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Inventory of China's Energy-Related CO₂ Emissions in 2008

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Executive Summary

Although China became the world's largest emitter of energy-related CO_2 emissions in 2007, China does not publish annual estimates of CO_2 emissions and most published estimates of China's emissions have been done by other international organizations. Undertaken at the request of the Energy Information Administration (EIA) of the US Department of Energy, this study examines the feasibility of applying the EIA emissions inventory methodology to estimate China's emissions from published Chinese data. Besides serving as a proof of concept, this study also helps develop a consistent and transparent method for estimating China's CO_2 emissions using an Excel model and identified China-specific data issues and areas for improvement.

This study takes a core set of data from the energy balances published in the China Energy Statistical Yearbook 2009 and China Petrochemical Corporation Yearbook 2009 and applies the EIA's eight-step methodology to estimate China's 2008 CO_2 emissions. First, China's primary and secondary fuel types and consumption by end use are determined with slight discrepancies identified between the two data sources and inconsistencies in product categorization with the EIA. Second, energy consumption data are adjusted to eliminate double counting in the four potential areas identified by EIA; consumption data from China's Special Administrative Regions are not included. Physical fuel units are then converted to energy equivalents using China's standard energy measure of coal equivalent (1 kilogram = 29.27 MJ) and IPCC carbon emissions coefficients are used to calculate each fuel's carbon content. Next, carbon sequestration is estimated following EIA conventions for other petroleum products and non-energy use of secondary fuels. Emissions from international bunker fuels are also subtracted under the "reference" calculation of estimating apparent energy consumption by fuel type and the "sectoral" calculation of summing emissions across end-use sectors. Adjustments for the China-specific conventions of reporting foreign bunkers and domestic bunkers fueling abroad are made following IPCC definitions of international bunkers and EIA reporting conventions, while the sequestration of carbon in carbon steel is included as an additional adjustment. Under the sectoral approach, fuel consumption of bunkers and other transformation losses as well as gasoline consumption are reallocated to conform to EIA sectoral reporting conventions.

To the extent possible, this study relies on official energy data from primary sources. A limited number of secondary sources were consulted to provide insight into the nature of consumption of some products and to guide the analysis of carbon sequestered in steel. Beyond these, however, the study avoided trying to estimate figures where directly unavailable, such as natural gas flaring. As a result, the basic calculations should be repeatable for other years with the core set of data from National Bureau of Statistics and Sinopec (or a similarly authoritative source of oil product data).

This study estimates China's total energy-related CO_2 emissions in 2008 to be 6666 Mt CO_2 , including 234.6 Mt of non-fuel CO_2 emissions and 154 Mt of sequestered CO_2 . Bunker fuel emissions in 2008 totaled 15.9 Mt CO_2 , but this figure is underestimated because fuel use by Chinese ship and planes for international transportation and military bunkers are not included. Of emissions related to energy consumption, 82% is from coal consumption, 15% from petroleum and 3% from natural gas. From the

sectoral approach, industry had the largest share of China's energy-related CO_2 emissions with 72%, followed by residential at 11%, transport and telecommunications at 8%, and the other four (commerce, agriculture, construction and other public) sectors having a combined share of 9%. Thermal electricity and (purchased) heat (to a lesser degree) are major sources of fuel consumption behind sectoral emissions, responsible for 2533 Mt CO_2 and 321 Mt CO_2 , respectively.

The 2008 emissions estimated for China in this study falls within the range of other international estimates, and suggests that the EIA methodology can be adopted to estimate China's emissions if the proper adjustments are made. While these results are helpful in understanding China's annual emissions, several key areas of data challenges affect the accuracy of this estimate. Industrial process-based emissions – an important source of emissions given China's industry-intensive economy and size of its cement sector – have not been included in this calculation and could be the focus of further model refinement. The accuracy of the Chinese emissions estimate can be further improved by addressing two unreported international bunker categories and developing China-specific carbon sequestration coefficients for non-fuel use energy products.

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1. Introduction

In 2007, China became the world's largest emitter of energy-related CO₂. This milestone was not reported by China, because China does not publish annual estimates of its CO₂ emissions. Estimates of China's emissions have been variously published by the Carbon Dioxide Information Analysis Center (CDIAC) at Oak Ridge National Laboratory, the Energy Information Administration (EIA) of the US Department of Energy, the International Energy Agency (IEA), and the Netherlands Environmental Assessment Agency (PBL), among others. Although all the published estimates ultimately rely on energy data reported by China's National Bureau of Statistics (NBS), differences in methodology and assumptions have resulted in variation in the published figures. In recent years, the estimates from CDIAC have ranged lowest, while those from PBL and EIA tend to be the highest (Table 1).

Estimate Source	2007	2008	2009
CDIAC	5,863	6,262	6,815
EIA	6,257	6,800	7,707
PBL*	6,415	6,826	7,420
IEA (Reference)	6,044	6,558	n/a
This Study (Reference)	-	6,666	-

Table 1. China Energy-Related CO₂ Emissions Estimates

*Excluding cement production process emissions

Since the Energy Act of 1992 directed the EIA to prepare inventories of US national emissions of greenhouse gases, EIA has annually published its calculation of US national emissions of all greenhouse gases. The methodology underlying these calculations has been fully described in the EIA publication *Documentation for Emissions of Greenhouse Gases in the United States 2006* (EIA 2008). With respect to carbon dioxide emissions from fossil fuel energy combustion, EIA "follows a bottom-up approach using consumption data disaggregated by fuel type and sector, as recommended by the *Good Practice Guidance* of the Intergovernmental Panel on Climate Change (IPCC)." The approach lays out both the estimation process and the data required in the estimation in a transparent and consistent manner.

Given China's lack of published emissions estimates, EIA requested LBNL to look in detail at the feasibility of applying the EIA inventory methodology to the estimation of emissions from fossil-fuel combustion in China using China's published energy data. The goals of the study are several-fold: to develop a CO₂ emissions estimate on the same basis as the US figure; to identify differences and problems with the data scope; and to identify calculations that cannot be done owing to a lack of publicly available data. The core set of data for this study is the energy balances published in the *China Energy Statistical Yearbook 2009* (NBS, 2010a) (hereafter, CESY 2009) containing the latest revisions of China's energy production and consumption figures from 1996 to 2008; this study, however, examines only the last year, 2008, for proof of concept of application of this approach.

The results of this study include both this report providing details about the calculation methodology and results, as well as an Excel model in which the calculations were done. The Excel model can be populated with the same data sources for other years to provide CO₂ emissions estimates on the same

basis as the 2008 estimate under study here. Screenshots and further details on the structure and use of the model are provided in the Appendix.

2. Methodology

The EIA *Documentation* lays out an eight-step estimation methodology:

- 1. Determine fuel consumption by fuel type and end use
- 2. Adjust energy consumption data to eliminate double counting
- 3. Determine energy consumption data to account for fuel consumption in territories
- 4. Convert physical fuel units to energy equivalents
- 5. Identify carbon emission coefficients and calculate total carbon content of each fuel type
- 6. Determine value of carbon sequestered in products
- 7. Subtract carbon in international bunker fuels
- 8. Calculate and sum emissions for all fuel types and end uses

Each of these steps will be examined in detail below.

2.1 Determine fuel consumption by fuel type and end use

The fuel types considered in this study follow the categories defined and reported in the CESY 2009. These are shown in Table 2.

	Coal and Coal-derived	Petroleum	Natural Gas
Primary	Raw Coal	Crude Oil	Natural Gas
Secondary	Cleaned Coal	Gasoline	
	Other Washed Coal	Kerosene	
	Briquettes	Diesel Oil	
	Coke	Fuel Oil	
	Coke Oven Gas	LPG	
	Other Gas	Refinery Gas	
	Other Coking Products	Other Petroleum Products	

Table 2. China Primary and Secondary Fuel Types

"Other Petroleum Products" primarily constitutes non-energy feedstocks and non-fuel products that are not further broken down by type in the NBS data. Because these products are the primary source of sequestered carbon in the emissions calculation (see 2.6), an alternative source of data was found to provide details on composition of this group of products. In this study, data were sourced from the *China Petrochemical Corporation Yearbook 2009*, which provides national data on the production, import, and export of the following Other Petroleum Products, shown in Table 3 along with the EIA categories (Sinopec 2009).

Table 3. Other Petroleum Products

China Product Category	EIA Product Category
Petroleum Asphalt	Asphalt and Road Oil
Lubricants	Lubricants
Lubricant base oil	Lubricants
n/a	Miscellaneous Petroleum Products
n/a	Pentanes Plus
Petroleum Coke	Petroleum Coke
Naphtha	Petrochemical Feedstock
Paraffin	Waxes and Polishes
Solvent oil	Special Naphtha
Detergents	n/a
Chemical light oil	Petrochemical Feedstock

Source: Sinopec 2009; EIA 2008

Generally, China's product categories map directly to those tracked by the EIA and used in their emissions calculations. However, two categories of China's products—chemical light oil and naphtha—map to a single EIA product—petrochemical feedstock. In China, "naphtha" is reported solely on an international trade basis, corresponding to the commodity classification meeting specific quality requirements as used in international trade. Domestic production of naphtha used in domestic petrochemical facilities is classified as part of "chemical light oil" (化工轻油 huagong qingyou), a category name in use since at least the 1970s that refers to a number of different product streams all used in the petrochemical light oil, but since the modernization and expansion of the ethylene industry began in earnest in the 1990s, the major constituent is now naphtha supplemented with hydrocracker tail oil (Zhang 2010). Although chemical light oil also includes other streams including feedstocks in the light gasoil distillation range for the production of white oils (mineral oils), and "flax softening oil" for softening flax fibers for bag production, in terms of the emissions calculations, the entire product category is treated in this study as naphtha owing to the lack of detailed composition data.

Because these data are derived from a secondary source outside of NBS, there exists a small discrepancy between the NBS reported total and the total calculated from Sinopec-reported volumes. For each product, Sinopec provides data on production, import and export, allowing the calculation of "apparent consumption," which differs from the NBS calculation of consumption by the amount of stock change. As show in Table 4, NBS reports total consumption of Other Petroleum Products as 71.13 million tonnes, including a stock build of 1.98 million tonnes. Adjusting the Sinopec apparent consumption total of 73.96 million tonnes by the NBS reported stock change still leaves a 0.85 million tonne discrepancy between the Sinopec and NBS totals. The discrepancy may result from differences in scope between Sinopec and NBS reporting, or differences in calculating and reporting totals by the two organizations.

"Other Petroleum Product"	Apparent Consumption (Mt)
Petroleum Asphalt	17.99
Lubricants	6.55
Lubricant base oil	1.24
Petroleum Coke	12.92
Naphtha	-0.74
Paraffin (Waxes and Polishes)	0.93
Solvent oil (Special Naphtha)	1.02
Detergents	0.39
Chemical light oil	33.64
Sinopec Reported Total	73.96
NBS Reported Stock Change	-1.98
NBS Reported Total	71.13
Discrepancy	0.85

Table 4. Comparison of Sinopec and NBS data on Other Petroleum Products

Source: Sinopec 2009; CESY 2009

In terms of fuel end-use, China tracks energy consumption across seven end-use sectors, as shown in Table 5.

Table 5. China Energy End-Use Sectors

Full End-Use Sector Name	Short Reference
Farming, Forestry, Animal Husbandry, Fishery & Water Conservancy	Agriculture
Industry	Industry
Construction	Construction
Transport, Storage, Postal & Telecommunications Services	Transportation
Wholesale, Retail Trade and Catering Service	Commerce
Residential Consumption	Residential
Other [Public Sector]	Other

Source: CESY 2009

Emissions from fossil fuel consumption in the power sector, following the EIA methodology, are allocated among these seven end-use sectors according to their share of final electricity demand. Similarly, emissions from fossil fuel consumption in the production of commercial heat are allocated among the seven end-use sectors according to their share of final purchased heat demand. Losses from other transformation sectors (coal washing, petroleum refining, coking, and gas works) are all allocated to industry.

2.2 Adjust energy consumption data to eliminate double counting

EIA identifies 4 areas of possible double counting that are subject to adjustment.

Ethanol. Ethanol is not reported in China's energy balance table; no adjustment is necessary.

Synthetic Gas from Coal. China produces significant volumes of coke oven gas and other coal gases from gas works that are used primarily in the industrial and residential sectors. In the sectoral calculation of emissions, emissions from these products are calculated in the end-use consuming sector under "Coke and derived products." Although China accounts for these industries in the transformation sectors along with electric power and heat production, the losses from coking and gas works are all added to industrial sector emissions along with the emissions from final consumption of these products in industry, instead of being allocated among consumption sectors according to share of consumption as was done with electricity generation and heat production.

Still Gas to Pipelines. All still gas/refinery gas in China is reported as consumed in the industrial sector, and emissions are allocated to that sector accordingly.

Biogas. The majority of biogas consumed in China is from rural methane digesters and remains unaccounted for in the national energy balance. Data are not available on the possible amounts of recovered landfill methane gas that enters local gas pipeline networks.

2.3 Determine energy consumption data to account for fuel consumption in territories

China's national energy statistical data do not include energy consumption in its Special Administrative Regions of Macau and Hong Kong, nor in Taiwan, and these data are excluded in this study as well.

2.4 Convert physical fuel units to energy equivalents

The National Bureau of Standards reports its official energy data in two formats, both in original physical units and in units of standard coal. The National Bureau of Statistics annually publishes its list of standard conversion factors for each energy form, including its Lower Heating Value (LHV) and conversion factor to "coal equivalent" China's standard energy measure. One kilogram of coal equivalent is defined as 29.27 megajoules (MJ) (Table 6).

Table 6. NBS Standard Conversion Factors

Energy	Average Low Calorific Value	Conversion Factor
Raw Coal	20 908 kjoule / (5 000 kcal) / kg	0.7143 kgce / kg
Cleaned Coal	26 344 kjoule / (6 300 kcal) / kg	0.9000 kgce / kg
Other Washed Coal	The second second states and the second states of the second states and the second states of the second second states and the second states	
Middlings	8 363 kjoule / (2 000 kcal) / kg	0.2857 kgce / kg
Slimes	8 363~12 545 kjoule / (2 000~3 000kcal)/ kg	0.2857~0.4286 kgce/kg
Coke	28 435 kjoule / (6 800 kcal) / kg	0.9714 kgce / kg
Crude Oil	41 816 kjoule / (10 000 kcal) / kg	1.4286 kgce / kg
Fuel Oil	41 816 kjoule / (10 000 kcal) / kg	1.4286 kgce / kg
Gasoline	43 070 kjoule / (10 300 kcal) / kg	1.4714 kgce / kg
Kerosene	43 070 kjoule / (10 300 kcal) / kg	1.4714 kgce / kg
Diesel	42 652 kjoule / (10 200 kcal) / kg	1.4571 kgce / kg
Liquefied Petroleum Gas	50 179 kjoule / (12 000 kcal) / kg	1.7143 kgce / kg
Refinery Gas	46055 kjoule / (11 000 kcal) / kg	1.5714 kgce / kg
Natural Gas	38 931kjoule / (9 310 kcal) / cu. m	1.3300 kgce / cu. m
Coke Oven Gas	16 726 ~ 17 981kKjoule/ (4 000 ~ 4 300kcal)/ cu. m	0.5714~0.6143 kgce/cu.m
Other Coal Gas		
By Gas Furnace	5 227 kjoule / (1 250 kcal) / cu. m	0.1786 kgce / cu. m
By Heavy Oil Catalytic Cracking	19 235 kjoule / (4 600 kcal) / cu. m	0.6571 kgce / cu.m
By Heavy Oil Thermal Cracking	35 544 kjoule / (8 500 kcal) / cu. m	1.2143 kgce / cu. m
Coke Gas	16 308 kjoule / (3 900 kcal) / cu. m	0.5571 kgce / cu. m
By Pressure Gasification	15 054 kjoule / (3 600 kcal) / cu. m	0.5143 kgce / cu. m
Water Coal Gas	10 454 kjoule / (2 500 kcal) / cu. m	0.3571 kgce / cu. m
Coal Tar	33 453 kjoule / (8 000 kcal) / kg	1.1429 kgce / kg
Benzene	41 816 kjoule / (10 000 kcal) / kg	1.4286 kgce / kg
Heat (in calorific value)		0.03412 kgce / Mjoule
		(0.14286 kgce / 1000 kcal)
Electricity (in calorific value)	3 596 kjoule / (860 kcal) / kW · h	0.1229 kgce / kW · h
(in coal equivalent)	calculated by average coal input for	
	thermal power generation in the year	
Biomass Energy		
Night Soil	18 817 kjoule / (4 500 kcal) / kg	0.643 kgce / kg
Cow Dung	13 799 kjoule / (3 300 kcal) / kg	0.471 kgce / kg
Pig Dung	12 545 kjoule / (3 000 kcal) / kg	0.429 kgce / kg
Sheep/Donkey/Horse/Mule Dung	15 472 kjoule / (3 700 kcal) / kg	0.529 kgce / kg
Poultry Manure	18 817 kjoule / (4 500 kcal) / kg	0.643 kgce / kg
Soybean Stalk, Cotton Stalk	15 890 kjoule / (3 800 kcal) / kg	0.543 kgce / kg
Paddy Stalk	12 545 kjoule / (3 000 kcal) / kg	0.429 kgce / kg
Wheat stalk	14 635 kjoule / (3 500 kcal) / kg	0.500 kgce / kg
Maize Stalk	15 472 kjoule / (3 700 kcal) / kg	0.529 kgce / kg
Fireweed	13 799 kjoule / (3 300 kcal) / kg	0.471 kgce / kg
Leaves	14 635 kjoule / (3 500 kcal) / kg	0.500 kgce / kg
Firewood	16 726 kjoule / (4 000 kcal) / kg	0.571 kgce / kg
Biogas	20 908 kjoule / (5 000 kcal) / cu. m	0.714 kgce / cu. m

Conversion Factors from Physical Unit to Coal Equivalent

Source: NBS 2010a

The average heat value of most energy forms do not vary from year to year in the NBS reports, but there are slight annual variations in "Coke Oven Gas" and "Other Gases" (which is actually an aggregation of different gas types produced from different technology routes). By dividing the reported physical unit figure by the reported standard coal unit figure, the annual average conversion factor and assumed heat content can be derived.

Because NBS reports both physical units and standard coal units, this study directly uses the standard coal units as the measure of each energy form's energy content. The reported "ton coal equivalent" (tce) value is then multiplied by 29.27 MJ/kgce to convert all energy values to terajoules (TJ). Products reported by Sinopec ("Other Petroleum Products") are reported in original weight units of million tonnes; these are then converted to tce using the NBS standard, then to TJ.

2.5 Identify carbon emission coefficients and calculate total carbon content of each fuel type

Because the Chinese energy data are reported as Lower Heating Value, this study uses the carbon coefficients as reported in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1-1, to calculate the carbon content of each fuel type (IPCC 1997a, IPCC 1997b). Carbon release from combustion is assumed to be 100% (Table 7). A weighted average carbon coefficient was calculated for 2008 for the constituent products of "Other Petroleum Products" to permit calculation of emissions when the constituents are not broken down in sectoral consumption calculations. The emissions coefficient for petroleum waxes follows EIA convention converted to a TJ basis.

Name	t C/TJ
crude oil	20.0
natural gas liquids	17.2
gasoline	18.9
jet kerosene	19.5
other kerosene	19.6
shale oil	20.0
gas/diesel oil	20.2
residual fuel oil	21.1
LPG	17.2
ethane	16.8
naphtha	20.0
bitumen	22.0
lubricants	20.0
petroleum coke	27.5
refinery feedstock	20.0
still gas/refinery gas	18.2
petroleum waxes	18.8
coking coal	25.8

Table 7. Carbon Coefficients

other bituminous coal	25.8
sub-bituminous coal	26.2
lignite	27.6
oil shale	29.1
other petroleum products (China 2008 weighted average)	21.6
coke oven/gas coke	29.5
natural gas (dry)	15.3
coke oven gas	13.0

Source: IPCC 1997a, IPCC 1997b; EIA 2006

2.6 Determine value of carbon sequestered in products

Calculation of the carbon sequestered in products follows EIA conventions for all the products listed in Table 3 (Other Petroleum Products) as well as for non-energy use of gasoline, kerosene, diesel (distillates) and fuel oil (residual), LPG, refinery gas/still gas, natural gas, and other coking products. In each case, the total carbon of the product consumed is calculated and the sequestration coefficient is applied.

