Supplementary Information

A Practical Approach to Screening Potential Environmental Hotspots of Different Impact Categories in Supply Chains. *Sustainability*, 2015, *7*, 11878-11892.

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1. Introduction

1.1. Recent Developments in Environmental Input-Output Analysis

Current challenges regarding the life cycle inventory (LCI) phase as described in Section 1 of the body text stem from differences of the unit environmental burdens or resource consumptions for the same type and quantity of outputs (product or service) between countries or regions. Previously, this type of accounting was based on embodied environmental intensities derived from single-region input-output (SRIO) models for a specific country, such as the Embodied Energy and Emission Intensity Data for Japan Using Input-Output Tables (3EID) [1,2]. In this case, however, one must be aware that the LCIs are based on the domestic technology assumption (DTA).

As discussed in the context of EF [3], MRIO models were not precise enough to calculate various types of interventions of individual products, and their sector resolutions were not high as compared with those of SRIO models. In recent years, various multi-region input-output (MRIO) models have provided embodied intensities of greenhouse gases (GHGs) and other substances that take into account the import and export. Cases exist in which accounting has been done for embodied carbon dioxide (CO_2) emissions in import and export for various countries around the world [4]. There is also a model and database that includes water consumption [5,6]. The global link input-output (GLIO) model that calculates the embodied intensities of global environmental burdens (GHGs and acidifying substances)

for Japanese domestically produced products (406 sectors) has not yet taken water resources into account [1,7].

1.2. Recent Developments in Life Cycle Impact Assessment

From the life cycle impact assessment (LCIA) perspective, the same amount of emissions from any part of the world can be deemed to have an equal amount of impact in terms of global warming. In impact categories, such as terrestrial acidification, however, the impacts are determined by atmospheric, soil, and other environmental conditions specific to each region. For such regional environmental impacts, the interventions are not simply added; the LCI must be aggregated for each nation/region and then characterized considering the region-dependent conditions.

Accurately determining regional dependency is an outstanding challenge in LCIA [8,9]. For impact categories that are regional or local, there are methods that include characterization factors for each country or region which take into account regionally-dependent environmental conditions, but currently these methods only target various European nations or Japan [10–16]. Moreover, ReCiPe 2008, a recently published method [17,18], recommends applying region-generic characterization factors that average the results of regionally dependent fate and exposure analyses for Europe as a whole. Though recent years have seen renewed commitment to identify the characterization factors for each nation or region [19,20], these developments are still in progress. In addition, the consistency with the above-mentioned LCIs based on EIOA in terms of regional scope or resolution is still unclear.

The impact of resource consumption (evaluated as depletion risks or surplus costs), for fossil or mineral resources that can be transported between regions, can be deemed to not be dependent on the consuming region, but for water resources, the difficulty of transportation between regions and the uneven distribution of usable volumes between nations or regions means that the impact from the consumption of the same volume is largely regionally dependent. There have been numerous water consumption characterization models proposed to reflect the differences in the environmental conditions between nations or watersheds [21].

2. Materials and Methods

2.1. Characterization Factors

By multiplying the amount of interventions of relevant substances by their characterization factors (impact per unit intervention) and aggregating them, the potential impact for each impact category can be derived. In this study, we used the midpoint characterization factors described below to analyze the characteristics across impact categories.

2.1.1. Global Warming

For global warming, the six substances were converted to CO_2 equivalents and aggregated into a unit GHG emission in 3EID (2005 table) and the GLIO model [1,7]. Of these, GHGs other than CO_2 are based on CO_2 equivalent emissions for 2005, published in the National GHGs Inventory Report of 2009 [22]. As the characterization factors for each substance, this national inventory report uses the

Global Warming Potential (GWP) with a time horizon of 100 years (GWP 100) from the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) [23].

2.1.2. Terrestrial Acidification

For terrestrial acidification, the characterization factors we applied were the average values for the Deposition-oriented Acidification Potential (DAP), which is the characterization factor for acidification used in the Life-cycle Impact assessment Method based on Endpoint modeling (LIME 2), an LCIA method developed in Japan [24]. For nitrous oxides (NOx) and sulfur oxides (SOx), we used the DAPs for nitrogen dioxide (NO_2) and sulfur dioxide (SO_2), respectively. The DAP [kg SO_2 eq/kg] for acidifying substance x is the respective Atmospheric Deposition Factor (ADF), expressed in SO_2 equivalents, and is described by Equation (S1) [24,25].

$$DAP(x) = ADF(x)/ADF(\text{SO}_2) \tag{S1}$$

Including LIME 2, the midpoint characterization factors for acidification (terrestrial or marine) in the LCIA are often the potential impacts on ecosystems per unit emissions of each substance converted into SO_2 equivalents [12–18,24–27]. The differences between methods are in their definition of impacts, and there are several types: substance dependent characterization factors based solely on the number of hydrogen ions potentially produced $\eta(x)$ [eq/kg] for each substance (called Generic AP) [26,27], regionally dependent characterization factors that take into account the atmospheric transfer coefficient and the deposition area of acidifying substances as well as critical load of the soil as regional environmental conditions [10–14,27–30], and region-generic characterization factors that take base saturation into account [17,18]. The ADF [eq/km^2/kg] in LIME 2 is described using Equation (S2) [24,25].

$$ADF(x) = SRR(x) \cdot \eta(x) \cdot NNR(x)/A_{Japan}^{L} \tag{S2}$$

Here, in addition to the number of hydrogen ions potentially produced and the non-neutralization ratio (NNR) of each substance, the source–receptor relationship (SRR) of each substance emitted in Japan and the land area of Japan A_{Japan}^{L} [km^2] are taken into consideration. The SRR is synonymous with the atmospheric transfer coefficient. As such, the DAP is deemed to be a regionally dependent characterization factor that assumes the environmental conditions in Japan.

