

## *Exposure of Chinese Exports to Potential Border Carbon Adjustments*

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**TRADE INVESTMENT  
& CLIMATE CHANGE**

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## *IISD's TRI-CC Program*

This work is an output of IISD's Trade, Investment and Climate Change Program (TRI-CC). Related research will aim to deepen understanding of energy intensive industries, so as to better understand the effect of policies on these sectors. In particular, it forms part of an assessment of trade impacts of BCAs in developing countries, and will be followed by a complementary analysis of how BCAs affect exports from South Africa. Related research will aim to deepen understanding of energy intensive industries, so as to better understand the effect of policies on these sectors. Together, these analyses will inform research on the practical aspects of developing and implementing a BCA system.

Other similar areas of work in the TRI-CC Program include developing guidance for policy makers in elaborating and implementing BCAs, deepening understanding of climate policy for the steel and cement sectors, and work on emerging issues such as GHG-intensity standards and subsidies for green industrial development. Under TRI-CC's Investment and Climate Change theme, IISD will work with host country governments to develop policies that help catalyse flows of climate friendly investment.

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## *Abstract*

China is one of the world's largest carbon emitters and is its largest exporter, and thus must be included in any discussion of border carbon adjustments (BCAs). This study examines the size of the impact of potential BCAs on Chinese exports. First we focus on carbon flows through Chinese exports, then we discuss how emissions could be captured by a BCA scheme. We apply the methodology developed by the Intergovernmental Panel on Climate Change and an input-output analysis to evaluate carbon emissions in exports from China. Based on existing assessments of vulnerability to leakage, we made reasonable assumptions about which industrial sectors might be subject to potential BCAs imposed by the United States and European Union. Our results show that carbon emissions captured by BCA schemes are only a small fraction of China's exported emissions. Nonetheless, for certain sectors or subsectors, the volume of exports covered by BCAs, and the value of impacts, might be significant. However, Chinese exporters may find that it is both possible and more cost-effective to divert carbon-intensive production to other regions rather than pay the charges applied under a BCA. We also discuss the pros and cons of input-output analysis as a method of assessing carbon content in products.

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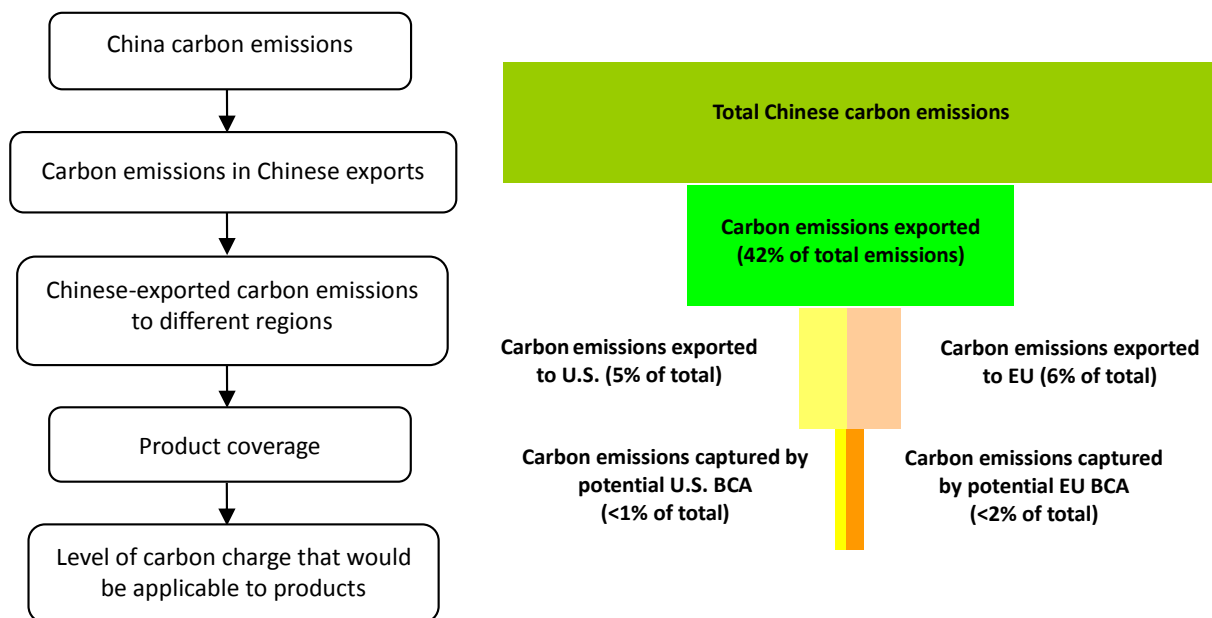
## 1.0 Introduction

Border carbon adjustments (BCAs) are an option for offsetting a loss in competitiveness and avoiding carbon leakage caused by uneven carbon pricing policies implemented in different countries, where emission reductions in a carbon-constrained region are offset by increased emissions elsewhere. BCAs can take the form of either adjustments to a domestic carbon tax regime or requirements for importers to purchase emission allowances. Currently, no BCAs have been implemented, but a particularly controversial policy that has BCA-like characteristics is the European Union's inclusion of aviation in phase III of its emission trading system, with the associated aviation levies.

The rapid growth of China's gross domestic product and exports in recent years has made the country the world's second-largest economy and its largest exporter. Because China's production is carbon intensive, carbon emissions embedded in Chinese traded goods have received considerable attention. Statistics indicate that China emitted 6,032 million tonnes of carbon dioxide in 2007,<sup>1</sup> or 21 per cent of the world total (IEA, 2010). Based on rough calculations from the 2007 input-output table, nearly 42 per cent of China's total carbon was embedded in exports, with 5 per cent exported to the United States and 6 per cent exported to the European Union.

A number of countries have considered BCAs, but discussions have advanced furthest in the European Union and the United States. For both regions, existing proposals give some guidance for possible designs for future schemes. Our analysis is based on these proposals, but we do not follow their design exactly, nor do we assume implementation would be restricted to these regions.

The carbon price applied, the methodology for assessing the embodied carbon content of goods and the design details of BCA schemes are key, and we explore them in this study.



**FIGURE 1: RESEARCH STEPS IN THE STUDY**

<sup>1</sup> Statistics from 2007 have been used because they are the most recent input-output tables available for the economy. China's carbon emissions have risen since 2007, as has its share of world carbon emissions.

## 2.0 Literature Review

A number of studies use various assumptions and methodologies to evaluate the potential impacts of BCAs on Chinese exports. Generally, they apply three key assumptions.

The first assumption is that the measure is implemented only for products from carbon-intensive industries in China. It is more likely that only a limited range of Chinese exports would be subject to potential BCAs. Shen and Li (2010) assume that carbon tariffs will be implemented on the Chinese exports from 15 industrial sectors. Dong and Whalley (2009) divide industries into two groups, a high-carbon-emission group and a low-carbon-emission group, and conclude that the high-carbon-emission industries are more affected by BCAs. Clearly, the assumption of a BCA measure applied to all Chinese exports will result in overestimating the impacts of a potential BCA. Instead, we make reasonable assumptions based on the relevant U.S. and EU climate legislative initiatives to decide which products or sectors might be subject to BCAs.

The second key assumption is related to the charge base. If a BCA is based on the carbon content of the exporting country, it may cause discriminatory issues and incompatibility with World Trade Organization (WTO) rules. Mattoo et al. (2009) consider policy options in which a BCA is based either on the carbon content embodied in the domestically produced good in the importing country, or on foreign unrestricted carbon content. The results turn out to be significantly different, with the latter having much more significant economic impact. Our paper will examine two scenarios: a BCA measure based on the carbon content for the exporting country (China) and on the average carbon content for importing countries (United States).

The third key assumption is the methodology for calculating carbon content. The calculation could include only direct emissions: process emissions from fuel combustion and non-fuel sources. Or it could also include indirect emissions, from the generation of electricity used to produce a sector's output (H.R. 2454, p. 1094). An alternate possibility would be to include all "embodied" emissions—a concept for which no uniform definition exists. Jiang, Cosbey and Murphy (2008) define *embodied carbon* as the carbon emitted at all stages of a good's manufacturing process, from the mining of raw materials through the distribution process to the final product provided to the consumer. Zhou et al. (2010) estimate that the total charges paid under the embodied carbon emissions structure are four times the charges paid under the direct carbon emissions structure. In this paper, we compare both cases.

**TABLE 1: LITERATURE REVIEW**

STUDY	METHOD	PRODUCTS OR SECTORS COVERAGE	CHARGE BASE	CARBON PRICE	CONCLUSIONS
Shen (2010, 2009)	Dynamic computable general equilibrium model and 2002 input-output table	15 industrial sectors	Embodied carbon emissions in exports from China	\$30/t CO <sub>2</sub> e \$60/t CO <sub>2</sub> e	China's exports decrease 3.53% 6.95%
ZHOU et al. (2010)	2007 input-output model	All industrial sectors	Embodied carbon emissions and direct carbon emissions in exports from China	\$35/t CO <sub>2</sub> e \$50/t CO <sub>2</sub> e \$60/t CO <sub>2</sub> e	Tariff equivalent: 0.81%–3.64% 1.16%–5.2% 1.39%–6.25%
Dong & Whalley (2009)	4-country general equilibrium model	High-emission goods Low-emission goods	Carbon content in importing countries	\$25/t CO <sub>2</sub> e \$50/t CO <sub>2</sub> e \$100/t CO <sub>2</sub> e \$200/t CO <sub>2</sub> e	China's high-emission goods export decrease: 0.016% 0.031% 0.059% 0.110%
Mattoo et al. (2009)	Dynamic computable general equilibrium (CGE) model	All merchandise imports All merchandise imports Energy-intensive merchandise imports Energy-intensive merchandise imports	Exporting country Importing country Exporting country Importing country	\$234.8/t CO <sub>2</sub> e \$239.9/t CO <sub>2</sub> e \$248.1/t CO <sub>2</sub> e \$244.0/t CO <sub>2</sub> e	China's total exports decrease: 15.8% 2.7% 2.4% 1.2%

### 3.0 Key Assumptions

From existing studies, we found that different assumptions about coverage of products and sectors, charge base, and carbon price greatly influence the results. Table 2 outlines the assumptions for our research.

**TABLE 2: KEY ASSUMPTIONS**

	BASED ON THE POTENTIAL U.S. BCA	BASED ON THE POTENTIAL EU BCA
Reference legislation initiative	Waxman-Markey bill	European Commission (2009)
Product scope	<ul style="list-style-type: none"> <li>46 eligible sectors: list released in Interagency Report (2009).</li> <li>Exclusion for any eligible sectors where China is the source of less than 5% of total U.S. imports.</li> <li>We also run hypothetical cases wherein the exclusion thresholds are 1% and 10%.</li> </ul>	<ul style="list-style-type: none"> <li>European Commission issued a list, including 164 sectors and subsectors deemed to be at risk of carbon leakage.</li> <li>Only energy-intensive and trade-intensive sectors are included.</li> <li>Covered goods with imports from China under €500,000 are excluded.</li> <li>For comparison, another two cases are also considered: Excluding covered goods with imports from China under €5 million and under €50 million.</li> </ul>
Charge base	<ul style="list-style-type: none"> <li>China's direct carbon emissions in domestic production.</li> <li>China's embodied carbon emissions in domestic production. U.S. direct and indirect carbon emissions in domestic production.</li> </ul>	<ul style="list-style-type: none"> <li>China's direct carbon emissions in domestic production.</li> <li>China's embodied carbon emissions in domestic production.</li> </ul>
Carbon price	\$20/t CO <sub>2</sub> e \$50/t CO <sub>2</sub> e	



## 4.0 Carbon Emissions in Chinese Products

The carbon emissions of a product can be assessed in a variety of ways. The most common is to assess emissions from fuel combustion, a method developed by the Intergovernmental Panel on Climate Change (IPCC). Embodied carbon emissions have also been discussed as an assessment tool, and the IPCC's (2006) Tier 1 approach will also be considered in this report. Our analysis will use China's 2007 input-output table to calculate the embodied carbon emissions in Chinese exports (National Bureau of Statistics of China, 2009).