Gasoline	0.50
Kerosene	0.50
Diesel Oil	0.50
Fuel Oil	0.50
LPG	0.80
Refinery/Still Gas	0.80
Petroleum asphalt	1.00
Lubricants	0.50
Lubricant base oil	0.50
Miscellaneous petroleum products	1.00
Pentanes plus	0.00
Petrochemical Feedstock (Chem Light Oil + Naphtha)	0.75
Petroleum coke	0.00
Naphtha (Petrochemical Feedstock)	0.00*
Paraffin (Waxes and Polishes)	1.00
Solvent oil (Special Naphthas)	0.00
Detergents	0.00
Chemical light oil (Petrochemical Feedstock)	0.75
Other Coking Products	0.75

Table 8. Sequestration Coefficients for Non-Energy Use Fuels and Non-Fuel Energy Products

*Set to zero as a net export; domestic use under Petrochemical Feedstock Source: EIA 2006

For the products accounted for individually in the NBS data—gasoline, kerosene, diesel, fuel oil, LPG and refinery gas—the volume of each product listed as "feedstock or non-energy use" under the industrial

sector was used in the calculation of the sequestration amount following the EIA methodology. Although it is assumed that some portion of the non-fuel use of the distillate and residual oil was used in the chemical industry as is the case in the US, it cannot be confirmed from the NBS data directly.

Similarly, NBS listed only 45% of its "Other Petroleum Products" in the non-fuel or feedstock category, equivalent to the total volume of petrochemical feedstock (chemical light oil) accounted for in the category breakdown. It is assumed that the balance—asphalt, petroleum coke, lubricants, etc—is categorized under Industry and Construction energy use. For the purpose of calculating emissions and sequestration, however, the EIA conventions were followed for each constituent product.

NBS records about 55 million tonnes of raw coal, cleaned coal, other washed coal, briquettes, coke, coke oven gas and other coking products used for non-energy purposes. The majority of these products are assumed to be inputs to China's ammonia industry, which is largely coal based and consumed (in 2007) 55 million tonnes of coal, or to production of methanol for the chemical industry, which consumed 12 million tonnes of coal in 2007 (Wang, F., 2008). Consequently, it is assumed that the carbon in these applications is non-sequestering and 100% of the volume is emitted. "Other Coking Products", however, is assumed to be composed primarily of the tar by-products of the coking process and thus is mainly a sequestering use, following EIA convention.

NBS does not report natural gas flaring as a separate statistical category. It may wholly or in part be captured in the "Loss" category of the national energy balance, in which case the carbon emissions are included in the reference CO_2 calculation.

2.7 Subtract carbon in international bunker fuels

The IPCC excludes from the calculation of energy consumption both international and military bunker fuels. The EIA first includes international bunkers consumption in the calculation of national emissions, but then separately reports them and deducts them from the US total. This method has been applied in this study for China as well, but the NBS treatment of bunker fuels differs from IPCC definition, and thus the results are incomplete. The Chinese energy balance contains two international bunker categories: one is "China Airplanes & Ships Refueling Abroad," which is counted as an import (and thus should be treated as other countries' international bunkers in IPCC calculations), and "Foreign Airplanes & Ships Refueling in China," which is counted as an export. The NBS data do not indicate that amount of bunker fuels sold to Chinese airplanes and ships in China; this amount is contained within final demand in the transportation sector and cannot be further disaggregated from the NBS data alone. Similarly, military bunkers are recorded in the "Other" sector (which includes all public sector activities, including the military) and cannot be further disaggregated from the NBS data alone. A first order estimate of military jet fuel bunkers may be the kerosene (jet fuel) consumption in the "Other" sector.

2.8 Calculate and sum emissions for all fuel types and end uses

This report develops two calculations of China's CO₂ emissions: a "reference" calculation based on the IPCC reference top-down approach of estimating apparent energy consumption by fuel type, multiplied by the carbon emissions factor by fuel type, following EIA methodology on treatment of non-fuel emissions and sequestration. The second is a "sectoral" calculation" of emissions across end-use sectors,

by fuel type, and allocating electricity and heat emissions to each sector according to their share of consumption. Again, EIA convention is followed for treatment of non-fuel emissions and sequestration. The results of these calculations are presented in section 0.

2.9 Variances, Adjustments, Missing Data, and Incomplete Data

Primary Energy Calculation

In China's energy balance, by definition, Total Primary Energy Supply (TPES) is equivalent to Total Consumption (TC), which is the sum of consumption in transformation, losses and end-uses. Because transformation consumption is by convention reported as a negative, the identity is:

$TPES \equiv |Transformation| + Losses + Final Consumption$

Not unexpectedly in such a large energy system, total reported supply does not always equal total reported consumption, and NBS reports this discrepancy as "statistical difference". For most energy forms, the statistical difference is small, less than 0.5% of the total (0.001% in the case of crude oil and 0.45% for natural gas), but for coal, the difference was 2.1% in 2008, equal to over 60 million tonnes of raw coal. When reported consumption is greater than reported supply, the difference is expressed as a negative; when reported supply is greater than reported consumption, the difference is expressed as a positive.

In this study, for the purposes of calculating emissions from primary energy forms, the larger of the two numbers is used. In the case of coal, for example, the statistical difference is negative, and thus TC was used as the basis for emissions calculations. For crude oil and natural gas, where the statistical difference was positive, TPES was used for emissions calculations¹.

Bunker Adjustments

As discussed in section 2.7, a major variance in China energy statistics is its treatment and reporting of energy data related to international bunkers. In CESY 2009, NBS reports the secondary fuel consumed by China Airplanes & Ships Refueling Abroad as an import and deducts Foreign Airplanes & Ships Refueling in China as an export in calculating its total primary energy supply. As such, fuel use from Exports and Foreign Airplanes & Ships Refueling in China are expressed as negative values in the national energy balance. Following this China-specific convention of reporting exports and international bunkers, the NBS Total Primary Energy Supply (TPES) is calculated as:

TPES_(NBS) = Import + Export + China Airplanes & Ships Refueling Abroad + Foreign Airplanes & Ships Refueling in China + Stock Change

As a component of international bunkers defined by the IPCC as "fuels sold to and consumed by air or marine vessels engaging in international transport activities," the refueling of foreign and domestic airplanes and ships involved in international transport within a country is not usually reported

¹ In the emissions model, the statistical difference is tested through an "if" statement formula to automatically select TPES or TC as appropriate.

separately (IPCC 1997a). China, however, makes the distinction between these two components and reports "Foreign Airplanes & Ships Refueling in China" separately from "China Airplanes & Ships Fueling in China" before departing for international transport. In fact, China only reports the component of foreign vessels refueling domestically as an export and data on Chinese airplanes & ships fueling in China and leaving for international transport is missing. EIA, on the other hand, treats bunker fuels sales the same as other sales and includes carbon emissions from bunkers sales as part of the domestic energy consumption statistics. The international bunker portion is then listed separately as an adjustment item and subtracted from total emissions from domestic energy consumption. In applying this convention of subtracting bunker adjustments from total emissions, the Foreign Airplanes & Ships Refueling in China will need to be included in the domestic energy consumption calculation instead of being excluded as an export. In China's case, however, the reported international bunker adjustment is actually an underestimate of China's international bunker fuels (and thus the adjusted emissions is overestimated) because it does not include Chinese airplanes & ships fueling in China.

The bunker category China Airplanes & Ships Refueling Abroad is unique in that this is not usually reported in domestic data since it is included as national data in the country where the Chinese airplanes and ships refuel. In accordance with the EIA estimation and reporting methodology, China Airplanes & Ships Refueling Abroad need to be excluded from the TPES used for calculating domestic energy consumption and emissions because it is not a standard component of IPCC bunker fuel calculations and is already captured in the other country where the refueling occurs.

Thus, to align with the EIA conventions of reporting emissions and bunker adjustments, two adjustments to the NBS reported TPES are needed to include Foreign Airplanes & Ships Refueling in China and to exclude China Airplanes & Ships Refueling Abroad. Following the energy balance convention of expressing exports as negative values, the adjusted TPES, expressed as TPES', is calculated as:

TPES' = *Import* + *Export* - *Foreign Airplanes & Ships Refueling in China* + *Stock Change*

which can also be expressed as:

 $TPES' = TPES_{(NBS)} - China Airplanes & Ships Refueling Abroad - (2 x Foreign Airplanes & Ships Refueling in China)$

Since the two categories of bunker data are reported only for three secondary petroleum products of kerosene, diesel oil and fuel oil, the TPES adjustment is only applied to these three fuels.

A missing category of international bunkers not explicitly reported by NBS is fuel consumption from military bunkers involved in international transport. While there is no publicly available data sources for Chinese military bunkers, it is possible to estimate a first order of magnitude of military bunker fuel consumption using data from the national energy balance table. In the reporting of final energy consumption by sector, the other (public) sector includes the military and thus its kerosene consumption can be used as an approximation for military marine vessels' fuel consumption. This will likely be an overestimate as it does not distinguish between military and non-military public use of aircrafts

and vessels, nor does it distinguish between the fuel consumed by military fleet used for domestic versus international transport. Due to the missing data, military bunkers are not included in the Chinese bunker adjustment in this model.

Carbon Steel Adjustments

China is the world's largest producer of steel so an additional China-specific adjustment for carbon sequestration in carbon steel manufactured through the Basic Oxygen Furnace (BOF) method has been added beyond the standard EIA methodology. Crude steel can be categorized as alloy steel or carbon steel, where carbon is the main alloying constituent, and is produced using pig iron from a blast furnace via the BOF method or from scrap metal using the Electric Arc Furnace (EAF) process. In other words, total crude steel production can be expressed by the two equations below:

Total Steel	= BOF Steel + EAF Steel	= (BOF Alloy + BOF Carbon) + (EAF Alloy + EAF Carbon)
Total Steel	= Carbon Steel + Alloy Steel	= (BOF Carbon + EAF Carbon) + (BOF Alloy + EAF Alloy)

In order to calculate the BOF carbon steel production where the primary carbon sequestration occurs, data inputs on total crude steel production, the BOF share of total steel production, the alloy share of total steel, and BOF share of alloy steel production are needed. While NBS reports total crude steel production in the China Statistical Yearbook (NBS, 2010b), Chinese industry reports and studies are needed to determine the BOF and alloy shares. The BOF carbon steel can then be calculated as:

BOF Carbon Steel = Total BOF Steel – BOF Alloy Steel

For 2008, the BOF carbon steel share of total crude steel production is estimated to be 81% (CISRI 2011, CASIS 2010), and the BOF share of alloy steel production 92% (CISRI 2011).²

After determining the total BOF produced carbon steel, the carbon sequestration can be estimated by dividing steel into two key categories with different average carbon contents: structural steel used for construction and infrastructure and product steel used in manufacturing appliances, equipment and other common products. Using the shares of structural and product steel and the estimated carbon content of each of the two types of steel, an overall average carbon mass content of carbon steel can be calculated. In essence, the carbon sequestered in carbon steel can be expressed as:

C_{seq} = Total Steel Production (Mt) x BOF carbon steel share (%) x Average Steel Carbon Content (% of mass)

The carbon sequestered in carbon steel is reported as part of the carbon sequestration in the nonenergy use of coal.

EAF-produced carbon steel may also sequester a small amount of carbon. According to China's product standards, an average of 27.5% pig iron is added as input to EAF steel production in China (CISRI and CISA 2010). Although pig iron used in steelmaking is mandated to have at least 3.5% carbon content, it is

² The reported high share of BOF alloy steel production is questionable, given that the EAF process in China is elsewhere described as being "primarily for alloy steel and specialty steel production." The reported share may be the results of a statistical collection system that compiles information on enterprises "of designated scale and above," and thus may omit many of the small EAF plants (Mysteel 2009)

unclear how much of this carbon remains as "newly sequestered" carbon in the carbon steel output from the EAF process. Assuming that EAF output of carbon steel has the same average carbon content as BOF carbon steel (0.15%), and that 27.5% of the carbon was contributed from the pig iron input, then the additional sequestration would total 91,714 t CO_2 , or 0.06% of total sequestered carbon.³

Sectoral Approach Adjustments

In the sectoral approach, several adjustments are made to capture adjustments made under the reference approach (e.g., bunkers) and to allocate certain fuel consumption and losses on a basis comparable to EIA sectoral reporting conventions.

The sectoral allocation of gasoline consumption needs to be adjusted because NBS has historically allocated transport fuels to the end-user (e.g., allocating gasoline to the residential sector for private transport) rather than to the actual end-use (transport) sector. Since EIA and other international energy statistical agencies allocate gasoline consumption to the transport sector, an adjustment is made to allocate all gasoline to the transport sector. The only exception is the portion of gasoline that is consumed by the industrial sector for non-energy use, which remains allocated to the industrial sector because is constitutes a portion of the distillates and residual petroleum used for non-energy purposes (petrochemicals) in which only a portion of the carbon is emitted. The transport sector final energy consumption of kerosene, diesel oil and fuel oil is further adjusted for the two Chinese bunker categories, with the addition of fuel consumed by Foreign Airplanes & Ships Refueling Abroad following EIA reporting conventions and the deduction of fuel consumed by China Airplanes & Ships Refueling Abroad.

The industrial sector final energy consumption is also adjusted to account for other transformation losses not captured in the reported final energy consumption or in the thermal power and heat transformation sectors. Since the losses associated with other transformation processes of coal washing, coking, petroleum refineries, gas works, and briquettes occur within energy processing industries, the calculated emissions from the net losses are allocated to the industrial sector. For each of these transformation processes, the emissions are calculated by multiplying the net transformation loss from the energy balance table by the carbon content of the fuel type of the dominant fuel loss. These emissions associated with the other transformation losses are then added to the final energy consumption of the industrial sector.

Incomplete Data and Emission Sources Excluded

In addition to energy-related emissions, another important source of CO_2 emissions is from industrial processes such as cement manufacture, limestone consumption, and aluminum manufacture, which is included in the EIA methodology. This is especially significant for China's industries, where process-related CO_2 emissions have been estimated to be as much as half of all direct CO_2 emissions from cement production (Wang, L., 2008). However, the significant amount of detailed process-related data needed to estimate CO_2 emissions from industrial process is not publicly available in China. Due to the

³ The emissions model contains a calculation box for EAF carbon steel sequestration, but the results have not been added to the sequestration totals

lack of systematic reporting of data needed for estimating emissions, the CO_2 emissions produced and released during industrial processes are also excluded from both the reference and sectoral approaches. The one exception is the adjustment for sequestered carbon in carbon steel production, as discussed above. Another source of CO_2 emissions reported by EIA for the U.S. but not included in this inventory for China is the emissions from renewables, namely the combustion of municipal solid waste and the flash geothermal technology and dry steam used in geothermal power generation.

Because NBS and other public statistical sources do not report the volume of vented and flared natural gas, emissions from natural gas flaring cannot be estimated and is thus excluded from both the reference and sectoral approaches. While some of the emissions from natural gas flaring may be captured as losses in the balance table, it is not systematically estimated or included as part of the non-energy use emissions from natural gas.

Besides incomplete and missing data on natural gas flaring, there is also insufficient data on the specific end-uses and applications of non-energy use of petroleum products such as detergents, solvents and petroleum coke in China. Because certain products such as petroleum coke can have multiple applications ranging from use as a fuel in refineries and cement industries to the manufacture of graphite electrodes and anodes, the carbon emissions associated with petroleum coke consumption will likely differ depending on how it is used. Therefore, more data on the relative shares of applications and non-energy end-uses of these petroleum products will help determine if China-specific sequestration coefficients may be more appropriate than default EIA coefficients and should be developed to more accurately estimate CO₂ emissions

3. Results

3.1 Total Emissions

China's energy-related CO_2 emissions in 2008 estimated under the reference approach total 6665.8 Mt CO_2 after excluding 15.9 Mt of CO_2 from international bunker fuels (Table 1). As previously mentioned, this adjusted total CO_2 emissions is likely to be slightly overestimated due to missing adjustments for two categories of international bunkers: Chinese airplanes and ships involved in international transport that refuel in China and military bunkers. In terms of fuel, the largest share of unadjusted energy-related CO2 emissions is attributed to coal use with 82%, followed by petroleum at 15% and natural gas at 3%. Non-fuel emissions are responsible for 3.5% of total CO_2 emissions, while only 2% of unadjusted emissions are sequestered by non-fuel use of energy fuels (Figure 1).

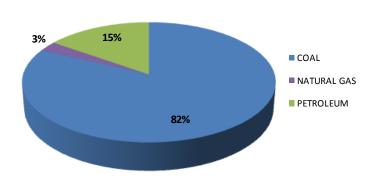
ENERGY CONSUMPTION		
	EMISSIONS - T C	EMISSIONS - T CO ₂
COAL	1,496,952,842	5,488,827,086
NATURAL GAS	48,638,365	178,340,673
PETROLEUM	276,699,464	1,014,564,701

Table 9. China's 2008 Total C	O ₂ Emissions from Energy	y Consumption: Reference Approach
	og Linissions nom Lincig	y consumption. Acterence Approach

ENERGY SUBTOTAL	1,822,290,671	6,681,732,460
	EMISSIONS - T C	EMISSIONS - T CO ₂
NON-FUEL USE EMISSIONS ¹	63,977,962	234,585,860
NON-FUEL USE SEQUESTRATION ²	41,996,294	153,986,411
ADJUSTMENTS TO ENERGY		
	EMISSIONS - T C	EMISSIONS - T CO ₂
		-
BUNKER FUEL EMISSIONS	-4,341,951	-15,920,486
TOTAL ADJUSTMENTS	-4,341,951	-15,920,486
ADJUSTED TOTAL		
	EMISSIONS - T C	EMISSIONS - T CO ₂
ADJUSTED TOTAL	1,817,948,720	6,665,811,974

¹Emissions from nonfuel uses are included in energy subtotal above.

²The carbon sequestered has been subtracted from emissions included in the energy subtotal above.



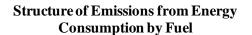


Figure 1. China's 2008 Total CO₂ Emissions from Energy Consumption by Fuel

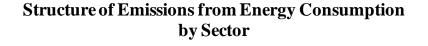
From the sectoral approach, China's total energy-related CO₂ emissions in 2008 are estimated to be slightly higher at 6785.3 Mt CO₂ (Table 10). This difference in total estimated emissions between the reference and sectoral approach is likely the result of losses not captured in the transformation sector and statistical differences reported in the Chinese energy balance. Industry is responsible for the majority of energy-related emissions with 72% share, followed by 11% share from the residential sector and 8% from the transport and telecommunications sector (Figure 2). CO₂ emissions from each sector and the fuel shares of sectoral emissions are examined in detail in the section below.

ENERGY-RELATED EMISSIONS		
	EMISSIONS - T C	EMISSIONS - T CO ₂
Agriculture	37,659,226.91	138,083,832.00
Industry	1,335,623,049.32	4,897,284,514.16
Construction	22,703,228.23	83,245,170.18
Transport & Telecomm	156,227,902.49	572,835,642.47
Commerce	36,388,244.49	133,423,563.11
Residential	196,797,340.14	721,590,247.18
Other (Public) Sector	65,146,860.85	238,871,823.10
TOTAL	1,850,545,852.42	6,785,334,792.21
Thermal Electricity ¹	690,855,316.36	2,533,136,159.97
Heat ²	87,620,322.82	321,274,517.01

Table 10. China's 2008 Total CO₂ Emissions from Energy: Sectoral Approach

¹Thermal electric power sector emissions are calculated on the basis of primary fossil fuel energy inputs and allocated to sectors based on their proportion of total demand. Emissions distributed to each end-use sector are included in the sectoral totals above.

²Heat sector emissions are also calculated using primary energy inputs and allocated to end-use sectors based on their proportion of total commercial heat demand. Heat-related emissions distributed to each end-use sector are included in the sectoral totals above.



