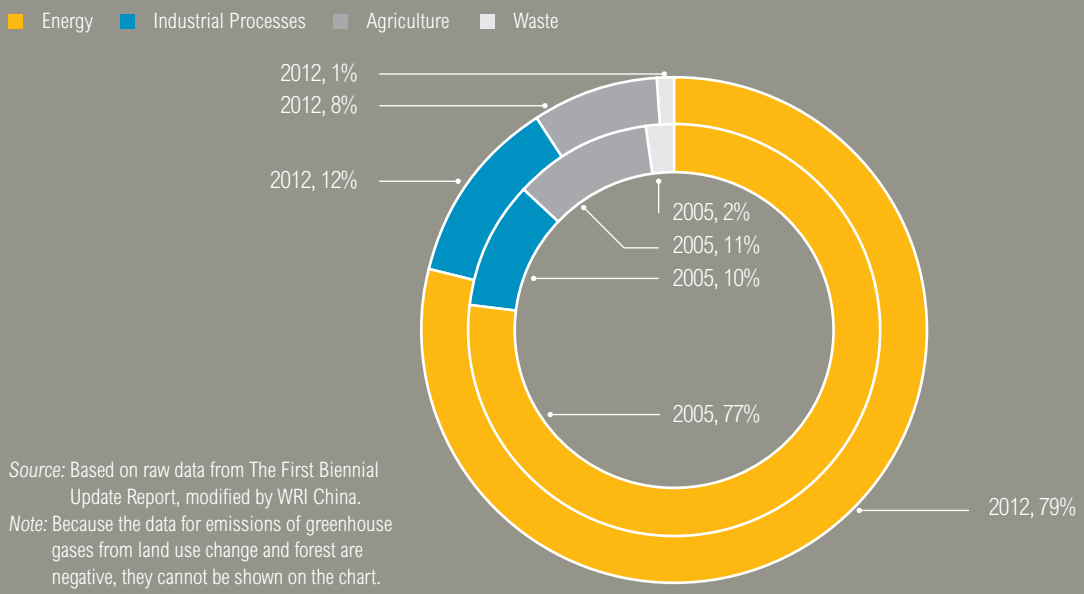
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Energy	86.88	5.79	0.69	–	–	–	93.37
Industrial Processes	11.93	0.00	0.79	1.54	0.12	0.24	14.63
Agriculture	–	4.81	4.57	–	–	–	9.38
Waste	0.12	1.14	0.33	–	–	–	1.58
Land-Use Change and Forestry (LUCF)	–5.76	0.00	0.00	–	–	–	–5.76
Total (excluding LUCF)	98.93	11.74	6.38	1.54	0.12	0.24	118.96
Total (including LUCF)	93.17	11.74	6.38	1.54	0.12	0.24	113.20

Source: Data from The First Biennial Update Report.

Box 1 | Data from National Greenhouse Gas Inventories

Based on *The Second National Communication* and *The First Biennial Update Report* published by China, WRI has compared and summarized the industry-wide all-gas emissions information between 2005 and 2012. Based on industry classification, the emissions of different industries between 2005 and 2012 can be compared, as shown in Figure 2. It can be seen that the breakdown information across various industries is generally consistent, in which energy activities are the largest source of emissions, while waste disposal produces the least amount of greenhouse gas emissions.

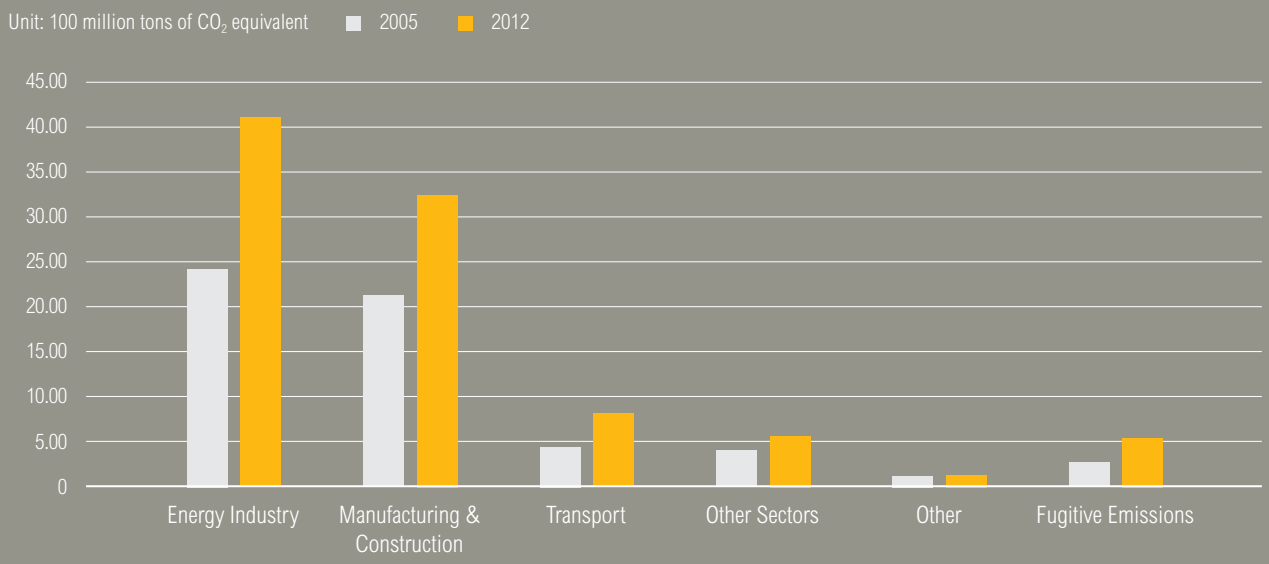
Figure 2 | Breakdown of Emissions of Greenhouse Gases by Sector: 2005 vs. 2012



Source: Based on raw data from The First Biennial Update Report, modified by WRI China.
Note: Because the data for emissions of greenhouse gases from land use change and forest are negative, they cannot be shown on the chart.

