China Council for International Cooperation on
Environment and Development (CCICED)

Secure and Green Trade: Five Recommendations for Improving the Security and Sustainability of Selected Soft and Hard Commodities Critical to Chinese Trade

CCICED Special Policy Study Report

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EXECUTIVE SUMMARY

A number of recent external developments at the intersection of trade, supply chains, and sustainability will impact China. For instance, new international trade policies are putting a price on carbon and tackling deforestation. New international agreements are requiring signatories (including China) to improve the sustainability of its economic (including trade) activities. Accelerating corporate trends are signaling that companies and financial institutions will increasingly focus on reducing greenhouse gas emissions from their global supply chains. Finally, trends indicate that domestic Chinese consumers are increasingly desiring products (whether domestically sourced or imported) to be sustainably produced.

These developments will particularly impact Chinese trade in a handful of commodities, most notably soybeans, beef, palm oil, and industrial goods (e.g., electrical equipment, machinery, textile products). For China to successfully respond in a manner that meets China's aspirations for trade security and carbon neutrality, we propose five policy recommendations:

A. China could integrate sustainability or "green" criteria into all its global supply chain arrangements. A good start would be the signing of a green value chain partnership among China and ASEAN countries (scheduled for September/October 2023 at the China-ASEAN Environment Collaboration Forum).

B. China could negotiate and sign a trade agreement with Brazil to secure long-term supplies of legal and sustainable soy and beef. To give such a landmark trade agreement the profile it deserves, China and Brazil could jointly announce the agreement at either the G20 Ministerial Meeting on Agriculture to be held in mid-2024 in Brazil (where sustainable agriculture will be a focus topic) or at the 30th Conference of the Parties to the UNFCCC to be held in late-2025 in Belem, Brazil. The trade agreement would be a natural evolution of the historic meeting in Beijing between Chinese President Xi Jinping and Brazilian President Lula in mid-April 2023.

C. China could negotiate and sign a trade agreement with Indonesia and Malaysia to secure long-term supplies of legal and sustainable palm oil. The trade agreement would build upon recent progress by China with both nations. For instance, in November 2022, Chinese Vice Minister and China International Trade Representative from the Ministry of Commerce (MOFCOM) called for green trade of palm oil at the China-Indonesia Agricultural Trade Promotion Event. In April 2023, the China Chamber of Commerce of Import and Export of Foodstuffs, Native Produce and Animal By-Products signed a Memorandum of Understanding (MOU) with the Malaysian Palm Oil Board regarding increasing the stability and sustainability of palm oil supply chains.

D. China could leverage the power of both market and policies to drive the low-carbon transformation of trade patterns of industries. With the help of market mechanism, the booming coal price will lead to a lower export carbon emission in China. Raising the price of energy from fossil fuel sources will eliminate industries with heavy pollution and lower the carbon emission in export by market mechanism. The market is an important force to lower carbon emission, while government should also take actions actively thorough a "destruction" comes after "construction" way.

E. China could develop incentives for green products in the regional trade agreements. China could consider cutting the import tariff on green products and further advocate green tariff cuts in the World Trade Organization and other regional trade agreements, such as RCEP and CPTPP.

1 CONTEXT

A suite of Chinese government aspirations and external developments will impact the degree to which China can achieve trade and supply chain security in a manner that is also long-term sustainable.

1.1 CHINESE GOVERNMENT ASPIRATIONS

Three Chinese government aspirations or ambitions are particularly relevant for the nexus of trade, supply chains, and sustainability.

Aspiration 1: Achieve carbon peaking before 2030 and carbon neutrality before 2060

In 2020, the Chinese government announced an aspiration to peak national carbon emissions before 2030 and achieve carbon neutrality before 2060 (United Nations, 2020). In this context, "carbon" means carbon dioxide equivalent (CO2e), which encompasses all greenhouse gases (GHGs). These climate aspirations cover all major sectors of the economy, including energy generation, transportation, food systems, land use, and more. In addition, there are signs that China is beginning to consider the climate footprint of trade (Xi, 2022). The "14th Five-Year Plan for High-Quality Development of Foreign Trade" calls for establishing green and low-carbon trade standards and certification systems and calls for exploring the development of a life-cycle carbon footprint tracking system for traded products. The Ministry of Ecology and Environment also is studying the development of green trade policies (Yicai, 2023).

Aspiration 2: Achieve food and energy security and resiliency

Food security and resiliency is critical to China's national security. In 2020, President Xi Jinping stated that "food security is an important foundation for national security" (Xinhuanet, 2020) and that every actor should take responsibility for securing food supplies (People's Daily, 2021). Moreover, China's new "dual circulation strategy" encourages China to reduce its international supply chain uncertainties (CCICED, 2021). Together, these are calls for an appropriate combination of self-sufficiency and open trade.

Likewise, energy security is critical to China's national security. China's 14th Five-Year Plan for Modern Energy System prioritized the establishment of a modern energy system that addresses both sustainability and supply security issues. It requires the promotion of green and low-carbon energy transformation through strengthening clean energy industry, implementing renewable energy substitution actions, promoting the construction of a new power system, and gradually increasing the proportion of new sources of energy (NEA, 2022). The Report to the 20th National Congress of the Communist Party of China (hereafter "CPC report") reinforces the importance of ensuring energy security while gradually achieving the carbon peaking and neutrality targets. Based on China's energy and resource endowment, China seeks to advance initiatives to reach peak carbon emissions in a well-planned way, including better control over the amount and intensity of energy consumption—particularly of fossil fuels—and a transition toward controlling both the amount and intensity of carbon emissions.

Aspiration 3: Transform from manufacturing country to a manufacturing power

China's industrial green upgrading refers to the transformation and upgrading of traditional industries into green and sustainable industries. This concept is in line with the new development concept proposed at the 20th National Congress of the Communist Party of China, which emphasizes the need to promote coordinated

economic, social, and environmental development. This development blueprint for high-tech industries is a key part of China's industrial green upgrading. The Chinese government has identified high-tech sectors—such as new energy, biotechnology, and information technology—as priority areas for development. These industries have the potential to reduce environmental pollution and improve resource utilization, which are essential for achieving sustainable development. The Chinese government has implemented various policies and initiatives as well as increasing investment for R&D and tax incentives for these sectors.

China's industrial green upgrading also involves the optimization of traditional industries. The government has implemented measures to improve energy efficiency, reduce emissions, and promote the use of renewable energy in traditional industries such as steel, cement, and petrochemicals. To ensure the success of industrial green upgrading, China has also strengthened environmental regulations and enforcement. The government has implemented strict pollution controls and imposed penalties on violators. It also has encouraged the adoption of cleaner production methods and promoted circular economy practices.

1.2 EXTERNAL DEVELOPMENTS

A number of recent external developments will impact the nexus of trade, supply chains, and sustainability, as well. For instance, new international trade policies are putting a price on carbon and tackling deforestation. New international agreements are requiring signatories (including China) to improve the sustainability (including avoided deforestation) of its economic (including trade) activities. Accelerating corporate trends are signaling that companies and financial institutions will increasingly focus on reducing greenhouse gas emissions from their global supply chains. Finally, consumer trends indicate that domestic Chinese consumers are increasingly desiring products (whether domestically sourced or imported) to be sustainably produced.

International trade policies

• EU CBAM: The Carbon Border Adjustment Mechanism (CBAM) is a policy proposed by the European Union (EU) that would impose a carbon border tax on certain imports from countries that do not have equivalent carbon pricing policies. The aim of the tax is to level the playing field between domestic producers and foreign producers who are not subject to the same carbon costs. The CBAM would cover a range of goods, including steel, cement, aluminum, fertilizers, and electricity.

CBAM means challenges as well as opportunities for China. As the world's largest exporter, the CBAM could result in higher costs for Chinese exporters and consequently lower competitiveness in the European market, if China does not take significant action to reduce its carbon emissions. Meanwhile, the policy also presents opportunities for China to accelerate its transition to a low-carbon economy and promote its green industries. The policy could encourage China to invest more in renewable energy and other green technologies, which would create new opportunities for the green transformation of supply chains.

