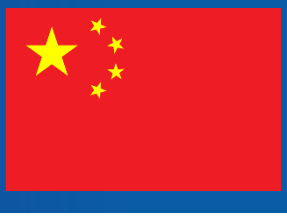
Implementation of bioenergy in China

Country Reports

IEA Bioenergy: 12 2024



This report was prepared based on data from the 2024 IEA World Energy Balances and Renewables Information[1], combined with data and information provided by the IEA Bioenergy Executive Committee and Task members. Reference is also made to FAOstat data as well as data from national statistics. All individual country reports were reviewed by the national delegates to the IEA Bioenergy Executive Committee, who have approved the content. General background on the approach and definitions can be found in the central introductory report for all country reports.

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HIGHLIGHTS

- Renewables make up 10% of *total energy supply* in China in 2022. The renewable energy share in *final energy consumption* is 16%[2], of which around a quarter is from biomass.
- Growth in renewable energy is mainly in electricity through hydropower, solar energy and wind power. The traditional use of biomass for residential heating is going down (and mostly replaced by oil and gas). Modern use of biomass for power and/or heat production is growing.
- China has important opportunities to further deploy bioenergy, particularly through the replacement of coal by solid biomass in existing assets, the increase of transport biofuels (which are still less than 1.5% of transport fuels) as well as biogas to replace natural gas. There are ample opportunities for (renewable) energy from MSW as part of the development of waste management systems.
- China has considerable potential of biomass resources. Under the strategy of "carbon peak and carbon neutral", bioenergy should be actively exploited, and departments at all levels should form a consensus on priority utilization of bioenergy, to play a positive role in achieving the goal of addressing climate change.

[1] www.iea.org/statistics

[2] The difference between the share of renewables in supply and consumption relates to unused heat from power plants (which is counted in energy supply, but not in final consumption).

- Bioenergy enriches the alternative scenario of non-electric clean energy, fully reflects the new concept of circular economy of green and sustainable development, and plays a special role in a clean and stable new energy system that takes into account the harmonious development of rural and urban areas in China.

CONTENTS

COUNTRY PROFILE

Population and land use

China is a large country in Asia, with a total land area of 9,6 million km². It is the world's most populated country (together with India) with over 1.4 billion inhabitants. Its population density is relatively high with 152 persons per km².

China's landscape is vast and diverse, ranging from deserts in the arid north to subtropical forests in the wetter south. Around a quarter of the land area is forest land, of which one third are planted forests. 56% is agricultural land, of which a quarter is arable land, and three quarters are permanent meadows and pastures.

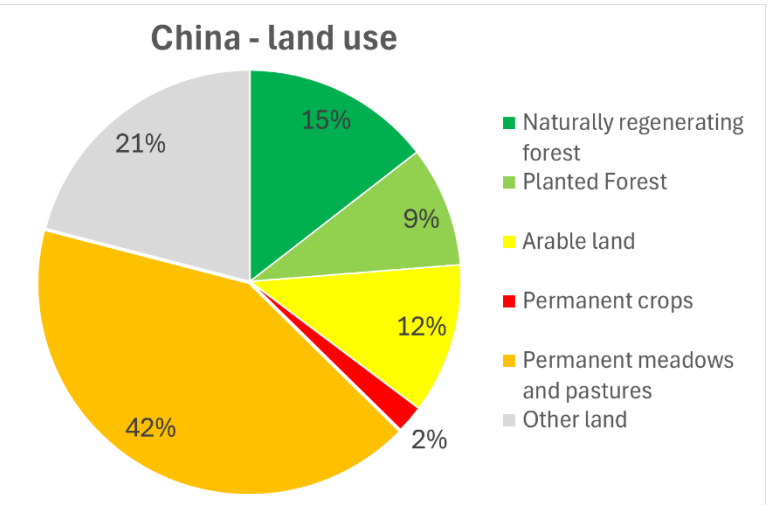

***Figure 1**: Land use in China (2022 figures - Source: FAOstat)*

Economic development and CO_2 emissions

Since China's accession to the World Trade Organization, its economy has entered a chapter of tremendous development fuelled by export and urbanization. During 2000-2022, its exports increased by 13 times, and the urban area (the area of urban land that meets certain standards for construction and infrastructure) by 1.8 times.

The soaring economy greatly increased China's real GDP per capita by 13 times, from US$ 959 in 2000 to US$ 12,741 in 2022. Large-scale industrial development, accelerated urbanization, and increasingly modernized lifestyles of a large population resulted in a significant expansion in energy consumption, which is the fundamental cause of the increase of CO_2 emissions in China.

On the plus side, China's CO_2 emissions per unit of energy consumption, energy consumption per unit of GDP, and CO_2 emission per unit of GDP have all reached their turning points and showed obvious downward trends. China's CO_2 emissions per unit of energy in 2022 decreased by 16% compared with 2000, and its energy consumption per unit of GDP and carbon intensity dropped by 75% and 77% during the period, a result of China's relentless efforts in energy conservation, emission reduction, and clean energy development in recent years. China has achieved remarkable results in promoting green, sustainable, and low-carbon development.

However, during the same period, China's CO_2 emissions per capita increased by 1.8 times. Despite the downward trends of the previous three factors, China is yet to reach its peak in CO_2 emissions per capita. How to reach the turning point quickly and drive down CO_2 emissions per capita steadily will be the determining factor for China to fulfil its commitment to striving to peak CO_2 emissions by 2030 and achieve carbon neutrality by 2060.[3]

[3] http://english.scio.gov.cn/in-depth/2021-05/08/content_77475496.htm

Final energy consumption

Overall final energy consumption in China (*also including non-energy use of oil, natural gas, and coal in industry*) comes down to 1.64 tonnes of oil equivalent (toe) per capita, which is around two thirds of the average of IEA Bioenergy countries. More than half of final energy consumption in China is in industries - levels of energy use in industry (per capita) are comparable to several OECD countries. Transport energy consumption and residential energy use per capita are very low.

***Table 1**: Distribution of the final consumption of energy carriers by sector in China (2022 figures - data source: IEA (2024) World Energy Balances and Renewables Information)*

Final consumption energy carriers	Toe/capita (2022)	% of total	*Median* (toe/capita)*
Industry (energy use)	0.79	48%	*0.71*
Industry (non-energy use)	0.13	8%	*0.18*
Transport	0.23	14%	*0.66*
Residential	0.27	17%	*0.50*
Commercial & public services	0.07	4%	*0.32*
other	0.15	9%	*0.08*
Total	1.64		*2.50*

** Median of the 23 member countries of IEA Bioenergy*[4]

[4] Comparative figures of the different IEA Bioenergy member countries are discussed in the central Countries' Report.

THE CONTRIBUTION OF BIOENERGY IN NATIONAL ENERGY SUPPLY

TOTAL ENERGY SUPPLY

The total energy supply (TES) of China in 2022 amounted to 161 exajoule (EJ) with fossil fuels (coal, oil, gas) still contributing 87%. Coal (99.4 EJ) is the dominant fuel, representing 62% of total energy supply. Oil products (28.1 EJ) represent another 17%, gas 8% (12.4 EJ) and nuclear energy 2.8% (4.6 EJ). Renewable energy sources represent 10.3% of total energy supply (16.5 EJ), which can be split up in modern bioenergy (3.1 EJ), traditional bioenergy (1.4 EJ), hydropower (4.7 EJ), wind energy (2.7 EJ), solar power (2.7 EJ) and geothermal power (1.1 EJ).