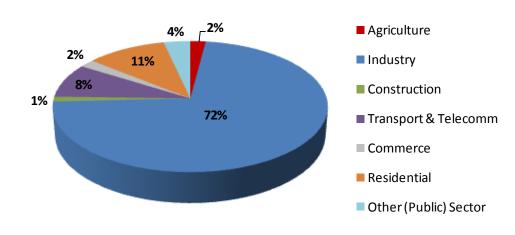


Figure 2. China's 2008 Total CO₂ Emissions from Energy by Sector

3.2 Sectoral Emissions

Agriculture

China's agricultural CO_2 emissions total 138 Mt CO_2 and originate primarily from electricity use, petroleum (namely diesel oil), coal, coke and other derivatives and heat (Table 11). The total CO_2 emissions include half from thermal electricity generation, a quarter from petroleum, and a quarter from coal and coke and derivatives (Figure 3).

TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO2
TOTAL	37,659,226.91	138,083,832.00
Energy Emissions	EMISSIONS- T C	EMISSIONS -T CO2
Coal	8,750,102.58	32,083,709.46
Coke and Other Derivatives	445,765.24	1,634,472.53
Petroleum	9,522,987.85	34,917,622.12
Crude Oil	0.00	0.00
Gasoline	0.00	0.00
Kerosene	10,582.00	38,800.67
Diesel Oil	9,467,178.30	34,712,987.08
Fuel Oil	13,234.76	48,527.47
LPG	31,992.79	117,306.90
Refinery Gas	0.00	0.00
Other Petroleum Products	0.00	0.00
Natural Gas	0.00	0.00
Heat ¹	28,100.17	103,033.96
Electricity ²	18,912,271.07	69,344,993.94

¹Share of heat sector's CO₂ emissions weighted by agricultural sector's share of final energy consumption of heat. ²Share of thermal electricity sector's CO₂ emissions weighted by agricultural sector's share of final energy consumption of electricity.

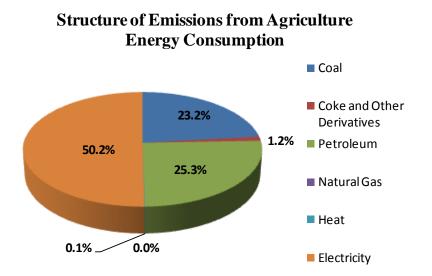


Figure 3. China's 2008 Agriculture CO₂ Emissions by Major Fuels

Industry

China's 2008 energy-related CO_2 emissions in the industrial sector are estimated to total 4897.3 Mt CO_2 (Table 12). This estimated total includes two specific adjustments: carbon sequestered by carbon steel and emissions from other transformation sector losses. This estimate does not include process-based emissions (with the exception of carbon steel). Emissions from electricity use comprise 37% of total industry emissions, while the remainder is mostly from direct fuel use and non-fuel use of coal, petroleum and natural gas (Figure 4). Coal and coke and derivatives consumption together contribute half of energy-related industrial CO_2 emissions, followed by petroleum and heat. The emissions from other transformation sector losses comprise of only 2.5% of industrial CO_2 emissions.

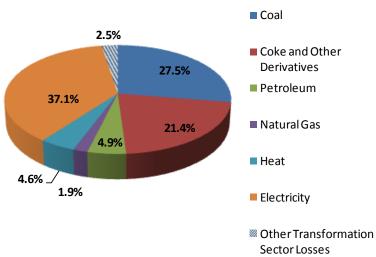
Table 12: China	's 2008 CO ₂	Emissions	from Energy	gy: Industry
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TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO2
TOTAL	1,335,623,049.32	4,897,284,514.16
Energy Emissions		
	EMISSIONS- T C	EMISSIONS -T CO2
Coal	367,697,859.82	1,348,225,486.02
Coke and Other Derivatives	285,734,341.61	1,047,692,585.90
Petroleum	66,083,737.05	242,307,035.85
Crude Oil	9,975,206.80	36,575,758.27
Gasoline	76,556.53	280,707.27
Kerosene	388,163.17	1,423,264.97

Diesel Oil	19,900,181.22	72,967,331.13
Fuel Oil	13,431,547.74	49,249,008.38
LPG	4,256,127.83	15,605,802.03
Refinery Gas	7,408,167.54	27,163,280.97
Other Petroleum Products	10,647,786.23	39,041,882.84
Natural Gas	24,822,785.91	91,016,881.66
Heat ¹	61,733,304.90	226,355,451.31
Electricity ²	495,715,559.07	1,817,623,716.58
Other Transformation Sector Losses ³	33,835,460.96	124,063,356.86

¹Share of heat sector's CO₂ emissions weighted by industrial sector's share of final energy consumption of heat. ²Share of thermal electricity sector's CO₂ emissions weighted by industrial sector's share of final energy consumption of electricity.

³Other transformation sector losses include coal washing, coking, petroleum refining, gas works and briquettes.



Structure of Emissions from Industry Energy Consumption

Figure 4. China's 2008 Industry CO₂ Emissions by Major Fuels

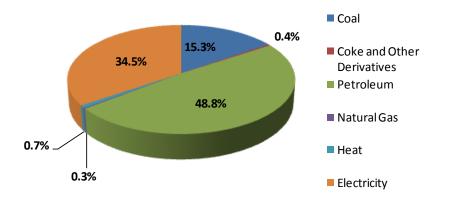
Construction

As a relatively small sector in terms of energy consumption, the Chinese construction sector's energyrelated emissions totaled only 82.2 Mt CO_2 in 2008 (Table 13). Nearly half of the emissions are from petroleum fuel use, particularly in the use of other petroleum products and diesel oil (Figure 5). It is likely that the majority of asphalt consumption—and thus carbon sequestration—is recorded in this sector. Electricity and coal are also major sources of construction CO_2 emissions.

TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO2
TOTAL	22,703,228.23	83,245,170.18
Energy Emissions		
	EMISSIONS- T C	EMISSIONS -T CO2
Coal	3,474,707.50	12,740,594.17
Coke and Other Derivatives	89,734.81	329,027.64
Petroleum	11,077,927.11	40,619,066.09
Crude Oil	0.00	0.00
Gasoline	0.00	0.00
Kerosene	81,212.65	297,779.71
Diesel Oil	3,194,483.00	11,713,104.35
Fuel Oil	332,633.74	1,219,657.03
LPG	53,165.25	194,939.23
Refinery Gas	0.00	0.00
Other Petroleum Products	7,416,432.48	27,193,585.76
Natural Gas	58,967.15	216,212.87
Heat ¹	170,051.68	623,522.81
Electricity ²	7,831,839.98	28,716,746.60

Table 13. China's 2008 CO₂ Emissions from Energy: Construction

¹Share of heat sector's CO₂ emissions weighted by construction sector's share of final energy consumption of heat. ²Share of thermal electricity sector's CO₂ emissions weighted by construction sector's share of final energy consumption of electricity.



Structure of Emissions from Construction Energy Consumption

Figure 5. China's 2008 Construction Sector CO₂ Emissions by Major Fuels

Transport, Post and Telecommunications

Unlike many other countries including the US, China reports its transport energy consumption and related CO₂ emissions in the same sector as postal service and telecommunications. The transport, post and telecommunications sector also includes two emissions adjustments: the addition for international bunkers (which is not captured in final energy consumption reporting) and the reallocation of gasoline from all other sectors except industrial non-energy use sectors to this sector. In 2008, the adjusted CO₂ emissions for this sector totaled 572.8 Mt, with transport responsible for the majority of emissions as 87% of emissions can be attributed to petroleum fuels (Table 14). This includes significant emissions from diesel oil and gasoline for road transport, as well as kerosene and fuel oil for air and water transport. In contrast, a notable portion of the 8% share of emissions from electricity is likely from telecommunications services, including data centers (Figure 6).

TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO ₂
TOTAL	156,227,902.49	572,835,642.47
Energy Emissions		
Coal	EMISSIONS- T C	EMISSIONS -T CO ₂
	3,834,629.70	14,060,308.92
Coke and Other Derivatives	5,506.36	20,189.97
Petroleum	135,809,225.07	497,967,158.59
Crude Oil	0.00	0.00
Gasoline	49,870,367.85	182,858,015.45
Kerosene	9,705,961.40	35,588,525.13
Diesel Oil	66,051,680.39	242,189,494.78
Fuel Oil	9,709,287.57	35,600,721.07
LPG	471,927.86	1,730,402.16
Refinery Gas	0.00	0.00
Other Petroleum Products	0.00	0.00
Natural Gas	3,761,984.78	13,793,944.20
Heat ¹	625,118.84	2,292,102.41
Electricity ²	12,191,437.74	44,701,938.37

Table 14. China's 2008 CO₂ Emissions from Energy: Transport, Post and Telecommunications

¹Share of heat sector's CO₂ emissions weighted by transport, post and telecommunication sector's share of final energy consumption of heat.

²Share of thermal electricity sector's CO₂ emissions weighted by transport, post and telecommunication sector's share of final energy consumption of electricity.

Structure of Emissions from Transport, Post & Telecommunications Energy Consumption

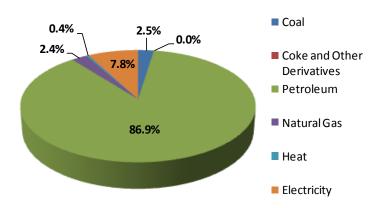


Figure 6. China's 2008 Transport, Post and Telecommunications Sector CO₂ Emissions by Major Fuels

Commerce

China's commercial sector covers wholesale, retail and catering services with total energy-related CO_2 emissions estimated at 133.4 Mt CO_2 in 2008 (Table 15). The majority of emissions are from thermal electricity use, followed by coal, petroleum and heat (Figure 7).

Table 15. China's 2008 CO	² Emissions from Energy: Commerce
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TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO ₂
TOTAL	36,388,244.49	133,423,563.11
Energy Emissions	EMISSIONS- T C	EMISSIONS -T CO ₂
Coal	10,290,023.93	37,730,087.73
Coke and Other Derivatives	187,020.92	685,743.39
Petroleum	1,988,922.53	7,292,715.95
Crude Oil	0.00	0.00
Gasoline	0.00	0.00
Kerosene	174,854.95	641,134.81
Diesel Oil	1,315,735.17	4,824,362.30
Fuel Oil	55,144.85	202,197.78
LPG	443,187.56	1,625,021.05
Refinery Gas	0.00	0.00
Other Petroleum Products	0.00	0.00
Natural Gas	1,057,239.23	3,876,543.85

Heat ¹	1,172,798.34	4,300,260.56
Electricity ²	21,692,239.54	79,538,211.64

¹Share of heat sector's CO₂ emissions weighted by commerce sector's share of final energy consumption of heat. ²Share of thermal electricity sector's CO₂ emissions weighted by commerce sector's share of final energy consumption of electricity.

Structure of Emissions from Commerce Energy Consumption

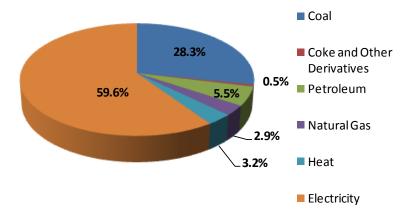


Figure 7. China's 2008 Commerce Sector CO₂ Emissions by Major Fuels

Residential

In 2008, energy-related CO_2 emissions in China's residential sector are estimated to total 721.6 Mt CO_2 , including 48% from thermal electricity and 26% from coal use (Table 16). The residential sector is also the second highest end-use sector after industry for CO_2 emissions from commercial heat with 11%, followed by 9% of total emissions from petroleum, 5% from natural gas and 2% from coke and derivatives (Figure 8).

TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO ₂
TOTAL	196,797,340.14	721,590,247.18
Energy Emissions		
	EMISSIONS- T C	EMISSIONS -T CO ₂
Coal	50,479,751.54	185,092,422.30
Coke and Other Derivatives	3,074,292.63	11,272,406.30
Petroleum	17,782,145.08	65,201,198.62
Crude Oil	0.00	0.00

Gasoline	0.00	0.00
Kerosene	106,499.85	390,499.45
Diesel Oil	5,100,941.88	18,703,453.55
Fuel Oil	0.00	0.00
LPG	12,574,703.35	46,107,245.63
Refinery Gas	0.00	0.00
Other Petroleum Products	0.00	0.00
Natural Gas	10,132,959.95	37,154,186.49
Heat ¹	21,601,529.69	79,205,608.85
Electricity ²	93,726,661.26	343,664,424.61

¹Share of heat sector's CO₂ emissions weighted by residential sector's share of final energy consumption of heat. ²Share of thermal electricity sector's CO₂ emissions weighted by residential sector's share of final energy consumption of electricity.



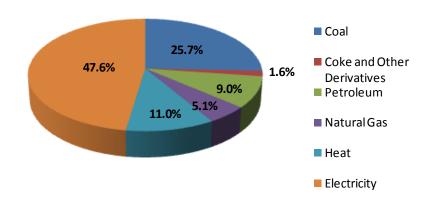


Figure 8. China's 2008 Residential Sector CO₂ Emissions by Major Fuels

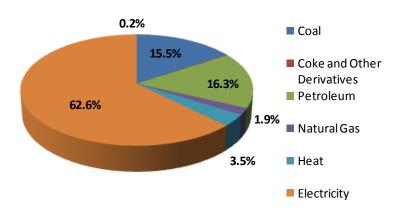
Other (Public) Sector

China's other (public) sector is estimated to emit 238.9 Mt CO_2 in 2008, with the bulk coming from thermal electricity use (60%), coal and petroleum (16% each) and smaller shares from heat and natural gas. This sector's fuel consumption includes that of military bunkers, which is not included in the bunker adjustment due to the lack of data.

TOTAL ENERGY EMISSIONS			
	EMISSIONS- T C	EMISSIONS -T CO ₂	
TOTAL	65,146,860.85	238,871,823.10	
Energy Emissions			
	EMISSIONS- T C	EMISSIONS -T CO ₂	
Coal	10,116,379.34	37,093,390.90	
Coke and Other Derivatives	100,035.07	366,795.25	
Petroleum	10,609,829.51	38,902,708.19	
Crude Oil	0.00	0.00	
Gasoline	0.00	0.00	
Kerosene	217,550.80	797,686.26	
Diesel Oil	9,923,183.76	36,385,007.11	
Fuel Oil	83,474.30	306,072.45	
LPG	385,620.65	1,413,942.37	
Refinery Gas	0.00	0.00	
Other Petroleum Products	0.00	0.00	
Natural Gas	1,245,890.02	4,568,263.41	
Heat ¹	2,289,419.21	8,394,537.10	
Electricity ²	40,785,307.70	149,546,128.24	

Table 17. China's 2008 CO₂ Emissions from Energy: Other (Public) Sector

¹Share of heat sector's CO₂ emissions weighted by other(public) sector's share of final energy consumption of heat. ²Share of thermal electricity sector's CO₂ emissions weighted by other(public) sector's share of final energy consumption of electricity.



Structure of Emissions from Other (Public Sector) Energy Consumption

Figure 9. China's 2008 Other (Public) Sector CO₂ Emissions by Major Fuels

Thermal Electricity

As a major energy source for many end-use sectors, thermal electricity emits a significant portion of China's energy-related CO_2 emissions with 2533.1 Mt CO_2 emitted in 2008 (Table 18). The vast majority of CO_2 emissions related to energy use in thermal electricity generation is from coal with a 98% share of emissions, followed by petroleum at less than 1% and coal and coke at a combined share of 1.2% (Figure 10).

TOTAL ENERGY EMISSIONS				
	EMISSIONS- T C	EMISSIONS -T CO ₂		
TOTAL	690,855,316.36	2,533,136,159.97		
Energy Emissions	EMISSIONS- T C	EMISSIONS -T CO ₂		
Coal	677,412,133.91	2,483,844,490.99		
Coke and Other Derivatives	3,189,409.79	11,694,502.57		
Petroleum	5,371,412.10	19,695,177.71		
Crude Oil	74,181.58	271,999.14		
Gasoline	0.00	0.00		
Kerosene	0.00	0.00		
Diesel Oil	1,594,960.50	5,848,188.51		
Fuel Oil	3,066,318.36	11,243,167.30		
LPG	0.00	0.00		
Refinery Gas	298,769.68	1,095,488.84		
Other Petroleum Products	337,181.98	1,236,333.91		
Natural Gas	4,882,360.55	17,901,988.70		

Structure of Emissions from Thermal Electricity Sector Energy Consumption

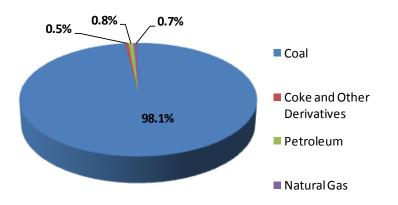


Figure 10. China's 2008 Thermal Electricity Sector CO₂ Emissions by Major Fuels

Heat

Commercial heat is primarily supplied as a secondary energy form to the industrial and residential sectors, followed by smaller uses in other (public) sector and transport sectors. In 2008, fuel consumption for producing commercial heat is estimated to total 321.3 Mt CO₂ (Table 19). Coal is the predominant fuel source of China's heat supply and contributed almost 94% of total CO₂ emissions from heat, followed by petroleum, natural gas and coke and derivatives at 4%, 2% and 1%, respectively (Figure 11).

TOTAL ENERGY EMISSIONS		
	EMISSIONS- T C	EMISSIONS -T CO ₂
TOTAL	87,620,322.82	321,274,517.01
Energy Emissions		
	EMISSIONS- T C	EMISSIONS -T CO ₂
Coal	82,114,790.47	301,087,565.05
Coke and Other Derivatives	717,381.72	2,630,399.65
Petroleum	3,513,507.27	12,882,860.00
Crude Oil	7,945.04	29,131.81
Crude Oil Gasoline	7,945.04	<u>29,131.81</u> 0.00
Gasoline	0.00	0.00

Table 19.	China's 2008 CO	Emissions from	Energy: Heat	Production

LPG	53,424.17	195,888.61
Refinery Gas	1,462,121.40	5,361,111.80
Other Petroleum Products	844,856.65	3,097,807.72
Natural Gas	1,274,643.36	4,673,692.30

Structure of Emissions from Heat Sector Energy Consumption

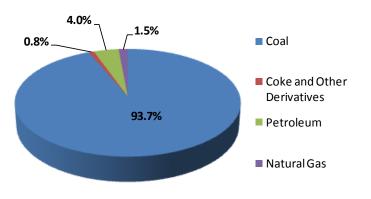


Figure 11. China's 2008 Heat Sector CO₂ Emissions by Major Fuels

3.3 Emissions from Nonfuel Use of Energy

Of the total estimated CO₂ emissions for China in 2008, a portion derive from nonfuel uses of fossil fuels, rather than from combustion during direct fuel consumption. The nonfuel (and feedstock) use of fuels is accounted for in the industrial sector, although as noted in the discussion on sequestration (section 3.4), there is apparent consumption of non-fuel petroleum products in other sectors, and some of these products, such as lubricants, result in carbon emissions as well. Nonfuel emissions captured in the industrial sector include coal, coke and coking products; crude oil, gasoline, kerosene, diesel oil, fuel oil, LPG, refinery gas and other petroleum products; and natural gas. In 2008, the CO₂ emissions from nonfuel use totaled 234.6 Mt CO₂, or 3.5% of the total adjusted emissions of 6666 Mt CO₂ (Table 20). The majority of the nonfuel emissions are from industrial non-energy use of raw coal (34%), coke (16%), petroleum coke (19%), chemical light oil (11%) and lubricants (4%), and natural gas (10%) (Figure 12).