### 4.1 Carbon Emissions Calculation Using the IPCC Approach

Based on the consumption of various types of fossil fuels in China's economy in 2007,<sup>2</sup> we could calculate carbon emissions from fuel combustion through the IPCC's (2006) Tier 1 approach using the following equation:

$$Emissions_{CO_2, fuel} = Fuel\ Consumption_{fuel} \cdot Emission\ Factor_{CO_2, fuel}$$

Where:

Emissions<sub>CO<sub>2</sub>,fuel</sub> = emissions of CO<sub>2</sub> by type of fuel (kg CO<sub>2</sub>)

Fuel Consumption<sub>fuel</sub> = amount of fuel combusted (TJ)

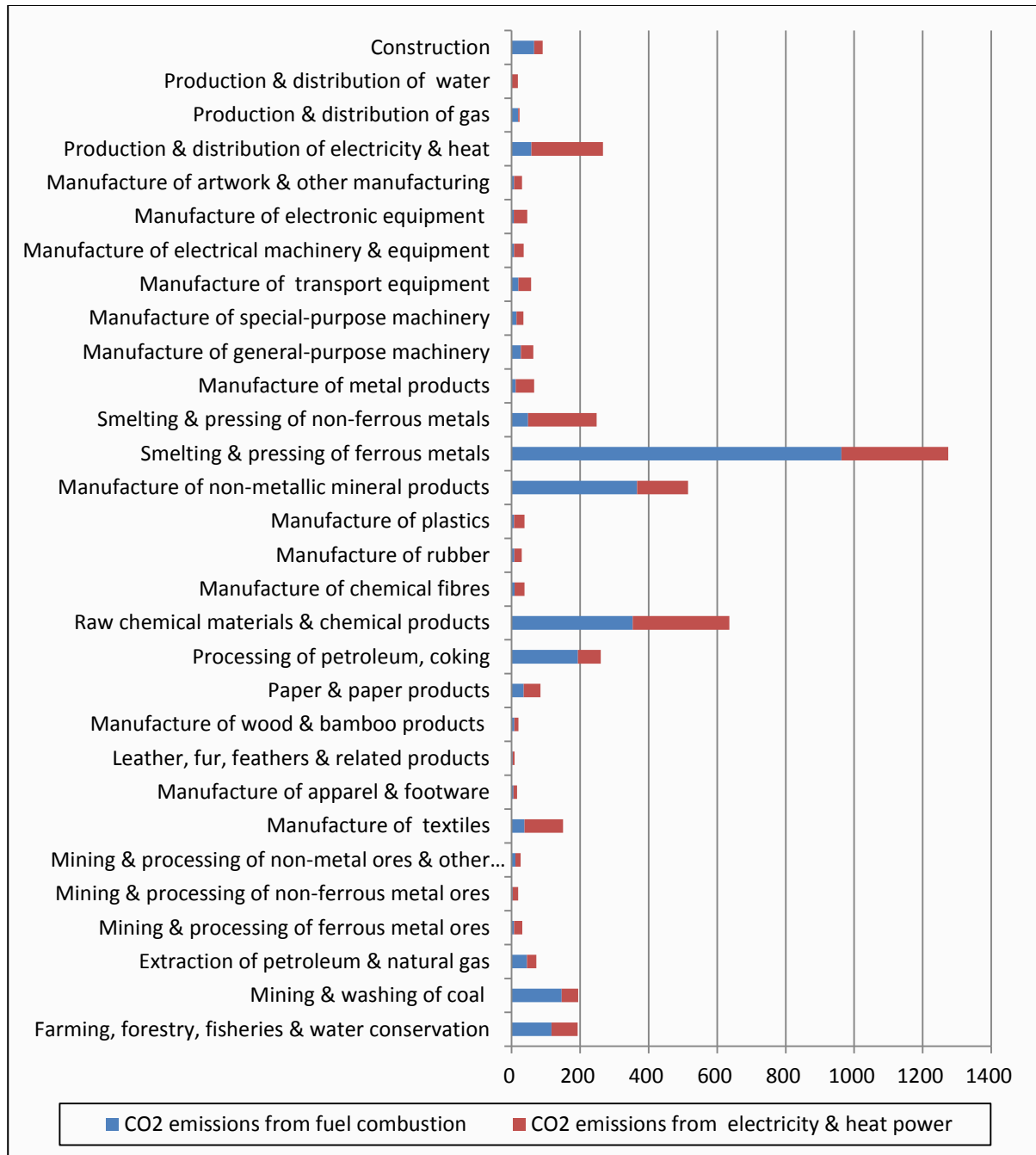
Emissions Factor<sub>CO<sub>2</sub>,fuel</sub> = default emission factor of CO<sub>2</sub> by type of fuel  
(kg CO<sub>2</sub> per TJ on a Net Calorific Basis)

By applying energy data from the 2008 China Energy Statistical Yearbook and emission factors from the IPCC's 2006 *Guidelines for National Greenhouse Gas Inventories*, we calculated 6,339 megatonnes of carbon dioxide emissions from fuel combustion in China in 2007 (see Annex 1), which is very close to the IEA's estimation of 6,032.3 megatonnes of carbon dioxide (IEA, 2010).

Because China's energy generation is highly dependent on coal, the electricity and heating sectors contribute nearly half of China's total carbon emissions. Most of the energy generated by these sources is used by industrial sectors. So we separate carbon emissions from the electric and heat power sectors into emissions from fuel consumption for its own use and emissions from producing electricity and heat power for other industrial sectors (see Figure 1).

Three industrial sectors are the main carbon emitters in China. The smelting and pressing of ferrous metals is the largest contributor, producing approximately 963 megatonnes from fuel combustion directly and 312 megatonnes from electricity and heat used indirectly in the process. In total, this sector accounts for 20 per cent of China's carbon emissions. The second-largest contributor is the manufacturing of raw chemical materials and chemical products, with 353.6 megatonnes produced from fuel combustion directly and 282 megatonnes from electricity and heat used indirectly. In total, this sector accounts for 10 per cent of China's carbon emissions. The third-largest emitter is the manufacturing of non-metallic mineral products, which accounts for 8 per cent of China's total energy-related carbon emissions.

<sup>2</sup> Figures are based on the *Energy Statistical Yearbook of 2008* and the carbon dioxide emission factors of various types of energy drawn from IPCC (2006).



**FIGURE 2: CARBON DIOXIDE EMISSIONS BY SECTOR IN 2007 (MEGATONNES)**

## 4.2 Embodied Carbon Calculation Through Input-Output Analysis

Carbon content calculations such as embodied carbon are calculated at the point of consumption, whereas carbon emissions from fuel combustion are calculated at the point of manufacture. Therefore, the concept of embodied carbon is useful as a basis for potential BCAs.

To evaluate embodied carbon in Chinese exports, we used the input-output analysis developed by Lin and Sun (2010). We assume an economy with  $n$  sectors where the output of the whole economy is  $\mathbf{x}$  and the final demand is  $\mathbf{y}$ , both column vectors. The matrix of direct input coefficients is represented by  $\mathbf{A}$ . The element  $\mathbf{A}_{ij}$  represents the amount of output from sector  $i$  required to produce a unit of output from sector  $j$ . The final demand is represented by  $\mathbf{y}$  and includes final consumption, investment and net export (a detailed input-output analysis is shown in Annex 2). The relationship between the final demand,  $\mathbf{y}$ , and the total output,  $\mathbf{x}$ , can be represented as

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \mathbf{y}$$

For our analysis, the input-output model can be coupled with carbon dioxide emissions. Direct carbon dioxide emissions are represented by the row vector  $\mathbf{c}^d$ . In sector  $j$ , each unit of output is  $\mathbf{x}_j$ , and its direct carbon dioxide emissions are represented by the element  $\mathbf{c}^d_j$ . The domestic emissions generated by all sectors can be represented by  $\mathbf{C}^d$ . The direct carbon dioxide emission coefficient reflects the carbon dioxide emissions from fuel combustion per unit of output in the production of a sector domestically. Embodied emissions are represented by the row vector  $\mathbf{E}^d$ , and the element  $\mathbf{E}^d_j$  is the embodied emissions per unit of final demand  $\mathbf{y}$  in sector  $j$ . In other words,  $\mathbf{E}^d_j$  represents the total carbon dioxide emissions generated in sector  $j$  to meet per unit final demand, including emissions produced through the whole production process.

$$\mathbf{C}^d = \mathbf{c}^d \mathbf{x} = \mathbf{c}^d (\mathbf{I} - \mathbf{A})^{-1} \mathbf{y} = \mathbf{E}^d \mathbf{y}$$

Further, the relationship between the embodied emissions coefficient vector,  $\mathbf{E}^d$ , and the direct emissions coefficient vector,  $\mathbf{c}^d$ , can be represented as

$$\mathbf{E}^d = \mathbf{c}^d (\mathbf{I} - \mathbf{A})^{-1}$$

Based on the 2007 input-output tables released by the National Bureau of Statistics of China (2009) and the direct carbon dioxide emissions factors calculated using the equations above, we can calculate the embodied emissions factors for all sectors. Data for emissions coefficients are shown in Annex 3.

## 5.0 China's Targeted Products Subject to Potential BCAs

We could use several possible definitions for coverage of China's exports under a BCA regime, each with different implications for economic impacts. Here we explore two plausible scenarios, as well as the WTO legal status of BCAs.

### 5.1 Which Products Would Be Covered Under the United States' Schemes?

Both the Waxman-Markey bill (also called the American Clean Energy and Security Act of 2009, H.R. 2454) and the Kerry-Lieberman bill (also called the Clean Energy Jobs and American Power Act, S. 1733) outlined criteria to determine which sectors could be covered under BCA schemes, referring to imports from eligible sectors that need to buy international reserve allowances. "Eligible industrial sectors" are defined in Section 773 of the Kerry-Lieberman bill as manufacturing sectors (excluding refining) that are at least 5 per cent energy (or carbon dioxide) intensive and 15 per cent trade intensive, or are 20 per cent energy intensive.<sup>3</sup> These criteria are applied at the six-digit level the North American Industry Classification System (NAICS).

Following the criteria of the Waxman-Markey bill, the Interagency Report (2009) compiled a list of 46 sectors that are likely to be deemed eligible for allowance rebates. In our study, we use the sectors on this list as the sectors eligible for BCAs.

#### 5.1.1 Is China Potentially Targeted?

In both the Waxman-Markey bill and the Kerry-Lieberman bill, another set of criteria specifies which countries could be exempt from BCAs. According to Section 768 of the Waxman-Markey bill, a country will not be targeted if:

- "The country is a party to an international agreement to which the United States is a party that includes a nationally enforceable and economy-wide greenhouse gas emissions reduction commitment for that country at least as stringent as the greenhouse gas emission reductions levels established under this Act."
- "The country is a party to a multilateral or bilateral emission reduction agreement for that sector to which the United States is a party."
- "The country has an annual energy or greenhouse gas intensity ... for the sector that is equal to or less than the energy or greenhouse gas intensity for the industrial sector in the United States in the most recent calendar year for which data are available."
- The foreign country has been identified by the United Nations as among the least developed of developing countries.
- The foreign country is one that the U.S. president has determined to be responsible for less than 0.5 per cent of global greenhouse gas emissions and less than 5 per cent of U.S. imports of covered goods with respect to the eligible industrial sector (the Kerry-Lieberman bill stipulates "less than 5 percent of global production in the eligible industrial sector").

<sup>3</sup> Energy intensity is calculated as cost of energy inputs relative to total cost of production. Trade intensity is calculated as is  $(M+X)/(Q+M)$ , where M = imports, X = exports and Q = production.

Our paper considers a situation in which China’s share of U.S. imports in the eligible sectors must be more than 5 per cent; otherwise they would be excluded. For the purposes of comparison, we also consider cases where the cut-off share of U.S. imports from eligible Chinese industrial sectors is less than 1 per cent or less than 10 per cent.

### 5.1.2 China’s Potential Targeted Products under a U.S. BCA Scheme

This study uses the list of 46 sectors eligible for BCAs published in the Interagency Report (2009) for our analyses.<sup>4</sup>Based on the trade data for sectors eligible for BCAs, and on embodied carbon emissions factors derived from the input-output analysis, we can estimate embodied carbon in Chinese exports captured by the U.S. BCA scheme.

In this section, trade data are from the U.S. Department of Commerce and International Trade Commission database (U.S. International Trade Commission, 2012). Since BCAs affect imports, and the import data from the U.S. statistical administration may be more reliable, we use import data from the United States instead of export data from China. To avoid fluctuation of trade flow, we apply the average import value of U.S. imports from China from 2007 to 2009. As noted above, we examine three scenarios where the share of U.S. imports from China in eligible industrial sectors must be greater than 1 per cent, 5 per cent or 10 per cent to be covered.