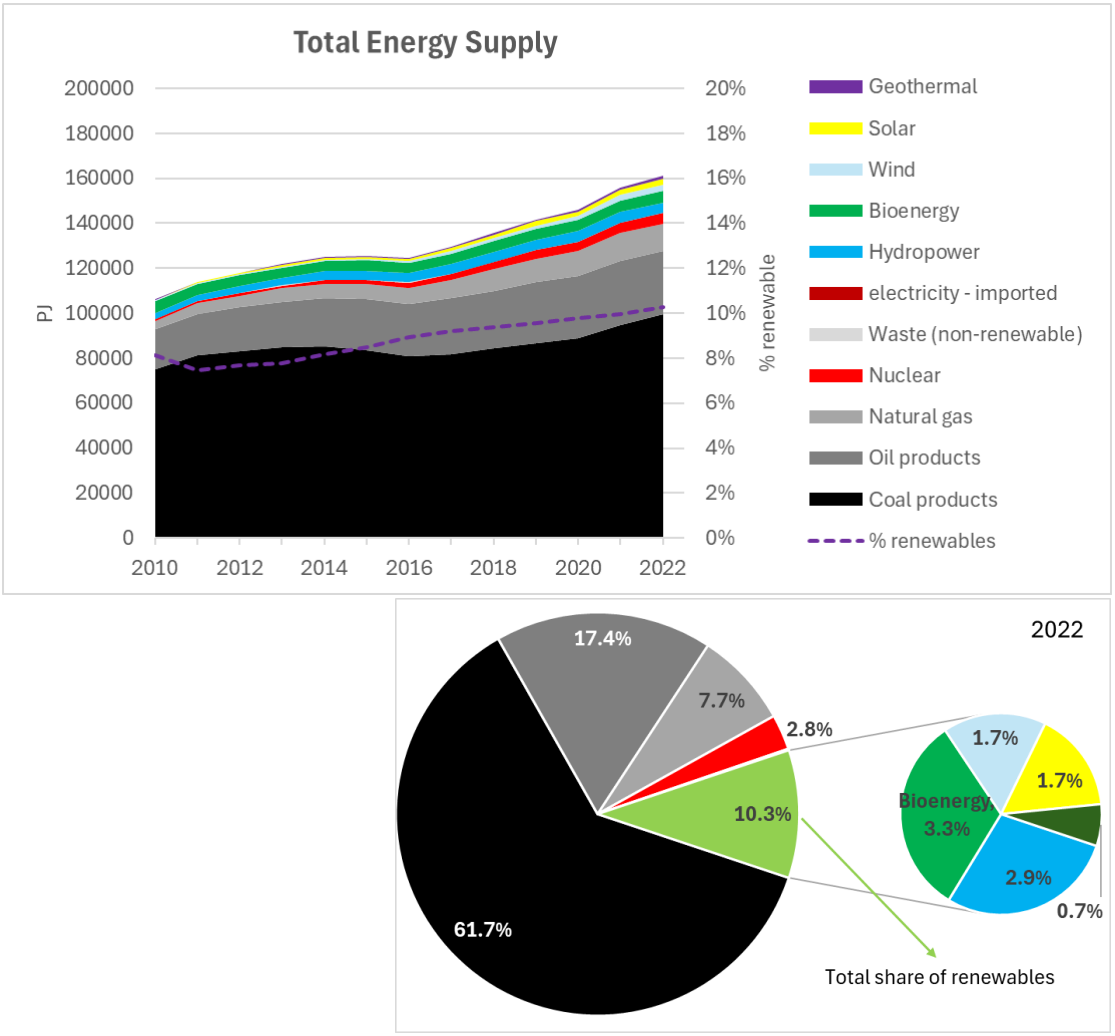

***Figure 2**: Total energy supply[5] and the contribution of different energy sources in China, with distribution in 2022 (Source: IEA (2024) World Energy Balances and Renewables Information)*

Total energy supply in China continues to grow after a short temporisation in 2014-2016. Between 2013 and 2017 coal stabilized; however, in recent years the increase in coal use picked up again

[5] Total energy supply represents all the energy required to supply end users in the country. Some of these energy sources are used directly while most are transformed into fuels or electricity for final consumption. In terms of the role in the energy system this distribution overestimates the role of resources producing electricity with a high share of unused waste heat (like coal and nuclear power plants).

(with a continuing increase for power production and a decrease for industrial heat). Since 2010, oil has grown by 57% (from 17.9 to 28.1 EJ) and natural gas has grown more than threefold (from 3.7 to 12.4 EJ).

Renewable energy has been relatively stable around 9 EJ in the 2000s, see 2021 Country Report[6] (which means that the share of renewable energy went down due to the growing TES); after 2011 there was a consistent growth up to 16.5 PJ in 2022, which corresponds to an increased share from 8.1% to 10.3%. The main growth in this period was in hydropower, solar and wind energy.

EVOLUTION OF BIOENERGY IN TOTAL ENERGY SUPPLY

Solid biofuels represent the major part (>90%) of bioenergy in China. The figure shows that traditional biomass uses for residential heating and cooking dominated[7], but modern biomass applications are steadily taking over. This is now reversing the negative trend of bioenergy up to 2016. Modern use of solid biofuels includes the use of agricultural and forestry residues, mainly for electricity production. In addition, pellets are used for industrial heating and a small part of residential heating.

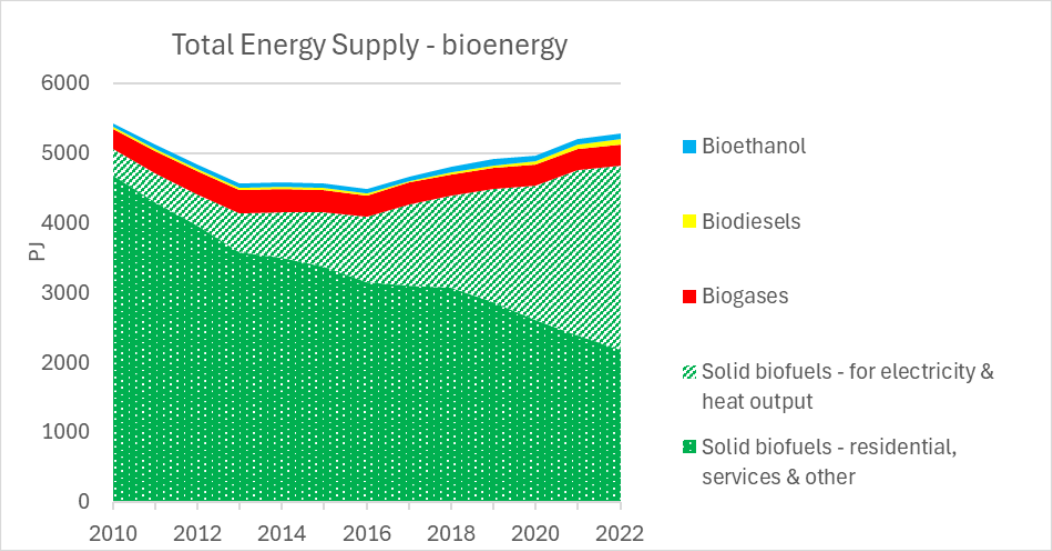

***Figure 3**: Development of total energy supply from bioenergy in China (Source: IEA (2024) World Energy Balances and Renewables Information)*

Evolution of the bioenergy carriers:

- In the past 20 years the share of biomass for residential heating (mostly traditional biomass) dropped from 70% to 20% and was replaced by oil and gas. Prior to 2006, traditional biomass was used mainly in rural areas and heating for urban residents was mainly coal-fired central heating. After 2012 the decline of solid biofuels in residential heating was compensated by an increase of solid biofuels in electricity and heat production. Since 2016 the overall use of solid biomass for energy increases again.

[6] 2021 Country Report for China available at: https://www.ieabioenergy.com/wp-content/uploads/2021/11/CountryReport2021_China_final.pdf

[7] The data used for biomass in residential applications are estimations. National statistics in China mainly monitor bioenergy use in commercial applications.

- Biogas has stabilised around 300 PJ[8], which is 14% of bioenergy. This is mainly used to supply gas to residents for cooking and electricity production.
- Liquid biofuels (predominantly bioethanol) represent 3% of bioenergy in China. This will be further discussed in the chapter on transport biofuels.
- There is no reporting of energy from municipal waste.

ENERGY DEPENDENCY

The following graphs show the difference between domestic production and total energy supply of different energy carriers. Based on the difference between these figures, we can deduct the energy import dependency.