Table 20. China's 2008 CO₂ Emissions from Nonfuel Use of Energy Fuels

	EMISSIONS - T C	EMISSIONS -T CO ₂
COAL	34,078,169.12	124,953,286.76
PETROLEUM	23,694,096.31	86,878,353.14
NATURAL GAS	6,205,696.48	22,754,220.42
Total Non-fuel Emissions	63,977,961.90	234,585,860.31

CARBON EMISSIONS FROM NON-FUEL	Nonfuel % of Total Emissions	3.5%
USE- COAL		
	EMISSIONS - T C	EMISSIONS -T CO₂
Raw Coal	21,711,191.75	79,607,703.10
Cleaned Coal	815,200.72	2,989,069.29
Washed Coal	1,060,707.63	3,889,261.32
Briquettes	59,556.79	218,374.91
Coke	9,920,869.93	36,376,523.08
Coke Oven Gas	111,887.83	410,255.37
Other Gas	0.00	0.00
Other Coking Products	398,754.46	1,462,099.67
	Nonfuel % of Total Coal Emissions	2.3%
CARBON EMISSIONS FROM NON-FUEL US	SE - PETROLEUM	
	EMISSIONS - T C	EMISSIONS -T CO ₂
Gasoline	76,556.53	280,707.27
Kerosene	24,030.92	88,113.36
Diesel Oil	189,850.80	696,119.61
Fuel Oil	333,577.37	1,223,117.02
LPG	92.88	340.55
Still Gas	12.04	44.15
Petroleum Asphalt	0.00	0.00
Lubricants	2,739,031.63	10,043,115.98
Lubricant base oil	519,271.09	1,903,993.99
Miscellaneous petroleum products	0.00	0.00
Pentanes plus	0.00	0.00
Petrochemical Feedstock	0.00	0.00
Petroleum Coke	12,082,537.50	44,302,637.50
Special Naphtha	-634,444.20	-2,326,295.40
Paraffin (Waxes and Polishes)	0.00	0.00
Solvent oil (Special Naphtha)	855,806.26	3,137,956.27
Detergents	274,120.00	1,005,106.67
Chemical light oil	7,233,653.50	26,523,396.17
Subtotal	23,694,096.31	86,878,353.14
	Nonfuel % of Total Petroleum Emissions	8.6%
CARBON EMISSIONS FROM NONFUEL US		0.070
	EMISSIONS -T C	EMISSIONS -T CO ₂
Natural Gas Flaring	0.00	0.00
Natural Gas	6,205,696.48	22,754,220.42
	Nonfuel % of Total Natural Gas	
	Emissions	12.8%

Note: Emissions from nonfuel use of energy fuels are included in the emissions from energy consumption tables.

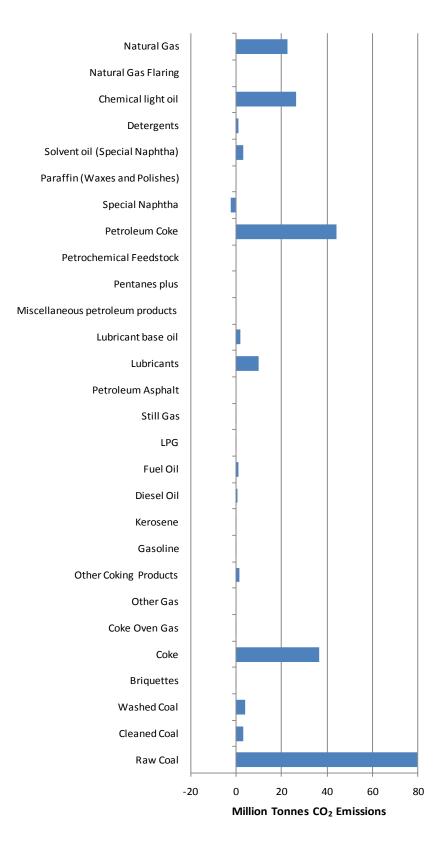


Figure 12. China's 2008 CO₂ Emissions from Non-fuel Use of Energy by Fuel Type

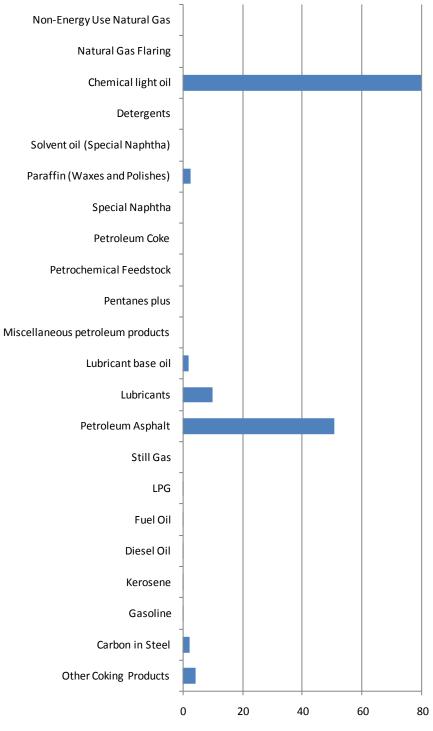
3.4 Carbon Sequestration

In estimating China's total CO₂ emissions for 2008, the carbon sequestered in the non-energy use of energy inputs including carbon steel and other coking products, and secondary petroleum products including plastics and other feedstocks are estimated and then deducted from total emissions. CO₂ sequestration is estimated to total 154 Mt CO₂ in 2008, or 2.3% of total carbon (Table 21). The majority (95% share) of sequestered carbon is from non-fuel use of petroleum products, with most of the carbon stored in chemical light oil, petroleum asphalt and lubricants (Figure 13). The remaining 5% of stored carbon is sequestered in the non-energy use of other coking products and carbon storage coefficient of the non-energy use of natural gas in China is in ammonia production with a carbon storage coefficient of zero, there is no carbon storage from non-energy use natural gas.

	SEQUESTRATION- T C	SEQUESTRATION -T CO ₂
COAL	1,807,450.09	6,627,316.98
PETROLEUM	40,188,843.93	147,359,094.40
NATURAL GAS	0.00	0.00
Total Sequestration	41,996,294.01	153,986,411.38
	% of Total Carbon	2.3%
CARBON SEQUESTRATION FROM NON-FUEL USE- CO	AL	
	SEQUESTRATION- T C	SEQUESTRATION -T CO ₂
Other Coking Products	1,196,263.37	4,386,299.02
Carbon in Steel	611,186.72	2,241,017.96
	% of Total Coal Carbon	0.12%
CARBON SEQUESTRATION FROM NON-FUEL USE - PE	TROLEUM	
	SEQUESTRATION- T C	SEQUESTRATION -T CO ₂
Gasoline	76,556.53	76,556.53
Kerosene	24,030.92	24,030.92
Diesel Oil	189,850.80	189,850.80
Fuel Oil	333,577.37	333,577.37
LPG	371.51	92.88
Still Gas	48.17	12.04
Petroleum Asphalt	13,850,529.00	50,785,273.00
Lubricants	2,739,031.63	10,043,115.98
Lubricant base oil	519,271.09	1,903,993.99
Miscellaneous petroleum products	0.00	0.00
Pentanes plus	0.00	0.00
Petrochemical Feedstock	0.00	0.00
Petroleum Coke	0.00	0.00
Special Naphtha	0.00	0.00
Paraffin (Waxes and Polishes)	754,616.42	2,766,926.86

Table 21. China's 2008 Carbon Sequestration by Nonfuel Use of Energy Fuels

Solvent oil (Special Naphtha)	0.00	0.00
Detergents	0.00	0.00
Chemical light oil	21,700,960.50	79,570,188.50
Subtotal	40,188,843.93	145,693,618.86
	% of Total Petroleum Carbon	12.7%
CARBON SEQUESTRATION FROM NONFUEL USE - NA	TRUAL GAS	
	SEQUESTRATION- T C	SEQUESTRATION -T CO ₂
Natural Gas Flaring	0.00	0.00
Non-Energy Use Natural Gas	0.00	0.00
	% of Total Natural Gas	
	Carbon	0.0%



Million Tonnes CO₂ Sequestered

Figure 13. China 2008 CO₂ Sequestration by Nonfuel Uses of Energy Fuels by Fuel Type

4. Conclusions and Areas for Improvement

This study assessed the applicability of the EIA methodology for estimating China's 2008 CO₂ emissions using published Chinese data. In applying the US estimation and reporting methodology to Chinese data, several areas of key statistical differences and data problems are highlighted. While the EIA method of calculating and reporting energy-related emissions by fuels and by sector can be applied using statistics from primary and secondary Chinese data sources, adjustments to account for significant differences between US and Chinese energy statistics are necessary. The total primary energy supply data for kerosene, diesel and fuel oil needs to be adjusted in order to exclude Chinese ships refueling abroad data (reported by other countries) and to include foreign ships refueling in China. China's important role as a global steel producer also suggests that carbon steel needs to be considered as a source of carbon sequestration and included in estimating total emissions. In the sectoral approach, fuels (gasoline) and emissions (bunkers and other transformation losses) must be reallocated to align with US conventions for reporting sectoral emissions.

In addition to the necessary adjustments to Chinese data for applying the EIA emissions inventory methodology, there are several remaining areas for improvement that will impact the accuracy and comparability of the emissions estimates. First, data insufficiencies precluded the estimation of industrial process-based emissions such as those from cement production, limestone consumption and natural gas production. Although US industrial process emissions only had a 2% share of total emissions in 2008, this share is higher in China where industrial activity dominates the economy. Because of the complexity surrounding various industrial processes that emit CO₂, more data and research into industrial processes outside of the scope of this study are prerequisites for appropriately estimating total CO_2 emissions. Similarly, emissions from natural gas flaring, which is omitted in this study due to insufficient data, is another area where data improvements can help increase the accuracy of the CO_2 estimate. Second, data on two missing categories of fuel consumption for international bunkers -Chinese vessels fueling in China and military bunkers – are needed to properly account for all international bunkers and adjust total CO₂ emissions accordingly. Third, developing China-specific carbon sequestration coefficients through the better understanding of end-use applications for non-fuel petroleum products in China will also contribute to a more accurate CO_2 emissions inventory estimate. Ultimately, this study serves as the first step in establishing a consistent methodology for estimating China's annual energy-related CO₂ emissions and highlights possible directions for deeper understanding of the drivers behind the world's largest CO₂ emitter.

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Appendix: Overview of the China Carbon Emissions Model

Structure of the China Carbon Emissions Model

The China Carbon Emissions Model is a macro-enabled spreadsheet model consisting of three types of worksheets: emissions results reports, data input worksheets and reference values worksheet, and calculation results worksheet. A navigation bar with shortcuts to the three types of worksheets (including drop-down for selecting the sectoral results worksheets) as well as a shortcut button to "Save & Exit" the model is included⁴.

The emissions results reports have grey (colorless) tabs and include:

- Total Emissions: summary of total energy-related emissions estimated under reference and sectoral approach
- Sectoral Emissions Results: agriculture, industry, construction, transport & telecom, commerce, residential, other (public sector), thermal electricity and heat
- Non-fuel Emissions
- Carbon Sequestration

Each results worksheet include data table of major results as well as visual graphics (pie or bar chart) illustrating the results.

The "Calculation Results" worksheet has a green tab.

The data input worksheets have a light red tab and include:

- Non-fuel data inputs
- Energy Balance SCE (standard coal equivalent) table
- Energy Balance (physical) table

In the data input and calculations results worksheets, the legend for cell colors is:

- Green cells: represent data inputs from data sources
- Blue cells: the results of a calculation (mostly done in the Calculation Results worksheet)
- Yellow cells: highlight a subtotal value

There is also a "Base Data" worksheet with IPCC and EIA default values for carbon coefficients as well as the China-specific energy conversion factors from the *China Energy Statistical Yearbook*.

⁴ All changes to the model are automatically saved when the "Save and Exit" button is used. If the user wishes to save the model under a different name, the "Save As" menu should be used, and the file type of "Excel Macro-Enabled Workbook (*.xlsm)" chosen in order to preserve the embodied macros.

INA CARBON EMISSION N	IODEL		X L
INPUT NON FUE	L DATA TOTAL EMISSIONS	CALCULATION PROCESS	SECTOR ANALYSIS
INPUT NATIONA	L DATA CARBON SEQUESTRATIO	NON FUEL EMISSIONS	SAVE & EXIT
China Carbon Dioxide	Emissions From Energy: Reference	e Approach	
ENERGY CONSUMPT	ION		
	EMISSIONS - T C	EMISSIONS - T COz	Structure of Emissions from Energy
COAL	1,496,952,842	5,488,827,086	Consumption by Fuel
NATURAL GAS	48,638,365	178,340,673	Consumption by Fuel
PETROLEUM	276,699,464	1,014,564,701	
ENERGY SUBTOTAL	1,822,290,671	6,681,732,460	
	EMISSIONS - T C	EMISSIONS - T COz	
NON-FUEL USE EMISSION	IS 63,877,862	204,585,880	3% 15%
NON-FUEL USE SEQUEST	B 41,396,294	153,386,411	
ADJUSTMENTS TO ENI	RGV		= COAL
IDJCOTALITIO TO LIT			82%
	EMISSIONS - T C	EMISSIONS - T COz	PETROLEUM
BUNKER FUEL EMISSION: TOTAL ADJUSTMENTS	5 -4,341,951 -4,341,951	-15,920,486 - 15,920,486	
·			
ADJUSTED TOTAL			
	EMISSIONS - T C	EMISSIONS - T CO ₂	
ADJUSTED TOTAL	1,817,948,720	6,665,811,974	
China Carbon Dioxide	Emissions From Energy: Sectoral	Approach	
ENERGY-RELATED E	MISSIONS		Structure of Emissions from Energy Consumption
			by Sector
	EMISSIONS - T C	EMISSIONS - T COz	
Agriculture	37,659,226.91	138,083,832.00 4,897,284,514.16	4% _2% ■ Agriculture
Industry Construction	1,335,623,049.32	4,897,284,514.16 83,245,170.18	2% 11% Industry
Transport & Telecomm	156,227,902.49	572,835,642.47	
Commerce	36,388,244.49	133,423,563.11	1% Construction
Residential	196,797,340.14	721,590,247.18	72% ■ Transport & Telecomm
Other (Public) Sector	65,146,860.85	238,871,823.10	
TOTAL	1,850,545,852.42	6,785,334,792.21	Commerce
			Residential
			Residential

A.1 Screenshot of China Carbon Emissions Model Total Emissions Summary

Model Data Inputs

The first data input sheet in the model for estimating China's CO_2 emissions is the "Non-fuel Use of Energy: Inputs" worksheet. This worksheet contains two sections of input data: one relating to the calculations for CO_2 sequestration in carbon steel and another relating to calculations for apparent consumption of other petroleum products not reported by NBS.

For the carbon steel inputs section, data on total crude steel production for the given year can be obtained from the annual *China Statistical Yearbook*'s table on "Output of Industrial Products" in the Industry chapter. The remaining data inputs on EAF % of Total Steel Production, Alloy Steel % of Total Steel Production and BOF % of Alloy Steel Production should be reviewed and updated based on the latest literature on Chinese steel production.

The second section on data inputs for other petroleum products uses data from Sinopec's *China Petrochemical Corporation Yearbook*.

NON-FUEL USE OF ENERGY: INPUTS				
	Total Crude Steel Production (Mt)	EAF % of Total Steel	Alloy Steel % of Total Steel	BOF % of Alloy Steel
CARBON STEEL Inputs	503.06	12.60%	6.95%	92.1
PETROLEUM PRODUCTS -MT				
	Production	Imports	Exports	Apparent Consumptio
Petroleum Asphalt	14.78	3.23	0.02	17
Lubricants	6.41	0.27	0.12	ŧ
Lubricant base oil	0.00	1.37	0.13	1
Miscellaneous Petroleum Products				
Pentanes Plus				
Petrochemical Feedstock				
Petroleum Coke	13.80	0.92	1.80	12
Naphtha		0.77	1.51	-(
Paraffin (Waxes and Polishes)	1.52	0.03	0.62	(
Solvent oil (Special Naphtha)	0.99	0.04	0.00	1
Detergents	0.39	0.00	0.00	(
Chemical light oil	33.64	0.00	0.00	33
			Sinopec Total	73
			NBS Total	71
			Stock Change	4
			Discrepancy	C

A.2: Data Input Sheet for Non-Fuel Use of Energy

M 📈 Non Fuel Emissions 📈 Carbon Sequestration 🦽 Calculation Results 🚽 Input Non-Fuel Data 🖉 Energy baland 🕅 🚛

In this worksheet, the dark blue and black fonts denote the petroleum product category name used by EIA while the light blue bolded font denotes the China-specific product category name.

The second data input worksheet is the annual "Energy Balance of China" table, which can be obtained from the *China Energy Statistical Yearbook* in both standard quantity (coal equivalent) units and physical units. The standard quantity energy balance table is used for the majority of calculations in estimating China's CO₂ emissions, with an adjusted Total Primary Energy Supply calculation for excluding China Airplanes & Ships Refueling Abroad and including foreign bunkers.

A.3: 2008 China Energy Balance Table (Standard Quantity)

												T
Jnit: 10.000 tce					PRIMARY	SECONDARY	SECONDARY	SECONDARY	SECONDARY	SECONDARY	SECONDARY	SECONDARY
		能源合计 E	nergy Total									
		(发电煤耗	电热当量	煤合计	原煤	洗精煤	其他洗煤	型煤	焦炭	焦炉煤气	其他煤气	其他焦化产
项 目	Item	计算法)	计算法)				Other					Other
		(coal equivalent	(calorific value	Coal Total	Raw Coal	Cleaned	Washed	Briquettes	Coke	Coke Oven	Other Gas	Coking
		calculation)	calculation)			Coal	Coal			Gas		Products
	(Adjusted Calculation: Excludes Bunkers in row 17)											
- 可供本地区消费的能源量	Total Primary Energy Supply	287,011.28	273,079.23	196,401.74	196,250.85	231.02	(71.14)	(8.99)	(2,253.58)			33
1.一次能源生产量	Indigenous Production	260,551.54	246,350.88	200,146.86	200,146.86							
水电	Hydro Power	19,470.31	7,191.95	201,024.19								
核电	Nuclear Power	2,275.60	840.56	196,401.74								
2.回收能	Recovery of Energy	6,510.84	6,510.84									
³ Fridley, David:	Import	35,977.34	35,896.72	2,946.16	2,154.86	617.15	174.14	0.02				139
Excluded from calculations; not a standard component of	China Airplanes&Ships Refueling in Abroad	786.51	786.51									
5 IPCC bunkers calculations	Export (-)	(9,230.99)	(8,881.76)	(3,456.81)	(3,135.64)	(311.09)	(1.20)	(8.89)	(1,186.40)			(106
6	Foreign Airplanes&ships Refueling in China	(723.62)	(723.62)			-						
7.库存増(-)、瑊(+)量	Stock Change	(6,860.33)	(6,860.33)	(3,234.48)	(2,915.24)	(75.04)	(244.08)	(0.13)	(1,067.18)			
加工转换投入(-)产出(+)里	Input(-) & Output(+) of Transformation	(5,166.01)	(67,071.12)	(140,581.68)	(147,039.13)	1,863.82	3,999.64	593.99	31,207.51	3,235.61	61.99	771
1.火力发电	Thermal Power	(0.00)	(58,541.24)	(89,701.86)	(88,203.08)	(23.53)	(1,475.25)			(548.14)	(290.04))
2.供热	Heating Supply	(0.00)	(3,363.86)	(10,873.51)	(10,613.96)	(5.86)	(253.70)			(78.82)	(109.71))
3.洗选煤	Coal Washing	(2,502.81)	(2,502.81)	(2,502.81)	(43,442.79)	34,646.61	6,293.37					-
4.炼 焦	Coking	(819.06)	(819.06)	(36,457.95)	(4,231.75)	(32,177.47)	(48.73)		31,115.40	3,766.36	15.99	741
5.炼油	Petroleum Refineries	(1,380.18)	(1,380.18)									
6.制 气	Gas Works	(235.41)	(235.41)	(1,004.65)	(428.72)	(575.93)			274.36	96.20	445.75	36
#焦炭再投入里(-)	Coke Input (-)	(187.65)	(187.65)						(182.25)			(5
7.煤制品加工	Briquettes	(40.89)	(40.89)	(40.89)	(118.83))	(516.05)	593.99				
损失望	Loss	7,736.14	3,209.10									-
.终端消费量	Total Final Consumption	278,546.14	207,234.95	60,442.51	53,812.12	2,115.09	3,928.75	586.55	28,862.83	3,213.99	5,583.54	803
1.农、林、牧、渔、水利业	Farming, Forestry, Animal Husbandry, Fishery & Water Conservance	6,013.13	4,150.86	1,158.67	1,143.55		15.13		51.62			1
2. 工 业	Industry	196,832.49	145,707.08	48,929.32	43,297.62	2,100.15	3,344.22	187.33	28,723.40	2,940.41	5,147.97	803
#用作原料、材料	Non-Energy Use	10,745.81	10,745.81	3,131.25	2,874.96	107.95	140.46	7.89	1,148.94	29.40		184
3.建筑业	Construction	3,812.53	3,035.33	460.12	454.13	1.80	4.19		10.39			
4.交通运输、仓储及邮电通迅业	Transport, Storage, Postal & Telecommunications Services	22,484.75	21,261.26	507.78	486.79	13.14	7.84		0.28		0.81	
5.批发和零售贸易业、餐饮业	Wholesale, Retail Trade and Catering Service	5,733.58	3,554.32	1,362.59	1,338.08		12.23	12.28	7.32	6.82	25.71	
6. 牛活消费	Residential Consumption	31,898.32	21,855.35	6,684.45	5,823.90	1	477.74	382.81	63.07	255.75	409.05	.]
城 镇	Urban	19,615.20	13,430.43	1,752.99	1,456.75		170.78	125.45	41.14	255.75	404.93	
乡村	Rural	12,283.12	8,424.92	4,931.46	4,367.15		306.96	257.35	21.94		4.11	
7.其他	Other	11,771.34	7,670.74	1,339.60	1,268.05		67.40	4.14	6.73	11.01		
平衡差额	Statistical Difference	(4,437.01)	(4,435.93)	(4,622.46)	(4,600.41)	(20.25)	(0.25)	(1.56)	91.10	21.62	(0.01)) 2
消费量合计	Total Final Consumption	291,448.30	277,515.17		200,851.25							