Each sector can be further broken down into subsectors for emissions comparison. Figure 3 shows the emissions information under different subsectors of energy activities. The platform also shows the relevant emissions information of the industrial processes, agricultural activities, and land use change and forestry.

Figure 3 | Emissions Information under Different Subsectors of Energy Activities



Source: Based on raw data from The First Biennial Update Report, modified by WRI China.

For the scope of gases, because the CO_2 emission intensity target proposed by China is only for CO_2 produced by the combustion of fossil fuels, other greenhouse gases will not be considered subsequently. For the scope of sectors, WRI also is consistent with the national targets, covering only emissions from energy production activities; no other industries are included. At the same time, due to data availability and other issues, WRI only has access to data related to the combustion of fossil fuels; therefore, the calculation of CO_2 emissions in this technical note can cover only energy activities. It can be seen from *The Second National Communication and The First Biennial Update Report* that energy production activities have been the largest source of CO_2 over the years. For example, the CO_2 emissions produced by energy activities in 2012 stood at 8.688 billion tons, accounting for 88 percent of total CO_2 emissions (9.993 billion tons, excluding land use change and forestry, LUCF). In 2005, the proportion was 90 percent. Therefore, it is plausible that we only analyze the CO_2 emissions from the combustion of fossil fuels in this paper.

In *The Second National Communication* and *The First Biennial Update Report*, the CO_2 emissions generated by energy activities in 2005 and 2012 stood at 5.404 billion tons and 8.688 billion tons, respectively. However, according to the notes in *The First Biennial Update Report*, in The Third National Economic Consensus completed in 2014, the official amount of energy consumption since 2000 has been revised, and the variety and scope of energy covered in the *2005 China Greenhouse Gas Inventories* is different from that in the *2012 China Greenhouse Gas Inventories*. Accordingly, China will release an updated *2005 China Greenhouse Gas Inventories* in *The Third National Communication*. Before the revision, energy consumption stood at 2.360 billion tons of standard coal in 2005; after the revision, the amount was 2.614 billion tons of standard coal, up 10.8 percent. It can be expected that 2005 CO_2 emissions numbers will be correspondingly revised upward in future official releases.

According to WRI calculations, CO_2 emissions from energy activities in 2005 and 2012 were 5.47 billion tons and 8.88 billion tons, respectively, with respective differences of 1.3 percent and 2.2 percent when compared with official data (see Table 6). It is expected that the difference between the officially revised 2005 data in *The Third National Communication* and the WRI calculation will narrow.

In addition to the aforementioned adjustments to energy statistics, another reason WRI calculations differ slightly from the official numbers is due to differences in the calculation method of WRI from its of the National Greenhouse Gas Inventories. Firstly, the National Greenhouse Gas Inventories does not use raw coal consumption. Instead, the calculation is made by subdividing the amount of raw coal into the amount of anthracite, bituminous coal, and lignite. But published energy statistics only use data for raw coal. Secondly, as mentioned earlier, when considering non–energy use, WRI only deducts the energy consumption of industrial materials used as raw materials and is unable to deduct the non–energy uses that may exist in other industries or other energy sources. When taking into account the effect of carbon sequestration in non–energy uses, it may overstate CO_2 emissions when treating non–energy uses as combustion of fossil fuels. Thirdly, the WRI calculation method does not completely eliminate the emissions from international aviation and navigation activities as calculated by the National Greenhouse Gas Inventories. Although we have deducted CO_2 emissions resulting from foreign ships and aircraft refueling domestically, we are unable to deduct emissions that result from domestic ships and aircraft refueling overseas. Therefore, the overall amount of emissions may be overstated.

Given that the WRI calculations are only 1–2 percent different from the national inventories data, in the results analysis of this technical note, we mainly will use the WRI calculations but also will show the results calculated based on official data in 2005 and 2012.

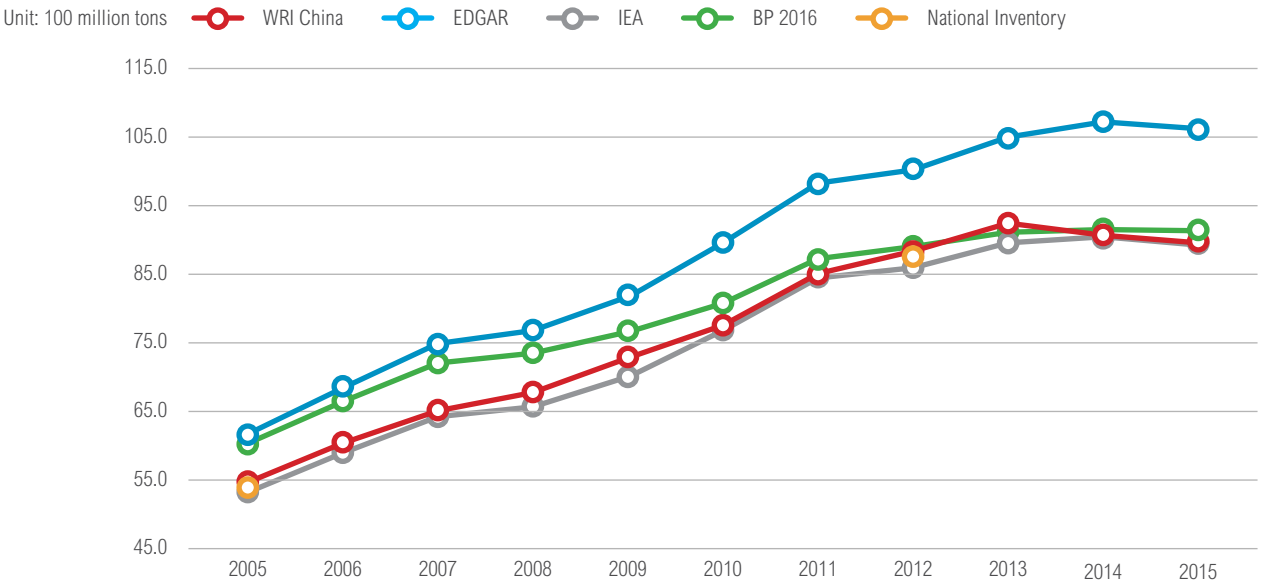
In addition, this note also compares the CO_2 emissions as calculated by WRI with the calculations of several other institutions. The CO_2 emissions calculated by the International Energy Agency (IEA) and the BP Statistical Review of World Energy 2016 are based on the CO_2 emissions generated from the combustion of fossil fuels, which are both consistent with WRI's calculation method. Data from the European Union's (EU) Emissions Database for Global Atmospheric Research (EDGAR) include not only emissions from energy activities, but also CO_2 emissions from industrial processes; therefore, the emission readings from EDGAR are higher than those of other agencies. As