The United States is the second-largest importer of Chinese goods and accounted for 19 per cent of China’s total exports in 2007.<sup>5</sup> The embodied emissions of these exports are 313 megatonnes of carbon dioxide, which accounts for 12 per cent of China’s exported emissions. The three scenarios listed in Table 3 show that with a lower proportion of imports excluded, more carbon emissions are captured by BCA schemes, but this is no more than 2 per cent of the total embodied carbon emissions in Chinese exports. From a broader perspective, carbon emissions captured by the U.S. BCA measures only account for a small fraction of China’s exported emissions. However, for certain sectors or subsectors, the vulnerable exports from China might be quite significant.

**TABLE 3: EMBODIED EMISSIONS CAPTURED UNDER THE U.S. BCA SCHEME, BASED ON 2007 DATA**

		EMBODIED CARBON EMISSIONS		
		IMPORT < 1% EXCLUDED	IMPORT < 5% EXCLUDED	IMPORT < 10% EXCLUDED
Total emissions	Mt CO <sub>2</sub>	6,339		
Emissions exported	Mt CO <sub>2</sub>	2,678		
Emissions exported to U.S.	Mt CO <sub>2</sub>	313		
Emissions captured by BCA in U.S. *	Mt CO <sub>2</sub>	53.8	50.4	45.3
<u>Emissions captured by BCA</u> Total emissions	%	0.85	0.8	0.71
<u>Emissions captured by BCA</u> Emissions exported	%	2.0	1.9	1.7
<u>Emissions captured by BCA</u> Emissions exported to U.S.	%	17.2	16.1	14.5

\*Uses 2007–2009 average data.

<sup>4</sup> Annex 4 shows list of 46 eligible sectors.

<sup>5</sup> As data for carbon emissions are from 2007, we used trade data from 2007 for comparison.

## 5.2 Chinese Products Possibly Covered Under an EU BCA Scheme

Phase III (2012–2020) of the EU Emissions Trading Scheme (EU ETS) includes an option to cover imports from energy-intensive industries as part of the scheme, possibly for implementation after 2020. This would mean imports would have to purchase allowances for their embodied emissions: a BCA regime. Although the European Union has not yet implemented or proposed any specific BCA measures, the European Commission (2009) has issued a list of 164 sectors and subsectors that are deemed to be at risk of carbon leakage, and these sectors might be subject to trade measures such as BCAs. We used these 164 sectors and subsectors as a starting point, but our analysis excluded those sectors and subsectors that qualified solely by being trade-intensive, without having to pass an energy-intensity test. These goods, listed in Paragraph 16(b) of the European Commission Decision (2009), are arguably not appropriate for coverage, since the actual risk of leakage is low. Annex 5 lists the resulting sectors and subsectors for use in this analysis. Trade data for these eligible sectors are from the Eurostat External Trade Database (<http://epp.eurostat.ec.europa.eu/newxtweb>).

We use the embodied carbon emissions factors for Chinese exports and trade data from eligible sectors for the European Union to assess Chinese exports subject to a potential EU BCA. For ease of comparison, we exclude some insignificant eligible sectors, considering three scenarios where eligible sectors are excluded if their import value is less than €500 thousand, €5 million or €50 million. Table 4 lists the results.

The European Union is the largest importer of Chinese goods and accounted for 20 per cent of China’s total exports in 2007. The embodied carbon dioxide emissions of these exports are 359 megatonnes, which is 13.4 per cent of China’s total export carbon emissions. The European Union deems more sectors to be at risk of carbon leakage than does the United States, so up to 5 per cent of Chinese exported carbon emissions are captured by a potential EU BCA, and over one-third of Chinese carbon emissions exported to the European Union may be subject to carbon charges.

**TABLE 4: EMBODIED EMISSIONS CAPTURED UNDER A POTENTIAL EU BCA SCHEME, USING 2007 DATA**

		EMBODIED CARBON EMISSIONS		
		IMPORT < €500K EXCLUDED	IMPORT < €5 MILLION EXCLUDED	IMPORT < € 50 MILLION EXCLUDED
Total emissions	Mt CO <sub>2</sub>	6,339		
Emissions exported	Mt CO <sub>2</sub>	2,678		
Emissions exported to EU	Mt CO <sub>2</sub>	359		
Emissions captured by BCA in EU *	Mt CO <sub>2</sub>	122	121	109
<u>Emissions captured by BCA</u> Total emissions	%	1.9	1.9	1.7
<u>Emissions captured by BCA</u> Emissions exported	%	4.6	4.5	4.1
<u>Emissions captured by BCA</u> Emissions exported to U.S.	%	34.0	33.7	30.4

\*Uses 2007–2009 average data.

### 5.3 Compatibility with WTO Rules

Whether BCAs would be compatible with WTO rules has been widely discussed in the literature, but remains uncertain. Since this paper focuses on the economic impacts of BCAs, we will briefly summarize the discussions in this area.

Studies show that the WTO compatibility of BCAs depends strongly on their design details and how they are implemented (Jegou & Derksen, 2010). In the end, only a WTO Dispute Settlement Panel ruling could give a definitive answer to whether a BCA is legal (Wooders, Cosby & Stephenson, 2009), but it is possible to discuss which WTO rules relate to BCA measures. Some key ways in which BCA measures are potentially incompatible with WTO rules include the following:

- Most BCA designs would face difficulties with the disciplines of non-discrimination: the most-favoured-nation and national-treatment principles. First, BCA measures should not discriminate between domestic producers and foreign producers of like products—both should be treated similarly (national treatment). Second, they should not discriminate between like products based on the country of production (most-favoured nation) (Cosbey, 2009).
- Otherwise-illegal trade measures for environmental purposes have been accepted in several WTO cases based on the General Agreement on Tariffs and Trade's (GATT) General Exceptions (Carbon Trust, 2010). With respect to relevant exceptions, Article XX(b) or XX(g), the main obstacle for the justification of BCAs under these provisions seems to be the fact that only one of their purposes, namely preventing carbon leakage, relates to the conservation of the environment and that the evidence of this carbon leakage is inconclusive (Jegou & Derksen, 2010). Other, more economic, purposes for BCAs, such as preventing loss of competitiveness, would not likely be deemed acceptable by the GATT General Exceptions.

## 6.0 How Chinese Exports Are Affected by a Potential U.S. BCA

Carbon price is one of the key factors affecting the vulnerability of Chinese exports to potential BCAs. We consider two carbon prices: \$20 and \$50 per tonne of carbon dioxide. Under these price assumptions, we calculate the charges for Chinese exports under BCA regimes. We also estimate an ad valorem tax set at a level that reflects the vulnerability of certain Chinese export product categories to BCAs.

### 6.1 How Chinese Exports Are Exposed to Potential BCAs

In this report, we discuss three main factors that make Chinese exports vulnerable to potential BCAs: carbon price, coverage of eligible sectors in potential BCAs and methodology for assessment of carbon content. In Section 5 we evaluated how coverage of eligible sectors makes Chinese exports vulnerable to BCAs by comparing the carbon emissions captured by different BCA coverage scenarios. In this section we discuss how carbon price and carbon content assessments would affect Chinese exports. For carbon content assessments, we consider charging for BCAs on Chinese exports based on embodied and direct carbon dioxide emissions.

Based on the coverage of eligible sectors given above, the total amount payable under the EU and U.S. schemes is calculated by applying a carbon price to the emissions associated with eligible sectors. The analyses use different emission calculations and price assumptions to calculate total charges, as well as total charges as a percentage of the value of exports covered by the BCA proposals (see Table 5, Annex 6 and Annex 7).<sup>6</sup> Table 5 shows that at \$20 per tonne, the additional cost could range from US\$0.3 billion, if the United States only applied charges to direct emissions, to US\$3.5 billion, if both the United States and the European Union applied charges to embodied emissions. As carbon prices rise, BCA charges increase proportionally.

At a carbon price of \$20 per tonne, total charges from BCAs applied by both the United States and the European Union for embodied emissions are four times those applied for direct emissions.

**TABLE 5: CHARGES FROM LEVYING BCAS ON CHINESE EXPORTS**

		U.S. BCAS		EU BCAS		U.S. & EU	
		\$20/T	\$50/T	\$20/T	\$50/T	\$20/T	\$50/T
Based on direct carbon emission	Charges (US\$ billion)	0.3	0.8	0.5	1.2	0.8	2.0
	Charges as % of export value of covered sectors	2.3%	5.7%	0.9%	2.2%	1.2%	2.9%
Based on embodied carbon emission	Charges (US\$ billion)	1.0	2.5	2.4	6.1	3.4	8.6
	Charges as % of export value of covered sectors	7.6%	19.1%	4.4%	11.3%	5.1%	12.8%

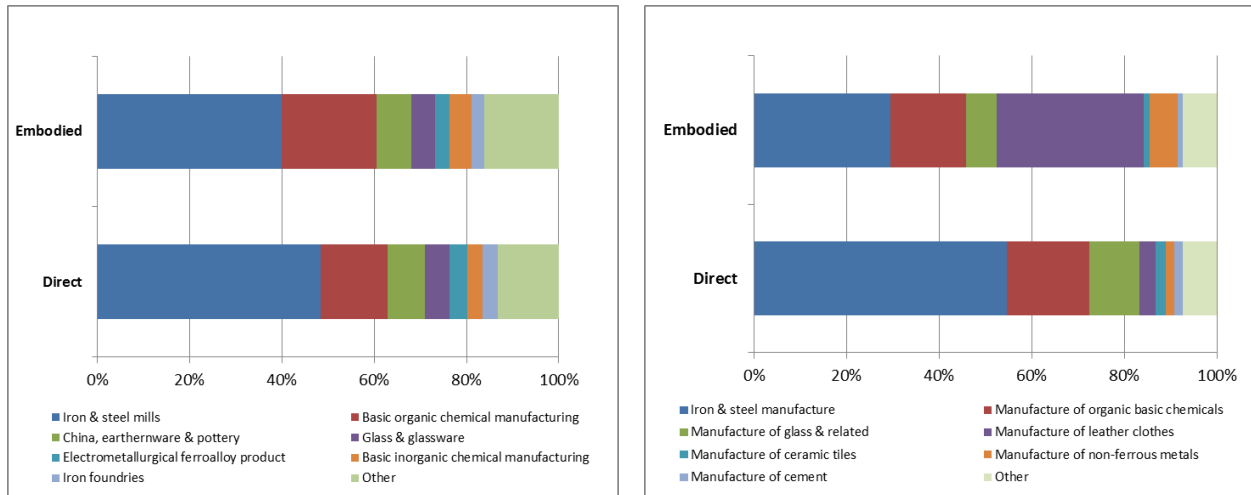
*Note: Coverage of eligible sectors is given, Chinese imports from eligible sectors that constitute less than 5% of total US imports in that sector are excluded, and EU eligible sectors with import values of less than €5 million are excluded.*

### 6.2 How Vulnerable Are Certain Sectors Subject to Potential BCAs?

In the examination of individual subsectors, iron and steel mills and basic organic chemical manufacturing account for the majority of charges in the United States, when calculated using a direct emissions approach (Figure 3). For the European Union, the same two subsectors account for the majority of charges when based on direct emissions, but on an embodied emissions basis, the manufacture of leather products results in the highest charges.

<sup>6</sup> Calculated using 2007 input-output tables.





**FIGURE 3: ACCUMULATION OF TOTAL CHARGES BY EACH SUBSECTOR**

The total charge is converted into an ad valorem tax for separate sectors to give an indication of relative price effects. In both the European Union and the United States, the highest rates are charged to the iron and steel sector. When tax rate equivalents are calculated using \$20 per tonne, direct emissions calculations result in an average rate of 8.3 per cent for the European Union and 3.4 per cent for the United States, and embodied emissions calculations result in 18.9 per cent for the European Union and 9.4 per cent for the United States.<sup>7</sup> These products could be considered the most exposed to the effects of BCAs. However, it is worth noting that the subsector analysis is not necessarily representative of the effects that may occur at the product level.

<sup>7</sup> For the European Union, this includes manufacture of basic iron and steel and of ferroalloys, cold drawing, and manufacture of cast-iron tubes. For the United States, it includes iron and steel mills, electrometallurgical ferroalloy product manufacturing and iron foundries.