2008 China Energy Balance Table (continued)

5.07 市田华迈亚等于(村村县) 00								_						
5-26 中国能源平衡表(标准量) -20 ENERGY BALANCE OF CHINA -200														
	(
Unit: 10,000 tce			PRIMARY	SECONDARY	SECONDARY	SECON		SECONDARY	SECONDARY	SECONDARY	PRIMARY			(10 000 to
		油品合计	原油	汽油	煤油	Calculation		液化石	炼厂干气	其他石	天然气	热力	电力	其他能源
页目	Item	Petroleum						油气		油制品 Other				
~ 1		Products	Crude Oil	Gasoline	Kerosene	/ Diesel Oil	Fuel Oil	LPG	Refinerv	Petroleum	Natural Gas	Heat	Electricity	Other
		Total	cross on	Custinic		/ 2	1001011	210	Gas	Products		11041	Licenterry	Energy
	(Adjusted Calculation: Excludes Bunkers in row 17)	Totai			416.00	258.61	2,524.97		Gas	Fioducts				Luergy
		53,365.67	50,713.31	(293.61)	193.52	195.25	2,324.97	341.97		65.16	10,860.65		8,160.58	989.3
	Total Primary Energy Supply			(293.01)	193.52	195.25	2,150.07	341.97		05.10				989.3
1. 一次能源生产量	Indigenous Production	27,206.20	27,206.20								10,679.90		8,317.92	
水电	Hydro Power												7,191.95	
核电	Nuclear Power										10,812.03		840.56	
2. 回收能	Recovery of Energy													989.3
³ Fridley, David:	Import	32,151.34	25,555.54	292.35	953.16	909.89	3,123.03	444.42		872.95	612.33		47.22	
4. 4 Excluded from calculations; not a standard component of	China Airplanes&Ships Refueling in Abroad	786.51			278.09	12.55	495.87							
5. IPCC bunkers calculations	Export (-)	(3,496.08)	(605.37)	(299.21)	(789.32)	(91.87)	(1,045.25)	(116.32)		(548.75)	(431.59)		(204.55)	
6)	Foreign Airplanes&ships Refueling in China	(723.62)			(250.29)	(37.96)	(435.38)							
7.库存増(-)、减(+)量	Stock Change	(2,558.67)	(1,443.06)	(286.76)	1.87	(597.35)	11.80	13.88		(259.04)	1,455.22			
二.加工转换投入(-)产出(+)單	Input(-) & Output(+) of Transformation	(2,871.11)	(48,722.61)	9.339.05	1.705.21	19.268.72	1.797.25	3.271.90	1.391.76	9.077.62	(1.455.22)	8.789.72	34.290.06	(519.9
1. 火力发电	Thermal Power	(888.62)	(12.67)	(0.18)		(269.75)	(496.48)		(56.08)	(53.45)	(1,090.20)		34,290.06	(312.4
2.供热	Heating Supply	(605.80)	(1.36)			(,	(185.42)	(10.61)	(274.46)		(284.62)	8,789.72	,	(201.1
3.洗选煤	Coal Washing	(000.00)	((0.0.1)			(100110)	(,	()	((10			(20
4.炼 焦	Coking													
5.炼油	Petroleum Refineries	(1,373.79)	(48,708.58)	9,339.24	1,705.21	19.538.47	2.482.05	3,282.51	1,722.30	9,265.01				(6.3
	Gas Works	(1,373.79) (2.90)	(40,700.30)	9,559.24	1,703.21	19,000.47	2,462.05	3,202.01	1,722.30	9,205.01	(80.39)			(0.5
		(2.90)					(2.90))			(80.39)			
#焦炭再投入量(-)	Coke Input (-)													
7.煤制品加工	Briquettes													
三损失量	Loss	289.65	286.22					3.43			183.94	108.06	2,627.45	
四、终端消费量	Total Final Consumption	50,183.74	1,703.96	9,042.33	1,904.00	19,448.59	3,939.78	3,618.42	1,390.63	9,136.03	9,172.87	8,681.47	39,823.86	467.0
1.农、林、牧、渔、水利业	Farming, Forestry, Animal Husbandry, Fishery & Water Conservanc			236.07	1.85	1,601.17	2.14	6.35				2.78	1,090.18	
2.工业	Industry	18,461.33	1,703.96	862.21	72.22	3,397.80	2,228.77	845.46	1,390.63	7,960.28	5,542.78	6,116.57	28,575.17	467.0
#用作原料、材料	Non-Energy Use	4,825.78	226.63	27.68	8.42	64.22	108.02	92.24	11.96	4,286.61	1,385.69			40.0
3.建筑业	Construction	2,083.35		288.67	14.23	540.28	53.86	10.56		1,175.75	13.17	16.85	451.46	
4.交通运输、仓储及邮电通迅业	Transport, Storage, Postal & Telecommunications Services	19,147.66		4,547.26	1,728.29	11,145.81	1,632.56	93.74			840.03	61.94	702.77	
5. 批发和零售贸易业、餐饮业	Wholesale, Retail Trade and Catering Service	549.17		199.05	30.63	222.53	8.93	88.03			236.08	116.20	1,250.43	
6. 生活消费	Residential Consumption	4,637.31		1,258.26	18.66	862.71		2,497.68			2,262.63	2,140.29	5,402.81	
	Urban	3,437.83		895.54	2.53	640.15		1,899.61			2,254.60	2,140.29	3,142.90	
	Rural	1,199,48		362.72	16.13	222.57		598.07			8.02		2,259,91	
7.其他	Other	3,457.33		1,650.81	38.11	1,678.29	13.52	76.59			278.20	226.84	2,351.04	
五平衡差额	Statistical Difference	21.17	0.52	3.11	(5.27)	15.37	7.54	(7.98)	1.13	6.74	48.62	0.19	(0.68)	2.3
五·平開左颌 六.消费量合计	Total Final Consumption	21.17	0.52	3.11	(3.21)	13.37	1.34	(1.90)	1.13	0.74	40.02	0.19	(0.00)	2.3.
八小用炭里百斤	rotarrinarconsemption			-										

The energy balance table in physical units is primarily included as a reference and used to calculate the energy conversion factor for other coal gas.

Model Calculations

The underlying calculations behind all of the results analysis is laid out in the "Calculations Results" worksheet, which is divided into four main sections. Table 1 and its corresponding sub-tables include all of the calculations for primary and secondary energy-related emissions by fuel under the reference approach. It also includes a summary table of all emissions from energy consumption, non-fuel emissions, non-fuel sequestration, and the bunker adjustment.

A.4: Calculation Results Worksheet

A	В	С	D		E	F	G
1	CHINA CARBON EMISSION MODEL					23	
2 Table 1: Total Energy-Related Emissions	INPUT NON FUEL DATA	TOTAL EMISSIONS	ALCULATION PROCESS	SECTO	R ANALYSIS		
3	INPUT NATIONAL DATA	CARBON SEQUESTRATION	NON FUEL EMISSIONS	1	•	SAVE & EXIT	
4 Table 1.1: Primary Energy Emissions							
5	10 ⁴ tc		fce	τJ	Tons of Carbon	Total Carbon Emissions (tons)	
6 Raw Coal	200,851.2			,790,395.58	1,516,792,206.03	1,516,792,206.03	5,561,571,422.10
7 Natural gas	10,860.6			3,178,978.13	48,638,365.31	48,638,365.31	178,340,672.82
8 Crude Petroleum 9 Subtotal	50,713. 262,425.			,844,096.75 ,813,470.46	296,881,935.01 1,862,312,506.35	296,881,935.01 1,862,312,506.35	1,088,567,095.03 6,828,479,189.95
5 Subtotal	262,420	2,624,202,0	e.ioj 76	,813,970.96 <u> </u>	1,862,312,006.30	1,862,312,006.30	6,828,473,183.30
11							
2 Table 1.2: Secondary Energy Emissions	10 ⁴ tc		[ce	LT	Tons of Carbon	Total Carbon Emissions (tons)	Total (02 Emissions (tons)
13 Cleaned Coal	231.0			67,621.07	1,744,623.58	1,744,623,58	6,396,953.12
4 Washed Coal	-71			-20,822.52	-537,221.14	-537,221.14	-1,969,810.84
5 Briquettes	-8.5			-2,632.20	-67,910.73	-67,910.73	-249,005.99
16 Coke	-2,253.5	8 -22,535,8	0.02 -	659,636.72	-19,459,283.15	-19,459,283.15	-71,350,704.87
7 Coke Oven Gas	0.0	0	0.00	0.00	0.00	0.00	0.00
8 Other Gas	0.0	0	0.00	0.00	0.00	0.00	0.00
9 Other Coking Products	33.3	4 333,3	0.60	9,758.55	287,877.16	287,877.16	1,055,549.58
0 Secondary energy -Coal Subtotal	-2,069.3	5 -20,693,5	2.32	-605,711.82	-18,031,914.27	-18,031,914.27	-66,117,019.00
1 Gasoline	-293.	-2,936,0	9.24	-85,941.43	-1,624,293.02	-1,624,293.02	-5,955,741.06
22 Kerosene	416.0			121,765.75	2,374,432.04	2,374,432.04	8,706,250.80
23 Diesel Oil	258.			75,698.10	1,529,101.71	1,529,101.71	5,606,706.27
Fuel Oil	2,524.5			739,072.98	15,594,439.84	15,594,439.84	57,179,612.73
25 LPG	341.5			100,097.10	1,721,670.18	1,721,670.18	6,312,790.64
26 Other Petroleum Products	65.			19,072.89	411,022.18	411,022.18	1,507,081.33
27 Secondary energy -Petroleum Subtotal	3,313.	0 33,131,03	2.40	969,765.39	20,006,372.93	20,006,372.93	73,356,700.73
	10 ⁴ tc			τJ	T	T	T-1-1 000 F-1-1-1-1 (1-1-1)
Table 1.3: Bunker Fuel Emissions Kerosene	-250.2		lce	-73,260.00	Tons of Carbon -1,428,569,97	Total Carbon Emissions (tons) -1.428.569.97	-5,238,089.91
1 Diesel Oil	-200.2			-11.110.38	-1,428,563.37 -224,429.68	-1,420,060.37 -224,429,68	-0,238,089.91
2 Fuel Oil				-127,438.44	-2,688,951.12	-2,688,951.12	
Bunker Fuel Subtotal	-723.6			-211,808.82	-4,341,950.78	-4,341,950.78	-15,920,486.18
34							
5 Table 1.4: Total Energy Emissions							
6 Energy Consumption	Тс	e	TJ Total Carbon Emissi	ions (tons)	Total CO2 Emissions (tons)	% of Total Emissions	
37 Coal	1,987,818,997.5	4 58,184,6	3.76 1,496	3,952,841.67	5,488,827,086.12		
8 Natural gas	108,606,470.0			3,638,365.31	178,340,672.82		
9 Petroleum	540,264,096.2			699,464.01	1,014,564,701.36		-
Energy Subtotal	2,636,689,564.2	3 77,177,5		,290,670.99	6,681,732,460.30	6,835,718,871.68	
1 Nonfuel Use Emission				3,977,961.90	234,585,860.31	3.52%	nzheng:
2 Nonfuel Use Sequestration				1,996,294.01	153,986,411.38	2.25%	Total Carbon = energy
13 Bunker Fuel				,341,950.78	-15,920,486.18		consumption emissions
14 Total			1,817	,948,720.21	6,665,811,974.12		non-energy emissions + CO2 sequestration
45	Invitation Desults / Jacob No. 5 10 1	En annu halta an COD	2000	(aleraia D			
Non Fuel Emissions Carbon Sequestration	Iculation Results / Input Non-Fuel Data	Energy balance SCE	2008 energy balance	(physical)			

Table 2 and the subsequent sub-tables in this section focus on calculating carbon emissions and sequestration from the non-energy use of fuels, including carbon steel sequestration, non-energy emissions and sequestration of petroleum products, and emissions from non-energy use of natural gas. The purple sidebar includes an additional side calculation estimating EAF carbon steel which is not included in the final results.