• EU Deforestation Regulation: The EU Regulation on Deforestation-free products (EUDR) prohibits the placing on the EU market covered commodities (soy, cattle, palm oil, coffee, cocoa, rubber and wood) and certain derivatives (such as chocolate and beef) that were produced on land deforested or degraded after December 31, 2020. Covered commodities and products also must be produced in accordance with local laws. The EUDR requires that companies, domestic and international, placing these products on the EU market conduct due diligence to assess the risk associated with these products and submit a due diligence declaration stating that no or negligible risk was found—including the provision of geographic coordinates or a polygon

of the area of production. The European Parliament voted to pass the regulation in April 2023, and a final vote in the European Council is expected shortly. Companies are required to comply with the regulation starting 18 months after the regulation enters into force. Small and medium-sized enterprises have 24 months after entry into force before they need to comply.

While the regulation applies to companies not countries, those countries that produce or process covered commodities that are placed on the EU market will likely receive increasing requests for clarification of local laws governing production and processing, as well as requests for information about where products processed in China were sourced from in order to comply with the geolocation requirement. Other markets—such as the United Kingdom, Norway, and the United States—are developing or considering similar demand-side measures, pointing to a likely shift in market norms towards traceability and due diligence requirements in global commodity supply chains.

• Regional trade deals: The regional trade deals, such as the Regional Comprehensive Economic Partnership (RCEP) and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) have significant impact on China.

The RCEP agreement involves 15 countries in the Asia-Pacific region, accounting for around 30% of the world's population and GDP. As a founding member, China will benefit from reduced tariffs, increased market access, and improved trade and investment flows within the region. However, China also will face intensified competition from other member countries, particularly in areas where it has traditionally been strong, such as manufacturing.

The CPTPP agreement, which includes 11 countries across the Asia-Pacific, is a high-standard free trade agreement that covers a wide range of sectors, including goods, services, and intellectual property. China is not a member of the CPTPP but has expressed interest in joining. Joining the agreement would require China to meet the high standards of the agreement. For example, the CPTPP's environment chapter requires its parties to take practical measures to promote the effective enforcement of their environmental laws, to commit to high standards of transparency and to consultation with respect to the laws. These items could entail costly economic reforms and restructuring, but may also bring opportunities, just as the following diagram about the trade structure changes relevant to the EU-Canada CETA agreement in 2017.

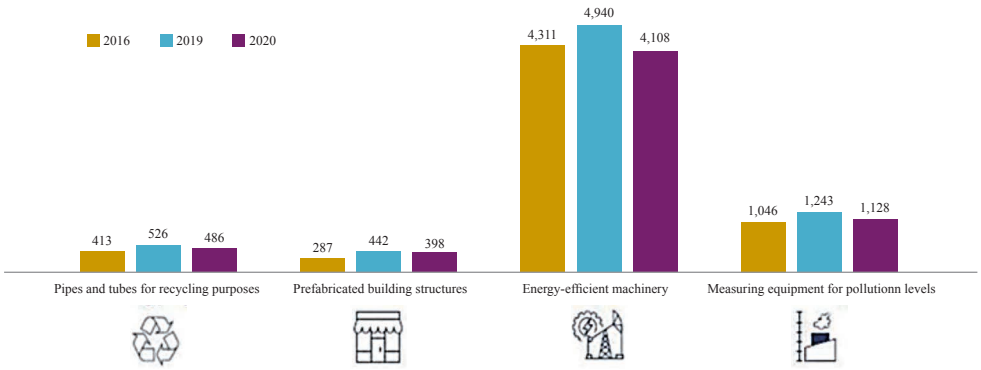

Figure 1: Canada-EU Trade in Environmental Goods, in €million

Source: Eurostat, Statistics Canada

Furthermore, the RCEP and CPTPP agreements are seen as a response to China's growing economic influence and its Belt and Road Initiative. These agreements provide other countries in the region with an alternative option for economic integration, which could reduce China's regional dominance.

While the RCEP and CPTPP agreements present opportunities for China to expand its economic influence and deepen its economic ties with other countries in the region, they also pose challenges in terms of the need for economic reforms and the need for conforming with related environment standards and requirements. Additionally, these agreements represent a potential shift in the balance of power in the region, which could have implications for China's regional and global influence.

• Glasgow Declaration on Forests and Land: The Glasgow Leaders Declaration on Forests and Land Use represents a commitment by country leaders to collectively halt and reverse forest loss and land degradation by 2030 while promoting sustainable development and an inclusive rural transformation. The Declaration was launched at the November 2021 United Nations Climate Change Conference (COP26) and was signed by 141 countries, including China. As part of this commitment, countries agreed to facilitate trade and development policies—internationally and domestically—that promote sustainable development, sustainable commodity production, and sustainable commodity consumption that work to the mutual benefit of signatories and that do not drive deforestation and land degradation.

• Kunming-Montreal Global Biodiversity Framework (GBF): The GBF is a new global agreement designed to safeguard the world's biodiversity (CBD, 2022). It was signed by 196 countries (Vandvik, 2023), including China, in December of 2022 at the Conference of Parties to the Convention on Biological Diversity. GBF goals are to halt biodiversity loss, sustainably use biodiversity, equitably share biodiversity's benefits, and adequately implement financial resources and technology. The GBF includes a number of targets, including (a) protection of 30% of the world's land, ocean, and freshwater ecosystems by 2030, (b) restoration of 30% of the world's degraded ecosystems, (c) and cessation of unsustainable use and trade of wild species, and (d) policy measures to have companies monitor, assess, and transparently disclose their risks, dependencies, and impacts on biodiversity. Underpinning all of this, GBF calls for sustainable production systems and legal trade practices that are aligned with biodiversity conservation goals in order to prevent further degradation and biodiversity loss in exporter countries. Given the amount of imports into China from countries with high levels of biodiversity, the GBF will have implications for Chinese international trade.

Corporate trends

• SBTi: The Science Based Targets Initiative (SBTi) is a partnership between CDP, the United Nations Global Compact, WRI, and WWF. This initiative provides a framework for companies to set science-based targets to reduce their greenhouse gas emissions, and also provides support and technical assistance to those companies. The goal of the SBTi is to limit global warming to 1.5°C, and targets set through SBTi must align scientifically with this goal. As of May 2023, nearly 2,500 companies representing one-third of the world's market capitalization have set science-based targets through SBTi (SBTi, 2023a).

Science-based targets validated by the SBTi must include all Scope 1 emissions (from assets owned by the company) and Scope 2 emissions (from purchased electricity) as defined by the Greenhouse Gas Protocol. If a company's Scope 3 emissions (those from its supply chains) comprise 40% or more of its total emissions, then those emissions also must be included in targets (SBTi, 2023b). This attention to scope 3 emissions means that these companies will increasingly focus on reducing greenhouse gas emissions from their global supply chains, which will include the agricultural products, manufactured goods, and other raw material they purchase (including those processed in and re-exported from China).

• ESG investing: ESG investing, sometimes referred to as "sustainable investing" or "responsible investing", describes investing that incorporates environmental, social, and governance-related issues (OECD, 2020). ESG investing balances traditional investing (focused solely on immediate financial returns) with ESG

considerations to form a longer-term perspective, considering both a company's financial performance as well as its societal impacts.

The PRI (Principles for Responsible Investment) is a UN-supported organization that represents the largest coalition of organizations committed to ESG investing and also supports signatories in their efforts to engage in responsible investing. As of year-end 2022, the PRI had 5,319 global signatories, representing $121 trillion in assets under management (PRI, 2023). As more and more investors adopt ESG investment principles, the sustainability of the raw materials and products companies trade domestically and internationally (including those processed in and re-exported from China) will come under increasing scrutiny. A case in point is financial commitment to deforestation-free soft commodities. As of November 2022, more than 30 financial institutions with combined assets under management of more than US$ 8.7 trillion have already signed up to the commitment to use best efforts to eliminate agricultural commodity-driven deforestation (for palm oil, soy, beef, pulp & paper) from their investment and lending portfolios by 2025 and publish credible progress—a critical step toward reversing deforestation globally and aligning the sector with a Paris Agreement-compliant 1.5°C pathway (UNFCCC, 2022).