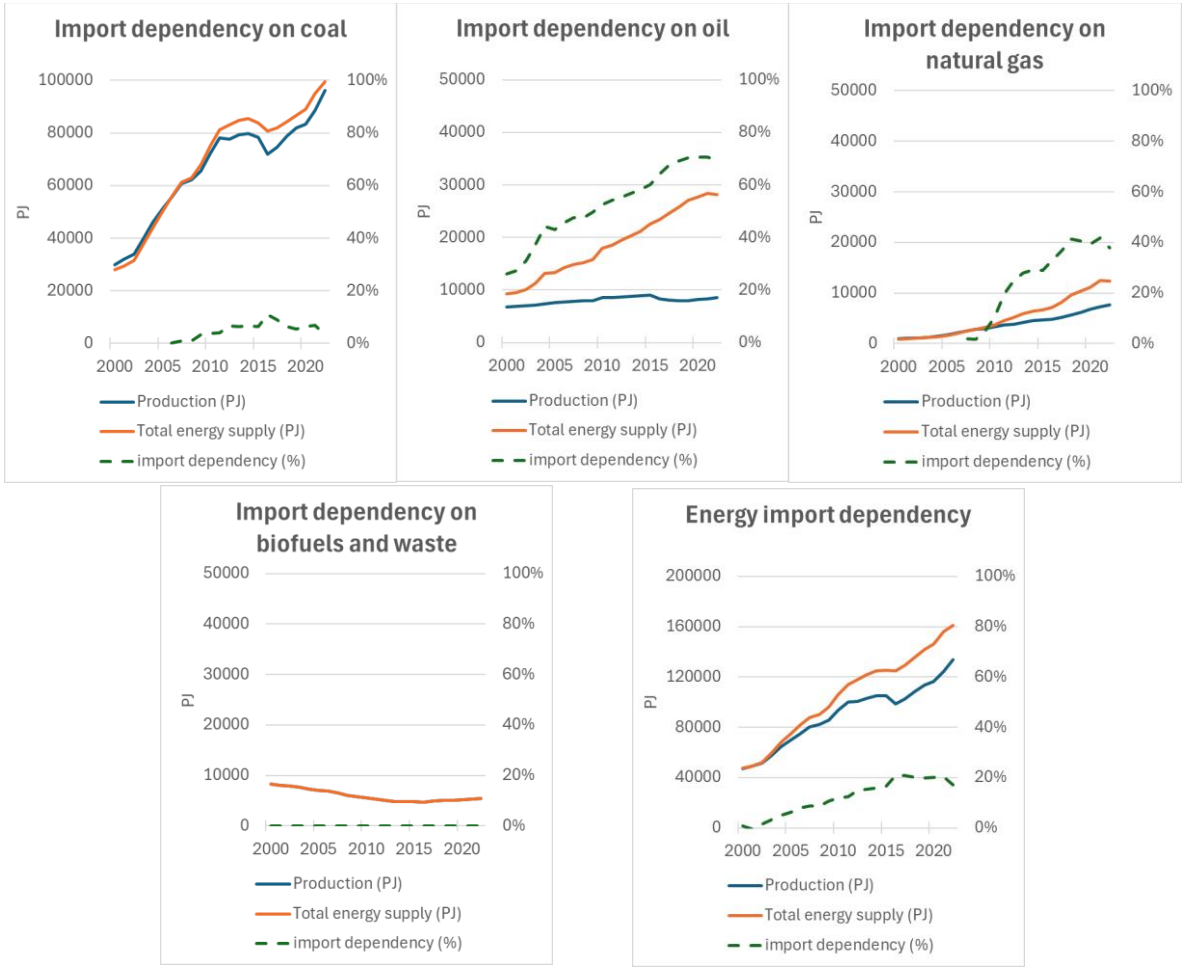

Figure 4: Evolution of energy import dependency for different energy carriers in China (data source: IEA (2024) World Energy Balances and Renewables Information)

In terms of its high consumption of coal, China only relies for 3 to 6% on imports; most of the coal is produced domestically. The situation is different for oil and gas: China is for 70% dependent on oil imports and for 40% dependent on gas imports. All bioenergy is produced from domestic sources.

[8] Mind that data on biogas production after 2016 are not updated.

With bioenergy, as well as other types of renewable energy (hydropower, solar, wind) being produced domestically, this leads to an overall energy import dependency of around 20%.

There is no reporting of trade flows of bioenergy carriers; nevertheless, there are substantial exports of biodiesels to Europe (or used cooking oil to be converted to biodiesel in Europe).

NATIONAL POLICY FRAMEWORK IN CHINA

TARGETS AND STRATEGIES RELATED TO CLIMATE AND RENEWABLE ENERGY

Renewable Energy Law of the People's Republic of China January 1, 2006

The Renewable Energy Law of the People's Republic of China was issued in 2005 and was carried out formally on January 1, 2006. The Renewable Energy Law is a framework policy which lays out the general conditions for renewable energy to become a more important energy source in the People's Republic of China.[9]

Blue-Sky Action Plan[10] July 3, 2018

China's State Council released a three-year "Blue Sky Protection Plan (2018-2020)". The plan focuses on reducing the total emissions of major air pollutants and reducing greenhouse gas emissions.

Action plan for reaching carbon dioxide peak before 2030[11] October 26, 2021

According to the plan, the consumption ratio of non-fossil energy will reach 20 percent of the total in 2025, with energy consumption and carbon dioxide emissions per unit of GDP down 13.5 and 18 percent compared with that of 2020. During the 15th Five-Year Plan (2026-2030) period, the nation will basically establish a policy system to support green, low-carbon and circular development. By 2030, the consumption ratio of non-fossil energy will account for 25 percent of the total and carbon dioxide emissions per unit of GDP will be reduced by more than 65 percent compared with 2005, the total installed capacity of wind and solar power will be above 1.2 billion kW.

The 14th Five-Year Plan for Modern Energy System[12] March 22, 2022

By 2025, China aims to bring the annual domestic energy production capacity to over 4.6 billion tons of standard coal, according to the plan jointly released by the National Development and Reform Commission and the National Energy Administration. China aims to gradually increase the share of non-fossil energy consumption to around 20 percent by 2025, and the proportion of non-fossil energy power generation will reach approximately 39 percent, according to the plan.

Hydrogen Industry Development Plan[13] March 23,2022

The Chinese government laid out a medium- and long-term development plan for hydrogen, for the period 2021-2035. China targets to bring 50000 hydrogen fuel-cell vehicles on the road by 2025 and to build a number of hydrogen refuelling stations. The plan targets green hydrogen production using

[9] https://www.iea.org/policies/3080-renewable-energy-law-of-the-peoples-republic-of-china

[10] http://english.www.gov.cn/policies/latest_releases/2018/07/03/content_281476207708632.htm

[11] http://english.www.gov.cn/policies/latestreleases/202110/26/content_WS6178023cc6d0df57f98e3d5c.html

[12] China specifies energy targets for 2021-2025 (www.gov.cn)

[13] https://en.ndrc.gov.cn/news/pressreleases/202203/t20220329_1321487.html

renewable feedstock resources to reach 100,000-200,000 tonnes per year by 2025, achieving a reduction of 1-2 million tons/year in carbon dioxide emissions. Besides transport, the plan envisages the use of clean hydrogen in other sectors: energy storage, electricity generation and industry. Currently, China is already the world largest producer and consumer of hydrogen.

Implementation Plan for Accelerating the Establishment of a Unified and Standardized Carbon Emission Statistical Accounting[14] April 22, 2022

In April 2022, the Implementation Plan for Accelerating the Establishment of a Unified and Standardized Carbon Emission Statistical Accounting was issued to promote the improvement of the carbon emission statistical accounting system for enterprises in key industries, establish and improve the carbon emission accounting methods for raw materials, semi-finished products and finished products in key industries.

Guidelines to ramp up green transition of economic, social development[15], August 11, 2024

The Communist Party of China (CPC) Central Committee and the State Council have unveiled a set of guidelines to ramp up green transition in all areas of economic and social development. The guidelines main objectives are that by 2030, the country will achieve "remarkable results" in the green transition in all areas of economic and social development; and by 2035, a green, low-carbon, and circular development economic system will be basically established, and the goal of Beautiful China will be basically achieved.

Table 2: renewable energy and climate targets in China.

Sector	Share of renewables in gross final consumption	GHG reduction target
Overall target	non-fossil energy accounts for 25% by 2030	-65% by 2030 per unit of GDP compared to 2005 Peak CO_2 emissions by 2030 Carbon neutrality by 2060
Guidelines to ramp up green transition of economic, social development		By 2030, the carbon emission intensity of commercial transport per unit of turnover will drop by about 9.5 percent compared with 2020, and the annual utilization of bulk solid waste will reach about 4.5 billion tonnes, with the output rate of main resources to increase by about 45 percent compared with 2020.
The 14th Five-Year Plan for Modern Energy System		By 2025, China aims to bring the annual domestic energy production capacity to over 4.6 billion tons of standard coal. The annual crude oil output will recover and stabilize at 200 million tons, while the annual natural gas output will reach over 230 billion cubic meters by 2025. The annual crude oil output will recover and stabilize at 200 million tons, while the annual natural gas output will reach over 230 billion cubic meters by 2025

[14] https://en.ndrc.gov.cn/news/pressreleases/202203/t20220329_1321487.html

[15] China issues guidelines to ramp up green transition of economic, social development (www.gov.cn)

A description of renewable energy and climate policies and measures in China is available at the IEA's Policies and Measures Database © OECD/IEA: https://www.iea.org/policies?country=China

Specific policies related to renewable electricity, renewable heat and transport biofuels will be highlighted in the chapters about the role of bioenergy in different sectors.