	Carbon Steel Production Parameters	C Ton Sequestration	CO2 Ton Sequestration							
otal Crude Steel Production	503,057,500.00	611,186.72	2,241,017.96	National Bureau of Statistics	2010	EAF Carbon Steel Calcula	tion			
rimary Steel Production (BOF method)	439,672,255.00	0.041%					tonnes			
lloy Steel Share of Total Steel	6.95%			China Association of Scrap I		Total Alloy Steel Production	34,962,496			
OF Alloy Steel Share of Alloy Steel	92%			China Central Iron & Steel Re		EAF Alloy Steel Production	2,748,052			
AF Steel Share of Total Steel Production	12.6%			China Association of Scrap I	ion and Steel, 2010.	EAF Steel Production	63,385,245			
OF Carbon Steel Share of Total Steel	81.02					EAF Carbon Steel Production	60,637,193			
Product Steel	50%			Komesaroll, 2008		EAF Carbon Steel Pig Iron Use	16,675,228			
werage carbon content product steel	0.2%			Anonymous, 2010, "Carbon S	teel" on Baidu Website (In Chinese).	New Sequestered Carbon	25,013			
Structural Steel	50%			Komesarolf, 2008		Share of Total Sequestered Carb-	0.06%			
werage carbon content structural steel	0.1%			Anonemous 2010 "Carbon S	teel" on Baidu Website (In Chinese)					
wg Carbon Content	0.150%									
	10 ⁴ toe	Tce	TJ	Cton	CT S	Total Carbon Emissions (tons)	Total CO2 Emissions (tons)	Sequestration Coefficient	Reference	
aw Coal	2.874.36	28,749,620,47	841,519.06	21,711,191,75	C Ton Sequestration 0.00		79.607.703.10	0.00	Page 27	
Neaned Coal	2,014.30	20,143,020,41	31,596.93	815,200.72	0.00		2,989,069,29	0.00		
								0.00	Page 27	
/ashed Coal	140.46	1,404,572.46	41,112.70	1,060,707.63	0.00		3,889,261.32		Page 27	
Briquettes	7.89	78,864.18	2,308.40		0.00		218,374.91	0.00	Page 27	
Coke	1,148.34	11,489,361.61	336,300.68	9,920,869.93	0.00		36,376,523.08	0.00	Page 27	
Coke Oven Gas	29.40	294,040.84	8,606.76	111,887.83	0.00		410,255.37	0.00	Page 27	
)ther Gas	0.00	0.00	0.00	0.00	0.00		0.00	0.00	Page 27	
Ither Coking Products	184.72	1,847,190.49	54,068.40		1,196,263.37		1,462,099.67	0.75	Page 27	
				Subtotal	1,196,263.37	34,078,163.12	124,953,286.76			
otal Non Energy use Coal		C Ton Sequestration	C Ton Emission	questration % Total Carbon N	Ionfuel Emissions % Total Emissions					
	1	1,807,450.09	34,078,169.12	0.12%	2.28%	1				
		•								
able 2.2 : Non Energy use - Petroleum										
<i>"</i>	10 ⁴ T ce	Tco	LT.	CTon	C Top Sequestration	Total Carbon Emissions (tons)	Total CO2 Sequestered	Sequestration Coefficient	Reference	
lasoline	27.68		8,101.22		76.556.53		280.707.27	0.50	Page 12	
erosene	8.42	84,204,22	2,464.71	48.061.83	24.030.32		88,113.36	0.50	Page 12	
iesel Oil	64.22	642,183,62	18,797.11	379,701.61	183,850,80	189,850.80	696,119,61	0.50	Page 12	
al Oil	108.02	1.080.220.16	31.618.71	667,154,74	333.577.37		1,223,117.02	0.50	Page 12	
PG	32.24	322.335.20	26.999.07	464.38	371.51		1,223,111.02	0.80		
till Gas	32.24		26,333.01		48.17		1,362.13	0.80	Page 13	
till Gas	11.36	119,593.85	3,500.58					0.80	Page 23	
		_		Subtotal	624,435.23	624,120.53	2,289,596.07			
		Ton	TJ	CTon	C Ton Sequestration		Total CO2 Sequestered	Sequestration Coefficient	Reference	
etroleum asphalt	17.99	17,987,700.00	623,563.50	13,850,529.00	13,850,529.00	0.00	50,785,273.00	1.00	Page 10	
bricants	6.55	6,550,200.00	273,903.16	5,478,063.26	2,739,031.63		10,043,115.98	0.50	Page 18	
ubricant base oil	1.24	1,241,800.00	51,927.11	1,038,542.18	519,271.03		1,903,993.99	0.50	Page 18	
liscellaneous petroleum products	0.00	0.00	51,327.11	1,038,542.18	0.00	0.00	0.00	1.00	Page 18	
fiscellaneous petroleum products entanes plus	0.00	0.00	51,927.11	1,038,542.18	0.00	0.00	0.00	1.00	Page 18 Page 19	
liscellaneous petroleum products entanes plus etrochemical Feedstock (Chem Light Oil + Naphtha)	0.00 0.00 0.00	0.00 0.00 0.00			0.00 0.00 0.00	0.00 0.00 0.00	0.00 0.00 0.00	1.00 0.00 0.75	Page 18	
liscellaneous petroleum products entanes plus etrochemical Feedstock (Chem Light Oil + Naphtha)	0.00 0.00 0.00 12.92	0.00	51,927.11	1,038,542.18	0.00 0.00 0.00 0.00	0.00 0.00 0.00 12,082,537.50	0.00	1.00	Page 18 Page 19	
fiscellaneous petroleum products entanes plus	0.00 0.00 0.00	0.00 0.00 0.00			0.00 0.00 0.00	0.00 0.00 0.00 12,082,537.50	0.00 0.00 0.00	1.00 0.00 0.75	Page 18 Page 19 Page 20	
Niscellancous petroleum products entance plus etrochemical Feedstock (Chem Light Oil + Naphtha) etroleum coke	0.00 0.00 0.00 12.92	0.00 0.00 0.00 12,322,500.00	439,365.00	12,082,537.50	0.00 0.00 0.00 0.00	0.00 0.00 12,082,537,50 -634,444.20	0.00 0.00 0.00 0.00	1.00 0.00 0.75 0.00	Page 18 Page 19 Page 20 Page 21	
Niscellineous petroloum products ontanes plus etrochamical Feddrock (Chem Light Oil + Naphtha) etroleum cole Japhtha	0.00 0.00 0.00 12.82 -0.74	0.00 0.00 12,322,500.00 -741,000.00	439,365.00 -31,722.21	12,082,537.50 -634,444.20	0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 12,082,537,50 -634,444,20 0.00	0.00 0.00 0.00 0.00 0.00	1.00 0.00 0.75 0.00 0.00	Page 18 Page 19 Page 20 Page 21 Page 23	Fridley, David:
facellineous petroleum products entance plus etrochamical Feedstock (Chem Light Oil + Naphtha) etrochamical Feedstock (Chem Light Oil + Naphtha) aratifia (Vacas and Polisheo) onstat (I Gpacial Naphtha)	0.00 0.000 0.000 18.82 0.014 0.033 0.033	0.00 0.00 12,322,500.00 -741,000.00 334,600.00	439,365.00 -31,722.21 40,187.80	12,082,537.50 -634,444.20 754,616.42	0.00 0.00 0.00 0.00 0.00 754,616.42 0.00	0.00 0.00 12,082,537,50 -634,444,20 0.00 855,806,26	0.00 0.00 0.00 0.00 2,766,328,86 0.00	1.00 0.00 0.75 0.00 0.00 1.00	Page 18 Page 19 Page 20 Page 21 Page 21 Page 20 Page 20 Page 20	No data on non-fuel
liseellisoous petroleum products extenses plus extecleum (effectorech (Chen Light Oil + Naphtha) extecleum coke liphtha araffin (Vaxes and Polishes) overast oil (Goscial Naphtha) exergants	0.00 0.00 0.00 18.85 0.01 0.01 0.03 0.03 0.03 0.03 0.03	0.00 0.00 12,522,500.00 -741,000.00 334,600.00 1,023,300.00 331,600.00	439,365.00 -31,722.21 40,187.80 42,790.31 13,706.00	12,082,537.50 -634,444,20 754,616,42 855,806,26 274,120,00	0.00 0.00 0.00 0.00 754,6542 0.00 0.00	0.00 0.00 12,082,533.50 -634,444.20 0.00 855,806.26 274,120.00	0.00 0.00 0.00 0.00 2,766,326.86 0.00 0.00	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	Fridley, David: No data on non-fuel petroleum coke
fiscillancous petroloum peroducts entance plus etrochumicuf Feedrock (Chem Light Oil + NopMts) etroloum cole upplaha araffia (Vascisal Poliches) araffia (Vascisal Poliches) etergiants henicul light oil	0.000 0.000 12.532 0.014 0.033 102 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.035 0.035 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000	0.00 0.00 12,82,500.00 -744,000.00 334,600.00 1,023,300.00 331,600.00 331,600.00	433,365.00 -31,722.21 40,187.80 42,730.31 13,706.00 1,446,730.70	12,082,537.50 -634,444.20 -754,516.42 -855,806.26 -274,120.00 -28,334,514.00	0.00 0.00 0.00 0.00 175,615.42 0.00 0.00 0.00 21,700,560.50	0.00 0.00 12/082,537.50 -634,444.20 0.00 855,806.55 274,120.00 7,233,653.50	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.05 0.00 0.00 1.00 0.00	Page 18 Page 19 Page 20 Page 21 Page 21 Page 20 Page 20 Page 20	No data on non-fuel
liscillisous petroleum peroducts extranse plus teroleum ocks spithh araffin (Vares and Polishec) olreat all (Special Naphtha) etergants hemical light all Subtotal	0000 000 000 000 0282 001 014 033 1022 033 0334 03334 03334	0.00 0.00 12,522,500.00 -741,000.00 334,600.00 1,023,300.00 331,600.00	439,365.00 -31,722.21 40,187.80 42,790.31 13,706.00	12,082,537,50 -634,444,20 754,616,42 655,806,62 271,120,00 28,334,614,00 62,634,384,41	0.00 0.00 0.00 0.00 754,616.42 0.00 0.00	0.00 0.00 12/082,537.50 -634,444.20 0.00 855,806.55 274,120.00 7,233,653.50	0.00 0.00 0.00 0.00 2,766,326.86 0.00 0.00	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
facellanous petroleum products ontanes plus etroleum oke hphtha araffia (Vaces and Polishes) ohrant all (Special Naphtha) etragantz henical light all Subtotal	0000 000 000 000 0282 001 014 033 1022 033 0334 03334 03334	0.00 0.00 12,82,500.00 -744,000.00 334,600.00 1,023,300.00 331,600.00 331,600.00	433,365.00 -31,722.21 40,187.80 42,730.31 13,706.00 1,446,730.70	12,082,537.50 -634,444.20 -754,516.42 -855,806.26 -274,120.00 -28,334,514.00	0.00 0.00 0.00 0.00 175,615.42 0.00 0.00 0.00 21,700,560.50	0.00 0.00 12/082,537.50 -634,444.20 0.00 855,806.55 274,120.00 7,233,653.50	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
Riscillances petroloum peroducts extense plus extense plus extension roke hyphth aurifin (Vaces and Politikec) ownen of Opencial Napatala extergante hemicul light oil Subtotal ference Report: Documentation for Inclusions of Greenhouse Gaues in th	0000 000 000 000 0282 001 014 033 1022 033 0334 03334 03334	0.00 0.00 0.00 14,242,500.00 1-741,000.00 334,600.00 334,600.00 336,643,900.00 73,555,600.00	433,365.00 -31,722.21 40,167.80 42,730.31 13,706.00 1,446,730.70 2,906,457.37	12,082,537,50 -634,444,20 754,516,42 655,606,26 274,120,00 28,334,514,00 62,634,514,00 21,33	0.00 0.00 0.00 0.00 154,56,42 0.00 0.00 0.00 2,1100,566,50 0.0564,40664	0.00 0.00 12,082,5750 -0.34,444,20 0.00 24,34,444,20 0.00 24,444,20 0.00 24,449,20 24,409,20 24,449,20 24,409,20 24,449,20 24,	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
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Sicelihaosu petroloum peroducts extranse plus tetroleum cole uphtha aurdim (Verone and Polisikec) overa oil (Special Naphtha) etergenst kumical light oil Subtotal Etermene Report: Documentation for Enclassions of Greenhouse Gales in th	0000 000 000 000 0282 001 014 033 1022 033 0334 03334 03334	0.00 0.00 0.00 14,242,500.00 1-741,000.00 334,600.00 334,600.00 336,643,900.00 73,555,600.00	433,365.00 -31,722.21 40,167.80 42,730.31 13,706.00 1,446,730.70 2,906,457.37	12,042,537,50 -604,444,20 1754,684,42 875,506,26 274,120,00 8,834,644,00 62,934,384,441 21,53 questration X, Total Carbon N 2,17	0.00 0.00 0.00 0.00 754,5642 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.000 0.001 12.005,357,500 0.002 0.003	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
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iscollascour petroleum peroducts hease plus treschenical Federicek (Chun Light Oil + Napitha) treschenical Federicek (Chun Light Oil + Napitha) tresues phila nuffin (Vivez and Pelifikez) head of general Repetition terregens menical light of Subtotal Subtotal Subtotal Non Energy use Petroleum able 2.2.1: Non Energy use- Petroleum - Emissions and × Product Emittee	0.00 0.00 0.00 0.222 0.01 0.232 0.033 0.03 00 0.03 0.03 0.03 0.03 00000000	0.00 0.00 12,22250000 344,000.00 334,600.00 334,640,000 73,555,000.00 C Tos Sequestration 40,889,843,33 23,069,915 TB	433,365.00 -31,722.21 40,07130 42,730.31 13,706.00 1,446,730.70 2,366,457.37 C T on Emission	12,082,531,50 -63,444,20 174,684,42 87,506,28 27,41,20,00 28,334,64,00 62,634,894,41 21,33 questration X, Total Cathon, N 12,75 questration X, Total Cathon, N 14,75 questration X, Total Cathonno, N 14,75 questration X	0.00 0.00 0.00 0.00 154,464.42 0.00 0.00 21(100,465.0 33,564,408.44 0.00 23,564,408.64 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0	0.000 0.001 12.005,357,500 0.002 0.003	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
liscillarous petroloum products strates plas strachanical Feedstock (Chan Light Oil + Naphtha) strachanical Feedstock (Chan Light Oil + Naphtha) stratements patha partific (Yuzar and Polisher) bortal (Decidi Naphtha) stergants bortal (Decidi Naphtha) stergants fermicel fight oil Subtotal fermice Papert: Documentation for Znissions of Greenbruss Gases in the otal Non Energy use Petroleum able 2.2.1 : Non Energy use- Petroleum - Emissions and	0.00 0.00 0.00 0.222 0.01 0.232 0.033 0.03 00 0.03 0.03 0.03 0.03 00000000	0.00 0.00 12,22250000 344,000.00 334,600.00 334,640,000 73,555,000.00 C Tos Sequestration 40,889,843,33 23,069,915 TB	433,365.00 -31,722.21 40,07130 42,730.31 13,706.00 1,446,730.70 2,366,457.37 C T on Emission	12,082,537,50 -6,94,444,20 174,646,42 075,006,26 271,200,00 28,334,546,00 08,204,384,41 21,53 questration × Total Carbon M [Fridler, Do [Prictoum Re [Garage Pares Notwide Pares Notwide Pares	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.001 12.005,357,500 0.002 0.003	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
Nicelikanse periorium peroducts senser per erochamical Federock (Cham Light Oil + Niphtha) erochamical toolanical (Special Niphtha) erocygants bancial light eli Subtotal	0.00 0.00 0.00 0.222 0.01 0.232 0.033 0.03 00 0.03 0.03 0.03 0.03 00000000	0.00 0.00 12,22250000 344,000.00 334,600.00 334,640,000 73,555,000.00 C Tos Sequestration 40,889,843,33 23,069,915 TB	433,365.00 -31,722.21 40,07130 42,730.31 13,706.00 1,446,730.70 2,366,457.37 C T on Emission	12,082,537,50 -6,94,444,20 174,646,42 075,006,26 271,200,00 28,334,546,00 08,204,384,41 21,53 questration × Total Carbon M [Fridler, Do [Prictoum Re [Garage Pares Notwide Pares Notwide Pares	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.001 12.005,357,500 0.002 0.003	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
Nicelikanse periorium peroducts senser per erochamical Federock (Cham Light Oil + Niphtha) erochamical toolanical (Special Niphtha) erocygants bancial light eli Subtotal	0.00 0.00 0.00 0.222 0.01 0.232 0.033 0.03 00 0.03 0.03 0.03 0.03 00000000	0.00 0.00 12,22250000 344,000.00 334,600.00 334,640,000 73,555,000.00 C Tos Sequestration 40,889,843,33 23,069,915 TB	433,365.00 -31,722.21 40,07130 42,730.31 13,706.00 1,446,730.70 2,366,457.37 C Tos Emission	12,082,537,50 -6,94,444,20 174,646,42 075,006,26 271,200,00 28,334,546,00 08,204,384,41 21,53 questration × Total Carbon M [Fridler, Do [Prictoum Re [Garage Pares Notwide Pares Notwide Pares	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.001 12.005,357,500 0.002 0.003	0.00 0.00 0.00 2,765,326.85 0.00 0.00 79,570,188.50	1.00 0.00 0.75 0.00 0.00 1.00 0.00 0.00	Page 18 Page 19 Page 20 Page 20 Page 23 Page 20 Page 20 Page 20 Page 20	No data on non-fuel
Nicelikanse petroloum products senser per errockning i Fedrock (Chen Light Oil + Niphtha) etroloum coke infla (Vianze and Politika) otrast all (Special Niphtha) etrogents hemical light all Subtotal Subtotal Non Energy use Petroleum "able 2.2.1: Non Energy use- Petroleum - Emissions and % Product Emittee % Product Sequestered	0.00 0.00 0.00 0.222 0.01 0.232 0.033 0.03 00 0.03 0.03 0.03 0.03 00000000	0.00 0.00 16,2822,500.00 -141,000.00 354,600.00 354,600.00 354,600.00 354,600.00 73,355,600.00 73,355,600.00 C Tos Sequetration 40,886,843.30 22,065,375,78 33,564,406.84	433,355.00 -31,722.21 40,1732.35 42,730.31 13,706.00 1,446,730.70 2,306,457.37 C Tos Emistion 20,694,096.31	12,082,531,50 -63,444,20 174,684,42 85,506,28 274,2000 8,394,64,00 62,054,394,41 21,52 questration % Total Carbon N 12,741,200 Partolam N (Europy Pare Nostral Pare Nostral Pare Nostral Pare	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.000 0.000 12.0853053 -454.444.20 0.000 655.006.28 274.12000 7.233.655.50 23.065.975.78 Artigs Davids Artigs Davids of "Data Paraleum Produce"	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	100 0.00 0.15 0.00 100 0.00 0.00 0.00 0.	Pags 19 Pags 19 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20	No data on non-fuel
Nacillacous petroloum peroducts dense pins terschning festrock (Chun Light Oil + Nephtha) etrochanicale sphtha nenicalight oil menicalight oil Subtotal second petroloum able 2.2.1: Non Energg use- Petroleum - Emissions and X Product Emitter X Product Sequestered able 2.3: Non Energg use- Natural Gas	0000 000 12,52 0,014 0,055 0,014 0,055 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,033 0,030 0,0000 0,0000 0,0000 0,000000	0.00 0.00 0.00 1,202,00.00 1,741,000.00 3,94,600.00 3,95,600.00 3,95,600.00 73,955,600.00 73,955,600.00 73,955,600.00 73,955,600.00 23,069,975,76 33,564,408,64	433,365.00 -31,122.21 40,175.03 153,706.00 1446,730.70 2,306,457.37 C Toe Emission 23,654,096.31	12,002,537,50 -604,444,20 T54,654,42 855,506,26 274,120,00 86,294,584,500 62,094,584,51 21,53 questration × Total Carbon h [Carup Paro Roundel Paro Nonted Paro Nonted Paro Nonted Paro Nonted Paro	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0000 000 000 12,062,370 -454,442,00 000 455,062,8 271,120,00 455,062,8 271,120,00 77232,653,50 23,063,975,76 - Fridley, David: Average Carbon Center Products** Tons of Carbon Emitted	0.000 0.000 0.000 2.765,926.85 0.000 0.000 0.000 0.000 0.373708.50 145,065,458.33	100 0.00 0.15 0.00 100 0.00 0.00 0.00 0.	Pags 19 Pags 19 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20	No data on non-fuel
Nacillanous petroloum peroducts somes plus etrochanical Federicols (Chen Light Oil + Naphtha) etroloum coles uphtha surfine (Wassead Polishes) owner of (Special Naphtha) etergants hereid light a Subtotal Fremese Repart: Documentation for Zeissions of Greenhouse Genes total Non Energy use Petroleum "able 2.2.1 : Non Energy use- Petroleum- Emissions and % Product Emitter % Product Sequesterer "able 2.3: Non Energy use- Natural Gas latural Gas Flaring	0000 0000 1238 0.14 0.35 102 0.354 0.355 0.354 0	0.00 0.00 16,2822,500.00 141,000.00 354,600.00 354,600.00 354,600.00 354,600.00 73,355,600.00 73,355,600.00 C Top Scapestration 40,88,843,353 22,069,375,15 33,564,408,84 7 Tee 0.00	433,355.00 01,722.21 4.0,1720.21 13,706.00 1,246.730.70 2,2066.457.37 C Tos Emistios 20,664.096.31 T J J 0,000	12,082,537,50 -63,444.20 174,664.42 85,506.26 274,120,00 8,934,644.00 62,954,834.41 24,520,4234.41 24,520,4234.41 1,741,42,00 1,741,420,420 1,741,420,420 1,741	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.000 0.000 12.08530750	0.00 0.00 0.00 0.00 0.166,826.86 0.00 15371365.50 145,066,490.33 145,066,490.33 10,00 1,00	100 000 0.05 0.00 100 0.00 0.00 0.00 0.0	Page 10 Page 10 Page 20 Page 20	No data on non-fuel
Nicellinsone petroloum peroducts extense plas extense plas extense plas extense plas extense mode spitula suraffin (Vivez sua Polisiker) overa oil (Special Polisiker) overa oil (Special Polisiker) overa oil (Special Polisiker) extense Report: Documentation for Emissions of Greenhouse Cases in the otal Non Energy use Petroleum able 2.2.1: Non Energy use- Petroleum - Emissions and % Product Emittee % Product Sequestered able 2.3: Non Energy use- Natural Gas latural Gas Flaring on-Energy Use	0000 000 000 0282 0.014 0.053 0.02 0.03 0.03 0.03 0.03 0.03 0.03 0.0	0.00 0.00 0.00 1,202,00.00 1,741,000.00 3,94,600.00 3,95,600.00 3,95,600.00 73,955,600.00 73,955,600.00 73,955,600.00 73,955,600.00 23,069,975,76 33,564,408,64	433,365.00 -31,122.21 40,175.03 153,706.00 1446,730.70 2,306,457.37 C Toe Emission 23,654,096.31	12,082,537,50 -63,444,20 T54,684,2 85,506,26 214,120,00 28,394,640,00 62,054,594,641 21,59 guestration % Total Cahon N Carbon K Carbon Person Noares Person Noares Person Tons of Cahon 0,000 62,0556,46	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0000 000 000 12,062,305 -634,444,20 000 655,306,28 274,120,00 72,335,653,50 23,069,317,18 Fridley, David: Average Carbon Context of "Obde Froloum Product" Tons of Carbon Emitted 0,000 6,305,556,48	0.000 0.000 0.000 2.756,326.85 0.000 0.000 7.35708.50 145,065,438.33	100 0.00 0.15 0.00 100 0.00 0.00 0.00 0.	Pags 19 Pags 19 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20 Pags 20	No data on non-fuel
Incollationare petroleum perodukts hinse plas trackeniel Feodrack (Chen Light Oil + Naphtha) traleum coke phila arfim (Vites and Polishes) hereid (Egocal Viteshal) tergent incollight ol Subtotal Subtotal Subtotal Anno Energy use Petroleum able 2.2.1 : Non Energy use- Petroleum - Emissions and X Product Emitter X Product Sequesterer able 2.3: Non Energy use- Natural Gas atural Gas Flaring	0.00 0.00 0.00 12.82 0.12.82 0.01 0.02 0.	0.00 0.00 16,2822,500.00 141,000.00 354,600.00 354,600.00 354,600.00 354,600.00 73,355,600.00 73,355,600.00 C Top Scapestration 40,88,843,353 22,069,375,15 33,564,408,84 7 Tee 0.00	433,355.00 01,722.21 4.0,1720.21 13,706.00 1,246.730.70 2,2066.457.37 C Tos Emistios 20,664.096.31 T J J 0,000	12,082,557,50 -634,444,20 174,684,42 055,506,26 28,346,400 28,346,400 62,264,384,41 21,32 guestration × Total Carbon N 12,17 12,17 12,12 14,12	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.000 0.000 0.000 0.000 0.00353750 0.043,444.20 0.000 0.55306.28 274,500.00 7.23365350 2.2065,375.10 2.3065,375.10 7.0%or Peroferm Prodects* Tons of Carbon Enitted 0.000 6.005,580.48 0.000	0.00 0.00 0.00 0.00 0.166,826.86 0.00 15371365.50 145,066,490.33 145,066,490.33 10,00 1,00	100 000 0.05 0.00 100 0.00 0.00 0.00 0.0	Page 10 Page 10 Page 20 Page 20	No data on non-fuel

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Table 3 marks the beginning of calculations for the sectoral approach of estimating China's CO₂ emissions and includes four sets of tables:

- fuel consumption by sector in original reported units of 10,000 tce
- fuel consumption by sector in converted units of tce
- fuel consumption by sector in converted units of TJ
- carbon emissions by sector and fuel
- CO₂ emissions by sector and fuel