Consumer trends

As outlined in a recent SPS on greening soft commodity value chains (CCICED, 2020), "tomorrow's markets" are increasingly demanding more sustainable food consumption and production. This trend is not relegated solely to European and North American consumers; domestic Chinese consumers are moving in this direction, too. With the rapid rise of the concept of green development and green lifestyles, more and more Chinese consumers regard choosing green products as a sign of high-quality life. According to a survey in 2022, 74% of consumers interviewed prioritize green and environmentally friendly products or brands in their daily lives. Green products are more in line with the pursuit of safety, health, and environmental friendliness in life. According to the survey, 69% of consumers expressed that they accept green products at higher prices than regular products, 79% of consumers will incorporate their moral values into their daily shopping, and 82% of consumers express willingness to purchase sustainable branded products (SynTao, 2022). Particularly with regard to food, according to a survey conducted in 2021, more than 90% of consumers are willing to pay a premium for low-carbon food, and more than half of consumers are willing to pay a premium of more than 10% (Xinhuanet et. al. 2022).

2 POSSIBLE IMPLICATIONS FOR SEVERAL SOFT COMMODITIES IMPORTANT TO CHINESE TRADE

The confluence of these Chinese government aspirations and recent external developments will likely have a number of implications for several key soft commodities that are important for Chinese trade. “Soft commodities” are raw materials and their derivatives that are grown or produced by the agriculture and forestry industries. These include plant- and animal-derived material for use as food, fiber, feed, medicines, cosmetics, detergents and fuels (CCICED, 2020). In this study, we focus on three such commodities for which China is a major global importer: soybeans, beef, and palm oil.

2.1 SOYBEANS

Soybeans are vitally important to the Chinese economy. As the largest processor of soybeans in the world, China processes more than 80% of the soybeans it produces and imports into oil and meal for animal feed (Figure 2). Around 15% of China’s soy consumption is for direct human food (e.g., tofu, soymilk, soy sauce) and derivative human food products (e.g., soy protein for sausage) (USDA, 2022).

China is a major player in the global soybean trade. China is the world’s largest soybeans importer (FAOSTAT and USDA, 2023), accounting for 60% of global soybean trade (Figure 3). These imports met 86% of Chinese consumption needs in 2021 (FAOSTAT, 2022). China’s imports have steadily grown since 1996, mainly to meet the need of its domestic livestock industries (Figure 4) and are expected to continue growing through 2030.

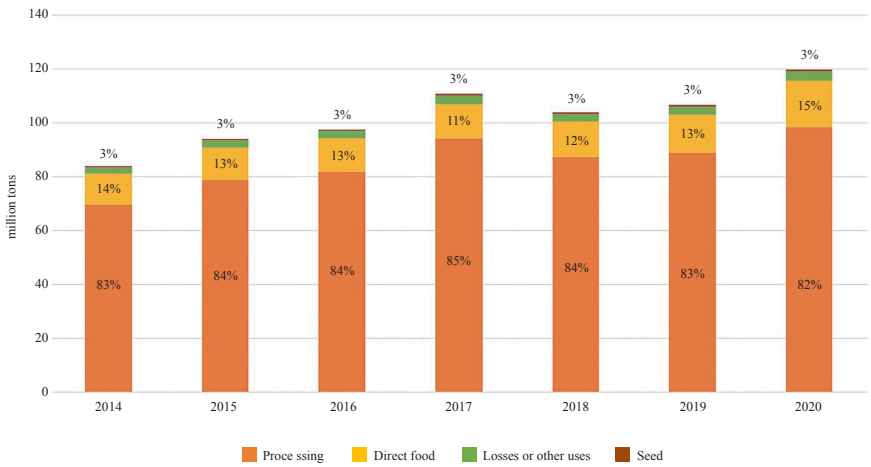

Figure 2: China’s soybeans consumption between 2014-2020 (million tons)

Note: Numbers may not add to 100 due to rounding

Source: China Zhiyan Consulting Group. 2021. In 2020, China's Soybean Market Will Exceed 350 billion RMB, of which Pressing Consumption Accounts for 82%.

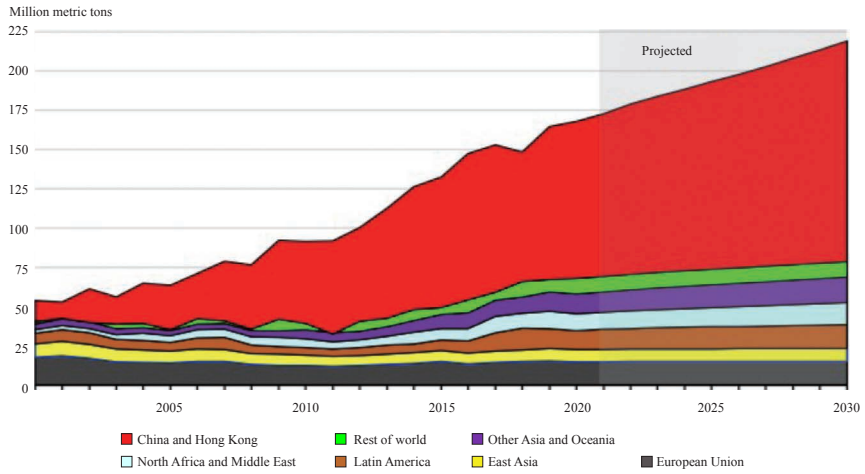

Figure 3: Global soybeans importers

Source: USDA. 2021. USDA Agricultural Projections to 2030.

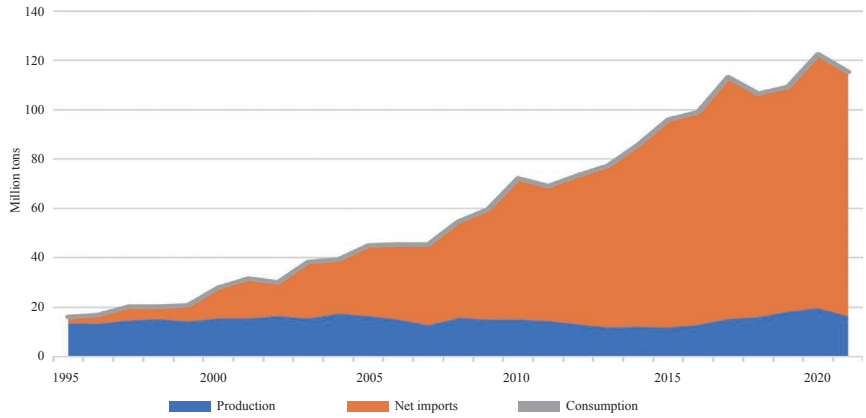

Figure 4: China's gradually growing imports of soybeans

Source: FAOSTAT. 2021. Production and Trade Balance.

China imports soybeans mainly from Brazil, the United States, and Argentina, which combined consist of around 95% of China's total soybean imports. In 2020, China brought in 64 million tons (accounting for 62% of China's total soy import) from Brazil, 26 million tons (accounting for 25% of China's total soy import) from the United States and 8 million tons (accounting for 7% of China's total soy import) from Argentina (Feng, 2022). Soy expansion is a large driver of conversion of forests and grasslands (Song et al., 2021). There are two types of impacts: "direct impacts" when forests and savannas are immediately converted to soy production and "delayed impacts" when forests are first cleared for other lower-economic-value land uses (mostly cattle grazing) and then later those pastures are converted into soybean fields (Schneider et al., 2021). From 2001-2015, soy directly converted 4 million hectares of forest and had a delayed impact on another 4 million hectares, mainly in the South American countries Brazil and Argentina (Weisse and Goldman, 2021). In 2019, one third of South American soybean planted area was located in the Cerrado (FAOSTAT and USDA, 2023), the most biodiverse savanna ecosystem in the world. In 2020, 264,000 hectares of soy was harvested from land deforested within the past five years In the Cerrado (SEI, 2022). Soy-driven deforestation has large greenhouse gas consequences. In 2020, Brazilian soybean-driven deforestation and conversion resulted in 28 million tonnes of CO2e from native vegetation (11% of the country's annual land use change emissions)

(USDA, 2021). Therefore, reducing the deforestation and savanna conversion associated with soy production will be an important component of China's efforts to align its soy sourcing and trade with its goals of carbon neutrality and meeting global agreements on biodiversity conservation and climate.