ROLE OF BIOENERGY IN DIFFERENT SECTORS

OVERVIEW

The overall 2022 share of renewables in **final energy consumption**[16] among electricity, transportation and heat sectors is almost 16%, with bioenergy making up 3.6% of the energy share (1.2% specifically for commercial bioenergy) (**Table 3**). Mind that these figures are different from the shares in total energy supply (where unused waste heat, e.g., in fossil and nuclear power production, is also included).

***Table 3**: Role of bioenergy and renewable energy in electricity, transport energy and fuel/heat consumption in 2022*

Sector	Share of bioenergy	Share of renewable energy	Overall consumption
Electricity[17]	2.0%	30.3% *(14.8% hydro)*	8874 TWh (31.9 EJ)
Transport energy (final consumption)	1.2%	2.5%	13.6 EJ
Overall fuel and heat consumption[18]	Direct biomass: 5.2%	9.8%	47.9 EJ
TOTAL FINAL ENERGY CONSUMPTION*	3.6% (1.2% commercial, 2.4% residential)	**15.7%**	**92.8 EJ**

Based on own calculations. Source of the data: IEA (2024) World Energy Balances and Renewables Information

Electricity represents around 34% of final energy consumption, transport fuels (excl. electricity) represent 15% and other fuels/heat (excl. electricity) 51%.

[16] Final energy consumption excludes non-energy use of coal, oil products and natural gas

[17] Renewable electricity production compared to final consumption. Potential renewable shares of imported electricity are not included.

[18] This includes final consumption of fuels and heat in industry, the residential sector, commercial and public services and agriculture/forestry. Transport fuels are excluded. Energy used for transformation and for own use of energy producing industries is also excluded.

Electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported.

The following paragraphs will consider the evolutions in the different sectors.

ELECTRICITY

The Chinese power production is largely dominated by coal, representing 58.4% of power production[19]. Natural gas and nuclear energy represent respectively 3 and 5%.

The overall share of renewables in electricity production has increased from 19% in 2010 to 30% in 2022. Hydropower is the dominant source of renewable electricity with 15% of total electricity production. In the past 10 years there was also a consistent growth of wind energy (now at 9%) and solar energy (now at 5%).

The role of electricity from biomass is very modest around 2%, but the amount has increased from 25 to 182 TWh since 2010 – this is mostly produced from solid biomass in electricity-only plants. Recent figures from national Chinese statistics indicate that in 2022, 52 TWh of that amount was produced from solid biomass, 4 TWh from biogas and 127 TWh from MSW (DOI: 10.28061/n.cnki.ncdlb.2023.000581).

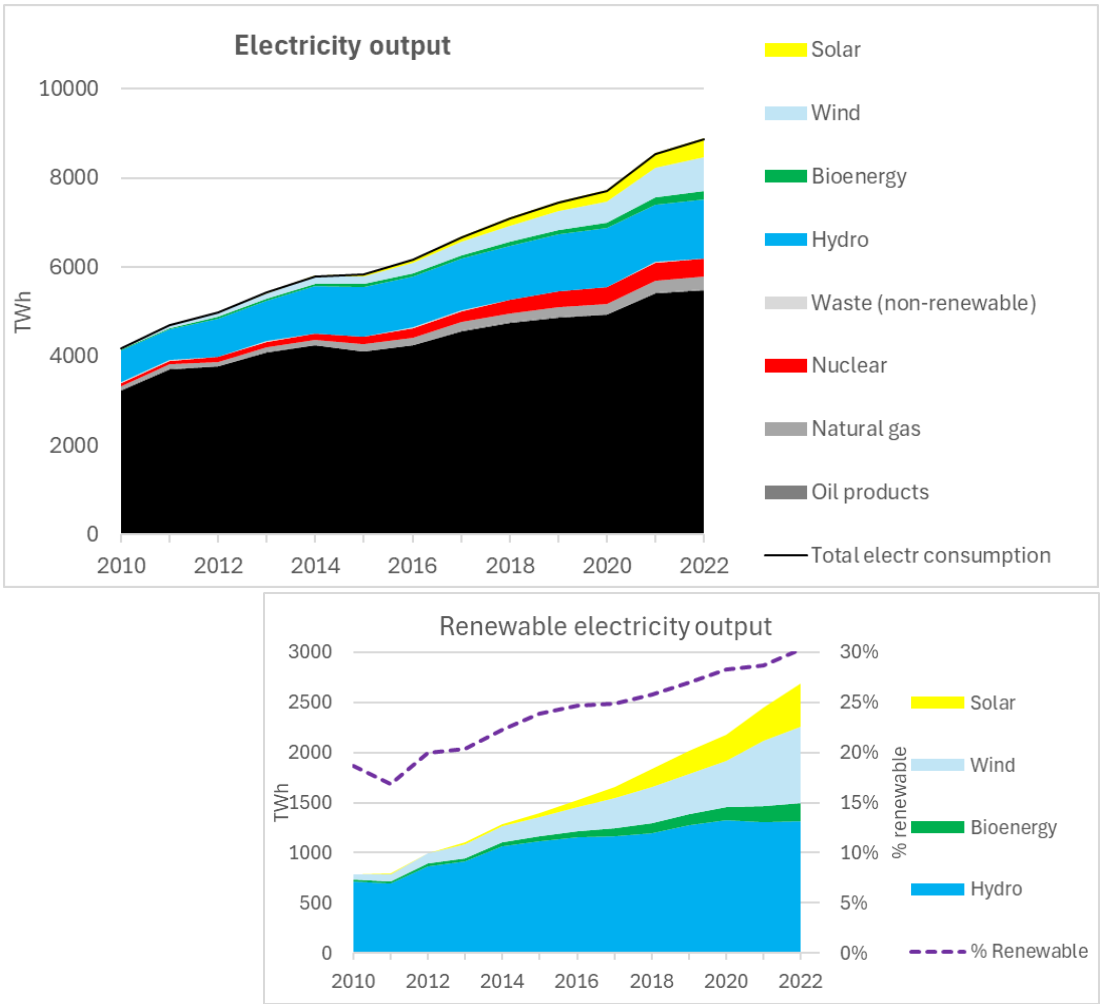

***Figure 5**: Evolution of the electricity mix in China (data source: IEA (2024) World Energy Balances and Renewables Information)*

[19] China Power Industry Economic Operation Report 2022 (stats.gov.cn)

The following figure shows the distinction between electricity produced in electricity-only plants and combined heat and power (CHP) plants for different types of energy carriers. 60% of coal power, 100% of gas power and 66% of gas power is produced in electricity-only plants, meaning that heat is condensed away. Most solid-biomass-based electricity is produced in electricity-only plants.

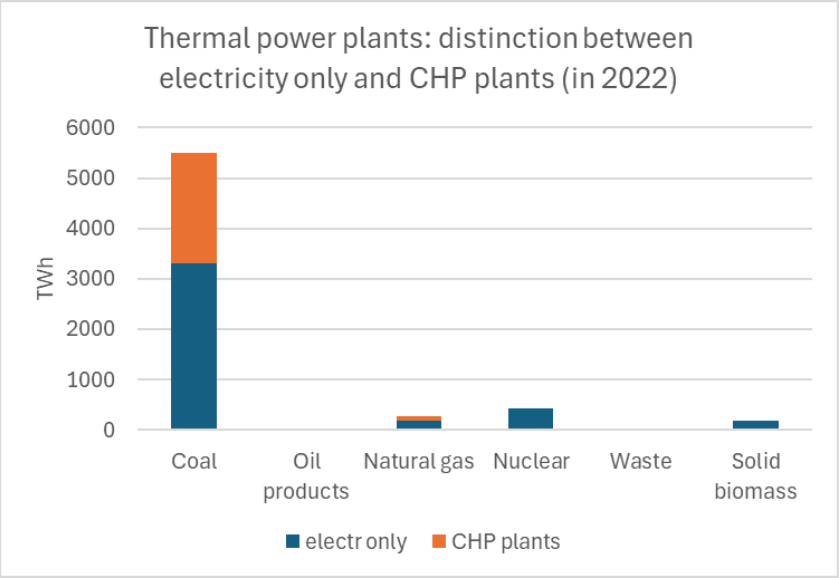

Figure 6: Electricity produced from electricity only vs CHP plants in China in 2022 (data source: IEA (2024) World Energy Balances and Renewables Information)