## 7.0 Conclusions and Implications

In this study we used an input-output table to determine the amount of embodied carbon in final products in China, and we applied a range of sensitivity analyses to assess the outcomes of potential BCAs applied to Chinese exports. Our analysis shows:

**BCAs may have limited impact on incentivizing overall carbon emission reductions.** Assuming implementation by the United States and the European Union, the value of exports captured under current proposals for BCAs would be around 10 per cent of the value of exports from China to these regions, or 6 per cent of the value of total exports from China. The corresponding charges paid by exporters would range from \$0.8 billion (or 0.2 per cent of the value of exports to the United States and European Union) at a price assumption of \$20/tCO<sub>2</sub> and based on direct emissions, through to \$8.6 billion (or 1.8 per cent of the value of exports to the United States and European Union) at a price assumption of \$50/tCO<sub>2</sub> and based on life-cycle emissions.

Given the limited share of Chinese export value at risk, the impact of such BCAs on incentivising carbon emission reductions is likely to be limited. Exporters may find that it is both possible and more cost-effective to divert this production to other destinations rather than pay the charges applied under the BCA. Further exploration of these and other responses would require a dynamic modelling approach.

**Methodology of carbon content assessment would strongly affect the outcomes of BCAs.** The charges imposed under a BCA regime will vary across subsectors depending on emissions intensity of production. It is likely that only a limited number would be materially impacted by a workable BCA. While recognizing the challenges of implementation, basing a scheme on life-cycle emissions would ensure the fullest coverage and would better align incentives to production.

However, using input-output tables to design and apply schemes across the entire economy is likely to be problematic. The data required for an input-output analysis is updated infrequently (tables are published only every five years or so and use data that is even older). Further, significant detail is lost by focusing on the subsector level available in input-output tables, with implications for both the economic effectiveness and political viability of the approach. Measuring emissions at company and product levels would be ideal, but establishing and operating a scheme for collecting the necessary data would be a significant undertaking on an economy-wide basis, demanding resources almost certainly well out of proportion to any possible benefits. However, further development of the approach for key products identified may be worth exploring.

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## Annex 1 CO<sub>2</sub> emissions from fuel combustion by sectors in 2007

SECTORS	INCLUDING TRANSFORMATION	CO <sub>2</sub> EMISSIONS FROM TOTAL FINAL CONSUMPTION	CO <sub>2</sub> EMISSIONS FROM TRANSFORMATION	TOTAL CO <sub>2</sub> EMISSIONS FROM FUEL COMBUSTION
		Mt CO <sub>2</sub>	Mt CO <sub>2</sub>	Mt CO <sub>2</sub>
Farming, Forestry, Animal Husbandry, Fishery & Water Conservancy		116.27		116
Mining and Washing of Coal	Coal Washing	106.35	40	146
Extraction of Petroleum and Natural Gas		44.49		44
Mining and Processing of Ferrous Metal Ores		6.94		7
Mining and Processing of Non-Ferrous Metal Ores		2.95		3
Mining and Processing of Nonmetal Ores and Other Ores		10.67		11
Processing of Food from Agricultural Products		24.48		24
Manufacture of Foods		15.25		15
Manufacture of Beverages		13.69		14
Manufacture of Tobacco		2.25		2
Manufacture of Textile		37.43		37
Manufacture of Textile Wearing Apparel, Footwear and Caps		5.32		5
Manufacture of Leather, Fur, Feather and Related Products		2.68		3
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm and Straw Products		7.60		8
Manufacture of Furniture		0.96		1
Manufacture of Paper and Paper Products		35.36		35
Printing, Reproduction of Recording Media		1.34		1
Manufacture of Articles For Culture, Education and Sport Activity		1.10		1
Processing of Petroleum, Coking, Processing of Nuclear Fuel	Coking & Petroleum Refineries	183.69	23.68	207
Manufacture of Raw Chemical Materials and Chemical Products		353.61		354
Manufacture of Medicines		10.18		10
Manufacture of Chemical Fibers		8.46		8
Manufacture of Rubber		7.76		8
Manufacture of Plastics		7.04		7
Manufacture of Non-Metallic Mineral Products		366.50		366
Smelting and Pressing of Ferrous Metals		962.71		963
Smelting and Pressing of Non-Ferrous Metals		47.71		48
Manufacture of Metal Products		11.66		12
Manufacture of General Purpose Machinery		27.23		27
Manufacture of Special Purpose Machinery		14.03		14

Manufacture of Transport Equipment		20.04		20
Manufacture of Electrical Machinery and Equipment		7.05		7
Manufacture of Communication Equipment, Computers and Other Electronic Equipment		6.30		6
Manufacture of Measuring Instruments and Machinery for Cultural Activity and Office Work		0.98		1
Manufacture of Artwork and Other Manufacturing	Briquettes	6.23	0.73	7
Recycling and Disposal of Waste		0.27		0
Production and Distribution of Electric Power and Heat Power	Thermal Power & Heating Supply	57.15	2857.51	2915
Production and Distribution of Gas	Gas Works	6.69	12.21	19
Production and Distribution of Water		0.80		1
Construction		65.61		66
Transport, Storage, Postal & Telecommunications Services		395.47		395
Wholesale, Retail Trade and Catering Service		58.53		59
Other		78.11		78
Residential Consumption		266.07		266
<b>Total</b>				<b>6,339</b>
<b>Total (excluding residential)</b>				<b>6,073</b>

## Annex 2 Input-output analysis

Assuming that an economy includes  $n$  sectors, the equation can be represented as:

$$\mathbf{x} = \mathbf{Ax} + \mathbf{y}$$

where  $\mathbf{x}$  is the total output of the entire economy and it is a column vector.  $\mathbf{Ax}$  is the intermediate input and  $\mathbf{y}$  is the final demand.  $A$  is the matrix of direct input coefficients, and its element  $A_{ij}$  represents the amount of output from sector  $i$  required directly to produce per unit output from sector  $j$ . The final demand  $\mathbf{y}$  in the input-output model includes final consumption, investment and net export.

So, the relationship between the final demand  $\mathbf{y}$  and the total output  $\mathbf{x}$  can be represented as

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \mathbf{y}$$

Coupled input-output model with  $\text{CO}_2$  emissions,  $\mathbf{c}^d$  is a row vector with each element  $\mathbf{c}^d_j$  representing the direct  $\text{CO}_2$  emissions per unit sector  $j$  output  $\mathbf{x}_j$ .  $\mathbf{c}^d_j$  was calculated in Step 4.

The domestic emissions generated by all sectors could be represented by  $\mathbf{C}^d$ :

$$\mathbf{C}^d = \mathbf{c}^d \mathbf{x} = \mathbf{c}^d (\mathbf{I} - \mathbf{A})^{-1} \mathbf{y} = \mathbf{E}^d \mathbf{y}$$

where  $\mathbf{E}^d$  is a row vector with typical element  $\mathbf{E}^d_j$  representing the domestic embodied emissions per unit final demand  $\mathbf{y}$  in sector  $j$ .  $\mathbf{E}^d_j$  represents total emissions generated during domestic supply to meet per unit final demand.

### Annex 3 Direct and embodied emissions factors in China by sectors (2007)

SECTORS	DIRECT CO <sub>2</sub> EMISSION FACTOR	RANK	DIRECT CO <sub>2</sub> EMISSION/VÀT	RANK	EMBODIED CO <sub>2</sub> EMISSION FACTOR	RANK
	KG CO <sub>2</sub> PER YUAN		KG CO <sub>2</sub> PER YUÁN		KG CO <sub>2</sub> PER YUÁN	
Production and Distribution of Electric Power and Heat Power	0.926	1	3.308	1	1.614	1
Smelting and Pressing of Ferrous Metals	0.237	2	1.189	2	0.657	2
Production and Distribution of Gas	0.171	3	0.851	3	0.426	6
Manufacture of Non-Metallic Mineral Products	0.161	4	0.585	4	0.510	3
Mining and Washing of Coal	0.152	5	0.330	7	0.416	8
Manufacture of Raw Chemical Materials and Chemical Products	0.104	6	0.530	6	0.492	4
Processing of Petroleum, Coking, Processing of Nuclear Fuel	0.098	7	0.553	5	0.370	10
Extraction of Petroleum and Natural Gas	0.047	8	0.078	14	0.278	23
Manufacture of Paper and Paper Products	0.042	9	0.195	8	0.288	21
Mining and Processing of Nonmetal Ores and Other Ores	0.028	10	0.071	16	0.310	19
Manufacture of Beverages	0.024	11	0.082	13	0.191	34
Farming, Forestry, Animal Husbandry, Fishery & Water Conservancy	0.024	12	0.041	25	0.127	38
Smelting and Pressing of Non-Ferrous Metals	0.023	13	0.125	9	0.370	11
Manufacture of Chemical Fibers	0.020	14	0.117	10	0.369	12
Manufacture of Foods	0.019	15	0.092	11	0.186	35
Mining and Processing of Ferrous Metal Ores	0.019	16	0.058	17	0.458	5
Manufacture of Rubber	0.017	17	0.088	12	0.333	17
Manufacture of Textile	0.015	18	0.076	15	0.241	29
Manufacture of Medicines	0.014	19	0.049	20	0.212	32
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products	0.012	20	0.052	19	0.242	27
Mining and Processing of Non-Ferrous Metal Ores	0.012	21	0.031	29	0.339	16
Manufacture of Artwork and Other Manufacturing	0.011	22	0.045	23	0.248	25
Manufacture of General Purpose Machinery	0.011	23	0.046	21	0.325	18
Construction	0.010	24	0.045	22	0.350	14
Manufacture of Special Purpose Machinery	0.010	25	0.044	24	0.341	15
Processing of Food from Agricultural Products	0.010	26	0.055	18	0.146	37
Production and Distribution of Water	0.007	27	0.015	34	0.415	9
Manufacture of Metal Products	0.007	28	0.032	26	0.417	7
Manufacture of Transport Equipment	0.006	29	0.031	28	0.286	22
Manufacture of Tobacco	0.006	30	0.009	37	0.081	39
Manufacture of Plastics	0.006	31	0.031	27	0.366	13
Manufacture of Textile Wearing Apparel, Footwear and Caps	0.005	32	0.021	30	0.196	33
Manufacture of Articles For Culture, Education and Sport Activity	0.004	33	0.018	32	0.268	24



Manufacture of Leather, Fur, Feather and Related Products	0.004	34	0.019	31	0.175	36
Printing, Reproduction of Recording Media	0.004	35	0.012	35	0.227	31
Manufacture of Electrical Machinery and Equipment	0.003	36	0.015	33	0.299	20
Manufacture of Furniture	0.002	37	0.008	39	0.241	28
Manufacture of Measuring Instruments and Machinery for Cultural Activity and Office Work	0.002	38	0.009	36	0.243	26
Manufacture of Communication Equipment, Computers and Other Electronic Equipment	0.002	39	0.009	38	0.230	30
Recycling and Disposal of Waste	0.001	40	0.001	40	0.035	40

## Annex 4 China's possible targeted products under a United States BCA scheme

NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE AND TITLE	2007-2009 AVERAGE IMPORT VALUE FROM CHINA	2007-2009 AVERAGE SHARE OF IMPORT FROM CHINA
	IN 1,000 DOLLARS	%
311613: Rendering and Meat Byproduct Processing	32,481.667	13.783
313111: Yarn Spinning Mills	32,277.000	5.958
314992: Tire Cord and Tire Fabric Mills	84,414.333	21.551
321219: Reconstituted Wood Product Manufacturing	172,412.000	10.727
322121: Paper (except Newsprint) Mills	445,421.667	7.657
325131: Inorganic Dye and Pigment Manufacturing	185,097.667	18.003
325181: Alkalies and Chlorine Manufacturing (including soda ash beneficiation)	92,714.000	17.498
325188: All Other Basic Inorganic Chemical Manufacturing	691,568.667	6.716
325199: All Other Basic Organic Chemical Manufacturing	2,985,031.667	13.897
325221: Cellulosic Organic Fiber Manufacturing	42,274.333	15.770
325222: Noncellulosic Organic Fiber Manufacturing	246,672.000	12.556
327111: Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories	276,956.333	35.048
327112: Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing	1,040,735.667	57.554
327113: Porcelain Electrical Supply Manufacturing	83,488.000	30.741
327122: Ceramic Wall and Floor Tile Manufacturing	154,408.667	12.227
327125: Nonclay Refractory Manufacturing	109,153.333	31.477
327211: Flat Glass Manufacturing	161,119.000	21.881
327212: Other Pressed and Blown Glass and Glassware Manufacturing	696,517.000	32.928
327213: Glass Container Manufacturing	125,366.333	14.196
327310: Cement Manufacturing	129,106.000	12.974
327992: Ground or Treated Mineral and Earth Manufacturing	151,355.333	50.847
327993: Mineral Wool Manufacturing	39,248.667	8.341
331111: Iron and Steel Mills	4,302,882.667	13.797
331112: Electrometallurgical Ferroalloy Product Manufacturing	343,414.667	8.730
331511: Iron Foundries	289,828.000	32.081
335991: Carbon and Graphite Product Manufacturing	143,116.667	18.178
<b>Total</b>	<b>13,057,061.333</b>	