Table 6 | China's CO_2 Emissions from Fossil Fuels (100 million tons)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
National Greenhouse Inventory	54.0	–	–	–	–	–	–	86.9	–	–	–
WRI Calculation	54.7	60.4	65.6	67.8	73.2	77.6	85.3	88.8	92.4	90.8	89.6
Difference	1.3%	–	–	–	–	–	–	2.2%	–	–	–

Source: Data of the National Greenhouse Inventory are derived from The Second National Communication and The First Biennial Update Report.

Figure 4 | Comparison of WRI Data with Other Institutions and National Greenhouse Gas Inventories



Source: Based on raw data from WRI China, EDGAR, IEA, BP 2016 and National Inventory, aggregated by WRI China.

Table 7 | GDP, 2005–2015 (100 million yuan)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Current Price	187,319	219,439	270,232	319,516	349,081	413,030	489,301	540,367	595,244	643,974	689,052
Conversion Factor (GDP index)	1,213	1,367	1,562	1,713	1,874	2,073	2,271	2,449	2,639	2,832	3,028
Constant 2005 Price	187,319	211,145	241,194	264,479	289,340	320,114	350,642	378,189	407,528	437,268	467,502

Source: Data from China Statistical Yearbook 2016.

shown in Figure 4, the difference between WRI data and National Greenhouse Gas Inventories is relatively small.

Gross Domestic Product

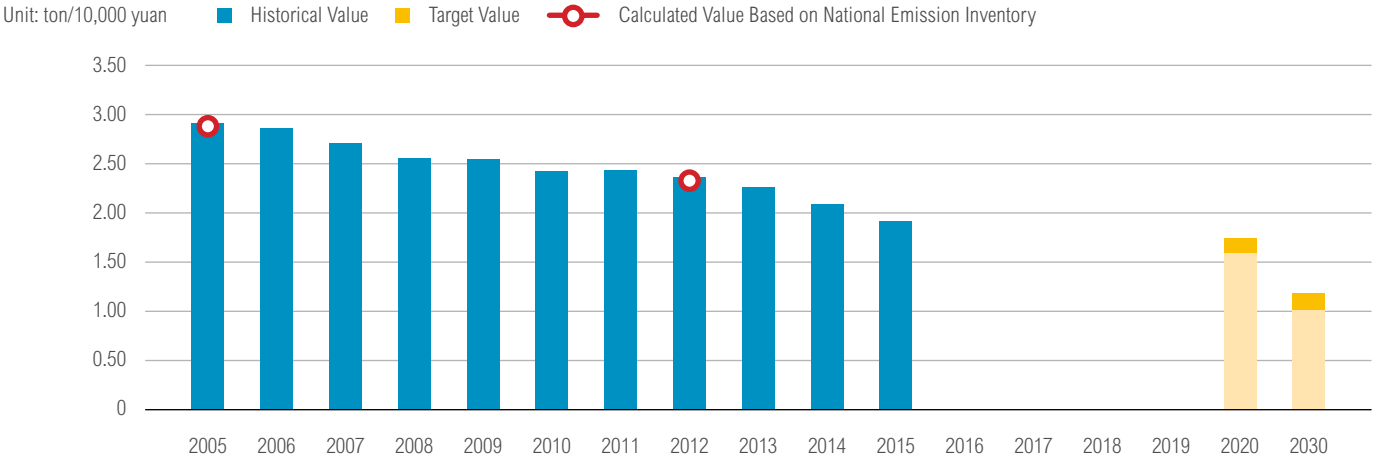
The data of current price for GDP in 2005–2015 and the GDP index are taken from the China Statistical Yearbook 2016. The constant 2005 price is the calculation data. See Table 7.

3.3 Results

According to WRI calculations, CO_2 emissions per unit of GDP were 2.92 tons/10,000 yuan in 2005. A decrease of 40–45 percent by 2020 means the CO_2 emissions per unit of GDP must decline to 1.61–1.75 tons/10,000 yuan, and a decrease of 60–65 percent by 2030 means CO_2 emissions per unit of GDP must further decline to 1.02–1.17 tons/10,000 yuan, as shown in Figure 5.