Policy framework

The main relevant policy instruments behind these evolutions, relevant for bioelectricity, are:

- Fixed feed-in tariff: Since 2010, the new agricultural and forestry biomass power generation projects have uniformly implemented the benchmark feed-in tariff of 0.75 yuan per kilowatt hour (including tax).
- Notice on improving price policy for bio-power from agricultural and forestry - July 18, 2010
- Views on promoting the healthy development of electricity from non-water renewable sources - January 20, 2020
- Improve the implementation plan of biopower project construction and operation - September 11, 2020
- Biomass Power Generation Project Construction Work Plan – August 11, 2021
- Opinions on Improving the Mechanisms and Policy Measures for Energy Green and Low-carbon Transition – January 30, 2022
- Notice on the promotion of renewable energy electricity consumption through full coverage of renewable energy green electricity certificates– July 2023

  Aim: clarify the green certificate renewable energy power environmental attributes of the only proof and renewable energy power production, consumption of the only certificate status, requiring full coverage of green certificate issuance.
- Renewable energy green power certificate issuance and trading rules – Aug 26, 2024

HEAT/FUEL CONSUMPTION

Figure 7 shows the role of different fuels/energy carriers for providing heat in different sectors (industry, residential sector, commercial and public services and other). Fuel use by energy producing industries for transformation and for own use is excluded. Mind that electric heating (direct or through heat pumps) is not included in these figures as this is not separately reported in IEA statistics.

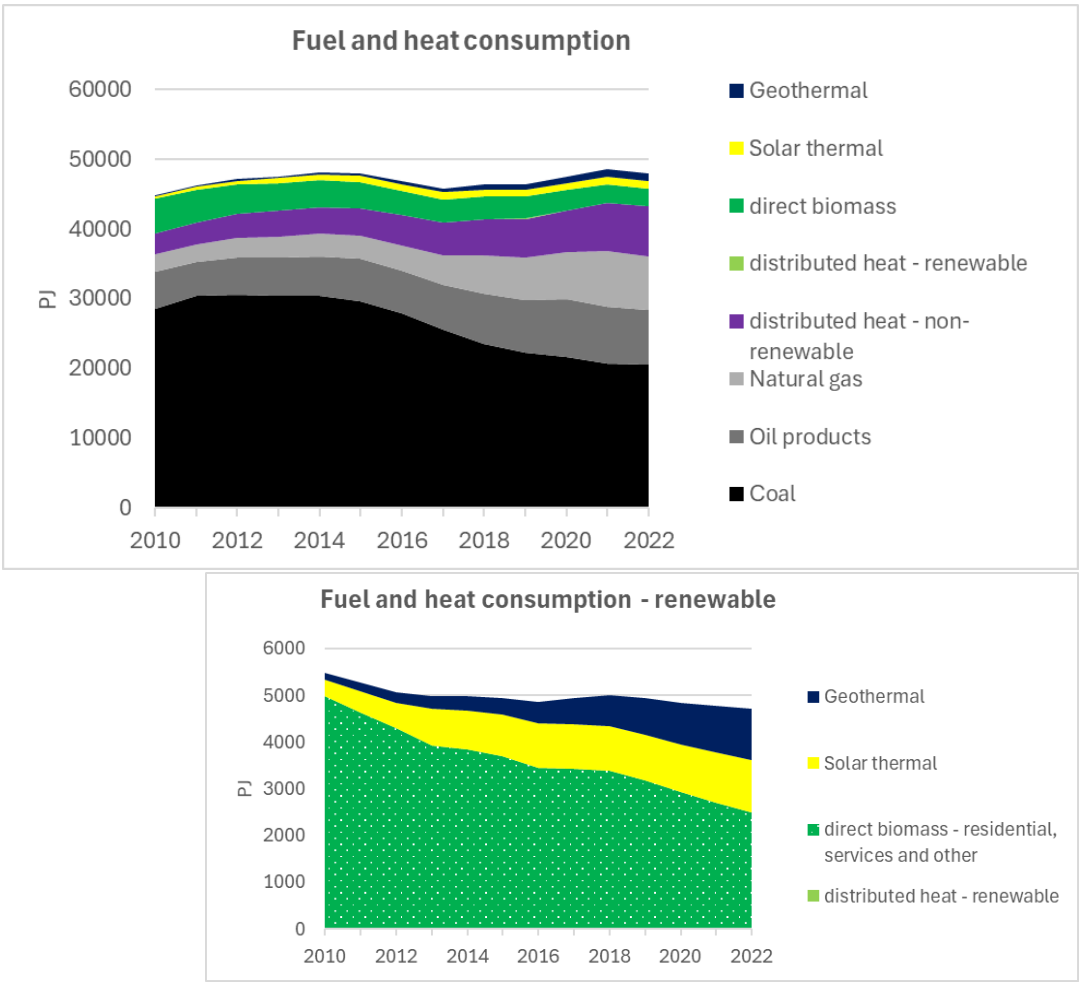

***Figure 7**: Evolution of fuel and heat consumption in China (data source: IEA (2024) World Energy Balances and Renewables Information)*

The provision of heat is largely based on fossil fuels, mainly coal, oil products and natural gas. Direct use of coal still dominates, although there was a decline in the past years, which is mostly compensated by other fossil fuels and (coal-based) heat distribution. Direct use of biomass, which consists of 88% solid biomass and 12% biogas, represents around 5% (2.5 EJ) of heat provision. This is less than half of levels of 2010. Most decline has been in the residential sector[20] where (traditional) biomass heating was replaced by oil and gas heating. On the other hand, there is also an increase of solar thermal and geothermal heat at residential level. Mind that the use of renewable energy for industry heat is marginal (<0.1%).

[20] The data used for biomass in residential applications are estimations. National statistics in China mainly monitor bioenergy use in commercial applications.

Heat output generated and sold by CHP plants and heat plants represents around 15% of fuel/heat provided and is steadily growing. This is also dominated by fossil fuels, particularly coal. The role of biomass for distributed heat is marginal (<0.2%).

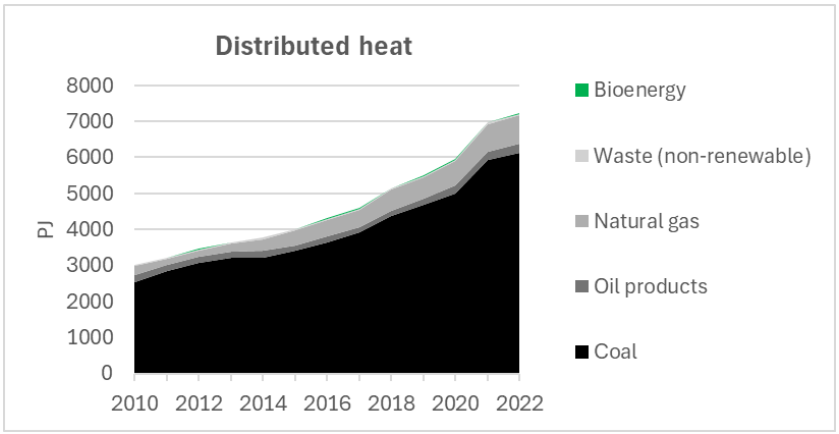

***Figure 8**: Evolution of fuels for heat output in China (data source: IEA (2024) World Energy Balances and Renewables Information)*

Policy framework

The main relevant policy instruments behind these evolutions, relevant for biomass-based heat, are:

- Guiding Opinions on Promoting the Development of Biomass-based Heating, December 2017
- North of China Winter Clean Heating Planning, December 2017
- 100 counties biomass CHP programme, January 2018
- Notice from the National Energy Administration regarding the effective implementation of renewable energy heating in accordance with local conditions, January 2021
- "14th Five-Year Plan" industrial green development plan, issued by the Ministry of Industry and Information Technology (MIIT)， November 2021: The plan calls for increasing the proportion of clean energy consumption. The plan encourages the application of alternative energy sources such as hydrogen energy, biofuels and waste-derived fuels in the steel, cement and chemical industries.
- Guidelines for the construction of a standard system for peaking carbon neutrality in the industrial sector (MIIT), February 2024. In terms of fuel replacement, focus on the development of biomass fuel replacement technology, hydrogen metallurgy, furnace hydrogen fuel replacement technology and equipment standards.