Source: United States import data of possible products in 6-digit NAICS is from United States Department of Commerce and International Trade Commission, retrieved from: [http://dataweb.usitc.gov/scripts/user\\_set.asp](http://dataweb.usitc.gov/scripts/user_set.asp)

## Annex 5 Sectors at risk in EU ETS

### 1.0 At THE NACE-4 LEVEL

#### 1.1 BASED ON THE QUANTITATIVE CRITERIA SET OUT IN PARAGRAPHS 15 AND 16 OF ARTICLE 10a OF DIRECTIVE 2003/87/EC

NACE CODE	DESCRIPTION
1010	Mining and agglomeration of hard coal
1430	Mining of chemical and fertilizer minerals
1597	Manufacture of malt
1711	Preparation and spinning of cotton-type fibres
1810	Manufacture of leather clothes
2310	Manufacture of coke oven products
2413	Manufacture of other inorganic basic chemicals
2414	Manufacture of other organic basic chemicals
2415	Manufacture of fertilizers and nitrogen compounds
2417	Manufacture of synthetic rubber in primary forms
2710	Manufacture of basic iron and steel and of ferro-alloys
2731	Cold drawing
2742	Aluminum production
2744	Copper production
2745	Other non-ferrous metal production
2931	Manufacture of agricultural tractors

#### 1.2. BASED ON THE QUANTITATIVE CRITERIA SET OUT IN PARAGRAPH 15 OF ARTICLE 10a OF DIRECTIVE 2003/87/EC

NACE CODE	DESCRIPTION
1562	Manufacture of starches and starch products
1583	Manufacture of sugar
1595	Manufacture of other non-distilled fermented beverages
1592	Production of ethyl alcohol from fermented materials
2112	Manufacture of paper and paperboard
2320	Manufacture of refined petroleum products
2611	Manufacture of flat glass
2613	Manufacture of hollow glass
2630	Manufacture of ceramic tiles and flags
2721	Manufacture of cast iron tubes
2743	Lead, zinc and tin production

### 1.3 BASED ON THE QUANTITATIVE CRITERIA SET OUT IN POINT (a) OF ARTICLE 10a(16) OF DIRECTIVE 2003/87/EC

NACE CODE	DESCRIPTION
2651	Manufacture of cement
2652	Manufacture of lime

### 2.0 BEYOND NACE-4 LEVEL BASED ON THE QUANTITATIVE CRITERIA SET OUT IN PARAGRAPHS 15 AND 16 OF ARTICLE 10a OF DIRECTIVE 2003/87/EC

PRODCOM CODE	DESCRIPTION
15331427	Concentrated tomato puree and paste
155120	Milk and cream in solid forms
155153	Casein
155154	Lactose and lactose syrup
15891333	Dry bakers' yeast
24111150	Hydrogen (including the production of hydrogen in combination with syngas).
24111160	Nitrogen
24111170	Oxygen
243021	Prepared pigments, opacifiers and colours, vitrifiable enamels and glazes, engobes, liquid lustres and the like; glass frit
24621030	Gelatin and its derivatives; isinglass (excluding casein glues and bone glues)
261411	Slivers, rovings, yarn and chopped strands, of glass fibre
26821400	Artificial graphite, colloidal, semi-colloidal graphite and preparations
26821620	Exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials and mixtures thereof

### 3.0 AT NACE-4 LEVEL BASED ON THE QUALITATIVE CRITERIA SET OUT IN PARAGRAPH 17 OF ARTICLE 10a OF DIRECTIVE 2003/87/EC

NACE CODE	DESCRIPTION
1730	Finishing of textiles
2020	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards
2416	Manufacture of plastics in primary forms
2751	Casting of iron
2753	Casting of light metals

## Annex 6 Charges under potential United States BCAs

### Annex 6.a Based on direct CO<sub>2</sub> emissions in Chinese exports

NAICS CODE AND TITLE	DIRECT CARBON EMISSION	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.
	TONNE CO <sub>2</sub> E	\$20/TONNE CO <sub>2</sub> E	%	\$50/TONNE CO <sub>2</sub> E	%
311613: Rendering and Meat Byproduct Processing	2,316	46	0.14	116	0.36
313111: Yarn Spinning Mills	3,438	69	0.21	172	0.53
314992: Tire Cord and Tire Fabric Mills	8,848	177	0.21	442	0.52
321219: Reconstituted Wood Product Manufacturing	14,252	285	0.17	713	0.41
322121: Paper (except Newsprint) Mills	134,320	2,686	0.60	6,716	1.51
325131: Inorganic Dye and Pigment Manufacturing	138,175	2,764	1.49	6,909	3.73
325181: Alkalies and Chlorine Manufacturing (incl soda ash beneficiation)	67,387	1,348	1.45	3,369	3.63
325188: All Other Basic Inorganic Chemical Manufacturing	512,089	10,242	1.48	25,604	3.70
325199: All Other Basic Organic Chemical Manufacturing	2,199,450	43,989	1.47	109,972	3.68
325221: Cellulosic Organic Fiber Manufacturing	5,919	118	0.28	296	0.70
325222: Noncellulosic Organic Fiber Manufacturing	34,364	687	0.28	1,718	0.70
327111: Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories	316,822	6,336	2.29	15,841	5.72
327112: Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing	1,196,578	23,932	2.30	59,829	5.75
327113: Porcelain Electrical Supply Manufacturing	95,646	1,913	2.29	4,782	5.73
327122: Ceramic Wall and Floor Tile Manufacturing	176,668	3,533	2.29	8,833	5.72
327125: Nonclay Refractory Manufacturing	125,177	2,504	2.29	6,259	5.73
327211: Flat Glass Manufacturing	184,695	3,694	2.29	9,235	5.73
327212: Other Pressed and Blown Glass and Glassware Manufacturing	799,862	15,997	2.30	39,993	5.74
327213: Glass Container Manufacturing	142,810	2,856	2.28	7,141	5.70
327310: Cement Manufacturing	152,563	3,051	2.36	7,628	5.91
327992: Ground or Treated Mineral and Earth Manufacturing	172,501	3,450	2.28	8,625	5.70
327993: Mineral Wool Manufacturing	45,324	906	2.31	2,266	5.77
331111: Iron and Steel Mills	7,270,349	145,407	3.38	363,517	8.45
331112: Electrometallurgical Ferroalloy Product Manufacturing	584,050	11,681	3.40	29,202	8.50
331511: Iron Foundries	491,269	9,825	3.39	24,563	8.48
335991: Carbon and Graphite Product Manufacturing	162,323	3,246	2.27	8,116	5.67
<b>Total</b>	<b>15,037,196</b>	<b>300,744</b>		<b>751,860</b>	

## Annex 6.b Based on embodied CO<sub>2</sub> emissions in Chinese exports

NAICS CODE AND TITLE	EMBODIED CARBON EMISSION	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.
	TONNE CO <sub>2</sub> E	\$20/TONNE CO <sub>2</sub> E	%	\$50/TONNE CO <sub>2</sub> E	%
311613: Rendering and Meat Byproduct Processing	3,3761	675	2.08	1,688	5.20
313111: Yarn Spinning Mills	5,5670	1,113	3.45	2,783	8.62
314992: Tire Cord and Tire Fabric Mills	14,3277	2,866	3.39	7,164	8.49
321219: Reconstituted Wood Product Manufacturing	29,5221	5,904	3.42	14,761	8.56
322121: Paper (except Newsprint) Mills	91,4317	18,286	4.11	45,716	10.26
325131: Inorganic Dye and Pigment Manufacturing	65,2242	13,045	7.05	32,612	17.62
325181: Alkalies and Chlorine Manufacturing (including soda ash beneficiation)	31,8091	6,362	6.86	15,905	17.15
325188: All Other Basic Inorganic Chemical Manufacturing	241,7260	48,345	6.99	120,863	17.48
325199: All Other Basic Organic Chemical Manufacturing	1,038,2256	207,645	6.96	519,113	17.39
325221: Cellulosic Organic Fiber Manufacturing	11,1193	2,224	5.26	5,560	13.15
325222: Noncellulosic Organic Fiber Manufacturing	64,5587	12,912	5.23	32,279	13.09
327111: Vitreous China Plumbing Fixture and China and Earthenware Bathroom Accessories	100,4858	20,097	7.26	50,243	18.14
327112: Vitreous China, Fine Earthenware, and Other Pottery Product Manufacturing	379,5168	75,903	7.29	189,758	18.23
327113: Porcelain Electrical Supply Manufacturing	30,3358	6,067	7.27	15,168	18.17
327122: Ceramic Wall and Floor Tile Manufacturing	56,0336	11,207	7.26	28,017	18.14
327125: Nonclay Refractory Manufacturing	39,7022	7,940	7.27	19,851	18.19
327211: Flat Glass Manufacturing	58,5793	11,716	7.27	29,290	18.18
327212: Other Pressed and Blown Glass and Glassware Manufacturing	253,6910	50,738	7.28	126,846	18.21
327213: Glass Container Manufacturing	45,2949	9,059	7.23	22,647	18.07
327310: Cement Manufacturing	48,3882	9,678	7.50	24,194	18.74
327992: Ground or Treated Mineral and Earth Manufacturing	54,7119	10,942	7.23	27,356	18.07
327993: Mineral Wool Manufacturing	14,3754	2,875	7.33	7,188	18.31
331111: Iron and Steel Mills	2,015,2526	403,051	9.37	1,007,626	23.42
331112: Electrometallurgical Ferroalloy Product Manufacturing	161,8915	32,378	9.43	80,946	23.57
331511: Iron Foundries	136,1738	27,235	9.40	68,087	23.49
335991: Carbon and Graphite Product Manufacturing	51,4838	10,297	7.19	25,742	17.99
<b>Total</b>	<b>50,428,045</b>	<b>1,008,561</b>		<b>2,521,402</b>	

## Annex 7 Vulnerability of Chinese manufactured exports to EU BCAs

NACE REV 1.1 OR PRODCOM	DESCRIPTION	HS 2007	2007-2009 AVERAGE IMPORT VALUE FROM CHINA	AVERAGE DIRECT CARBON EMISSION	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.	EMBODIED CARBON EMISSION	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.	TOTAL TARIFF IN 1000 DOLLARS	AD VALOREM TAX EQUIV.
			IN 1,000 EURO	TONNE CO <sub>2</sub> E	\$20/ TONNE CO <sub>2</sub> E	%	\$50/ TONNE CO <sub>2</sub> E	%	TONNE CO <sub>2</sub> E	\$20/ TONNE CO <sub>2</sub> E	%	\$50/ TONNE CO <sub>2</sub> E	%
<b>Manufacture of Leather, Fur, Feather and Related Products</b>													
1810	Manufacture of leather clothes	6101	96,229	3,575	72	0.11	179	0.26	168,088	3,362	4.94	8,404	12.36
		6103	205,917	7,699	154	0.11	385	0.26	361,947	7,239	4.96	18,097	12.41
		6105	239,835	8,955	179	0.11	448	0.26	420,973	8,419	4.96	21,049	12.40
		6107	448,293	16,775	336	0.11	839	0.26	788,648	15,773	4.97	39,432	12.41
		6102	199,436	7,401	148	0.11	370	0.26	347,947	6,959	4.94	17,397	12.36
		6104	831,447	30,927	619	0.11	1,546	0.26	1,453,960	29,079	4.94	72,698	12.35
		6106	204,137	7,586	152	0.11	379	0.26	356,657	7,133	4.95	17,833	12.36
		6108	896,634	33,560	671	0.11	1,678	0.26	1,577,713	31,554	4.97	78,886	12.42
		6109	1,324,904	49,563	991	0.11	2,478	0.26	2,330,051	46,601	4.97	116,503	12.42
		6111	832,451	31,151	623	0.11	1,558	0.26	1,464,486	29,290	4.97	73,224	12.41
		6112	524,815	19,677	394	0.11	984	0.26	925,077	18,502	4.97	46,254	12.43
		6114	241,920	9,097	182	0.11	455	0.27	427,655	8,553	4.98	21,383	12.46
		6116	232,447	8,705	174	0.11	435	0.26	409,224	8,184	4.98	20,461	12.45
		6117	199,190	7,433	149	0.11	372	0.26	349,425	6,988	4.96	17,471	12.39
		6201	1,298,670	48,604	972	0.11	2,430	0.26	2,285,003	45,700	4.97	114,250	12.42
		6203	2,175,717	81,273	1,625	0.11	4,064	0.26	3,820,837	76,417	4.96	191,042	12.41
		6205	727,187	27,249	545	0.11	1,362	0.26	1,281,033	25,621	4.97	64,052	12.43
		6207	107,816	4,045	81	0.11	202	0.26	190,170	3,803	4.98	9,508	12.44
		6202	1,888,811	70,672	1,413	0.11	3,534	0.26	3,322,434	66,449	4.97	166,122	12.42
		6204	3,664,261	136,947	2,739	0.11	6,847	0.26	6,438,203	128,764	4.96	321,910	12.40
		6206	631,841	23,554	471	0.11	1,178	0.26	1,107,305	22,146	4.95	55,365	12.39
		6208	199,500	7,482	150	0.11	374	0.26	351,730	7,035	4.97	17,587	12.44
		6209	391,396	14,659	293	0.11	733	0.26	689,159	13,783	4.97	34,458	12.42
		6211	649,386	24,334	487	0.11	1,217	0.26	1,143,980	22,880	4.98	57,199	12.44
		6212	726,526	27,133	543	0.11	1,357	0.26	1,275,579	25,512	4.95	63,779	12.39
		6213	11,599	435	9	0.11	22	0.26	20,428	409	4.98	1,021	12.44
		6214	155,074	5,762	115	0.10	288	0.26	270,887	5,418	4.94	13,544	12.34
		6215	89,072	3,342	67	0.11	167	0.26	157,108	3,142	4.98	7,855	12.44
		6216	103,600	3,873	77	0.11	194	0.26	182,088	3,642	4.96	9,104	12.41
		6217	81,680	3,055	61	0.11	153	0.26	143,630	2,873	4.96	7,182	12.41
		4203	598,020	22,492	450	0.11	1,125	0.27	1,057,403	21,148	4.99	52,870	12.48