2.2 BEEF

China is the world's largest beef importer. From 2010-2020, beef imports to China grew 110% to 3.4 million tons per year (Figure 5), accounting for 33 percent of the world's total exported beef (FAOSTAT, 2023). China's import of beef is projected to continue to grow for the rest of this decade (Figure 6).

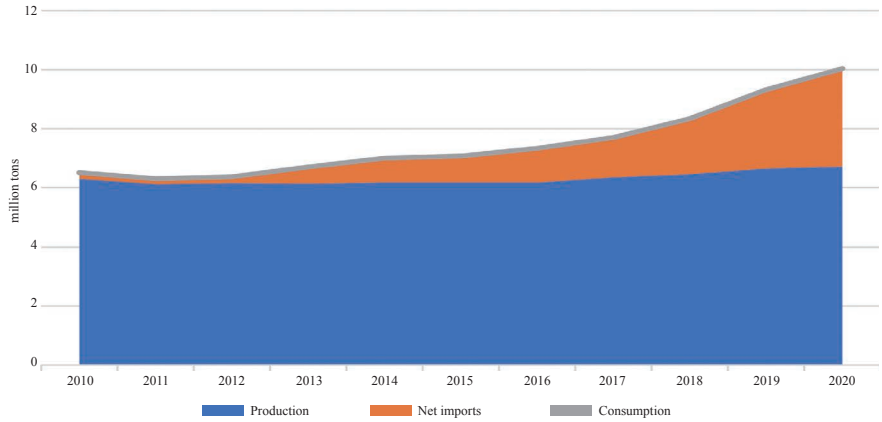

Figure 5: China's beef production and imports

Source: FAOSTAT. 2023. Food Balances.

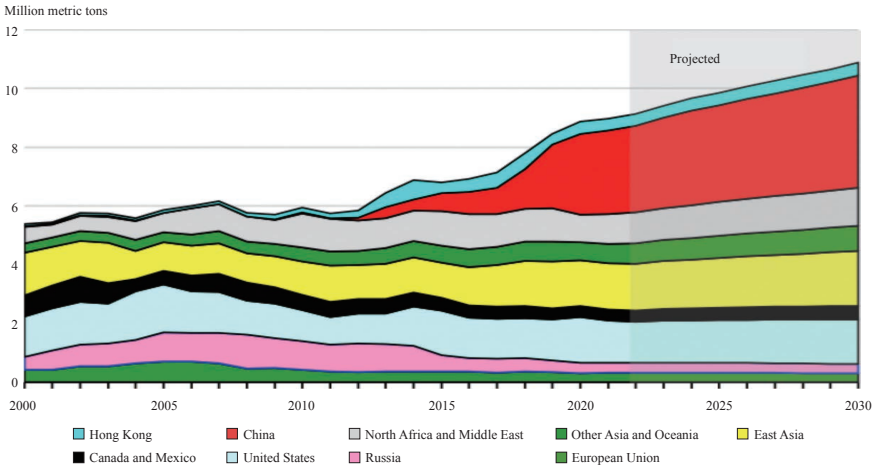

Figure 6: Global beef importers (2000-2030)

Source: USDA. 2021. USDA Agricultural Projections to 2030.

From 2016 to 2021, the annual growth rate of beef consumption in China was 7.5 percent (CAAA, 2023). In 2022, China's beef consumption reached 1.1 million tons, ranking second among nations in global beef consumption (CAAA, 2023). From 2011 – 2021, per capita beef consumption of China grew from 4.53 kg/capita/year to 6.95 kg/capita/year, a growth of about 50% (Figure 7) (CAAA, 2023). This growth could be attributed to the dietary transition in China driven by growth in GDP per capita.

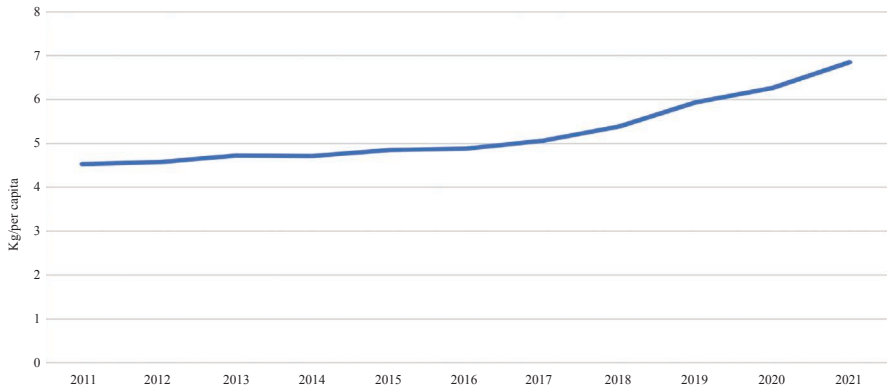

Figure 7: Per capita beef consumption in China (2011-2021)

Source: CAAA. 2023. Review of China's Beef Industry Development in 2022 and Outlook for 2023.

The largest source of imported beef into China is Brazil, accounting for more than 40 percent of imports by weight. Next in line are Argentina (15 percent) and Uruguay (10 percent). Brazil's exports to China were valued at 7.5 billion in 2022 (China Custom, 2023). Cattle ranching for beef, however, is by far the largest direct driver of deforestation in the Brazilian Amazon (Searchinger et al., 2019), and the Brazilian Amazon is the area of the planet experiencing the largest levels of deforestation per year (GFW, 2023). Tropical deforestation in the Amazon releases significant amounts of greenhouse gas emissions and severely threatens biodiversity.

2.3 PALM OIL

Palm oil is a versatile and important commodity to China, with 80% of its domestic consumption used for food and 20% used for industrial purposes (Oilcn, 2019). Palm oil is particularly popular in the food industry—accounting for 17% of China's vegetable oil consumption—due to its high saturated fat content which makes it resistant to high cooking temperatures and makes it stable. It is essential for a wide range of food products such as instant noodles, traditional snacks, fast food, ready-made products, industrial bakery, candy, chocolate, and edible oils. Additionally, palm oil is utilized for industrial oleochemicals such as soap, candles, make-up, and lubricants.

Since China does not produce palm oil, imports make up 98% of the country's total consumption (FAOSTAT, 2021). China has become the third largest consumer and the second largest importer of palm oil in the world (Jiang, 2020), with its imports accounting for 14% of global palm oil imports in 2020 (FAOSTAT, 2021). China's imports grew rapidly through 2009, followed by a decline by 2016 and a subsequent resurgence in growth (Figure 8). Indonesia and Malaysia supplied 71% and 27%, respectively, of China's imported palm oil in 2019 (CRR, 2021). And, in fact, 17% of Indonesia's exports in 2021 were to meet Chinese consumption demand (Statista, 2023).

Oil palm cultivation in Southeast Asia is the dominant factor in deforestation and peat conversion in the region, with the associated greenhouse gas emissions and loss of biodiversity habitat in one of the most biodiverse regions of the planet. The carbon and biodiversity consequences associated with clearing tropical forests are significant. For Indonesia, one third (3 million hectares) of its primary forest loss in the past 20 years is due to oil palm expansion (SEI, 2022). Therefore, to achieve its carbon neutrality and biodiversity goals, China will need to address the carbon emissions and biodiversity losses embedded in its palm oil supply

chain. This requires avoiding conversion of natural tropical forests and peatlands, while enhancing oil palm productivity (yield per hectare) on existing plantations. Otherwise, the long-term security of Chinese palm oil supply may be at risk. Fortunately, Indonesia has reduced deforestation associated with palm oil between 2018-2020 to only 18% of the level in 2008-2012, despite continued increase in palm oil production. This proves the possibility to balance the demand for palm oil products with conservation of tropical ecosystems (SEI, 2022).