TRANSPORT

Figure 9 shows an overview of the energy used in transport in China, split up by different fuels/energy carriers. Overall transport energy continued to grow until 2018 but has stabilized in recent years. Diesel and gasoline are the dominant fuels. The consumption of diesel (mostly linked to heavy duty transport) has stabilized around 4.7-5.2 EJ since 2016, representing 35% of transport energy; the consumption of gasoline (mostly linked to passenger cars) increased from 2.9 EJ in 2010 to 6.2 EJ in 2022, representing 45% of transport energy. Natural gas is also used as transport fuel (~10%) and its share continues to grow. There is also a relevant amount of aviation fuel for domestic flights, representing 9% of transport energy in 2021. Its level seems to have dropped substantially in 2022, it is not clear if this is a lasting trend.

Both bioethanol and biodiesel have doubled since 2010, but overall, they only represent 1.2% of transport energy. Together with renewable electricity, the share of renewable energy in transport is at 2.5%, which is quite low compared to other members of IEA Bioenergy.

Electricity *(of which 30% was renewable in 2022)* represents a share of 4.3% of total transport energy use; partly through rail, partly through electric scooters and cars. Particularly the use of electricity in road vehicles is steadily growing, reaching a substantial level of 1.7% of Chinese transport energy use in 2022.

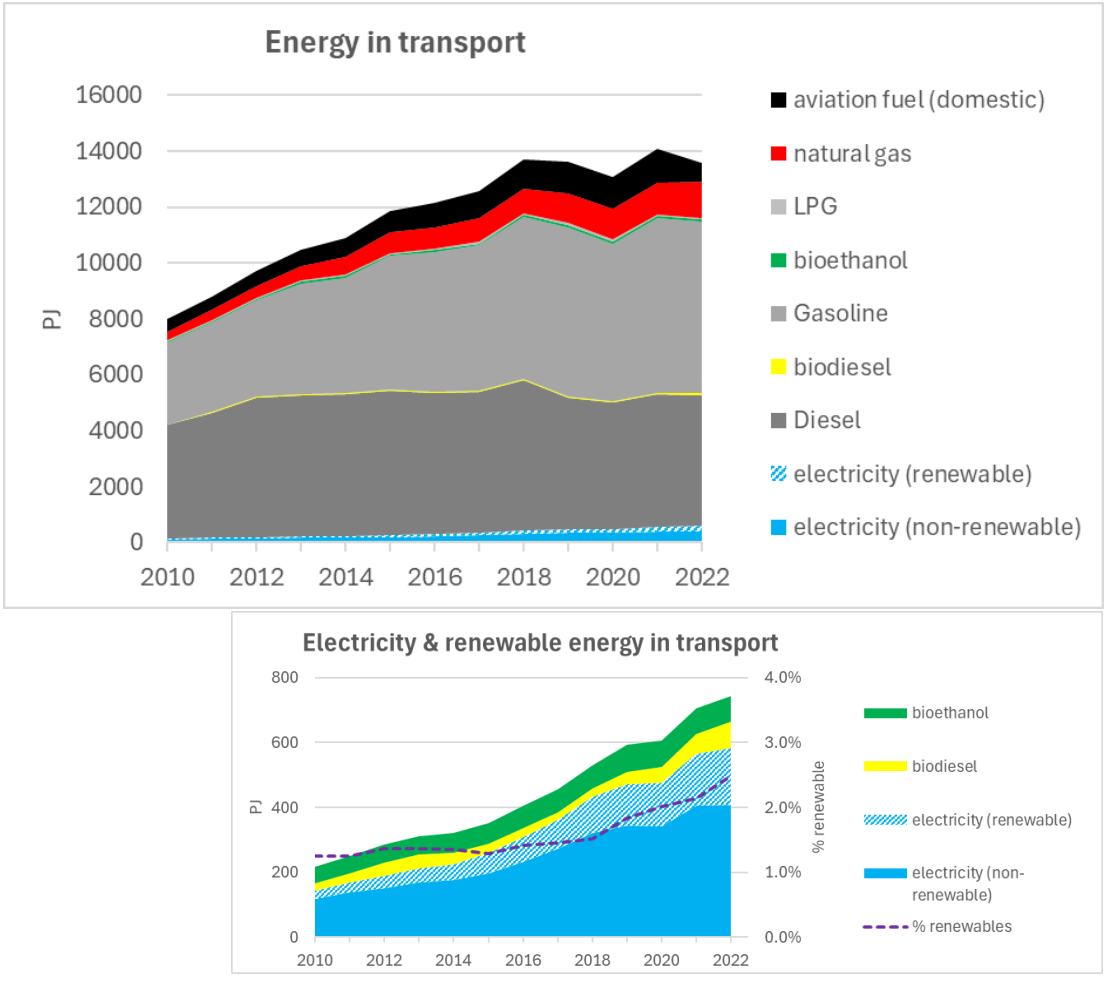

***Figure 9**: Evolution of transport fuels in China (data source: IEA (2024) World Energy Balances and Renewables Information)*

Policy framework

The main relevant policy instruments behind the evolutions in biofuels are:

- Expanded pilot programme for fuel ethanol - February 10, 2004
- Notification on strengthening the management of fuel ethanol projects, and promoting the healthy development of fuel ethanol industry - December 14, 2006
- Mid-long-term planning on the development of renewable energy - September 2007
- The 12th Five-Year Plan for bioenergy development (2011-2015) - July 24, 2012
- The 13th Five-Year Plan for bioenergy development (2016-2020) - October 28 ,2016
- Implementation plan on expanding biofuel ethanol production and promoting the use of fuel ethanol - September 13, 2017
- Notice on the Establishment of the Monthly Work Information System for Promoting the Production and Use of Biofuel Ethanol and the Expansion of Ethanol Gasoline for Vehicles – February 27, 2019
- The 14th Five-Year-Plan for Renewable Energy development (2021-2025) - June 1, 2022
- Notice of the National Energy Administration on organizing the pilot demonstration of the promotion and application of biodiesel-November 2023

GAS CONSUMPTION AND THE ROLE OF BIOGAS

Natural gas represented 8% of total energy supply in 2022 and its share has steadily grown (*although there seem to be some stabilisation in 2022*). The figure below shows the different users of natural gas. The most important gas users in 2022 are industry (40%), energy plants (20%), the residential sector (18%) and transport (10%). Next to end user sectors, there is some own use of gas in energy industries (producing gas) – this represents 8% of natural gas supply in China.

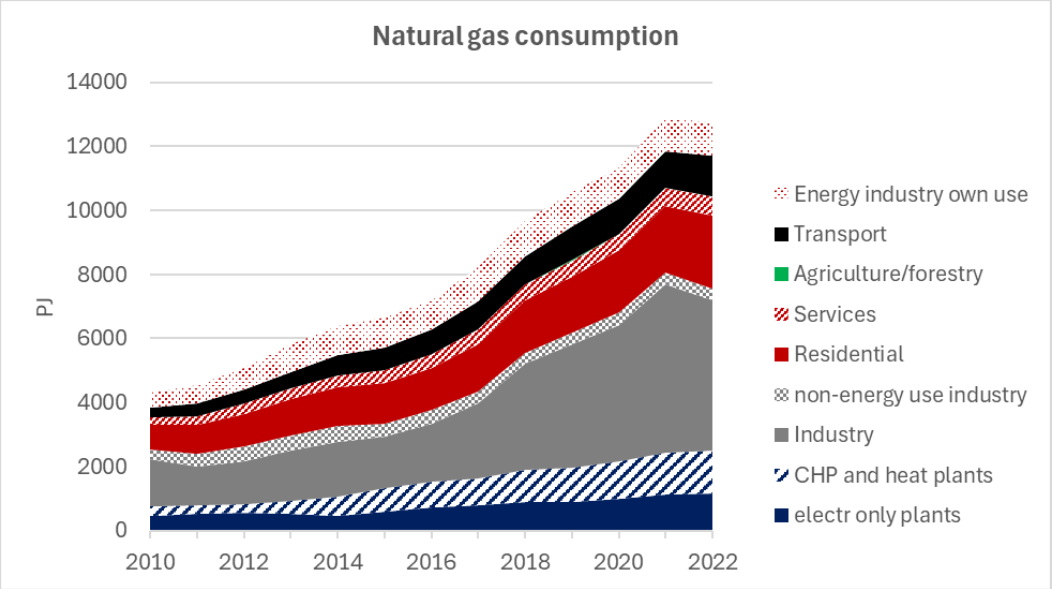

***Figure 10**: Evolution of gas consumption in different sectors in China (data source: IEA (2024) World Energy Balances and Renewables Information)*

Biogas has reached a level of around 300 PJ[21], which is mostly used in residential applications (in rural areas). In 2022, China's biomethane production capacity is about 200 million cubic meters per year. The use of biogas represents a little over 2% of overall gas consumption in China.