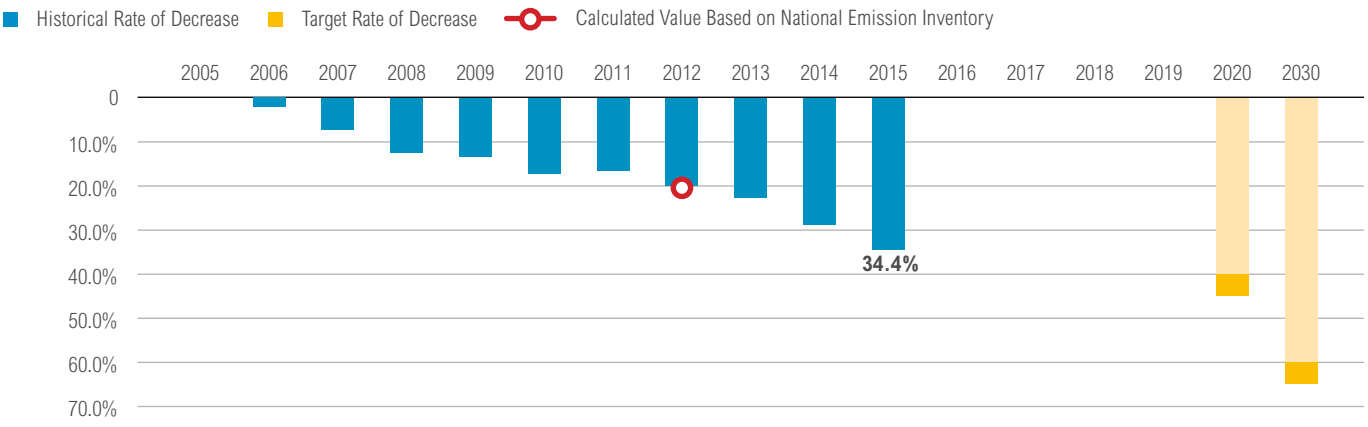
China's *12th Five-Year Plan* stipulates that by 2015, CO_2 emissions per unit of GDP must be reduced by 17 percent from 2010 levels, that is, to achieve 2.01 tons/10,000 yuan. China's *13th Five-Year Plan* shows CO_2 emissions per unit of GDP actually declined 20 percent during the *12th Five-Year Plan* period. According to WRI calculations, CO_2 emissions per unit of GDP declined 20.9 percent to 1.92 tons/10,000 yuan during the *12th Five-Year Plan* period, beating the target set in the *12th Five-Year Plan*. In 2015, CO_2 emissions per unit of GDP were down 34.4 percent from the level seen in 2005, which is nearing the 40–45 percent target for 2020, as shown in Figure 6.

Figure 5 | **Tracking Results for the CO_2 Emissions per Unit of GDP Target**



Source: WRI China.

Figure 6 | **Tracking Results for the Target Rate of Decrease of CO_2 Emissions per Unit of GDP**



Source: WRI China.

CO_2 EMISSIONS PEAK TARGET TRACKING

Methodology

For the CO_2 emissions peak target, the NDC has proposed achieving the peak by 2030, and striving to peak earlier. However, it has not established a specific emissions level for the peak. For tracking purposes, we convert the year of the peaking target into total CO_2 emissions. By mapping historical and future CO_2 emissions trends, we are able to show readers China's progress in reaching the target in an intuitive manner.

In fact, many scholars in the country have studied China's path toward reaching peak CO_2 emissions and proposed a variety of assumption scenarios. For example, a research group composed of Dadi Zhou, Jiankun He, Kejun Jiang, and other experts studied in detail the feasibility of China's reaching peak CO_2 emissions earlier. They proposed that to support the goal of keeping global temperature rise to well below 2°C above preindustrial levels by the end of this century, China would need to achieve peak CO_2 emissions from energy activities by 2025. Kejun Jiang et al. have analyzed the feasibility of achieving the peak between 2020 and 2022 from the perspectives of industry, transportation, building, and energy structure, among others, in *Analysis on the Model System for the Feasibility of Earlier Peaking of China's CO_2 Emissions* (Jiang et al. 2016). However, this technical note takes a different starting point than the above study, which mainly combines the CO_2 emissions intensity discussed in the previous chapter to simulate the possible trends in CO_2 emissions under the nation's 2020 target and NDC target for CO_2 emissions intensity.

Using Formula 2 discussed in Chapter 3, Section 3.1, CO_2 emissions are affected by change in GDP and CO_2 emissions per unit of GDP[1]. Using assumptions of GDP growth and CO_2 emissions intensity, this technical note attempts to simulate total CO_2 emissions in China from 2016 to 2030.

Data Description

- **GDP Growth**

GDP growth forecasts carry a certain level of uncertainty, and different institutions often have different views on China's future GDP growth. Table 8 lists forecasts from the Organisation for Economic Co-operation and Development (OECD), the World Bank, and others on China's average annual GDP growth every five years between 2016 and 2030. Meanwhile, the *13th Five-Year Plan* predicts China GDP to grow more than 6.5 percent between 2016 and 2020. Therefore, to balance the different forecasts, the platform will provide a range for GDP growth (plus or minus about 0.5 percent based on the maximum or minimum values in Table 8), and users can choose the average annual GDP growth (an increase of 0.1 percent) for every five years between 2016 and 2030 at their own discretion.

Table 8 | **Reference Range for Average Annual GDP Growth**

	2016–2020	2021–2025	2026–2030
OECD [2]	6.6%	4.8%	3.9%
World Bank, Development Research Center of the State Council	7%	5.9%	5%
PricewaterhouseCoopers	6.3%	3.5%	
13th Five-Year Plan	Above 6.5%		
Range for Average Annual GDP Growth	5.5%–7.5%	3%–6.5%	3%–5.5%

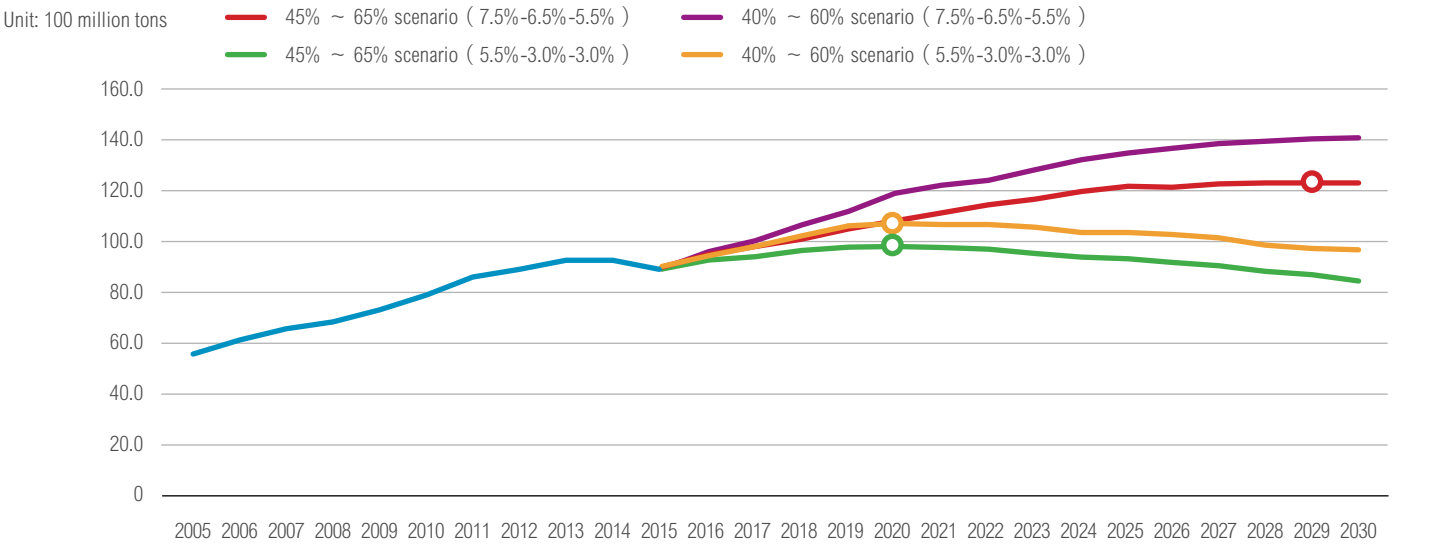
Source: Based on raw data from OECD, World Bank, PricewaterhouseCoopers and *13th Five-Year Plan*, aggregated by WRI China.