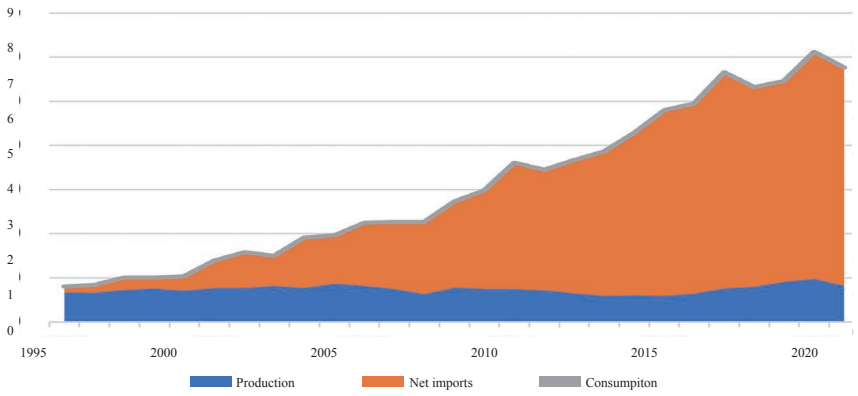

Figure 8: China's consumption and imports of palm oil

Source: FAOSTAT. 2021. Production and Trade Balance.

2.4 IMPETUS FOR "DEFORESTATION- AND CONVERSION-FREE" SOY, BEEF, AND PALM OIL

• *EU Regulation on deforestation-free products:* The new regulation requires due diligence from Chinese companies to ensure that the products (processed in China) including soy, beef, or palm oil placed on the EU market are not linked to post-2020 deforestation, as well as not violating local laws on production and processing. Failure to meet these standards could result market access restrictions, limiting the ability to sell products to markets within the EU and in other regions.

• *Kunming-Montreal Global Biodiversity Framework:* The GBF calls for sustainable production and trade aligned with biodiversity conservation and the prevention of degradation and biodiversity loss in exporter countries. Since China was a co-host country of the GBF (which was adopted by nearly all countries in the world), global expectations are that China will fulfill GBF goals in its domestic activities and international trade.

• *Glasgow Declaration on Forests and Land:* The Declaration includes a commitment among signatories to "facilitate trade and development policies, internationally and domestically, that promote sustainable development, and sustainable commodity production and consumption, that work to countries' mutual benefit, and that do not drive deforestation and land degradation". China is a signatory to this Declaration, and the country has already publicly committed to avoiding trade deals for soy (and other products) that drive deforestation or conversion of other natural ecosystems (WEF, 2022).

• *SBTi:* The Science Based Targets for Forest, Land, and Agriculture (FLAG) will help Chinese companies set reduction targets for Scope 3 GHG emissions in line with Paris Agreement (SBTi, 2022). 332 Chinese companies have committed to climate action through SBTi, and 20 companies among them are in the food and forest sectors or are restaurant chains and agriculture-related trading companies (SBTi, 2023a). For

example, the big fast-food restaurant company Yum China, which owns the exclusive operation and authorized operation rights of KFC, Pizza Hut, and Taco Bell, has recently signed to commit to the SBTi in 2021 (Yum China, 2021). Yum China has pledged to decrease its Scope 3 GHG emissions from purchased goods by 66.3% per ton of goods purchased by 2035 relative to 2020 (Yum China, 2022). There are other schemes to advance sustainable sourcing. For example, for SAI accredits certification bodies to audit production facilities, companies that do a substantial amount of sourcing from contracted suppliers can join the Signatory Member programme, which requires that the company issue a plan for moving company-owned and supplier facilities to SA8000 certification over time, and report publicly on progress (FAO, 2003).

3 POSSIBLE IMPLICATIONS FOR CHINESE INDUSTRY SUPPLY CHAINS

We have already discussed the overall impact of the CBAM in the section 1. By imposing additional carbon tariffs on foreign products with higher emission but lower levels of environmental regulations, CBAM resolved the environmental externalities of international trade to some extent, ensured fair competition between domestic and foreign suppliers and facilitated global low-carbon development.

However, given the different levels of development and situations of different countries, there are quite large differences in carbon market prices and measurement standards among countries. The implementation of the CBAM remains a big challenge and needs to overcome several obstacles. Based on this, this section introduces another way of reducing carbon emissions from exports, which is to emphasize the role of the market and raise the price of traditional fossil energy, to reduce China's carbon emissions.

Therefore, we define and pursue the carbon emissions of the value added of export commodities in China, and further study the correlation between China's export carbon emissions and energy price to make further policy implications.

3.1 DEFINITION

Firstly, it is important to establish a clear definition of "carbon emissions of the value added of export commodities". This measure calculates the amount of carbon emissions generated during the production of the total value added of an exported commodity. Total value added refers to the difference between the market value of a product or service and the sum value of its inputs.

We take iPhone X as an example to further illustrate total value added of a commodity. The lens may be made in Japan, the screen in South Korea, the audio processors in the US, the chips in Chinese Taipei, the buttons in Chinese Mainland, and the assembly process in Chinese Mainland. The Chinese value added in the export of an iPhone X is the value of the parts made and assembled in China. If the total value of the iPhone X exported from China is $409, and only $104 is attributed to Chinese value added, then the carbon emissions of value added for this iPhone X would only include the carbon emissions generated during the production of the $104 worth of Chinese value added.

3.2 STYLIZED FACTS OF CHINA'S EXPORT CARBON EMISSIONS AND CARBON INTENSITY

Once this definition is established, we can calculate the carbon emissions of value added for different export industries using the world input-output table and energy consumption formula. For instance, we find that China's carbon emissions of added value in the electric industry's exports, such as the iPhone X, were approximately 4.05 million tons in 2014. In the table below, we present the export carbon emissions for different industries according to the World Input-Output Database (WIOD). These figures illustrate the amount of carbon emissions generated during the production of added value in exported goods in each industry.

Table 1: Export carbon emissions in WIOD industry in 2014

WIOD Industry	Export carbon emission (ten thousand ton)
Manufacture of computer, electronic and optical products	405
Manufacture of electrical equipment	295
Manufacture of textiles, wearing apparel and leather products	247
Manufacture of machinery and equipment n.e.c.	214

Manufacture of basic metals	197
Manufacture of chemicals and chemical products	196
Manufacture of fabricated metal products, except machinery and equipment	146
Manufacture of other non-metallic mineral products	115
Manufacture of furniture; other manufacturing	111
Manufacture of rubber and plastic products	104
Manufacture of other transport equipment	57
Manufacture of motor vehicles, trailers and semi-trailers	57
Manufacture of coke and refined petroleum products	39
Manufacture of food products, beverages and tobacco products	35
Manufacture of paper and paper products	22
Manufacture of wood and of products of wood and cork, except furniture	20
Mining and quarrying	16
Manufacture of basic pharmaceutical products and pharmaceutical preparations	15
Crop and animal production, hunting and related service activities	7
Printing and reproduction of recorded media	3

From Table 1 we can get a clear picture of export carbon emissions. However, we can see that the export carbon emissions are positively related to the total amount of exports and the above table cannot tell us the carbon emission effectiveness in different industries. To make things clearer, we divide the export carbon emissions by the total value added in this industry and get the export carbon emission intensity. The results for the different WIOD industries are shown in the table below.

Table 2: Export carbon emissions intensity in WIOD industry in 2014

WIOD Industry	Export Carbon Emission Intensity (ton/ten thousand dollar)
Manufacture of furniture; other manufacturing	71
Manufacture of basic metals	59
Manufacture of chemicals and chemical products	57
Manufacture of other non-metallic mineral products	45
Printing and reproduction of recorded media	45
Manufacture of coke and refined petroleum products	44
Manufacture of paper and paper products	39
Manufacture of rubber and plastic products	37
Manufacture of fabricated metal products, except machinery and equipment	35
Mining and quarrying	26
Manufacture of electrical equipment	24
Manufacture of other transport equipment	23
Manufacture of machinery and equipment n.e.c.	21
Manufacture of textiles, wearing apparel and leather products	21
Manufacture of wood and of products of wood and cork, except furniture	20
Manufacture of motor vehicles, trailers and semi-trailers	20
Manufacture of computer, electronic and optical products	18
Crop and animal production, hunting and related service activities	15
Manufacture of food products, beverages and tobacco products	13
Manufacture of basic pharmaceutical products and pharmaceutical preparations	13

The table shows that furniture manufacturing has the highest carbon intensity, 71 tonnes per ten thousand

dollars, while hunting and food products have the lowest carbon intensity of all manufacturing industries. The average carbon intensity in heavy industry is obviously higher than that in other manufacturing sectors. Taking the total volume of heavy industries into account, there is a large potential for all these industries to reduce their carbon emissions.