		3926.20	377,967	14,123	282	0.11	706	0.26	663,963	13,279	4.96	33,198	12.40
		6113	65,774	2,464	49	0.11	123	0.26	115,845	2,317	4.97	5,792	12.42
		6210	985,540	36,827	737	0.11	1,841	0.26	1,731,321	34,626	4.96	86,566	12.40
		6501	2,024	75	2	0.10	4	0.26	3,537	71	4.92	177	12.30
		6502	2,022	76	2	0.11	4	0.26	3,564	71	4.97	178	12.43
		6504	17,588	657	13	0.11	33	0.26	30,889	618	4.95	1,544	12.37
		6505	413,920	15,489	310	0.11	774	0.26	728,190	14,564	4.97	36,410	12.42
		6506.99	21,093	789	16	0.11	39	0.26	37,097	742	4.97	1,855	12.41
		6507	4,567	171	3	0.11	9	0.26	8,021	160	4.96	401	12.40
<b>Processing of Petroleum, Coking, Processing of Nuclear Fuel</b>													
2310	Manufacture of coke oven products	2704	415,722	418,309	8,366	2.86	20,915	7.16	1,574,508	31,490	10.78	78,725	26.95
2320	Manufacture of refined petroleum products	2710.19	16,049	15,206	304	2.65	760	6.62	57,235	1,145	9.97	2,862	24.92
		2711	1,031	1,007	20	2.74	50	6.86	3,789	76	10.33	189	25.83
		2712	52,868	52,408	1,048	2.83	2,620	7.06	197,263	3,945	10.64	9,863	26.59
		2713	58,365	57,724	1,154	2.82	2,886	7.05	217,273	4,345	10.61	10,864	26.53
<b>Manufacture of Raw Chemical Materials and Chemical Products</b>													
2413	Manufacture of other inorganic basic chemicals	2207	1,521	1,648	33	2.99	82	7.47	7,780	156	14.10	389	35.24
2414	Manufacture of other organic basic chemicals	2901	9,098	9,502	190	2.97	475	7.41	44,851	897	14.00	2,243	35.00
1592	Production of ethyl alcohol from fermented materials	2902	23,468	24,583	492	2.96	1,229	7.40	116,040	2,321	13.98	5,802	34.95
24.11.11.50	Hydrogen (including the production of hydrogen in combination with syngas)	2903	108,801	114,049	2,281	2.97	5,702	7.42	538,355	10,767	14.00	26,918	35.01
24.11.11.60	Nitrogen	2904	17,991	18,915	378	2.97	946	7.44	89,288	1,786	14.04	4,464	35.10
24.11.11.70	Oxygen	2905	43,130	45,143	903	2.97	2,257	7.42	213,091	4,262	14.00	10,655	35.01
		2906	36,701	38,561	771	2.97	1,928	7.42	182,023	3,640	14.01	9,101	35.03
		2907	30,758	32,150	643	2.95	1,607	7.38	151,758	3,035	13.93	7,588	34.84
		2908	15,990	16,901	338	2.99	845	7.49	79,780	1,596	14.13	3,989	35.34
		3823	4,173	4,354	87	2.95	218	7.37	20,554	411	13.92	1,028	34.80
		2915	72,630	75,779	1,516	2.94	3,789	7.35	357,705	7,154	13.88	17,885	34.71



		2916	117,207	122,728	2,455	2.96	6,136	7.39	579,323	11,586	13.96	28,966	34.91
		2917	102,115	107,535	2,151	2.98	5,377	7.45	507,608	10,152	14.07	25,380	35.18
		2918	241,872	252,916	5,058	2.95	12,646	7.38	1,193,862	23,877	13.93	59,693	34.82
		2921	129,716	136,545	2,731	2.98	6,827	7.45	644,548	12,891	14.07	32,227	35.18
		2925	51,523	54,136	1,083	2.99	2,707	7.48	255,544	5,111	14.13	12,777	35.32
		2926	63,072	65,169	1,303	2.91	3,258	7.28	307,621	6,152	13.74	15,381	34.34
		2927	13,507	14,164	283	2.96	708	7.40	66,859	1,337	13.97	3,343	34.92
		2928	10,348	10,790	216	2.95	540	7.39	50,933	1,019	13.95	2,547	34.86
		2929	32,742	34,328	687	2.96	1,716	7.41	162,041	3,241	13.99	8,102	34.97
		2922	213,238	224,713	4,494	2.99	11,236	7.47	1,060,733	21,215	14.10	53,037	35.25
		2924	130,864	136,832	2,737	2.96	6,842	7.39	645,901	12,918	13.96	32,295	34.89
		2923	14,682	15,344	307	2.95	767	7.36	72,427	1,449	13.90	3,621	34.76
		2930	105,120	109,840	2,197	2.96	5,492	7.40	518,489	10,370	13.98	25,924	34.95
		2932	155,555	163,477	3,270	2.97	8,174	7.43	771,673	15,433	14.02	38,584	35.05
		2933	530,553	554,881	11,098	2.96	27,744	7.39	2,619,256	52,385	13.96	130,963	34.90
		2934	154,827	161,802	3,236	2.95	8,090	7.38	763,767	15,275	13.93	38,188	34.81
		2935	80,797	84,714	1,694	2.96	4,236	7.41	399,885	7,998	13.98	19,994	34.96
		2909	73,595	77,441	1,549	2.97	3,872	7.43	365,550	7,311	14.03	18,278	35.07
		2910	4,834	5,064	101	2.96	253	7.41	23,904	478	13.99	1,195	34.97
		2911	1,211	1,280	26	2.97	64	7.43	6,041	121	14.03	302	35.09
		2912	44,796	46,970	939	2.96	2,349	7.39	221,717	4,434	13.96	11,086	34.90
		2913	4,270	4,465	89	2.95	223	7.37	21,076	422	13.91	1,054	34.79
		2914	94,442	99,092	1,982	2.96	4,955	7.40	467,754	9,355	13.98	23,388	34.95
		2942	12,206	12,827	257	2.99	641	7.48	60,551	1,211	14.12	3,028	35.30
		3507	20,850	21,555	431	2.93	1,078	7.32	101,747	2,035	13.83	5,087	34.57
		2919	47,540	49,785	996	2.97	2,489	7.42	235,004	4,700	14.01	11,750	35.02
		2920	17,361	18,280	366	2.97	914	7.43	86,287	1,726	14.03	4,314	35.08
		2804	107,760	112,678	2,254	2.98	5,634	7.46	531,886	10,638	14.08	26,594	35.21
		2811	49,543	51,890	1,038	2.98	2,595	7.44	244,941	4,899	14.05	12,247	35.12
		2801	1,926	2,042	41	3.00	102	7.50	9,637	193	14.15	482	35.39
		2803	1,571	1,631	33	2.92	82	7.31	7,699	154	13.79	385	34.49
		2805	17,334	18,305	366	3.01	915	7.51	86,408	1,728	14.19	4,320	35.47
		2812	1,804	1,906	38	2.98	95	7.46	8,995	180	14.09	450	35.22
		2815	6,245	6,338	127	2.85	317	7.13	29,917	598	13.47	1,496	33.67
		2816	1,727	1,831	37	3.01	92	7.52	8,641	173	14.19	432	35.47
		2818.30	1,084	1,134	23	2.97	57	7.42	5,353	107	14.00	268	35.01
		2809	27,433	28,586	572	2.97	1,429	7.42	134,939	2,699	14.01	6,747	35.01
		2817	7,081	7,643	153	2.98	382	7.45	36,076	722	14.07	1,804	35.18

		2819	10,099	10,643	213	3.00	532	7.51	50,238	1,005	14.18	2,512	35.45
		2820	4,471	4,656	93	2.96	233	7.41	21,978	440	13.99	1,099	34.97
		2821	46,661	49,140	983	2.97	2,457	7.42	231,961	4,639	14.01	11,598	35.04
		2822	13,669	14,656	293	3.02	733	7.54	69,183	1,384	14.24	3,459	35.59
		2823	18,389	19,489	390	2.98	974	7.45	91,997	1,840	14.07	4,600	35.19
		2824	1,516	1,623	32	3.00	81	7.51	7,663	153	14.18	383	35.46
		2825	96,268	102,154	2,043	3.00	5,108	7.49	482,205	9,644	14.14	24,110	35.36
		2826	17,327	18,336	367	2.99	917	7.48	86,552	1,731	14.12	4,328	35.29
		2827	23,094	24,375	488	2.98	1,219	7.45	115,060	2,301	14.07	5,753	35.19
		2828	3,904	4,070	81	2.93	204	7.33	19,214	384	13.85	961	34.62
		2829	2,400	2,535	51	2.99	127	7.47	11,968	239	14.10	598	35.24
		2830	2,981	3,158	63	3.03	158	7.56	14,907	298	14.28	745	35.70
		2831	1,701	1,769	35	2.91	88	7.28	8,353	167	13.75	418	34.37
		2832	1,166	1,219	24	2.94	61	7.36	5,756	115	13.89	288	34.74
		2833	52,741	55,719	1,114	2.99	2,786	7.47	263,014	5,260	14.10	13,151	35.24
		2835	40,646	42,367	847	2.97	2,118	7.43	199,989	4,000	14.02	9,999	35.06
		2836	57,711	60,609	1,212	2.97	3,030	7.42	286,099	5,722	14.01	14,305	35.02
		2841	37,220	39,687	794	3.00	1,984	7.49	187,336	3,747	14.15	9,367	35.37
		2843	2,331	2,432	49	2.93	122	7.34	11,482	230	13.85	574	34.63
		2853	628	662	13	3.00	33	7.50	3,125	62	14.17	156	35.42
		2845	594	619	12	2.97	31	7.42	2,921	58	14.01	146	35.02
		2837	2,412	2,523	50	2.96	126	7.41	11,911	238	13.98	596	34.96
		2839	5,855	6,153	123	2.99	308	7.47	29,046	581	14.10	1,452	35.26
		2840	2,261	2,380	48	2.98	119	7.45	11,237	225	14.07	562	35.17
		2842	9,447	9,960	199	2.99	498	7.47	47,013	940	14.11	2,351	35.27
		2848	1,809	1,873	37	2.92	94	7.30	8,842	177	13.78	442	34.45
		2849	11,758	12,516	250	3.00	626	7.50	59,082	1,182	14.16	2,954	35.41
		2850	3,610	3,779	76	2.98	189	7.44	17,840	357	14.06	892	35.14
		2846	64,311	68,031	1,361	2.99	3,402	7.48	321,134	6,423	14.12	16,057	35.30
		3204	296,566	311,635	6,233	2.97	15,582	7.43	1,471,040	29,421	14.03	73,552	35.07
		3201	2,066	2,184	44	3.06	109	7.65	10,311	206	14.45	516	36.12
		3203	918	981	20	2.96	49	7.39	4,632	93	13.96	232	34.89
		3202	25,081	26,190	524	2.95	1,310	7.38	123,629	2,473	13.93	6,181	34.83
		3206	25,356	26,717	534	2.97	1,336	7.43	126,117	2,522	14.03	6,306	35.06
		3802.90	3,076	3,217	64	2.99	161	7.48	15,186	304	14.13	759	35.32
		3805	3,260	3,455	69	2.96	173	7.40	16,310	326	13.98	815	34.95
		3806	143,505	151,343	3,027	2.97	7,567	7.44	714,399	14,288	14.04	35,720	35.10
		4402	3,381	3,559	71	2.96	178	7.39	16,801	336	13.95	840	34.88