Table 9 | **Reference Values for CO_2 Emissions per Unit of GDP (ton/10,000 yuan)**

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
40%~60%	1.88	1.85	1.82	1.79	1.75	1.69	1.64	1.58	1.52	1.46	1.40	1.34	1.29	1.23	1.17
45%~65%	1.85	1.79	1.73	1.67	1.61	1.55	1.49	1.43	1.37	1.31	1.26	1.20	1.14	1.08	1.02

Source: WRI China.

Figure 7 | **Trends in China's Total CO_2 Emissions**



Source: WRI China.

In the *Statistical Communiqué of the People's Republic of China on the 2016 National Economic and Social Development* published by the National Bureau of Statistics, national GDP in 2016 was 74,412.7 billion yuan, equivalent to a constant 2005 price of 49,882.3 billion yuan. Based on the GDP growth estimates in Table 8, the annual GDP values of 2017–2030 can be calculated on the basis of 2016 GDP (constant 2005 price).

CO_2 Emissions Intensity

The CO_2 emissions intensity is simulated in two scenarios according to the interval value between the nation's target by 2020 and the NDC target. The first is a 40–60 percent scenario, where the corresponding amount of CO_2 emissions is derived according to the targeted CO_2 emissions intensity of 1.75 ton/10,000 yuan in 2020 and 1.17 ton/10,000 yuan in 2030, the CO_2 emissions intensity values between 2016 and 2019 are derived based on a linear decrease in the numerical range between 2015 and 2020, and the CO_2 emissions intensity values between 2021 and 2029 are derived based on a decrease in the numerical range between 2020 and 2030. The second is a 45–65 percent scenario, where the corresponding amount of CO_2 emissions is derived according to the targeted CO_2 emissions intensity of 1.61 ton/10,000 yuan in 2020 and 1.02 ton/10,000 yuan in 2030, and the treatment of values in the remaining years is the same as above. The CO_2 emissions intensity reference data for the two scenarios are shown in Table 9.

Results

Using the above assumptions and Formula 2, a general trend for CO_2 emissions can be calculated. Users of the platform can observe corresponding emission trends by adjusting the GDP growth rate. We will track actual emissions per year from 2016 to 2030 in follow-up research and cover the data in our figures to show the relationship between actual progress and the targets.

Formula 2 shows that CO_2 emissions and GDP growth are positively correlated; that is, faster GDP growth

will lead to higher levels of CO_2 emissions. In adjusting GDP growth assumptions, we see CO_2 emissions peak earlier in both scenarios when GDP growth is reduced. Figure 7 shows CO_2 emissions trends under the highest and lowest GDP growth rate assumptions. We see that CO_2 emissions could peak before 2030 in both scenarios when the lowest GDP growth rate is assumed. If China is able to cut its CO_2 emissions per unit of GDP by 45 percent in 2020 and by 65 percent in 2030 (its most ambitious target), CO_2 emissions will see a turning point in 2029 even when using the highest GDP growth rate assumption.

NON–FOSSIL FUEL CONSUMPTION TARGET TRACKING

As discussed in Chapter 3, energy activities have the biggest impact on CO_2 emissions. To reduce CO_2 emissions, mitigate climate change, and maintain sustainability of energy resources, it is crucial to improve the energy consumption structure and increase the proportion of non–fossil fuel consumption. This chapter tracks performance in meeting the non–fossil fuel related targets proposed by China.

Methodology

The non–fossil fuel consumption target is the share of non–fossil fuel energy used in primary energy consumption. The calculation is as follows:

Formula 7:

Share of non–fossil fuel consumption
=non–fossil fuel consumption ÷ primary energy consumption

In addition, in its *Guiding Opinions on the Establishment of a Guidance System for the Development and Utilization of Renewable Energy,* issued in March 2016, the National Energy Administration stipulates that non–hydro renewable energy must be no less than 9 percent of total power consumption by 2020. The indicator is designed to promote the development and utilization of renewable energy so as to meet the non–fossil fuel consumption target in the NDC. Therefore, the platform also will show this indicator.

Data Description

Data for 2005–2015 are mainly taken from the *China Energy Statistical Yearbook series. In China Energy Statistics Yearbook* 2016, Chapter 4-1: Total Energy Consumption and Composition shows the share of primary power and other energy in total energy consumption. The data are presented under two calculation methods: calorific value calculation method and coal equivalent calculation method. In accordance with the data calculation principles for setting the non–fossil fuel consumption target, WRI uses the results under the coal equivalent calculation method. It is worth noting that China's practice of converting the average thermal coal consumption into standard coal is not consistent with the three international common unified methods for converting primary power into primary energy units. Joanna Lewis et al. detail the differences in methodology in the paper *Understanding China's Non–fossil Energy Targets* (Lewis et al. 2015) and convert China's non–fossil fuel consumption target into international units for comparison. To show China's performance in meeting its non–fossil fuel consumption target and to be consistent with the principles of target setting, the platform is still based on the data under the Chinese calculation method. In addition to tracking the proportion of non–fossil fuel energy, the platform shows the absolute amount of energy consumption and its composition since 2005. See Table 10.