A	G	Н		J	К	L	M	N	0	P	Q	B
5 Table 3 : Emissions from Sector Energy Consumptio	on											
- ,												
7 Sector-Unit 10 ⁴ tce	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	LPG	Befineru Gas	ther Petroleum Products	Natural Gas	Heat	Electricitu	
8 Agriculture	0.00	236.07	1.85	1,601.17	2.14	6.35	0.00	0.00	0.00	2.78	1,090.18	
9 Industry	1,703.96	862.21	72.22	3,397.80	2,228.77	845.46	1,390.63	7,960.28	5,542.78	6,116.57	28,575.17	
0 Non-energy use	226.63	27.68	8.42	64.22	108.02	32.24	11.36	4,286.61	1,385.69			
21 Construction	0.00	288.67	14.23	540.28	53.86		0.00	1,175.75	13.17	16.85	451.46	
22 Transport & Telecom	0.00	4,547.26	1,728.29	11,145.81	1,632.56	93.74	0.00	0.00	840.03	61.34	702.77	
23 Commerce	0.00	199.05	30.63	222.53	8.93	88.03	0.00	0.00	236.08	116.20	1,250.43	
24 Residential	0.00	1,258.26	18.66	862.71	0.00		0.00	0.00	2,262.63	2,140.29	5,402.81	
25 Other (Public Sector)	0.00	1,650,81	38,11	1,678,29	13.52		0.00	0.00	278.20	226.84	2,351.04	
26 Thermal Electricity	12.67	0.18	0.00	269.75	436.48			53.45	1,030.20	0.00	0.00	
127 Heat Supply	1.36	0.01	0.00	0.00	185.42			133.94	284.62	0.00	0.00	
28			0.00									
29 Sector-Unit toe	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	LPG	Befineru Gas	ther Petroleum Products	Natural Gas	Heat	Electricitu	
130 Agriculture	0	0	18,540	16.011.636	21,429	63,547	0	0	0	27.842	10.901.845	
Industry	17,039,626	276,770	722,163	33,977,969	22,287,731	8,454,585	13.306.261	79,602,830	55,427,750	61,165,685	285,751,718	
132 Construction	0	0	142,284	5,402,781	538,582	105,601	0	11,757,483	131,670	168,488	4,514,603	
133 Transport & Telecom		90.146.512	17,282,917	111.458.036	16.325.612	937.379	0	0	8,400,280	619.371	7.027.668	
134 Commerce		0	306,345	2,225,283	89,288	880,293	0	0	2,360,750	1,162,015	12,504,338	
135 Residential		0	186,587	8,627,146	0,200	24,976,838	0	0	22,626,275	21,402,910	54,028,069	
136 Other (Public Sector)	, in the second se	0	381,149	16,782,932	135,157	765.949		0	2,781,996	2,268,369	23,510,401	
137 Thermal Electricity	126.717	0	001,140	2,637,533	4,364,814		560,833	534,544	10,302,010	2,200,000	20,0,0,001	
138 Heat Supply	13,572	0	0		1,854,180	106,115	2,744,607	1,339,375	2,846,200		0	
139	10,912	۳ ۱	°	•	1,004,100	100,10	2,144,001	1,000,015	2,040,200	•	Ŷ	
140												
141 Sector - Unit: TJ	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	LPG	Refinery Gas	ther Petroleum Products	Natural Gas	Heat	Electricity	
142 Agriculture	0.00	0.00	542.67	468,672.13	627.24	1,860.05	0.00	0.00	0.00	814.35	319,103.69	
143 Industry	438,760.34	8,101.22	21,138.16	334,556.04	652,375.60	247,470.83	407,044.82	2,330,023.76	1,622,404.31	1,790,357.19	8,364,128.33	
144 Construction	0.00	0.00	4,164.75	158,142.72	15,764.63	3,091.00	0.00	344,148.75	3,854.06	4,931.75	132,145.37	
145 Transport & Telecom	0.00	2,638,643.80	505,881.61	3,262,446.97	477,860.70	27,437.67	0.00	0.00	245,881.36	18,129.37	205,704.16	
146 Commerce	0.00	0.00	8,966.92	65,135.40	2,613.50	25,766.72	0.00	0.00	63,100.60	34,012.89	366,003.65	
147 Residential	0.00	0.00	5,461.53	252,521.88	0.00	731,087.40	0.00	0.00	662,284.36	626,476.33	1,581,434.78	
148 Other (Public Sector)	0.00	0.00	11,156.45	431,246.72	3,356.13	22,419.80	0.00	0.00	81,430.72	66,336.54	688,163.30	
149 Thermal Electricity	3,709.08	0.00	0.00	78,358.44	145,323.14	0.00	16,415.32	15,646.44	319,108.53	0.00	0.00	
150 Heat Supply	397.25	0.00	0.00	0.00	54,272.99	3,106.06	80,336.34	39,204.34	83,310.02	0.00	0.00	
151												
152									Subtotal	2,541,119.02	11,656,689.93	
									Subtotal	2,541,119.02	11,656,683.33	
153 Sector - Unit: tons of carbon emissions	Crude Oil	Gasoline	Kerosene	Diesel Oil	Fuel Oil	LPG	Refinery Gas	ther Petroleum Products	Subtotal Natural Gas	Heat	Electricity	Subtota
153 Sector - Unit: tons of carbon emissions 154 Agriculture		•	10,582	3,467,178	13,235	31,993			Natural Gas -	Heat 28,100	Electricity 18,912,271	37,659,226.3
153 Sector - Unit-tons of outbon emissions 154 Agriculture 155 Industry			10,582 412,194	3,467,178 20,030,032	13,235 13,765,125	31,393 4,256,433	Refinery Gas - 7,408,216	50,212,135	Natural Gas - 24,822,786	Heat 28,100 61,733,305	Electricity 18,912,271 435,715,553	37,659,226.3 1,343,783,882.3
153 Sector - Uhit-tans af carbon emissions 154 Agriculture 155 Industry 156 Construction	9,975,207	153,113	10,582 412,134 81,213	3,467,178 20,030,032 3,134,483	13,235 13,765,125 332,634	31,993 4,256,439 53,165	7,408,216		Natural Gas - 24,822,786 58,367	Heat 28,100 61,733,305 170,052	Electricity 18,912,271 495,715,559 7,831,840	37,658,226.3 1,343,783,882.3 22,703,228.2
Industry Industry Industry Industry Info Construction IF7 Transport & Telecom	9,975,207	153,113	10,582 412,134 81,213 3,864,631	9,467,178 20,030,032 3,194,483 65,301,423	13,235 13,765,125 332,634 10,082,861	31,933 4,256,439 53,165 471,928	7,408,216	50,212,135	Natural Gas - 24,822,786 58,967 3,761,985	Heat 28,000 61,733,305 170,052 625,119	Electricity 18,912,271 435,715,553 7,831,840 12,191,438	37,659,226. 1,343,783,882.3
Bit Sector - Unit tans of carbon emissions 64 Agriculture 55 Industry 156 Construction 157 Transport & Telecom 158 Construction	9,975,207	153,113	10,582 412,134 81,213	3,467,178 20,030,032 3,134,483	13,235 13,765,125 332,634	31,993 4,256,439 53,165	7,408,216	- 50,212,195 7,416,432	Natural Gas - 24,822,786 58,367	Heat 28,100 61,733,305 170,052	Electricity 18,912,271 495,715,559 7,831,840	37,659,226. 1,343,783,882.5 22,703,228.2 156,609,954.
Secies - John Const of carbon emissions Agriculture Agriculture Industry Industry Transport & Telecom Ornmerce Seciential	3,375,207	153,113 49,870,368	10,582 412,134 81,213 3,864,631	9,467,178 20,030,032 3,194,483 65,301,423	13,235 13,765,125 332,634 10,082,861	31,933 4,256,439 53,165 471,928	- 7,408,216 - -	50,212,195 7,416,432	Natural Gas - 24,822,786 58,967 3,761,985	Heat 28,000 61,733,305 170,052 625,119	Electricity 18,912,271 435,715,553 7,831,840 12,191,438	37,653,226. 1,343,763,882. 22,703,228.2
Sector - Unit cost of carbon emissions Statution Maintry Construction Transport & Telecom Construction	- 3,375,207 - -	153,113 - 43,870,368 -	10,582 412,194 81,213 3,864,691 174,855	9,467,178 20,090,032 3,194,483 65,301,429 1,315,735	13,235 13,765,125 332,634 10,082,861 55,455 - 83,474	31,393 4,256,433 53,165 471,328 443,188	7,408,216	- 50,212,195 7,416,432 -	Natural Gas 24,822,786 58,367 3,761,385 1,057,233	Heat 28,100 61,733,305 170,052 625,113 1,172,738	Electricity 18,912,211 435,715,553 7,831,840 12,191,438 21,632,240	37,659,226. 1,343,783,882. 22,703,228.3 156,609,354. 36,388,244.4 196,797,340.
192 Service's Unit cons of carbon emissions 193 Agriculture 195 Industry 196 Construction 197 Transport & Telecom 198 Commerce 198 Residential 198 Other (Fublic Sector) 198 Thema Electroligy		153,113 49,870,368	10,582 412,194 81,213 3,864,691 174,655 106,500	3,467,178 20,030,032 3,134,483 65,301,423 1,315,735 5,100,342	13,235 13,765,125 332,634 10,082,861 55,145	31,333 4,256,439 53,165 471,328 441,388 443,186 12,574,703	- 7,408,216 - - - - -	- 50,212,195 7,416,432 - -	Natural Gas 24,822,786 58,967 3,761,985 1,057,239 10,132,960	Heat 28,00 61733,005 700,052 625,113 1,172,738 21,60(,53)	Electricity 18,912,271 4.95,715,553 7,831,840 12,191,438 21,692,240 33,726,661	37,659,226. 1,343,783,882. 22,703,228.3 156,603,354. 36,388,244.4 136,797,340. 65,146,860.3
Sector - Unit cost of carbon emissions Status Mainstry Bodustry Construction Transport & Telecom Bodiennia Construction Other (Public Sector) District Public Sector) Heat Sciencing Heat Sciencing Heat Sciencing		153,113 43,870,368	10,582 412,194 81,213 3,664,691 174,855 106,500 217,551	3,467,178 20,030,032 3,134,483 65,301,423 1,035,735 5,100,342 3,323,184	13,235 13,765,125 332,634 10,082,861 55,455 - 83,474	31,333 4,256,433 53,165 471,928 443,186 12,574,103 385,621	7,408,216 	50,212,195 7,416,432	Natural Gas - 24,822,786 58,367 3,761,385 1,057,239 10,152,360 1,245,830	Heat 28,00 61733,005 700,052 625,113 1,172,738 21,60(,53)	Electricity 18,912,271 435,715,553 7,831,840 12,191,438 21,632,240 33,726,661	37,659,226. 1,343,783,882. 22,703,228,1 156,609,354. 36,388,244.4 196,797,340. 65,146,860. 630,855,316.3
92. Service's Unit cons of carbon emissions 94. Agriculture 95. Industry 95. Construction 96. Construction 97. Transport & Telecom 98. Commerce 98. Residential 90. Other (Fublic Sector) 91. Thermal Electricity 92. Heal Supply 93.	105,215,80	153,113 49,870,368	10,582 412,194 81,213 3,864,691 174,855 106,500 217,550 -	3,467,178 20,090,032 3,134,483 65,301,429 1,315,735 5,100,342 9,323,184 1,534,361	13,235 13,765,125 332,634 10,082,861 55,145 - - 83,474 3,066,318	31,333 4,255,433 53,165 441,528 443,186 12,574,103 385,821	- 7,408,216 - - - - - - - - - - - - - - - - - - -	50,212,195 7,416,432	Natural Gas 24,822,786 58,967 3,761,985 1,057,239 10,132,960 1,245,830 4,882,361	Heat 28,00 61733,005 700,052 625,113 1,172,738 21,60(,53)	Electricity 18,912,271 435,715,553 7,831,840 12,191,438 21,632,240 33,726,661	37,659,226. 1,343,783,882: 22,703,228,2 156,609,354. 06,388,244. 196,797,340. 65,146,860. 65,146,860. 630,855,316.3 87,620,322.6
Sector - Unit cons of carbon emissions 4 Agriculture 55 Industry 56 Construction 77 Transport & Telecom 98 Residential 90 Other (Public Sector) 91 Therma Electrolog 92 Head Supply 93	105,215,80	153,113 49,870,368	10,582 412,194 81,213 3,864,691 174,855 106,500 217,550 -	3,467,178 20,090,032 3,134,483 65,301,429 1,315,735 5,100,342 9,323,184 1,534,361	13,235 13,765,125 332,634 10,082,861 55,145 - - 83,474 3,066,318	31,333 4,255,433 53,165 441,528 443,186 12,574,103 385,821	7,408,24	50,212,195 7,416,432 	Natural Gas 24,822,786 58,367 3,761,385 1,057,239 10,152,360 1,245,880 4,882,361 1,274,643	Heat 28,00 5,173,305 170,052 625,113 1,172,786 2,289,413 2,289,413	Electricity 18,312,271 435,715,553 7,831,840 12,191,438 21,632,240 33,726,661 40,785,308	37,659,226. 1,343,783,882: 22,703,228,2 156,609,354. 06,388,244. 196,797,340. 65,146,860. 65,146,860. 630,855,316.3 87,620,322.6
52 Service's Unit cons of carbon emissions 54 Agriculture 55 Industry 66 Construction 77 Transport & Telecom 80 Commerce 80 Residential 80 Other (Public Sector) 18 Thermal Electroling 82 Heal Supply 84	105,215,80	153,113 49,870,368	10,582 412,194 81,213 3,864,691 174,855 106,500 217,550 -	3,467,178 20,090,032 3,134,483 65,301,429 1,315,735 5,100,342 9,323,184 1,534,361	13,235 13,765,125 332,634 10,082,861 55,145 - - 83,474 3,066,318	31,333 4,255,433 53,165 441,528 443,186 12,574,103 385,821	7,408,24	50,212,195 7,416,432	Natural Gas 24,822,786 58,367 3,761,385 1,057,239 10,152,360 1,245,880 4,882,361 1,274,643	Heat 28,00 5,173,305 170,052 625,113 1,172,786 2,289,413 2,289,413	Electricity 18,312,271 435,715,553 7,831,840 12,191,438 21,632,240 33,726,661 40,785,308	37,659,226. 1,343,763,882. 22,703,2823. 156,603,354. 36,368,244. 196,797,340. 65,146,860. 630,855,316.3 87,620,322.4 1,859,068,737.
39 Service - Unit cons of cablon emissions 4 Agriculture 50 Industry 50 Industry 51 Industry 52 Industry 53 Industry 54 Construction 57 Transport & Telecom 50 Other (Public Sector) 51 Thermal Electricity 54 Agriculture 55 Agriculture		153,113 49,870,368	10,582 442,184 8,844,691 174,875 06,500 217,591 -	3,467,178 20,090,032 3,134,483 65,301,428 1,315,735 5,100,942 3,323,184 1,534,361	13,235 13,165,125 332,854 10,008,861 55,145 	01393 4,256,439 53,165 4413,280 443,180 18,514,100 385,621 53,424	7,408,24	50,212,195 7,416,432 	Natural Gas 24,822,786 58,867 3,761,885 10,057,239 10,152,560 1,245,830 4,882,361 1,274,643 Subtotal	Heat 28,00 64,133,305 107,052 462,103 1,172,786 2,466(530 2,2653,419 87,620,322,82	Electricity 16,812,211 435,715,535 7,831,840 12,101,400 30,726,661 40,785,306 690,655,316,36	37,659,226. 1,343,783,882. 22,703,228. 156,609,354. 36,368,244. 196,797,340. 65,146,680. 630,855,318. 67,620,322. 1,859,088,737. Subtoi
Sector - Unit cons of cat/on emissions 4 Agriculture 56 Industry 56 Construction 77 Transport & Telecom 50 Construction 51 Presidential 52 Presidential 53 Thermal Electricity 54 Hectoricity 55 Thermal Electricity 56 Sector - Unit Cons of CD , emissions		153,113 43,810,366	10,582 41(34) 6(21) 3,644,691 174,635 106,500 21(7,51	3,467,178 20,080,032 3,314,483 65,301,423 1,515,735 5,500,342 3,323,184 1,554,361	13,235 13,765,125 13,065,125 10,008,061 55,145 55,145 3,0066,318 1,145,160 Fuel Dil	31393 4,255,459 53,165 411,028 440,100 18,214,103 308,561 53,424 LPG	7,408,24		Natural Gas 24,822,786 58,867 3,761,885 10,057,239 10,152,560 1,245,830 4,882,361 1,274,643 Subtotal	He at 283,00 6173,305 (625,115 1172,786 218,01530 2,285,415 07,620,322,62 He at	Electricity 16,812,271 435,715,553 7,831,840 12,151,438 21,658,240 33,726,661 40,785,086 690,855,016.36 Electricity	37,659,226. 1,343,783,882. 22,703,282. 155,609,354. 36,388,244.4 196,787,340. 65,146,860. 67,620,322.4 1,659,086,737. Subtot 138,089,83
Sector - Unit cons of calibon emissions 4 Agriculture 5 Industry 6 Construction 7 Transport & Telecom 9 Persidential Sector) 17 Transport & Suppl 17 Transport & Suppl 17 Transport & Suppl 18 18 19 19 10 10 11 12 12 14 15 16 17 18 19 19 10 11 12 14 14 15 15 16 17 18 19 19 10 11 12 14 15 16 17 18 19 10 10		63soline	10,582 412,194 0,129 0,864,691 114,895 0,66,500 21,551 - - - - - - - - - - - - - - - - - -	3,467,178 20,050,032 3,154,463 65,501,429 1,035,705 5,100,342 3,923,184 (5,543,661 Dilesel Oli 34,112,367	10,233 10,765,125 332,654 10,062,261 83,474 3,066,216 1,45,160 Fuel Dil 46,527	3 (333) 4,256,439 53,85 41,358 44,3,88 12,574,000 365,621 - 53,424 LPG 11,307	7,408,86 288,870 288,870 1,462,181 Relinerg Gas	- 50,212,385 7,416,432 	Natural Gas 24,822,786 3,761,385 1007,233 10,132,360 1,245,380 4,882,361 1,274,643 Subtotal Natural Gas	Heat 28,000 16,0733,305 171,092 665,073 2,000,022 2,000,020 8,000,022,000 1900,0000 1900,0000 1900,0000 1900,0000000000	Electricity 16,912,211 435,715,553 7,831,840 12,151,840 21,652,840 93,726,661 40,785,306 690,855,316,36 Electricity 69,344,354	37,653,226, 1,343,763,882, 22,703,282, 155,603,954, 36,386,244, 136,787,340, 65,146,580, 650,855,316,: 67,620,322, 1,653,086,737, Subto 138,083,83 4,382,207,56
		48,870,868	10,582 412,194 81,215 3,844,691 174,855 217,550 - - - - - - - - - - - - - - - - - -	3.467,176 20,039,032 3.154,483 6.5,01,423 3.537,55 5,500,542 3.532,184 1.554,961 Dilesel Oli 3.4,172,387 73,665,451	1 12.33 13,755,125 332,634 10,048,461 55,145 - - - - - - - - - - - - -	3(333) 4.256.459 53,865 417,568 443,868 18,278,400 385,821 53,424 LPG 111,007 15,507,844	7,409,216		Natural Gas 24,822,786 58,967 3,7161,385 1,057,239 10,132,960 1,245,380 4,882,361 1,274,643 Subtotal Natural Gas 91,016,882	Heat 28,00 6 (1733,305 1705,305 6 (45,116) 2 (1707,276 2,289,419 0 (16,60,530 2,289,419 0 (16,60,302,62) 0 (16,60,302,62) Heat 100,305 2,285,555,451	Electricity 16,312,211 445,115,553 7,831,840 12,151,430 21,552,240 33,726,651 40,765,305 630,455,316,36 Electricity 65,344,334 1,017,682,317	37,653,226, 1,343,783,882, 22,703,282, 155,605,954, 36,368,244, 165,187,340, 65,146,880, 690,855,316, 87,620,322, 1,859,086,737, Subtol 138,083,83 4,927,207,56 80,245,17
		53,113 43,970,564 	00582 412164 812164 9084691 1146955 0.05500 2.11591 - - - - - - - - - - - - - -	3,447,178 20,050,032 3,154,483 65,301,429 1,035,135 5,100,942 3,922,184 1,534,361 	1 3233 13,755,85 332,644 10,082,861 55,455 63,474 3,066,313 1,455,860 Fuel Cill 4,6,827 53,473,825 53,473,825 53,473,825	(3133) (4256.439 (526.439 (526.439 (526.431 (526.442,140) (526.442,140))))))))	7,408,66 288,770 1,462,121 Refinery Gas 27,66,458	- 50,212,355 7,416,432 	Natural Gas 24,822,786 58,867 3,761,885 10,172,280 10,172,280 10,122,860 1,245,830 4,882,361 1,214,643 Subtotal Natural Gas 91,016,882 2162,815	Heat 28,000 (61373.305 179.092 65519 2166530 2266530 2268548 01,440,5262,62 01,440,526,22,62 Heat Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,638,488 Heat 28,63	Electricity 19,312,211 495,715,555 7,051,840 19,101,439 21,652,240 33,786,661 40,765,06 690,055,316,36 Electricity 69,344,354 1,817,623,711 28,716,147	37,653,226, (343,763,882, 22,703,228, 156,603,354, 36,368,244, 136,1713,40, 65,146,860, 650,052,316, 81,620,322, 1,859,086,737, Subbol 138,063,83 4,927,207,56 93,245,17 514,266,43
System System Agriculture Hagriculture Instance Instance		49,870,968 49,870,968 	00582 482184 81219 30.064.611 174.695 211.551 - - - - - - - - - - - - - - - - - -	3.467,176 20,090,032 3.194,480 6.5,001,420 1.038,735 5.500,042 3.922,184 1.534,361 Diesel Oli 3.4,172,887 7.3,645,451 11,173,104 24,630,572 4.824,382	1 1233 13,755,125 302,634 16,042,641 35,145 	(3)333 (4256.439 (5)36 (4256.439 (5)36 (41536 (45,146 (5)374.050 (5)35.424 (5)374.050 (5)35.424 (5)374.050 (5)35.424 (5)373 (5)35.424 (5)373 (5)35.425 (5	7,409,216 289,770 1,462,121 Perinerg Gas 21,153,456		Natural Gas 24,822,786 3,761,885 10,057,239 10,1022,560 12,452,380 4,682,381 1,274,643 Subtotal Natural Gas 910,016,882 216,215 10,739,344 3,816,544	Heat 28,000 18,000 170,002 65,000 24,000,000 2,200,400 2,200,400 2,200,400 2,200,400 19,000,000 19,000,000 2,200,000 2,200,000 2,200,000 2,200,000 4,000,200,200,200,200 4,000,200,200,200,200,200,200,200,200,20	Electricity 18,91237 7,611640 12,111437 7,611640 12,111438 27,652,660 9,3,726,661 4,40,765,300 Electricity 6,3,544,584 16,776,25,015,26 Ultra T, 62,717 20,716,747 20,717,747 20,716,747 20,716,747 20,717,747 20	37,653,263 (343,763,862, 28,703,228, 195,603,354, 196,757,340, 650,635,318, 650,655,318, 650,655,318, 656,0,322, 1,655,082,737, Subtol 138,063,364, 93,245,17, 514,28,64, 133,423,56
Sector - Unit cons of cadeon emissions 4 Agriculture 56 Industry 57 Industry 58 Construction 59 Industry 50 Construction 51 Industry 52 Residential 50 Other (Public Sector) 51 Thermal Electricity 52 Heat Supply 53 55 Sector - Unit cons of CD , emissions 56 Agriculture 71 Industry 71 Industry 71 Transport & Telecom 72 To Industry 73 Transport & Telecom 74 Transport X Telecom 75 Transport X Telecom 76 Transport X Telecom 76 Transport X Telecom 76 Residential		43,870,368 43,870,368 - - - - - - - - - - - - - - - - - - -	0,0582 442,954 81,254 3,0664,691 776,495 0,005,00 2,275,91 4,005,00 2,275,92 4,005,00 3,005,00 3,005,00 3,005,00 3,005,00 4,61,05 3,004,03 3,004,03	2,4,47,10 20,950,002 3,354,483 4,3574,483 4,375,75 5,000,482 3,352,542 4,352,454 1,554,361 7,5,664,451 1,173,054 2,4,653,552 4,4,823,452 1,370,3454	1 12.33 13,755,125 302,644 10,042,461 55,444 3,066,310 1,145,160 Fuel Cil 4,05,27 55,472,125 1,233,677 39,574,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,447 2,457 2,577 2,457	19,393 4256,439 53,655 47,328 44,398 42,574,193 385,521 53,424 LPG 11,307 15,507,844 18,339 1730,402 165,507,144 18,439	7,409,260	50,212,185 7,416,422 	Natural Gas 24,822,786 58,387 3,761,385 10,972,239 10,152,380 1,245,380 4,882,381 1,274,643 Subtotal 8, 10 ,168,882 2,166,213 13,753,344 3,375,344 3,375,344	Heat 28,00 6 (1733,305 170,502 6 (45,110 1,172,736 2,289,419 2,289,419 6 (1,640,530 2,289,419 6 (1,640,322,82 1,640,535,451 2,825,554,51 2,828,208 4,300,263,153 17,300,560	Electricity 18,916271 7,8019460 12,191460 13,01262460 13,01262460 13,01262460 13,01262460 13,01262460 14,0125308 14,01263207 24,012642 14,0101390 13,0554242 34,3654242	37,652,225 (1,343,783,882; 22,703,228,5 (55,603,354, 36,508,244, 156,787,340, 65,085,284, 165,787,340, 650,055,385, 87,620,222, 1,659,068,373 (1,369,683,53) 4,927,207,55 (1,266,345) 1514,226,45 (1,342,356,245,17) 1514,236,245,17 (1,342,356,245,17)
Sector - Unit cons of callon emissions 4 Agiculture 51 Industry 52 Industry 63 Construction 77 Transport & Telecom 98 Residential 90 Other (Public Sector) 91 Terma Electrolog 92 Heat Supply 93 94 95 95 96 Agicouture 97 98 99 90 91 92 93 94 95 95 96 91 92 93 94 95 95 96 97 98 98 99 91 92 93 94 95 95 96 97 98 98 99		Gasoline 55,115 43,870,560 	0,0582 442,154 9,054,641 174,405 0,05500 217,551 - - - - - - - - - - - - - - - - - -	3,44,10 20,950,02 3,13,443 5,550,442 1,351,05 5,550,942 3,550,944 1,351,05 5,550,944 1,351,05 4,350,944 1,350,944 1,350,944 1,350,944 1,350,944 1,350,944 1,350,950 1,350,950,01 1,350,950,000,000,000,000,000,000,000,000,0	1 3233 1 3355.82 332,544 10,042,841 3,042,841 3,045,013 1,145,860 4,527 5,472,625 1,54,72,625 1,54,72,625 1,54,72,625 1,64,572 3,64,724,592 1,54,744,592 1,54,744,5921,54,545 1,54,744,545,54551,5455 1,54,74555555555555555555555555555555555	(3)333 (4256.439 (5)36 (4256.439 (5)36 (41536 (45,146 (5)374.050 (5)35.424 (5)374.050 (5)35.424 (5)374.050 (5)35.424 (5)373 (5)35.424 (5)373 (5)35.425 (5	7,408,26 		Natural Gas 24,822,786 58,367 3,761,385 1,077,233 10,152,360 1,245,350 4,882,361 1,274,643 Subtocal 9,1006,882 245,275 13,739,344 3,876,544 37,754,186 4,568,263	Heat 28,000 18,000 170,002 65,000 24,000,000 2,200,400 2,200,400 2,200,400 2,200,400 19,000,000 19,000,000 2,200,000 2,200,000 2,200,000 2,200,000 4,000,200,200,200,200 4,000,200,200,200,200,200,200,200,200,20	Electricity 18,91237 7,611640 12,111437 7,611640 12,111438 27,652,660 9,3,726,661 4,40,765,300 Electricity 6,3,544,584 16,776,25,015,26 Unit results 10,755,202 10,75	37,659,263 (344,763,868; 28,763,288; 156,609,354; 156,609,354; 166,797,340, 65,908,244, 196,797,340, 65,908,244, 196,797,340, 65,908,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,068,737; 1,659,058,759; 1,659,059,059; 1,659,059,059; 1,659,059,059; 1,659,059; 1,659,059; 1,659,059;1,659,059; 1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059; 1,659,059;1,659,059;1,659,059; 1,65
		43,870,368 43,870,368 - - - - - - - - - - - - - - - - - - -	0,0582 442,954 81,254 3,0664,691 776,495 0,005,00 2,275,91 4,005,00 2,275,92 4,005,00 3,005,00 3,005,00 3,005,00 3,005,00 4,61,05 3,004,03 3,004,03	2,4,47,10 20,950,002 3,354,483 4,3574,483 4,375,75 5,000,482 3,352,542 4,352,454 1,554,361 7,5,664,451 1,173,054 2,4,653,552 4,4,823,452 1,370,3454	1 12.33 13,755,125 302,644 10,042,461 55,444 3,066,310 1,145,160 Fuel Cil 4,05,27 55,472,125 1,233,677 39,574,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,23,754,265 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,24,754 2,447 2,457 2,577 2,457	(3) (3) (4) (5) (7,408,216	50,212,185 7,416,422 	Natural Gas 24,822,786 58,387 3,761,385 10,972,239 10,152,380 1,245,380 4,882,381 1,274,643 Subtotal 8, 10 ,168,882 2,166,213 13,753,344 3,375,344 3,375,344	Heat 28,00 6 (1733,305 170,502 6 (45,110 1,172,736 2,289,419 2,289,419 6 (1,640,530 2,289,419 6 (1,640,322,82 1,640,535,451 2,825,554,51 2,828,208 4,300,263,153 17,300,560	Electricity 18,916271 7,8019460 12,191460 13,01262460 13,01262460 13,01262460 13,01262460 13,01262460 14,0125308 14,01263207 24,012642 14,0101390 13,0554242 34,3654242	37,659,226. 1,340,763,282. 22,703,228.2 156,609,354. 36,509,244. 196,737,340. 650,055,318.2 650,055,318.2 650,055,318.2 108,053,308.2 1,659,068,737. Subtot 108,068,337. 108,053,318.2 109,055,318.2 109,