		2707	3,852	4,072	81	3.00	204	7.49	19,222	384	14.14	961	35.36
		2708	1,078	1,161	23	2.98	58	7.46	5,479	110	14.09	274	35.22
2415	Manufacture of fertilizers and nitrogen compounds	3102	1,614	1,700	34	2.97	85	7.44	8,024	160	14.04	401	35.10
		3104	616	652	13	3.02	33	7.56	3,079	62	14.27	154	35.67
		3105	8,014	8,400	168	3.00	420	7.50	39,653	793	14.16	1,983	35.40
		2834	2,167	2,276	46	2.96	114	7.40	10,743	215	13.97	537	34.92
		2814	1,093	1,163	23	3.13	58	7.83	5,491	110	14.78	275	36.94
2417	Manufacture of synthetic rubber in primary form	3901	28,631	30,128	603	2.98	1,506	7.46	142,215	2,844	14.08	7,111	35.21
2416	Manufacture of plastics in primary forms	3903	60,813	64,675	1,293	2.98	3,234	7.46	305,290	6,106	14.08	15,265	35.20
		3904	27,102	28,518	570	2.97	1,426	7.43	134,618	2,692	14.02	6,731	35.06
		3907	75,245	79,675	1,594	3.00	3,984	7.49	376,097	7,522	14.15	18,805	35.38
		3902	5,479	5,765	115	2.98	288	7.45	27,213	544	14.07	1,361	35.18
		3905	38,078	40,042	801	2.99	2,002	7.48	189,013	3,780	14.12	9,451	35.30
		3906	9,590	10,086	202	2.95	504	7.38	47,612	952	13.93	2,381	34.84
		3908	8,948	9,365	187	2.98	468	7.44	44,205	884	14.05	2,210	35.12
		3909	7,926	8,288	166	2.96	414	7.39	39,124	782	13.95	1,956	34.89
		3910	7,974	8,277	166	2.93	414	7.34	39,068	781	13.85	1,953	34.63
		3911	13,282	14,010	280	2.98	700	7.45	66,131	1,323	14.07	3,307	35.18
		3912	26,442	27,798	556	2.98	1,390	7.45	131,218	2,624	14.07	6,561	35.18
		3913	39,193	40,949	819	2.96	2,047	7.39	193,296	3,866	13.95	9,665	34.88
		3914	24,609	25,882	518	2.97	1,294	7.43	122,172	2,443	14.03	6,109	35.08
		4002	22,597	23,705	474	2.97	1,185	7.43	111,898	2,238	14.03	5,595	35.07
24.30.21	Prepared pigments, opacifiers and colours, vitrifiable enamels and glazes, engobes, liquid lustres and the like; glass frit	3207	31,804	33,474	669	2.97	1,674	7.44	158,012	3,160	14.04	7,901	35.11
24.62.10.30	Gelatin and its derivatives; isinglass (excluding casein glues and bone glues)	3503	5,585	5,905	118	2.97	295	7.43	27,875	558	14.04	1,394	35.09

Smelting and Pressing of Ferrous Metals													
2710	Manufacture of basic iron and steel and of ferro-alloys	7201	3,248	7,901	158	6.85	395	17.13	21,901	438	18.99	1,095	47.47
2731	Cold drawing	7202	416,286	1,011,660	20,233	6.90	50,583	17.26	2,804,198	56,084	19.14	140,210	47.84
		7205	16,372	39,396	788	6.81	1,970	17.01	109,201	2,184	18.86	5,460	47.16
		7206	2,827	6,821	136	6.85	341	17.14	18,907	378	19.00	945	47.50
		7207	32,418	78,224	1,564	6.77	3,911	16.93	216,828	4,337	18.78	10,841	46.94
		7218	7,727	18,464	369	6.76	923	16.91	51,181	1,024	18.75	2,559	46.87
		7224	8,192	19,734	395	6.79	987	16.97	54,699	1,094	18.82	2,735	47.05
		7208	1,577,705	3,832,018	76,640	6.89	191,601	17.24	10,621,890	212,438	19.11	531,094	47.78
		7210	935,169	2,272,330	45,447	6.86	113,617	17.16	6,298,624	125,972	19.02	314,931	47.56
		7212	37,763	92,430	1,849	6.85	4,622	17.13	256,205	5,124	19.00	12,810	47.49
		7211	49,042	119,838	2,397	6.77	5,992	16.92	332,177	6,644	18.76	16,609	46.89
		7219	400,602	982,911	19,658	6.81	49,146	17.04	2,724,510	54,490	18.89	136,225	47.22
		7220	7,853	18,925	379	6.75	946	16.88	52,459	1,049	18.72	2,623	46.79
		7209	306,731	743,024	14,860	6.92	37,151	17.30	2,059,573	41,191	19.18	102,979	47.96
		7225	74,998	179,879	3,598	6.89	8,994	17.23	498,604	9,972	19.11	24,930	47.77
		7226	4,782	11,534	231	6.78	577	16.94	31,970	639	18.78	1,598	46.95
		7213	227,292	559,395	11,188	6.80	27,970	17.00	1,550,574	31,011	18.85	77,529	47.13
		7214	135,143	330,270	6,605	6.87	16,514	17.18	915,469	18,309	19.05	45,773	47.63
		7221	1,341	3,265	65	6.74	163	16.85	9,049	181	18.68	452	46.71
		7227	30,763	74,333	1,487	7.09	3,717	17.72	206,042	4,121	19.65	10,302	49.12
		7216	90,684	220,467	4,409	6.93	11,023	17.32	611,108	12,222	19.21	30,555	48.02
		7301	9,122	21,671	433	6.75	1,084	16.88	60,068	1,201	18.72	3,003	46.79
		7302	7,809	18,425	368	6.70	921	16.74	51,072	1,021	18.56	2,554	46.40
		7215	22,261	54,127	1,083	6.85	2,706	17.13	150,034	3,001	18.99	7,502	47.48
		7222	9,299	22,604	452	6.83	1,130	17.07	62,655	1,253	18.93	3,133	47.32
		7228	160,749	389,021	7,780	6.91	19,451	17.26	1,078,318	21,566	19.14	53,916	47.85
		7223	29,486	71,158	1,423	6.80	3,558	16.99	197,242	3,945	18.84	9,862	47.11
		7229	29,474	70,668	1,413	6.86	3,533	17.15	195,884	3,918	19.02	9,794	47.55
		7304	443,723	1,070,024	21,400	6.84	53,501	17.11	2,965,976	59,320	18.97	148,299	47.42
		7305	16,279	38,974	779	6.80	1,949	16.99	108,030	2,161	18.84	5,402	47.10
		7306	214,728	521,859	10,437	6.83	26,093	17.07	1,446,529	28,931	18.93	72,326	47.32
2721	Manufacture of cast iron tubes	7307.11	46,028	109,818	2,196	6.74	5,491	16.85	304,402	6,088	18.68	15,220	46.71
		7307.19	76,834	183,093	3,662	6.75	9,155	16.87	507,513	10,150	18.71	25,376	46.76

Smelting and Pressing of Non-ferrous Metals													
2742	Aluminum production	7106	135,496	32,312	646	0.67	1,616	1.67	511,987	10,240	10.61	25,599	26.54
2744	Copper production	7108	13,700	3,220	64	0.67	161	1.67	51,029	1,021	10.56	2,551	26.39
2745	Other non-ferrous metal production	7110	2,034	478	10	0.65	24	1.63	7,577	152	10.36	379	25.90
2743	Lead, zinc and tin production	7115.10	4,762	1,130	23	0.66	56	1.66	17,900	358	10.52	895	26.31
		7403	8,566	2,048	41	0.68	102	1.69	32,444	649	10.73	1,622	26.83
		7405	1,595	365	7	0.64	18	1.61	5,787	116	10.19	289	25.48
		7502	1,123	267	5	0.67	13	1.67	4,230	85	10.58	211	26.45
		7601	38,389	9,267	185	0.67	463	1.68	146,834	2,937	10.65	7,342	26.62
		2818.20	6,437	1,510	30	0.67	76	1.67	23,927	479	10.57	1,196	26.42
		7801	6,058	1,471	29	0.67	74	1.67	23,314	466	10.57	1,166	26.41
		7901	56,670	13,757	275	0.67	688	1.67	217,984	4,360	10.57	10,899	26.42
		8001	40,651	9,756	195	0.67	488	1.68	154,582	3,092	10.66	7,729	26.65
		7407	6,771	1,596	32	0.67	80	1.67	25,295	506	10.58	1,265	26.45
		7408	15,969	3,792	76	0.67	190	1.68	60,085	1,202	10.64	3,004	26.59
		7409	2,035	481	10	0.67	24	1.67	7,629	153	10.59	381	26.48
		7410	21,170	5,010	100	0.67	250	1.67	79,377	1,588	10.58	3,969	26.45
		7411	102,967	24,394	488	0.67	1,220	1.68	386,527	7,731	10.62	19,326	26.55
		7412	204,811	48,407	968	0.67	2,420	1.67	767,020	15,340	10.57	38,351	26.43
		7505	2,004	471	9	0.66	24	1.65	7,458	149	10.46	373	26.15
		7506	939	221	4	0.67	11	1.67	3,504	70	10.56	175	26.40
		7507	1,014	241	5	0.67	12	1.67	3,818	76	10.61	191	26.51
		7603	1,161	273	5	0.67	14	1.66	4,324	86	10.55	216	26.37
		7604	174,016	41,074	821	0.67	2,054	1.67	650,822	13,016	10.58	32,541	26.46
		7605	18,614	4,481	90	0.67	224	1.68	71,005	1,420	10.62	3,550	26.56
		7606	93,329	22,110	442	0.67	1,106	1.69	350,338	7,007	10.69	17,517	26.72
		7607	132,546	31,440	629	0.67	1,572	1.67	498,174	9,963	10.62	24,909	26.54
		7608	22,342	5,264	105	0.67	263	1.66	83,403	1,668	10.55	4,170	26.38
		7609	9,522	2,248	45	0.67	112	1.67	35,614	712	10.57	1,781	26.43
		7904	957	228	5	0.67	11	1.67	3,610	72	10.58	181	26.44
		8003	2,877	672	13	0.66	34	1.66	10,654	213	10.50	533	26.24
		8112.92	22,442	5,320	106	0.67	266	1.68	84,291	1,686	10.65	4,215	26.62
		8101.10	11,705	2,780	56	0.67	139	1.68	44,055	881	10.65	2,203	26.63
		8101.94	2,666	631	13	0.67	32	1.66	10,006	200	10.54	500	26.36
		8102.94	21,917	5,286	106	0.68	264	1.69	83,757	1,675	10.70	4,188	26.75