For the latest data on non–hydro renewable energy consumption in China, only the data for 2015 are available. The data are derived from the *2015 Monitoring and Evaluation Report on National Renewable Energy Power Development,* which include non–hydro renewable energy consumption, hydropower consumption, and the share of non–hydro renewable energy consumption in the total power consumption throughout the whole society. In 2015, the proportion reached 5 percent.

Results

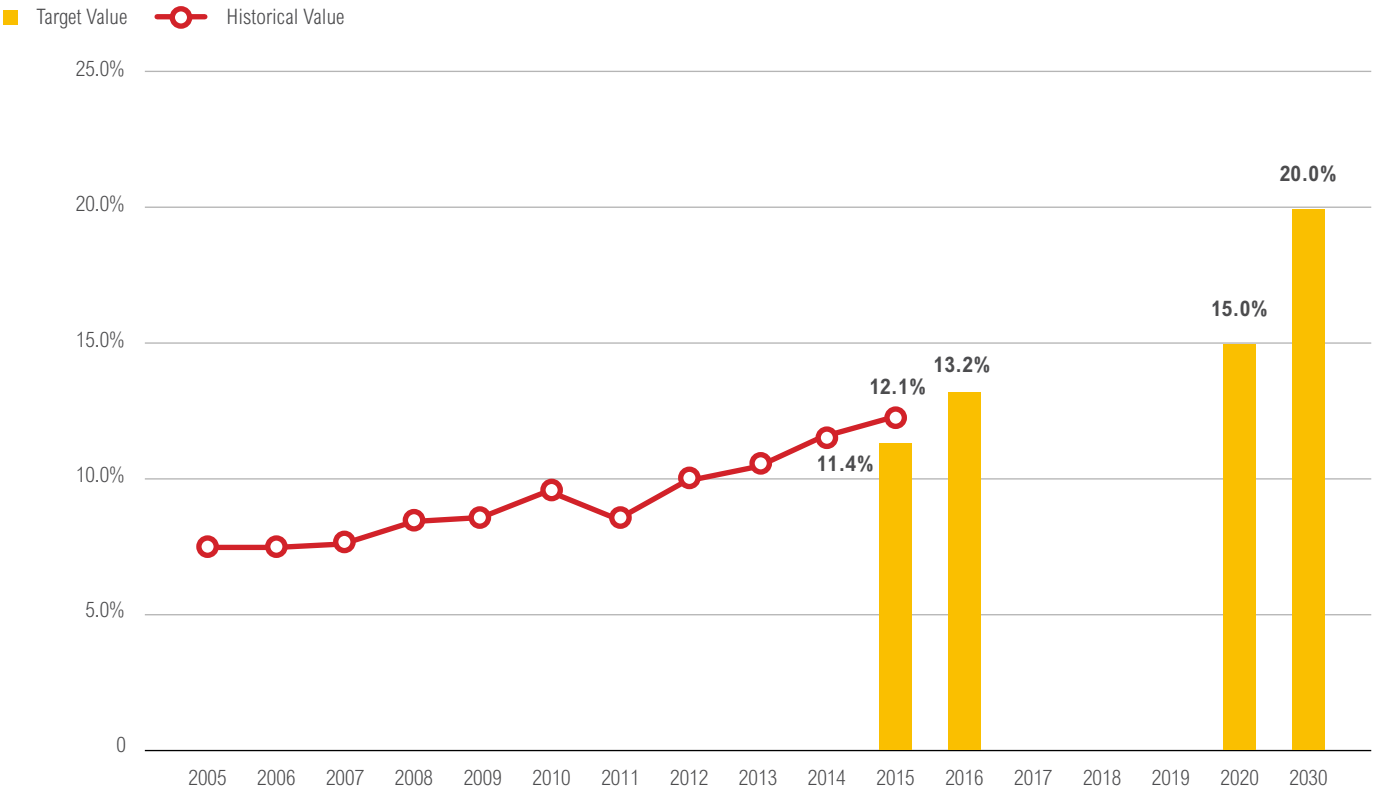
Along with the targets set in the NDC, China also targeted the share of non–fossil fuel consumption in primary energy to reach 11.4 percent by 2015 in the *12th Five-Year Plan*, while the State Energy Administration targeted the proportion reaching 13.2 percent by 2016. In Figure 8, it can be seen that the target was met in 2015, actually exceeding target set in the *12th Five-Year Plan*.

Table 10 | **China's Total Energy Consumption and Composition, 2005–2015 (10,000 tons of standard coal)**

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Energy Consumption	261,369	286,467	311,442	320,611	336,126	360,648	387,043	402,138	416,913	425,806	429,905
Coal	189,231	207,402	225,795	229,237	240,666	249,568	271,704	275,465	280,999	279,329	273,849
Petroleum	46,524	50,132	52,945	53,542	55,125	62,753	65,023	68,363	71,292	74,090	78,673
Natural Gas	6,273	7,735	9,343	10,901	11,764	14,426	17,804	19,303	22,096	24,271	25,364
Primary Electricity and Other Energy	19,341	21,199	23,358	26,931	28,571	33,901	32,512	39,007	42,525	48,116	52,019

Source: Data from China Energy Statistical Yearbooks.

Figure 8 | **Tracking Results of Non–Fossil Fuel Energy Target**



Source: Based on raw data from the China Energy Statistics Yearbook and Five-Year Plan, modified by WRI China.