FINAL ENERGY CONSUMPTION IN DIFFERENT SECTORS (EXCL TRANSPORT)

Final Energy consumption in industries

Figure 11 show the energy consumption (fuels, heat and electricity) in industries. This includes non-energy use of coal, oil and gas (e.g., for the production of chemicals). Electricity use is for broad purposes, including processes, machineries, electric appliances, lighting, and in some cases also for heating and/or cooling or air conditioning. For the renewable share of electricity consumption, we consider the Chinese electricity mix.

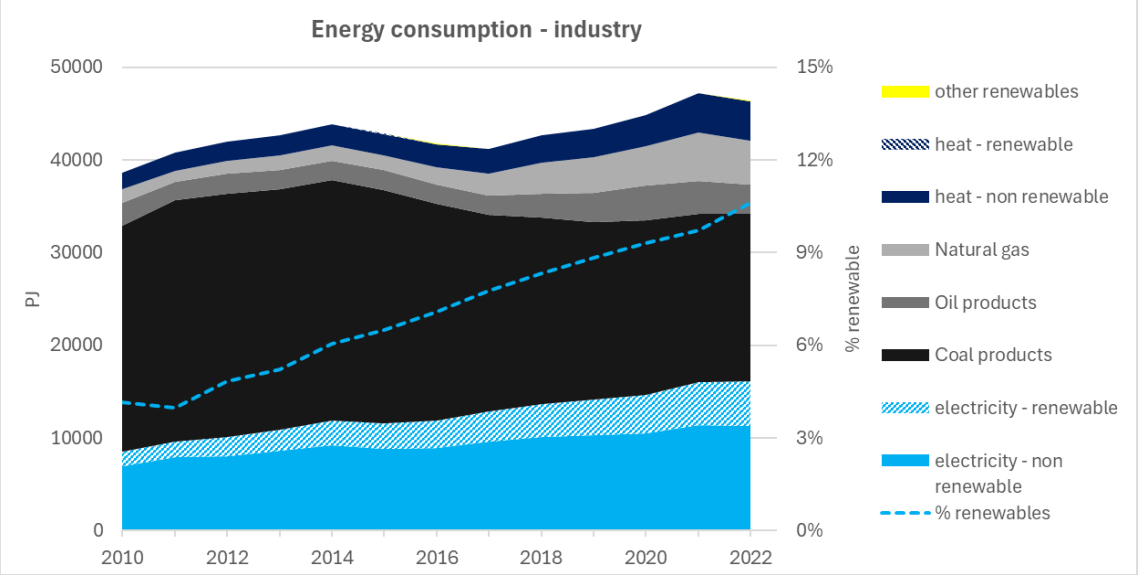

Figure 11: Evolution of final energy consumption in industries in China (data source: IEA (2024) World Energy Balances and Renewables Information)

Industries represent more than 50% of final energy consumption in China. In industries, electricity represents around 35% of final energy consumption, so the role of fuels – particularly coal - is still substantial. Mind that the share of electricity is increasing, while the share of coal (which still dominates) goes down. On the other hand, there is also a clear increase of natural gas and oil consumption in industries.

Overall, about 10% of final energy consumption in industries is from renewable sources, which is almost completely connected to the renewable share of electricity. There is no reporting of biomass use for energy in industries.

[21] Mind that data on biogas production after 2016 are not updated.

For comparison, **Figure 12** shows the **non-energy use** of coal, oil and gas in industries, e.g., for the production of chemicals. 63% of oil product consumption, 7% of natural gas consumption and 11% of coal consumption in Chinese industries is for non-energy purposes.

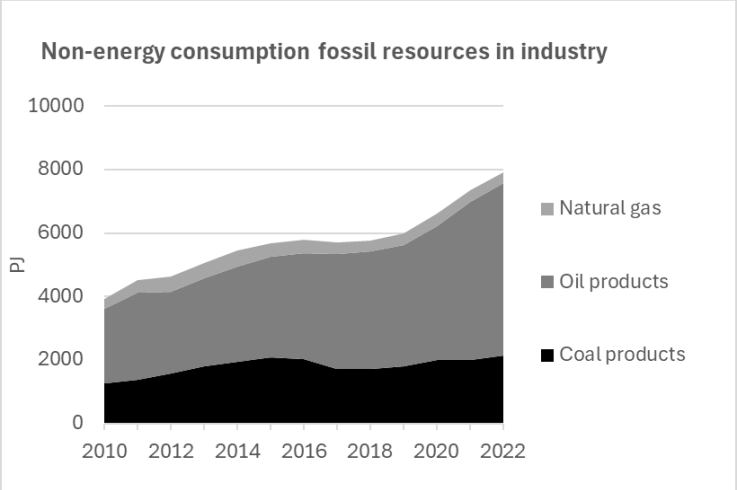

Figure 12: Evolution of non-energy use of coal, oil and gas in industries in China (data source: IEA (2024) World Energy Balances and Renewables Information)

Final Energy consumption in the residential sector

Figure 13 shows the energy consumption (fuels, heat and electricity) in the residential sector. Electricity use is for broad purposes, including electric appliances, lighting, and partly also for heating and cooling (e.g. in heat pumps/air conditioning). For the renewable share of electricity consumption, we consider the Chinese electricity mix.

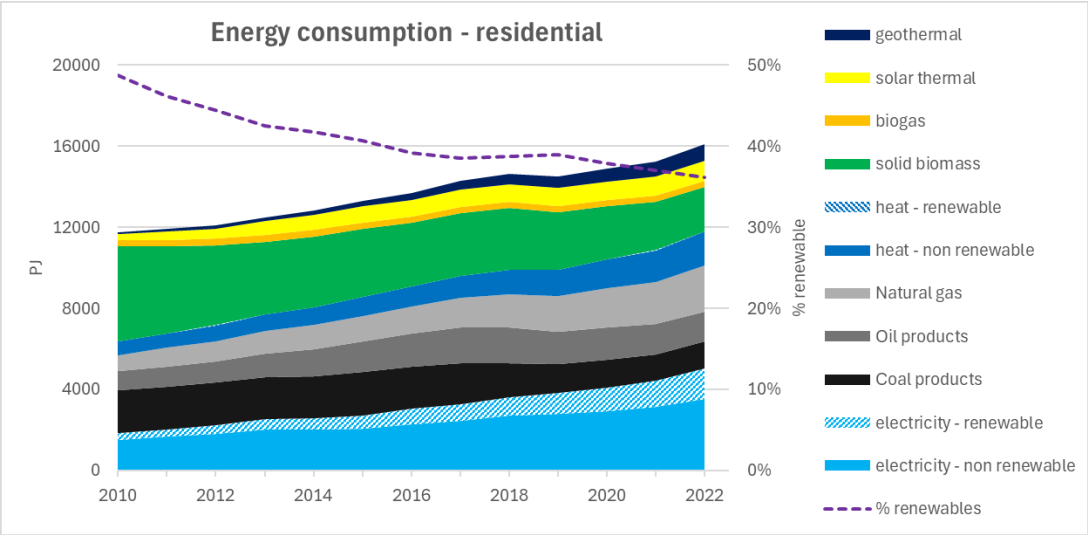

Figure 13: Evolution of final energy consumption in the residential sector in China (data source: IEA (2024) World Energy Balances and Renewables Information)

Energy consumption in the residential sector steadily increases, but this increase is merely in electricity consumption, which is now at 31% of final energy consumption in this sector. The use of fuels/heat is relatively stable, but there are shifts. For example, the use of solid biomass (now at 14%) and coal (now at 8%) in residential applications is steadily going down; this is mostly compensated by an increased use of natural gas (now at 22%), but there are also increases in district heating (now at 10%), solar thermal and geothermal energy.

About 36% of final energy consumption in residential applications in 2022 is from renewable sources, split between solid biomass (13.6%), renewable electricity (10.4%), solar thermal energy (6.3%), geothermal energy (5.0%), and biogas (2%).

Final Energy consumption in commercial and public services

Error! Reference source not found. shows energy consumption (fuels, heat and electricity) in commercial/public services. Electricity use is for broad purposes, including electric appliances, lighting, servers, and partly also for heating and cooling (e.g. in heat pumps and air conditioning). For the renewable share of electricity consumption, we consider the Chinese electricity mix.