Note: not all fuels are shown in this screenshot due to the table width. For thermal electricity and heat, the total energy input is summed across the fuel columns in the two energy unit tables and then redistributed to the sectors based on their relative proportion of final electricity and heat demand in the electricity and heat columns in the emissions tables.

Table 4 and sub-tables presents the data and calculations for estimating the adjustments to sectoral energy consumption, including other transformation sector losses (attributed to industry), international bunkers (attributed to transport) and China Airplanes and Ships Refueling Abroad (deducted from transport).

L7	7 Table 4: Emissions Adjustments to Sector Energy Cons	umption						
_	9 Table 4.1 Emissions from Other Transformation Sector Losses							
18	D	Primary Fuel Loss Type	10 ⁴ tce	Tce	LT	Tons of Carbon	Total C Emissions	Total CO2 Emissions
18	1 Coal Washing	Coal	2,502.81	25,028,148	732,589	18,900,803	18,900,803	69,302,944
18	2 Coking	Coal	819.06	8,190,641	239,745	6,185,424	6,185,424	22,679,887
18	3 Petroleum Refineries	Oil	1,380.18	13,801,826	403,988	8,079,758	8,079,758	29,625,781
18	4 Gas Works	Coal	47.76	477,602	13,980	360,676	360,676	1,322,480
18	5 Briquettes	Coal	40.89	408,907	11,969	308,799	308,799	1,132,265
18	6					Subtotal	33,835,461	124,063,357
18								
18	8 Table 4.2 Emissions from International Bunkers (Foreign Ships and Planes Ref	eling in China)						
18	9	10 ⁴ tce	Tce	LT	C ton	Total C Emissions	Total CO2 Emissions	
19	0 Kerosene	250.29	2,502,851	73,260	1,428,570	1,428,570	5,238,090	
19	1 Diesel Oil	37.96	379,575	11,110	224,430	224,430	822,909	
19	2 Fuel Oil	435.38	4,353,801	127,438	2,688,951	2,688,951	9,859,487	
19	3				Subtotal	4,341,951	15,920,486	
19	4 Table 4.3 Emissions from Chinese Airplanes and Ships Refueling Abroad							
19	5	10 ⁴ tce	Tce	LT	C ton	Total C Emissions	Total CO2 Emissions	
19	6 Kerosene	(278.09)	(2,780,946)	(81,400)	(1,587,300)	(1,587,300)	(5,820,100)	
19	7 Diesel Oil	(12.55)	(125,456)	(3,672)	(74,178)	(74,178)	(271,986)	
19	8 Fuel Oil	(495.87)	(4,958,671)	(145,143)	(3,062,524)	(3,062,524)	(11,229,256)	
19	9				Subtotal	(4,724,002)	(17,321,342)	

Table 5 shows the adjusted total emissions from sectoral energy consumption in terms of carbon and CO₂ emissions. The "Adjusted Subtotal" column includes the bunker adjustments to the transport sector and the gasoline reallocation adjustment (all except industrial non-energy use reallocated to transport sector). The Total Carbon/CO₂ Emissions column in yellow includes an additional adjustment for allocating Other Transformation Losses to industry and represents the adjusted sectoral total emissions reported in the results worksheets.

								nzheng:		
Sector - Unit: tons of carbon emissions	Fuel Oil	LPG	Refinery Gas	Other Petroleum Products	Natural Gas	Heat	Electricity	Adjusted St Allocate a		Total Carbon Em
Agriculture	13,235	31,993	-		-	28,100	18,912,271	37,65 transform	nation losses to	37,65
Industry	13,431,548	4,256,128	7,408,168	10,647,786	24,822,786	61,733,305	495,715,559	1,301,78	33,835,460	1,335,62
Construction	332,634	53,165		7,416,432	58,967	170,052	7,831,840	22,703,228.23		22,70
Transport & Telecom	9,709,288	471,928			3,761,985	625,119	12,191,438	156,227,902.49		156,2
Commerce	55,145	443,188			1,057,239	1,172,798	21,692,240	36,388,244.49		36,3
Residential		12,574,703			10,132,960	21,601,530	93,726,661	196,797,340.14		196,7
Other (Public Sector)	83,474	385,621			1,245,890	2,289,419	40,785,308	65,146,860.85		65,1
Thermal Electricity	3,066,318		298,770	337,182	4,882,361			690,855,316.36		690,
Heat Supply	1,145,160	53,424	1.462.121	844,857	1,274,643			87.620.322.82		87,
	1,10,100					1	Subtotal	1,816,710,391,46		1,850,9
	Fuel Oil	LPG	· · · ·	Other Petroleum Products	Natural Gas	Heat	Subtotal		Other Transformation Loss	1,850,
ector - Unit: tons of CO , emissions			· · · ·	· · ·		Heat 103,034	<u> </u>		Other Transformation Loss	1,850, 15 Total CO2
ector - Unit: tons of CO , emissions	Fuel Oil	LPG	· · · ·	Other Petroleum Products	Natural Gas		Electricity	Adjusted Subtotal		1,850 15 Total CO2 138
ector - Unit: tons of CO ₂ emissions Agriculture	Fuel Oil 48,527	LPG 117,307	Refinery Gas	Other Petroleum Products	Natural Gas	103,034	Electricity 69,344,994	Adjusted Subtotal (138,083,832		1,850, Is Total CO2 138, 7 4,891
ector-Unit:tonsofCO; emissions Agriculture Industry Construction	Fuel Oil 48.827 49.249.008	LPG 117,307 15,605,802	Refinery Gas	Other Petroleum Products	Natural Gas 91,016,882	103,034 226,355,451	Electricity 69,344,994 1,817,623,717	Adjusted Subtotal (138,083,832 4,773,221,157	124,063,3	Total CO2 138, 7 4,891 83
ector-Unit:tonsofCO, emizsions Agriculture Industry Construction Transport & Telecom	Fuel OII 48,527 49,249,008 1,219,657	LPG 117,307 15,005,502 194,333	Refinery Gas	Other Petroleum Products 38,041,883 27,133,566	Natural Gas 	103,034 226,355,451 623,523	Electricity 69,344,994 1,817,623,717 28,716,747	Adjusted Subtotal (138,083,832 4,773,221,157 83,245,170	124,063,3	Total CO2 13 7 4,897 83 5 5
ector-Unit: tons of CO ; emissions Agriculture Industry Construction Transport & Telecom Commerce	Fuel Oil 48,527 48,243,008 1,213,657 35,600,721	LPG 117,307 15,605,802 134,333 1,730,402	Refinery Gas	Other Petroleum Products 39,041,883 27,193,586	Natural Gas 91,016,882 216,213 13,793,944	103,034 226,355,451 623,523 2,292,102	Electricity 68,344,394 1,817,623,717 28,716,747 44,701,338	Adjusted Subtotal (138,083,832 4,773,221,157 83,245,170 572,835,642	124,063,3	Total CO2 138 7 4,891 80 5 572, 133
ictor-Unit:tonsofCO, emissions Agriculture Industry Construction Transport & Telecom Commerce Residential	Fuel Oil 48,527 48,243,008 1,213,657 35,600,721	LPG 117,307 15,605,802 194,939 1,730,402 1,826,021	Refinery Gas	Other Petroleum Products 39,041,883 27,133,586	Natural Gas 91,016,882 216,213 13,793,944 3,876,544	103,034 226,355,451 623,523 2,292,102 4,300,261	Electricity 63,344,394 1,817,623,117 28,718,747 44,701,338 79,538,212	Adjusted Subtotal 138,083,832 4,773,221,157 83,245,170 572,835,642 133,423,563	- 124,063,3 - - -	1,850, 15 Total CO2 138, 7 4,897 83 572, 133 721
ctor-Unit: tons of CO , emissions griculture industry Construction Transport & Telecom Commerce Residential Mere (Public Sector)	Fuel Oil 44,827 49,240,008 1,218,857 35,500,721 202,198	LPG 117.307 15.605.802 194.939 1.730.402 1.626.021 46.07.240	Refinery Gas	Other Petroleum Products 38,041,883 27,132,588	Natural Gas 91,016,882 216,213 13,793,944 3,876,544 37,154,186	103,034 226,365,451 623,523 2,292,102 4,300,261 79,205,609	Electricity 83,344,394 1,817,623,717 28,716,747 44,701,338 79,538,212 343,684,425	Adjusted Subtotal (138,083,832 4,773,221,157 83,245,170 572,835,642 133,423,563 721,590,247	- 124,063,3 - - - - -	Total CO2 138 7 4,89 8 572 138 572 133 772
Sector-Unit:tonsofCO, emissions Agriculture Industry	Fuel OII 48527 49,249,009 1,219,657 95,500,721 202,158 300,072	LPG 117.307 15.605.602 14.333 1.730.402 1.625.021 4.627.244 1.433.442	Refinery Gas 27,63,281	Other Petroleum Products 33,041,883 27,183,688	Natural Gas 91,016,882 216,823 13,793,944 3,876,544 37,764,988 4,568,263	103,034 226,355,451 623,523 2,282,102 4,300,281 79,205,609 8,394,537	Electricity 83,344,394 1,817,623,717 28,716,747 44,701,398 79,538,212 343,684,425 149,546,128	Adjusted Subtotal (138,083,832 4,773,221,87 83,245,170 572,835,842 133,423,582 721590,247 238,871,823	124,063,3	7

Tables 6 and 7 are linked to power generation data from the energy balance and included solely as references, and are not used in any

calculations.

228 Table 6: China Electricity Structure - 2008		
229	Electricity - Mtce	%
230 Hydro	7,191.95	17.1%
231 Nuclear	840.56	2.0%
232 Thermal	34,290.06	81.5%
233 Import	47.22	
234 Export	-204.55	
235 Total 236	42,070.80	
236		
237 Table 7: Thermal Power Generation		
238	Mtce	%
239 Coal	89,701.86	97.8%
240 Petroleum	888.62	1.0%
241 Natural Gas	1,090.20	1.2%
242		
242 243		
🕴 💶 🖻 📝 Carbon Sequestration _ Calculation Results / Input Non-Fuel Data / Energy balance SCE / 2008 energy balance (physical) / Base Data / Sour		