		8103.20	19,403	4,583	92	0.67	229	1.68	72,618	1,452	10.62	3,631	26.54
		8104.11	144,791	34,285	686	0.67	1,714	1.68	543,243	10,865	10.68	27,162	26.69
		8104.19	123,458	29,152	583	0.67	1,458	1.68	461,921	9,238	10.65	23,096	26.63
		8105.20	28,842	6,858	137	0.68	343	1.70	108,666	2,173	10.78	5,433	26.95
		8108.20	15,101	3,610	72	0.67	181	1.68	57,202	1,144	10.67	2,860	26.69
		8109.20	1,102	261	5	0.69	13	1.71	4,139	83	10.86	207	27.14
		8101.96	3,073	716	14	0.66	36	1.65	11,343	227	10.45	567	26.13
		8101.99	5,947	1,406	28	0.67	70	1.67	22,275	446	10.58	1,114	26.45
		8102.95	27,420	6,549	131	0.68	327	1.71	103,764	2,075	10.84	5,188	27.09
		8102.96	4,743	1,120	22	0.67	56	1.68	17,753	355	10.66	888	26.64
		8102.99	2,591	611	12	0.67	31	1.67	9,682	194	10.59	484	26.46
		8103.90	5,912	1,381	28	0.66	69	1.65	21,881	438	10.46	1,094	26.14
		8104.30	49,956	11,842	237	0.68	592	1.69	187,634	3,753	10.71	9,382	26.77
		8104.90	10,949	2,552	51	0.66	128	1.64	40,441	809	10.42	2,022	26.05
		8105.90	724	170	3	0.66	9	1.66	2,697	54	10.50	135	26.24
		8108.90	49,093	11,649	233	0.67	582	1.67	184,579	3,692	10.59	9,229	26.47
		8109.9	796	189	4	0.69	9	1.72	3,001	60	10.91	150	27.28
		8112.99	1,358	321	6	0.67	16	1.66	5,084	102	10.54	254	26.36
		8112.21	5,171	1,216	24	0.67	61	1.67	19,262	385	10.56	963	26.40
		8112.29	1,085	256	5	0.67	13	1.66	4,049	81	10.54	202	26.35
		8110	65,317	15,399	308	0.67	770	1.66	243,993	4,880	10.55	12,200	26.36
		8106	17,442	4,174	83	0.67	209	1.69	66,133	1,323	10.69	3,307	26.73
		8111	203,500	48,203	964	0.67	2,410	1.68	763,782	15,276	10.64	38,189	26.60
		8113	7,912	1,862	37	0.67	93	1.66	29,510	590	10.54	1,476	26.35

**Manufacture of Non-Metallic Mineral Products**

2611	Manufacture of flat glass	7001	3,552	5,762	115	4.59	288	11.47	18,274	365	14.56	914	36.39
2613	Manufacture of hollow glass	7002	13,777	22,325	446	4.58	1,116	11.46	70,807	1,416	14.54	3,540	36.35
26.14.11	Slivers, rovings, yarn and chopped strands, of glass fibre	7003	17,687	28,639	573	4.60	1,432	11.49	90,835	1,817	14.58	4,542	36.45
		7004	5,381	8,754	175	4.59	438	11.48	27,766	555	14.56	1,388	36.40
		7005	107,051	175,988	3,520	4.62	8,799	11.55	558,179	11,164	14.66	27,909	36.64
		7006	36,542	59,039	1,181	4.57	2,952	11.41	187,254	3,745	14.48	9,363	36.20
		7007	164,640	265,116	5,302	4.56	13,256	11.40	840,863	16,817	14.47	42,043	36.17
		7008	3,512	5,659	113	4.55	283	11.37	17,949	359	14.43	897	36.07
		7009	199,766	323,555	6,471	4.57	16,178	11.44	1,026,216	20,524	14.51	51,311	36.27

		7016	52,122	84,388	1,688	4.58	4,219	11.45	267,651	5,353	14.53	13,383	36.33
		7019	293,046	475,238	9,505	4.59	23,762	11.48	1,507,307	30,146	14.56	75,365	36.41
		7010	56,320	91,004	1,820	4.58	4,550	11.45	288,636	5,773	14.53	14,432	36.32
		7011	12,257	19,843	397	4.56	992	11.39	62,936	1,259	14.46	3,147	36.14
		7013	409,853	664,313	13,286	4.58	33,216	11.44	2,106,992	42,140	14.52	105,350	36.30
		7015	1,883	3,045	61	4.54	152	11.35	9,657	193	14.40	483	36.01
		7017	7,289	11,756	235	4.56	588	11.40	37,286	746	14.46	1,864	36.15
		9405.91	31,897	51,734	1,035	4.58	2,587	11.45	164,083	3,282	14.52	8,204	36.31
		8546.10	2,466	4,020	80	4.61	201	11.52	12,751	255	14.61	638	36.53
		7014	1,805	2,926	59	4.60	146	11.49	9,279	186	14.58	464	36.45
		7018	34,251	55,457	1,109	4.57	2,773	11.43	175,892	3,518	14.50	8,795	36.25
		7020	131,183	211,367	4,227	4.55	10,568	11.38	670,391	13,408	14.44	33,520	36.10
2630	Manufacture of ceramic tiles and flags	6901	8,027	13,082	262	4.59	654	11.49	41,493	830	14.57	2,075	36.43
		6907	72,241	117,140	2,343	4.58	5,857	11.45	371,530	7,431	14.52	18,577	36.31
		6908	231,708	375,255	7,505	4.57	18,763	11.43	1,190,189	23,804	14.50	59,509	36.26
2651	Manufacture of cement	2523	262,568	433,899	8,678	4.64	21,695	11.61	1,376,192	27,524	14.73	68,810	36.82
26.82.14.00	Artificial graphite, colloidal, semi-colloidal graphite and preparations	3801	16,828	27,150	543	4.59	1,357	11.47	86,110	1,722	14.55	4,306	36.39
26.82.16.20	Exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials and mixtures thereof	6806.20	1,243	2,014	40	4.64	101	11.60	6,389	128	14.71	319	36.78
<b>Others</b>													
1010	Mining and agglomeration of hard coal	2701	85,108	132,648	2,653	4.45	6,632	11.14	363,470	7,269	12.20	18,174	30.51
1430	Mining of chemical and fertilizer minerals	2511	30,109	8,488	170	0.80	424	2.00	94,899	1,898	8.94	4,745	22.36
		2529.21	2,896	816	16	0.79	41	1.97	9,125	183	8.80	456	22.01
		2529.22	26,773	7,549	151	0.80	377	2.00	84,407	1,688	8.96	4,220	22.40
		2530.90	15,454	4,347	87	0.80	217	2.00	48,608	972	8.93	2,430	22.31

1597	Manufacture of malt	2203	10,128	2,490	50	0.69	124	1.73	19,474	389	5.42	974	13.54
1711	Preparation and spinning of cotton-type fibres	5002	38,000	5,750	115	0.43	287	1.07	93,104	1,862	6.95	4,655	17.37
		5101.21	4,383	669	13	0.43	33	1.06	10,833	217	6.89	542	17.21
		5101.30	4,457	676	14	0.43	34	1.07	10,949	219	6.91	547	17.28
		5103.10	8,480	1,275	25	0.42	64	1.06	20,644	413	6.85	1,032	17.13
		5105	90,010	13,464	269	0.42	673	1.05	218,022	4,360	6.83	10,901	17.08
		5305	1,704	257	5	0.43	13	1.07	4,165	83	6.90	208	17.25
		5506	1,731	264	5	0.42	13	1.06	4,269	85	6.88	213	17.20
		5004	31,494	4,746	95	0.43	237	1.07	76,853	1,537	6.92	3,843	17.29
		5005	11,375	1,717	34	0.43	86	1.07	27,797	556	6.90	1,390	17.25
		5106	1,835	275	5	0.42	14	1.05	4,450	89	6.82	223	17.05
		5107	46,682	7,072	141	0.43	354	1.07	114,510	2,290	6.92	5,725	17.30
		5108	6,279	941	19	0.43	47	1.07	15,231	305	6.93	762	17.33
		5109	1,690	251	5	0.42	13	1.05	4,071	81	6.79	204	16.99
		5204	1,119	166	3	0.42	8	1.05	2,693	54	6.82	135	17.06
		5205	61,937	9,317	186	0.43	466	1.06	150,860	3,017	6.88	7,543	17.20
		5206	1,201	181	4	0.42	9	1.06	2,925	59	6.86	146	17.14
		5207	1,246	186	4	0.42	9	1.05	3,012	60	6.83	151	17.08
		5306	30,358	4,564	91	0.43	228	1.06	73,911	1,478	6.88	3,696	17.21
		5308	3,742	565	11	0.43	28	1.06	9,145	183	6.90	457	17.24
		5401	14,128	2,122	42	0.42	106	1.06	34,356	687	6.87	1,718	17.17
		5508	19,813	2,979	60	0.42	149	1.06	48,233	965	6.86	2,412	17.16
		5402.61	2,089	313	6	0.42	16	1.06	5,073	101	6.84	254	17.09
		5402.62	10,985	1,647	33	0.42	82	1.06	26,669	533	6.85	1,333	17.13
		5402.69	2,442	364	7	0.42	18	1.05	5,902	118	6.81	295	17.02
		5403.41	3,656	548	11	0.42	27	1.05	8,881	178	6.80	444	17.01
		5406	2,811	424	8	0.43	21	1.06	6,873	137	6.88	344	17.21
		5509	13,973	2,095	42	0.42	105	1.06	33,924	678	6.87	1,696	17.19
		5510	6,621	987	20	0.42	49	1.04	15,984	320	6.76	799	16.90
		5511	9,644	1,439	29	0.42	72	1.05	23,300	466	6.81	1,165	17.03
2931	Manufacture of agricultural tractors	8701	30,929	3,227	65	0.30	161	0.74	106,614	2,132	9.76	5,331	24.39
1562	Manufacture of starches and starch products	1702	2,533	257	5	0.29	13	0.72	3,742	75	4.21	187	10.53
15.51.54	Lactose and lactose syrup	1108	584	60	1	0.29	3	0.72	872	17	4.18	44	10.44



		3505	1,081	109	2	0.29	5	0.72	1,594	32	4.19	80	10.47
		1903	1,339	135	3	0.28	7	0.71	1,965	39	4.15	98	10.37
1583	Manufacture of sugar	1701	617	62	1	0.29	3	0.72	909	18	4.18	45	10.44
1595	Manufacture of other non-distilled fermented beverages	2204	1,941	475	9	0.69	24	1.72	3,714	74	5.39	186	13.46
		2206	4,512	1,106	22	0.69	55	1.73	8,647	173	5.41	432	13.53
2112	Manufacture of paper and paperboard	4703	835	357	7	1.21	18	3.04	2,431	49	8.26	122	20.66
		4706	20,305	8,656	173	1.21	433	3.02	58,923	1,178	8.22	2,946	20.56
		4801	7,811	3,355	67	1.20	168	3.01	22,841	457	8.19	1,142	20.49
		4802	41,359	17,667	353	1.20	883	3.01	120,262	2,405	8.18	6,013	20.46
		4803	13,968	5,884	118	1.19	294	2.97	40,052	801	8.10	2,003	20.24
		4804	3,595	1,550	31	1.21	77	3.03	10,550	211	8.25	527	20.62
		4805	31,077	13,523	270	1.21	676	3.04	92,051	1,841	8.27	4,603	20.67
		4806	2,152	918	18	1.20	46	3.01	6,249	125	8.19	312	20.46
		4807	784	333	7	1.19	17	2.98	2,265	45	8.11	113	20.27
		4808.30	586	250	5	1.20	12	3.00	1,701	34	8.17	85	20.42
		4808.90	2,133	898	18	1.18	45	2.96	6,112	122	8.06	306	20.16
		4810	2,506	1,044	21	1.17	52	2.94	7,104	142	7.99	355	19.98
		4809	118,424	50,203	1,004	1.19	2,510	2.98	341,730	6,835	8.12	17,087	20.30
		4811	37,329	15,859	317	1.20	793	3.00	107,950	2,159	8.16	5,398	20.40
2020	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	4412	4,189	497	10	0.34	25	0.84	10,294	206	6.97	515	17.42
		4410	6,616	787	16	0.34	39	0.84	16,294	326	6.94	815	17.36
		4411	16,254	1,921	38	0.34	96	0.84	39,788	796	6.94	1,989	17.36
		4408	366,192	43,556	871	0.34	2,178	0.84	902,223	18,044	6.95	45,111	17.37
		4413	5,209	615	12	0.34	31	0.84	12,737	255	6.94	637	17.36
2751	Casting of iron	7303	56,502	6,008	120	0.30	300	0.76	185,860	3,717	9.36	9,293	23.39
15.33.14.27	Concentrated tomato puree and paste	2002.90	110,940	21,446	429	0.54	1,072	1.36	206,654	4,133	5.25	10,333	13.13
15.51.53	Casein	3501.10	8,764	1,298	26	0.42	65	1.04	19,227	385	6.16	961	15.39
15.89.13.33	Dry bakers' yeast	2102.10	777	149	3	0.54	7	1.36	1,438	29	5.22	72	13.06



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