3.3 QUANTITATIVE ANALYSIS OF FACTORS INFLUENCING EXPORT CARBON EMISSION

In this section, we apply the econometrics model and study the impact of fuel prices on export emissions.

According to China's energy structure, coal is one of the most important fuel in China. It is the main source of energy, and also the main source of carbon emission. Therefore, we use the coal prices as the main indicator in this regression. Our regression model is shown as follows.

$$\ln \textit{(Export Carbon Emission)}_{ijt} = \beta_0 + \beta_1 * \ln p_{China,t} + \gamma * X_{ijt} + t + \alpha_i + \varepsilon_{ijt}$$

$$\ln \textit{(Export Carbon Emission)}_{ijt} = \beta_0 + \beta_1 * \ln \text{wind} p_{China,t} + \gamma * X_{ijt} + t + \alpha_i + \varepsilon_{ijt}$$

In this regression, i means country, j means industry and t means year. Ln $\textit{(Export Carbon Emission)}_{ijt}$ measures the log value of export carbon emission in year t country i and industry j. The independent variable is $\ln p_{China,t}$, the log value of coal price in China in year t. X_{ijt} relates to a series of control variables, including the log value of per capital income, the GDP growth rate, and the different ratio of secondary industries. We put all these control variables into the regression to alleviate the confounding problem which may be caused by missing some key variables. Finally, we put t and α_i into the regression to control the time trend as well as all the invariant country characteristics.

Besides, we also replace the independence variable to $\ln \text{wind} p_{China,t}$, the wind price of year t, to test the clean energy's impact on export carbon emissions.

Our main interest is β_1 among all the estimated coefficients. It represents the price elasticity of export carbon emission and shows that one percent change in coal price will result in β_1 percent change for export carbon emission in total. Regression shows that the β_1 equals to -0.129 with statistical significance at 1% level, which means that when the coal price goes up 10%, China's export carbon emissions go down 1.29%, while for clean energy, the according coefficient is positive and statistically insignificant. On the one side, differing from traditional energy prices, clean energy prices are stabilized by government subsidies, and we need a more sophisticated econometric method to estimate the influence of clean energy price. On the other side, the results indicate that compared with subsiding on clean energy, taxing on traditional fossil energy is more efficient on carbon emission reduction in China.

TABLE 3 THE MAIN REGRESSION RESULTS

	(1)	(2)
Dependent variable	ln(EEX)	ln(EEX)
Ln(p)	-0.129***	
	(0.0378)	
Ln(windp)		0.122
		(0.0836)
Control Variables	Yes	Yes
Country FE	Yes	Yes
Observation	29585	21217
Amount of ij pairs	2176	2176
R-squared	0.036	0.015

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Based on these findings, to further analyze the differences across industries, we restrict the sample to China and repeat the above regressions for different industries. Therefore, we can get the price elasticity for specific industries. We put the different industries' estimates together in the following table and we can find some industry results from it.

Table 4: Main estimated coefficient in WIOD industry

WIOD Industry	β_1 Coeff
Manufacture of basic metals	-0.43
Manufacture of machinery and equipment n.e.c.	-0.34
Manufacture of computer, electronic and optical products	-0.30
Manufacture of motor vehicles, trailers and semi-trailers	-0.23
Manufacture of textiles, wearing apparel and leather products	-0.23
Manufacture of other non-metallic mineral products	-0.17
Manufacture of paper and paper products	-0.13
Manufacture of food products, beverages and tobacco products	-0.13
Manufacture of chemicals and chemical products	-0.04
Manufacture of electrical equipment	-0.04
Manufacture of basic pharmaceutical products and pharmaceutical preparations	-0.01
Crop and animal production, hunting and related service activities	0.03
Manufacture of rubber and plastic products	0.03
Manufacture of furniture; other manufacturing	0.04
Manufacture of fabricated metal products, except machinery and equipment	0.05
Printing and reproduction of recorded media	0.06
Mining and quarrying	0.15
Manufacture of other transport equipment	0.24
Manufacture of wood and of products of wood and cork, except furniture	0.39
Manufacture of coke and refined petroleum products	0.52

This sub-regression gives us strong and intuitive interpretations. Firstly, the carbon emissions of exports in manufacturing industries (basic metal, machinery et al) have negative correlation with the coal price. It is very intuitive. All the industries are industry which highly rely on coal. When the coal price goes up, the production costs of these industries go up simultaneously, which drives the entrepreneurs in these industries to use cleaner technology and reduce carbon emission. Secondly, the carbon emissions of exports in mining or substitutes (wood or petrol) have positive correlation with the coal price. When the coal price goes up, more entrepreneurs will try to find other alternatives, driving larger demand in these industries. Therefore, the additional demand will drive more production and increase the total carbon emission in this case.

4 POLICY RECOMMENDATIONS

In light of Chinese government aspirations (section 2.1), emerging external developments (section 2.2), and implications for commodities critical to Chinese trade (sections 3 and 4), we propose several policy recommendations: (A) integrate sustainability (or "green") criteria within global supply chains, (B) secure a sustainable soy and beef trade agreement with Brazil, (C) secure a sustainable palm oil agreement with Indonesia and Malaysia, (D) leverage the power of both the market and public policies to drive the low-carbon transformation of trade patterns of industries , and E) develop incentives for green products in the regional trade agreements. The first applies to Chinese trade overall. The second and third focus on soft commodity trade. The fourth and fifth focus on trade in industrial commodities.

A. Integrate sustainability criteria within global supply chains

China could integrate sustainability or "green" criteria into all its global supply chain arrangements. The 14th Five-Year Plan (FYP) for High Quality Trade Development provides a foundation for this. For instance, the 14th FYP calls for:

• Establishing green and low-carbon trade standards and certification systems;

• Improving green standards, certification, and labeling systems and promoting international cooperation and mutual recognition;

• Promoting the integration of domestic and international green and low-carbon trade rules and mechanisms;

• Exploring the establishment of a carbon footprint tracking system for the whole life cycle of foreign trade products; and

• Conducting green and low-carbon trade cooperation, among other things.

One concrete step for doing this is for China to incorporate collaboration on sustainable trade and supply chains into existing frameworks for regional economic, trade, and environmental collaboration. A good instance of this is the signing of a green value chain partnership among China and ASEAN countries (scheduled for September/October 2023 at the China-ASEAN Environment Collaboration Forum).

B. Secure a Sustainable Soy and Beef Trade Agreement with Brazil

China could negotiate and sign a trade agreement with Brazil to secure long-term supplies of legal and sustainable soy and beef. To give such a landmark trade agreement the profile it deserves, China and Brazil could jointly announce the agreement at either the G20 Ministerial Meeting on Agriculture to be held in mid-2024 in Brazil (where sustainable agriculture will be a focus topic) or at the 30th Conference of the Parties to the UNFCCC to be held in late-2025 in Belem, Brazil. The trade agreement would be a natural evolution of the historic meeting in Beijing between Chinese President Xi Jinping and Brazilian President Lula in mid-April 2023, which resulted in the Brazil-China Joint Statement on Combatting Climate Change that included:

"We commit to broadening, deepening and diversifying our bilateral cooperation on climate issues, in areas such as, transition to a sustainable and low carbon global economy … We intend to engage collaboratively in support of eliminating global illegal logging and deforestation through effectively enforcing

their respective laws on banning illegal imports and exports."

Such a trade agreement is in the national interests of China and of Brazil. It would ensure long-term, stable supplies of soybean and beef (and thus improve Chinese food security) in a manner that is aligned with emerging international trade policies, meets international agreements signed by China (e.g., Glasgow Declaration on Forests and Land, Kunming-Montreal Global Biodiversity Framework), satisfies corporate trends (e.g., SBTi), and meets growing consumer trends [see section 2.2]. Such an agreement would be aligned with the ambitions of Chinese agricultural companies, too. For instance, COFCO's Sustainable Soy Sourcing Policy states, "We expect suppliers to collaborate in increasing our soy supply chain traceability, eliminating deforestation throughout our supply chain and transitioning towards soy production free from native vegetation conversion, so as to protect critical ecosystems such as the Amazon, Cerrado and Gran Chaco".