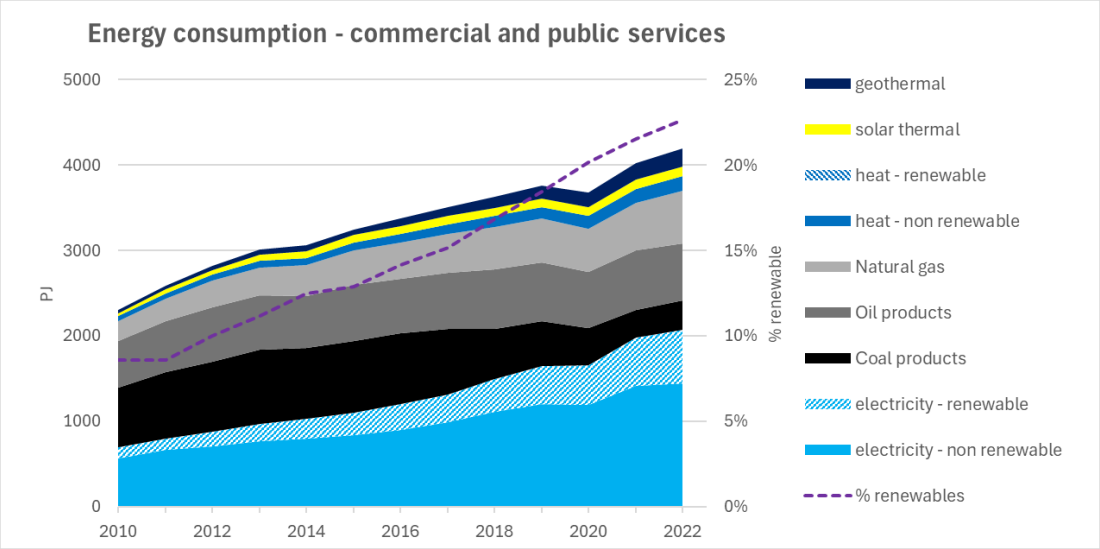

Figure 14: Evolution of final energy consumption in commercial and public services in China (data source: IEA (2024) World Energy Balances and Renewables Information)

Energy consumption by commercial and public services is quite low in China, about 10 times lower than in industries and 4 times lower than in the residential sector. There is also an increasing trend of electricity in commercial and public services (electric appliances, servers, heating and cooling (e.g. in heat pumps/air conditioning) and lighting), in 2022 reaching 50% of final energy consumption. As in households, the amount of fuel/heat used is relatively stable, but there is no reporting of bioenergy. There is a clear decreasing trend in coal use, which is compensated by increasing levels of natural gas, but also distributed heat, solar thermal and geothermal energy.

About 22% of final energy consumption in commercial and public services is from renewable sources, predominantly the renewable share of electricity (15%), followed by geothermal heat (5%) and solar thermal heat (2.7%).

RESEARCH FOCUS RELATED TO BIOENERGY

In terms of technical progress, from research to production practice, more attention has been paid to the development of flexible processing methods for various raw materials, construction of new product structures, and adoption of technical approaches to reduce process energy consumption, explore potential for net energy increase, as well as cost reduction. New approaches of cellulosic ethanol technology have been explored.

Carbon one industry flux gas generated from fossil fuels, various industrial and domestic waste, as well as lignocellulosic biomass provides an innovative raw material to lead the sustainable development. Approaches through the chemical and biological processing to convert the carbon one gas into biofuels and high-value chemicals has attached great importance. New approaches of biomass and waste gasification have also been explored.

RECENT MAJOR BIOENERGY DEVELOPMENTS

The Chinese Academy of Agricultural Sciences (CAAS) and Beijing Shoulang Biotechnology Co., Ltd. jointly made breakthroughs in the core technology of clostridium ethanol protein, greatly improved the reaction speed (22 seconds synthesis) and created the world record of the highest protein yield of 85% in one-step biosynthesis under industrial conditions. October 30, 2021

The initial installation of industrial bio-aviation coal equipment at China Petrochemical's Zhenhai Refining and Chemical Plant marked a significant milestone in the large-scale production of bio-aviation coal in China. This development represents a critical advancement towards widescale production and commercial viability of bio-aviation coal. In comparison to traditional petroleum-based aviation kerosene, bio-aviation coal offers the potential to reduce CO_2 emissions by more than 50% throughout its lifecycle. The equipment's processing capacity is tailored for 100,000 tons annually, sufficient to handle the recycling of gutter oil from a city housing ten million residents. This process could potentially lead to an annual reduction of approximately 80,000 tons of CO_2 emissions, which is comparable to the emissions generated by nearly 50,000 economy cars in a year. June 28, 2022

The National Development and Reform Commission and the Civil Aviation Administration of China held a pilot launch ceremony for the application of sustainable aviation fuel (hereinafter referred to as "SAF") in Beijing, aiming to implement the decision-making and deployment of the Party Central Committee and The State Council with practical actions, comprehensively promote the development of sustainable aviation fuel in China, and better promote the green and low-carbon development of the civil aviation industry. According to the pilot work arrangement, starting from September 19, 12 flights of Air China, China Eastern Airlines and China Southern Airlines taking off from Beijing Daxing, Chengdu Shuangliu, Zhengzhou Xinzheng and Ningbo Lishe airports will be officially filled with SAF. September 18,2024

LINKS TO SOURCES OF INFORMATION

An overview of the biomass energy policy in China - BE Sustainable Magazine (2015) http://www.besustainablemagazine.com/cms2/overview-of-biomass-energy-policy-in-china/

Global CO2 emissions and China's challenges (2021) http://english.scio.gov.cn/in-depth/2021-05/08/content_77475496.htm

b145a6631698460e8777d1ab4581ef1f.pdf (www.gov.cn)

Catalogue of Industries Encouraging Foreign Investment (2020 version - in Chinese): http://www.gov.cn/zhengce/zhengceku/2020-12/28/5574265/files/b145a6631698460e8777d1ab4581ef1f.pdf

Wei Liu, Congmin Liu, Parikshit Gogoi, Yulin Deng. Overview of Biomass Conversion to Electricity and Hydrogen and Recent Developments in Low-Temperature Electrochemical Approaches [J].Engineering, 2020,6(12):1351-1363. https://www.sciencedirect.com/science/article/pii/S2095809920303039

Bo Wu, et al. Current status and future prospective of bio-ethanol industry in China. Renewable and Sustainable Energy Reviews, Volume 145, July 2021, 111079 https://www.sciencedirect.com/science/article/abs/pii/S1364032121003671

China maps 2021-2035 plan on hydrogen energy development: https://en.ndrc.gov.cn/news/pressreleases/202203/t20220329_1321487.html

The Implementation Plan for Accelerating the Establishment of a Unified and Standardized Carbon Emission Statistical Accounting (2022- in Chinese): https://www.gov.cn/zhengce/zhengceku/2022-08/19/5706074/files/a924a706a96645f1a4eee8981e7da686.pdfWei Su. The biomass power generation industry awaits further efforts (in Chinese). Chinese Electric Power News, 2023-05-18(003). DOI:10.28061/n.cnki.ncdlb.2023.000581.

2021 Biomass Power Generation Project Construction Work Plan (2021, in Chinese) https://www.gov.cn/zhengce/zhengceku/202108/19/5632087/files/c29ac0ef2a8349a096f3f8811caeac1d.pdf

Opinions on Improving the Mechanisms and Policy Measures for Energy Green and Low-carbon Transition (2022, in Chinese) https://www.gov.cn/zhengce/zhengceku/2022-02/11/content_5673015.htm

Notice from the National Energy Administration regarding the effective implementation of renewable energy heating in accordance with local conditions (2021, in Chinese) https://www.gov.cn/zhengce/zhengceku/2021-02/13/content_5586982.htm

Notice from the General Office of the National Energy Administration Regarding the Establishment of the Monthly Work Information System for Promoting the Production and Use of Biofuel Ethanol and the Expansion of Ethanol Gasoline for Vehicles (2019, in Chinese) https://www.gov.cn/zhengce/zhengceku/2019-09/29/content_5434965.htm

The 14th Five-Year-Plan for Renewable Energy development (2022, in Chinese) https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202206/P020220602315308557623.pdf

Xinhuanet, 2022. China's first large-scale pilot production of bio-aviation coal in chemical industry. Retrieved from: http://www.nea.gov.cn/2022-07/01/c_1310636709.htm

https://english.www.gov.cn/news/202409/19/content_WS66ec1223c6d0868f4e8eb175.html