During the *11th Five-Year Plan* period (2005–2010), the share of non–fossil fuel consumption in primary energy increased by 27.03 percent; in the *12th Five-Year Plan* period (2010–2015), the proportion increased 28.72 percent. Based on the five-year average growth rate of 27.88 percent[3] and a proportion of 12.1 percent in 2015, the share of non–fossil fuel consumption in primary energy will likely reach 15.47 percent by 2020 and 20 percent around 2025. This shows that the 2020 target is achievable, and that the NDC target can be met ahead of schedule. But as total energy consumption (the base number) is constantly increasing, it is unclear whether or not the growth rate for the share of non–fossil fuel energy can maintain the average rate mentioned above. Therefore, further tracking is required.

FOREST COVER TARGET TRACKING

At present, the forest targets proposed by China mainly focus on forest area, coverage rate, and stock volume, and no target has been established to restrict the carbon sinks so far. Besides, due to the complexity in calculating carbon sinks, which must take into account the age and variety of trees, this chapter only uses statistical data to track the forest targets intuitively, and the data have not been converted into carbon sink estimates so far.

Methodology

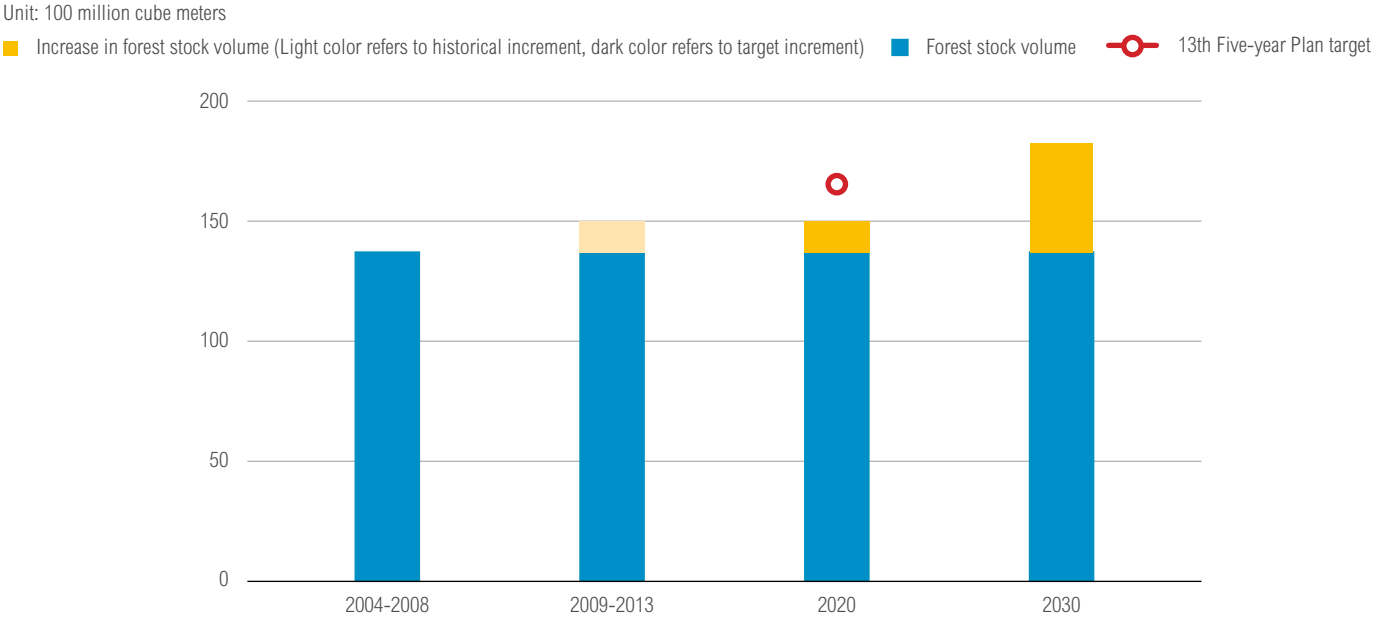
The forest targets committed by China to the international community mainly assess two indicators: forest cover and forest stock volume. The related department regularly publishes readings of the two indicators, so the target tracking method is to compare the information China publishes with the established target value.

In addition, the *12th Five-Year Plan* proposed a forest coverage rate of 21.66 percent by 2015, while the *13th Five-Year Plan* proposed a forest coverage rate of 23.04 percent by 2020. Therefore, WRI also will track the forest coverage rate.