Such a trade agreement is in the national interests of Brazil, as well. It would help the country eliminate illegal conversion of forests and other natural ecosystems (e.g., President Lula has publicly stated that ending illegal deforestation is one of his top priorities) and bring in much needed finance and know-how for boosting supply of sustainably grown soy and beef. As a result, such a trade agreement aligns with Brazil's national sovereignty, national laws, and national ambitions. Moreover, Brazil is already working to meet similar trade arrangements now being put forth by the European Union (i.e., the EU Deforestation Regulation) and the United Kingdom (i.e., the revised Environment Act), so a China-Brazil trade agreement would not place any additional burdens on Brazil.

Building blocks of a China-Brazil sustainable soy and beef trade agreement could include:

• Standards and certification – The agreement would define what qualifies as "legally" produced and traded soy and beef and, ultimately, what qualifies as natural ecosystem "conversion-free" soy and beef. The agreement could build on the learnings and infrastructure developed for voluntary efforts to create pragmatic regulatory standards or a public sector certification system. Fortuitously, voluntary definitions, standards, and associated certification systems have already been developed (or are in the process of being developed) with industry input. For example, the Consumer Good Forum's Forest Positive Coalition—led by 21 companies with a market value of US$2 trillion—has developed Soy and Beef Roadmaps that lay out commitments and actions the group will implement to remove soy-driven and cattle-driven deforestation and ecosystem conversion from their supply chains. The Soft Commodities Forum, led by the World Business Council for Sustainable Development, is a collaboration of six leading agribusinesses that identifies solutions to eliminate soy-driven deforestation and conversion of native vegetation in the Brazilian Cerrado. Members also have established procurement commitments, including COFCO's requirement that suppliers collaborate to eliminate deforestation and transition towards soy production free from native vegetation conversion. Furthermore, the Roundtable on Responsible Soy offers certification for responsibly produced soy.

• Due diligence and traceability – The agreement would articulate the means of traceability and due diligence. In this context, due diligence is the process of assessing and reducing the risk that soy or beef imports are linked to illegal or unsustainable practices. Traceability is the ability to follow a product from production/harvest all the way to the distribution stage of the supply chain. An array of tools already are available to support due diligence and traceability (Figure 1). When used in combination, due diligence and traceability can verify a commodity's origin, the chain of custody, and compliance with the trade agreement (e.g., legality, sustainability). Voluntary traceability systems are already in place and being used by numerous companies with operations in Brazil (Box 1). Brazilian government-led efforts at the state and national

level can also provide stepping-stones. For instance, the state of Pará successfully implemented the public-private partnership "Green Protocol of Grains" to eliminate illegal deforestation associated with soy, rice, and maize—which covers 96% of production (Planeta Campo, 2022). Brazil also has successfully implemented a national control system for the origin of forest products (SINAFLOR) to provide a federal oversight system over the forest sector across all states (FAO and WRI, 2022).

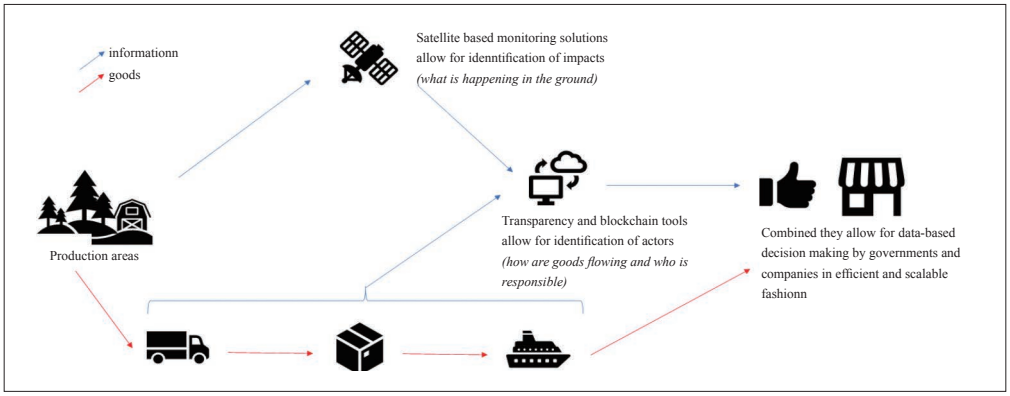

Figure 9: Technologies that enable due diligence and traceability across the value chain

Source: CCICED. 2021. Global Green Value Chains: C'ina's Opportunities, Challenges and Paths in the Current Economic Context.

Box 1. Corporate examples of traceability

Bunge traces 100% of its direct soy purchases to the farm level in the Brazilian regions with higher risk of soy-related deforestation, publishing quarterly traceability reports (Bunge, 2020). It also launched a program to trace 100% of its indirect soy supply to the farm level (Bunge, 2021).

COFCO International plans to be able to fully trace its direct soy supply in Brazil by 2023 (COFCO International, 2021).

JBS and Marfrig, the largest and second largest animal protein producers in the world, have been tracing 100% of their direct beef supply in the Amazon region for nearly a decade. Together they represent more than 50% of all Chinese imports of beef from Brazil (Trase, 2021). Both companies have committed to new systems to trace 100% of their indirect suppliers to the farm level and to zero deforestation in Brazil (Bloomberg, 2020). For them, traceability is important to meet export country food safety requirements, as well.

• "Restore, produce & protect packages" – If Brazil is to increase its supply of soy and beef to China over time without converting forests or other natural ecosystems into agricultural land, then Brazil will need to increase yields on existing croplands and grazing lands. In other words, Brazilian farmers and ranchers will need to simultaneously restore productivity to degraded areas, boost production yields, and protect the nature that remains. Numerous scientific studies demonstrate that this is possible in Brazil (Cohn et al., 2014, Cardoso et al., 2016, Ermgassen et al., 2018), and the country has a track record of productivity improvements. The trade agreement could include provisions for exchange of agricultural know-how, inputs, and financing to support sustainable intensification of Brazilian soy and beef production. Programs that demonstrate the feasibility of doing this already exist (Box 2).

Box 2. Syngenta's Reverté program

Owned by ChemChina, Syngenta is one of the world's largest agriculture input suppliers. Within just two years, its Reverté program has enabled supply of conversion-free soybeans from more than 100,000 hectares in the state of Mato Grosso, Brazil and aims to get 1 million hectares into the program over the coming few years. In the program, farmers agree to restore degraded pasturelands into soy production and avoid converting any more forests or natural grasslands. In return, Syngenta provides the production inputs (e.g., seeds, soil enhancers, fertilizers, technical assistance), Brazilian agricultural extension agency EMBRAPA provides input on agronomic practices, and Brazilian commercial bank Itaú provides commercial-rate long-term loans to participating farmers. Satellite imagery (freely available to all parties) combined with farm location data ensures adherence to each "restore, produce & protect" package. Notably, the Reverté program is a commercial arrangement, not a philanthropic arrangement.

Source: Interview with Syngenta team, 2023.

C. Secure a Sustainable Palm Oil Agreement with Indonesia and Malaysia

China could negotiate and sign a trade agreement with Indonesia and Malaysia to secure long-term supplies of legal and sustainable palm oil. The trade agreement would build upon recent progress by China with both nations. For instance, in November 2022, Chinese Vice Minister and China International Trade Representative from the Ministry of Commerce (MOFCOM) called for green trade of palm oil at the China-Indonesia Agricultural Trade Promotion Event. In April 2023, the China Chamber of Commerce of Import and Export of Foodstuffs, Native Produce and Animal By-Products (CFNA) signed a Memorandum of Understanding (MOU) with the Malaysian Palm Oil Board regarding increasing the stability and sustainability of palm oil supply chains. The MOU includes a call to jointly explore and implement palm oil traceability systems. The CFNA also signed the MOU with RSPO to co-work on sustainable palm oil in China. A natural evolution of these developments would be a sustainable palm oil trade deal between China and each of these countries. As with the aforesaid China-Brazil trade agreement, optimal timing of a palm oil trade deal announcement would be within the next two years given the focus of G20 2024 and the UNFCCC COP in Brazil.