Data Description

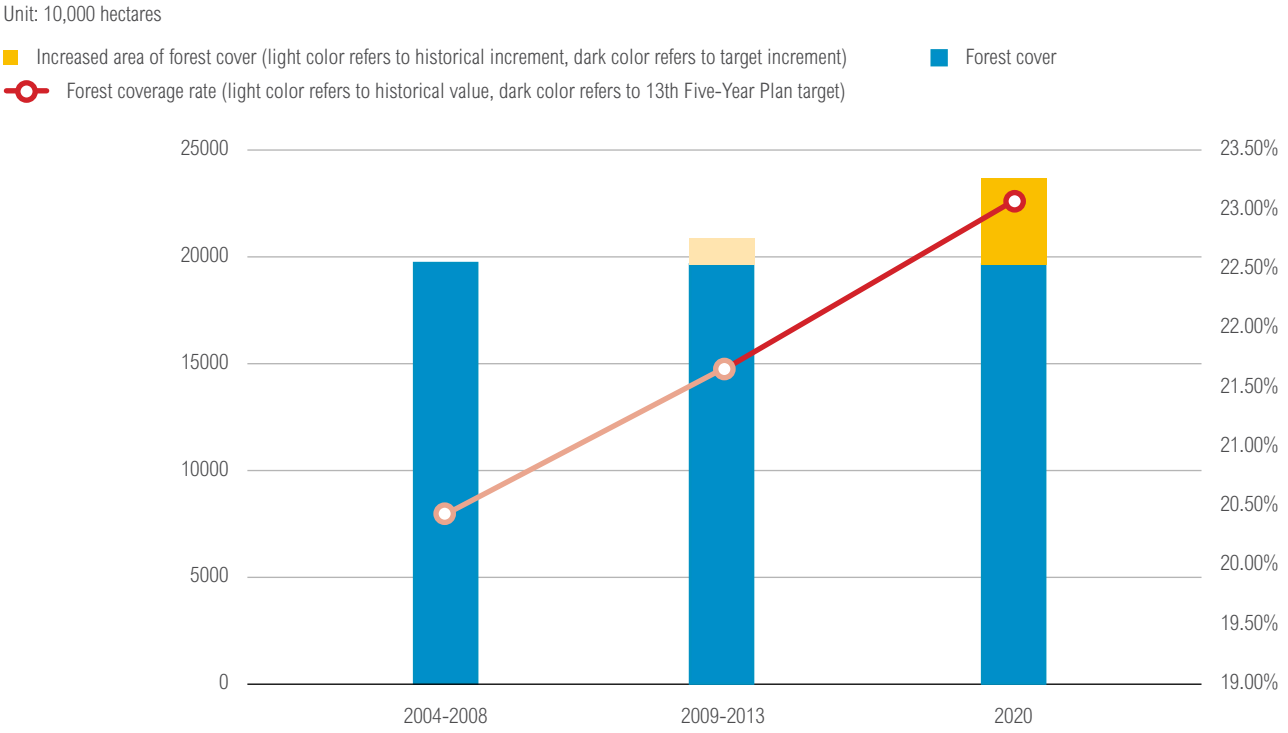
National forest data are derived from the national forest inventory in the China Forestry Database, which is updated every five years. Data from 2004–2008 are based on the 7th National Forest Inventory, while data from 2009–2013 are based on the 8th National Forest Inventory. The 9th National Forest Inventory, which was launched in 2014, is expected to be completed in 2018. Because the 9th National Forest Inventory has not been completed yet, relevant yearbooks released by the National Bureau of Statistics still use the 8th National Forest Inventory for its 2014–2015 data.

Figure 9 | **Forest Stock Volume Target Tracking Results**



Source: Based on raw data from National Forest Inventory, modified by WRI China.

Figure 10 | **Forest Cover Target Tracking Results**



Source: Based on raw data from National Forest Inventory, modified by WRI China.

Results

It can be seen from Figure 9 that China has accomplished its 2020 forest stock volume target proposed in 2009 ahead of schedule. By 2013, the nation's forest stock volume reached 15.1 billion cubic meters, up 1.4 billion cubic meters compared with 13.7 billion cubic meters in 2005, meaning the target of increasing forest stock volume by 1.3 billion cubic meters by 2020 has been achieved. Therefore, in the *13th Five-Year Plan*, the 2020 forest stock volume target has been adjusted to 16.5 billion cubic meters, indicating an increase of 2.8 billion cubic meters compared with that in 2005.

In the 8th National Forest Inventory, the forest coverage rate reached 21.66 percent during 2009–2013, meeting the coverage rate target proposed in the *12th Five-Year Plan*. Forest area has reached 207.69 million hectares, up 12.24 million hectares compared with that in 2005, but 27.76 million hectares short of the target which is to add 40 million hectares by 2020. See Figure 10. We will continue to track the performance through 2020.

LIMITATIONS AND FURTHER IMPROVEMENT PLAN

Data

The data included in this technical note cover both the national official data and the data as calculated by WRI. However, as the platform gives priority to the official data, under the special topic of CO_2 Emissions Target Tracking, we only show the CO_2 emissions intensity data for 2005 and 2012. Data for the remaining years are not disclosed on the platform and are provided only in the technical note. We will continue to check and verify the calculation of CO_2 emissions and constantly improve our data sources and the corresponding calculation methods, strive to narrow the difference with the national official data to show the data for the remaining years on the platform, and enhance the integrity and continuity of the data on the platform. At the same time, the national CO_2 emissions data presented by the technical note cover only CO_2 emissions from energy activities. In the future, more sectors of emissions will be covered, which will include CO_2 emissions from industrial production processes, land

use change, and forestry to provide a fuller picture of the nation's CO_2 emissions.

Methodology

In the section tracking the performance of meeting the peak target, current estimates of total CO_2 emissions are not used to forecast future emissions and only serve as a reference for trends in emissions levels because the parameters and assumptions used in this estimate are relatively simple and do not fully reflect the factors accounting for CO_2 emission changes. Future models will cover more relevant variables to provide more reliable results.

For target tracking, one major factor is the frequency of data updates. These depend on the time and frequency of relevant national statistics. At present, CO_2 emissions and energy data can be tracked and updated annually, but the national forest inventory is updated only every five years. As a result, in terms of timeliness, the forest target tracking is somewhat behind. In the future, we will attempt to integrate forest data from other sources into the platform, such as WRI's Global Forest Watch or the annual forest data published by the Food and Agriculture Organization of the United Nations to ensure the timeliness of our target tracking.

Scope of the Platform

The platform shows an analysis of target tracking at the national level. In the future, we will try to incorporate more topics and functions, such as blog function to publish in-depth analysis of related issues on a regular basis. For example, we may try to explore the relationship between forests and carbon sinks and then analyze the correlation between forest targets and CO_2 emission targets. We will constantly improve the platform to show information related to China's climate actions in a comprehensive manner and help the country, provinces, and cities achieve the emission peak at an earlier date, with a lower overall peak level.

ENDNOTE

1. In WRI's another technical note *Compact of Mayors Emissions Scenario Model* (Kovac et al. 2012), the authors elaborated on the analysis methodology of overall CO_2 emissions trend that they set the CO_2 emissions was affected by the change in population and emissions per capita. This technical note refers to its method and simplified assumptions and parameters in certain extent.

2. The average annual GDP growth rate for every five years between 2016 and 2030 is calculated based on the long-term GDP forecast provided by the OECD database. The reading for 2015 is US$13,325,589 million; the reading for 2020 is $17,709,685 million; the reading for 2025 is $21,987,556 million; and the reading for 2030 is $26,307,248 million.

3. Derived from the arithmetic mean value of 27.03 percent and 28.72 percent.

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

Our Challenge
Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision
We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach
COUNT IT
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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