Such a trade agreement is in the national interests of China. It would ensure long-term, stable supplies of palm oil for China in a manner that is aligned with emerging international trade policies and international agreements, while addressing corporate and consumer trends [see section 2.2].

Such a trade agreement would be in the national interests of Indonesia and Malaysia, too. Both nations seek to halt illegal clearing of forests and draining of peatlands for oil palm plantations. Indonesia even has a moratorium on all conversion of primary forest and peatlands to oil palm. Furthermore, both nations are demonstrating that they can remain palm oil export superpowers while dramatically driving down rates of deforestation. As evidence, in recent years Indonesia has had the greatest reduction in primary forest clearing among nations, while in Malaysia primary forest loss has leveled off (GFW, 2023). This recent performance indicates that adherence to a sustainable palm oil agreement with China would be feasible. Moreover, as with Brazil, Indonesia and Malaysia will already need to meet similar trade arrangements now being put forth

by the European Union and have set up a joint task force with the EU to work towards implementing the requirements.

Building blocks of sustainable palm oil trade agreements with Indonesia and with Malaysia would be similar to those described for soy and beef for Brazil, namely:

• Standards and certification – The trade agreement would define what qualifies as "legally" produced and traded palm oil and, ultimately, what qualifies as forest and peat "conversion-free". Fortunately, definitions, standards, and associated certification systems have already been developed. Both Indonesia, via the Indonesian Sustainable Palm Oil (ISPO) system, and Malaysia, via the Malaysian Sustainable Palm Oil (MSPO) system, have mandatory palm oil certification standards. In addition, the Roundtable on Sustainable Palm Oil (with more than 5,400 members globally) has a voluntary standard for ensuring no deforestation, no peatland conversion, and fair treatment of farmers that has achieved strong industry uptake. A trade agreement could include measures to support smallholders to achieve certification and thus ensure access to the Chinese market. As an example of such a measure, RSPO is providing support to the Indonesian province of Jambi to enable smallholders to gain ISPO certification as a stepping stone towards the more stringent RSPO certification. The Palm Oil Collaboration Group is generating industry alignment around an independent reporting framework and independent verification of sustainable palm oil. Trade agreements between China and Indonesia and Malaysia could specify standards for legality and sustainability that build on existing systems such as ISPO, MSPO and RSPO.

• Due diligence and traceability – The agreement would articulate the means of traceability and due diligence. Systems are already in place, including numerous voluntary systems applied by companies, and government-led traceability systems that are built into regulatory systems (Box 3). An example of a government-led traceability system is Indonesia's Timber legality verification system (also known by its Indonesian acronym as SVLK). The system is recognized by the EU as compliant with the EU Timber Regulation. The EU waived due diligence requirements for SVLK-licensed timber to facilitate market access. Similarly, a trade agreement on palm oil could recognize operational traceability systems in Indonesia or Malaysia as sufficient for the conduct of due diligence by companies importing palm oil into China.

Box 3. Corporate and government-led examples of due diligence and traceability

The Malaysian Sustainable Palm Oil (MSPO) Certification Scheme is a required government certification for all oil palm plantations, independent and organized smallholdings, and palm oil mills which includes a traceability requirement. MSPO certification covers 98% of Malaysia's licensed planted area. As of mid-2020, a quarter of smallholders had been certified under MSPO (Yap et al., 2021).

The Indonesian Sustainable Palm Oil (ISPO) Certification Scheme, a required government standard for palm oil production, was introduced in 2011. ISPO requires legal and regulatory compliance but does not currently include a formal traceability requirement (Nurfatriani et al., 2022).

Musim Mas, one of the world's largest palm oil companies, has committed to achieving a 100% deforestation-free supply chain by 2025 by reaching 100% traceability to plantation by 2025 (including indirect suppliers). The company already traces 100% of product from its own plantations and 93% from third-party owned palm oil mills since 2021 (Musim Mas, 2021).

Sime Darby is the world's largest producer of certified sustainable palm oil sourcing from its own areas, third-party production areas, and third-party mills. As of March 2022, Sime Darby had traced more than 70% of its global supply chain to plantation. Sime Darby uses this traceability data to assess compliance with its zero deforestation commitments. As of the first quarter of 2022, 64% of its global volumes are deforestation-free (Sime Darby, 2022).

The China Chamber of Commerce of I/E of Foodstuffs, Native Produce and Animal By-products (CFNA) is developing a due diligence system (Sustainable Soft Commodities Supply Chain Information Sharing Tool) to help their member companies to evaluate the sustainability risk of soft commodities supply chains such as palm oil, soybean, etc. This tool is piloted through both international and Chinese companies.

• "Produce & protect packages" – If Indonesia and Malaysia are to increase their supply of palm oil to China over time without converting forests or peatlands into oil palm plantations, then the two countries will need to increase yields on existing plantation area, including on smallholder plots (which tend to have lower yields than industrial-scale plantations). To support this, the trade agreement could include provisions where China offers innovative agriculture financing that helps smallholder growers remove old low-yield oil palm trees, purchase hybrid high-yielding oil palm varieties, and cover the five-year income gap before the newly planted trees bear fruit. Agricultural know-how, inputs, and financing to support sustainable intensification of palm oil.

• Lower import tariffs – China could have lower import tariffs on palm oil shipments that demonstrate they are legal and conversion-free (via the certification and traceability provisions described above).

D. Leverage the Power of Both the Market and Policies to Drive the Low-Carbon Trade Patterns and Industry Supply Chains

• Invisible Hand – Market - Based on our studies in last section, the first policy implication is that the market mechanism is our tool to achieve environmental goals. We find that when the coal price goes up 10%, China's export carbon emissions go down 1.29%. Precisely, when the price of coal goes up, the China's export of carbon emission goes down. This is because as the price of coal goes up, Chinese exporters find coal is relatively more expensive than other kinds of energy, and therefore they use less coal but more other relatively cheaper energy. Since coal is a nonrenewable energy, the more we use, the less we have and price of coal is in an ascending channel. With the help of market mechanism, the booming coal price will lead to a lower export carbon emission in China. To sum up, the raising price of energy from fossil fuels will eliminate industries with heavy pollution and lower the carbon emission in export by market mechanism.

• Visible Hand – Government - Market is an important force to lower carbon emission, while government should not only rely on market but also take actions actively.

First and foremost, government should lower carbon emission in a way that "destruction" comes after "construction". In other words, government should promote the "construction" of green industry in the first step. After the green industry is established and developed, government then started to limit the traditional "dirty" industry and reshape the economy. More precisely, we need a mature green industry as a preparation for the abolish of fossil energy. If we do not fully prepare the green industry but close the dirty industry in first step, there will cause severe economic imbalance, such as forced power rationing to achieve green targets.

Second, we need infrastructure to back up the foundation of the green industry. The development of green industry is important, but the development of supporting infrastructure for the green industry is more important.

Take the survey in Gansu Province as an example. Gansu as an inland province with deserts has abundant sunshine and wind power resources. Local government has only developed a few solar power plants and wind power plants. Limited development of green industry is caused by the limited consumers to buy their green energy. Local energy consumers are limited due to the deserts and culminate. Furthermore, the transmission line is not enough to send those green energy to the east part of China, where power demand exceeds supply. To sum up, infrastructure backing the green industry is vital for the development of green industry. It is important to build a single energy market from Xinjiang to Shanghai, which be an incentive to develop green energy.

Third, it is inevitable that an economic shift from dirty industries to green industries will lead to unemployment. A cut on heavy industries and mining could result in job loss in those industries. Government needs to prepare for the unemployment during the economic transformation from dirty to green.

E. Develop Incentives for Green Products in the Regional Trade Agreements

We recommend that China advocate the import tariff on green products, and further advocate the green tariff cut in the world trade organization and other regional trade agreements, such as RCEP and CPTPP.

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