2.1.3. Water Resource Consumption

For water resource consumption, we applied the Water Stress Indicator (WSI) [31,32], which has been proposed as a midpoint characterization factor. The WSI [m^3·water·eq] is calculated using Equation (S3) below for each water category i, with respect to water source and water quality. The equation deducts the volumes of water released V_i^{out} [m^3] from the volumes of water withdrawn V_i^{in} [m^3], which is weighted by the stress index α_i. This shows the availability of water resources of which other competing users are deprived as a consequence of water use [32].

$$WSI = \sum_i \alpha_i \cdot V_i^{in} - \sum_i \alpha_i \cdot V_i^{out} \tag{S3}$$

However, in the calculation of interventions in the EIOA, the water quality level at the source of water extraction and the destination of the water released is difficult to identify, so strictly, the WSI equation above cannot be applied. In this article, "water consumption," referred to in Section 2.2 of the body text, is defined as water that cannot be returned to the same water source from which it was withdrawn [33,34], therefore we approximated the WSI using Equation (S4). In other words, water consumption $\tilde{V}_i$ [m^3] for each water source (river water, ground water, and rain water) was multiplied by α_i of the average water quality level (surface water: S2b, ground water: G2b) of Japan, and then these results were aggregated into a total

$$WSI = \sum_i \alpha_i \cdot \left(V_i^{in} - V_i^{out}\right) \approx \sum_i \alpha_i \cdot \tilde{V}_i \tag{S4}$$

From the above, to gain an understanding of the potential impacts of water resource consumption abroad, an awareness is of the uneven distributions of water availability among nations or regions is necessary. The unevenness leads to uncertainty at the LCIA stage, in addition to uncertainties in the LCI. Note that for ground water in Japan, the α_i value is set to be smaller than that in other nations (see Table 1 of the body text), so the impact of ground water consumption per unit is smaller. For example, the α_i value for ground water (G2b) in China and the United States, which are Japan's top two import partners in 2012 [35], were respectively 0.620 and 0.510, and within the top ten nations (excluding Middle Eastern countries where α_i has not been defined), the only nation with a smaller α_i value for groundwater (G2b) than Japan is Malaysia [31].

2.2. Domestic Ratios of Potential Impacts

As described in Section 2.4 of the body text, the potential impacts that arise domestically and abroad are categorized on the basis of the embodied environmental intensities under the DTA and those excluding the input of imports using Equations (3) and (4). We can easily see, by looking at those equations, that the sum of the domestic and foreign potential impacts results in $\tilde{\boldsymbol{E}} \cdot (\boldsymbol{I} - \boldsymbol{A})^{-1}$, and the sum of column k matches the embodied environmental intensity Q_k under the DTA.

Moreover, as shown in Equation (S5), the sum of element q_{ik}^D in column k of $\boldsymbol{Q}^D$ as a ratio of the embodied intensity Q_k is hereinafter called the "domestic ratio" of product k. Similarly the column sum of element q_{ik}^F of $\boldsymbol{Q}^F$ as a ratio of Q_k in Equation (S6) is called the "foreign ratio".

$$\sum_i q_{ik}^D \Big/ Q_k \tag{S5}$$

$$\sum_i q_{ik}^F \Big/ Q_k \tag{S6}$$

However, it is important to be aware that these equations are based on the following assumptions: (a) spillover production activities induced abroad through the import by domestic economic activity are assumed to not induce further domestic production (*i.e.*, all production activities are induced abroad); (b) the input coefficients, unit direct interventions, and

characterization factors of each sector outside of the country are assumed to be the same as those within the country.

2.3. Domestic Ratios by Each Tier of the Supply Chain

The embodied environmental intensities that have been categorized as either domestic or foreign are further categorized into direct and subsequent tiers (t-th tier) as described by Equations (5)–(7) of the body text, which are made clear from the definitions in the Leontief inverse matrix. When the impacts from each tier are totaled from direct to an infinite tier of the supply chain, domestically it becomes $\widetilde{\boldsymbol{E}} \cdot (\boldsymbol{I} - (\boldsymbol{I} - \boldsymbol{M})\boldsymbol{A})^{-1}$, and abroad it becomes $\widetilde{\boldsymbol{E}} \cdot (\boldsymbol{I} - \boldsymbol{A})^{-1} - \widetilde{\boldsymbol{E}} \cdot (\boldsymbol{I} - (\boldsymbol{I} - \boldsymbol{M})\boldsymbol{A})^{-1}$. These values match Equations (3) and (4) of the body text that differentiate between domestic and foreign potential impacts.

Here, element $q_{ik}^{D(t)}$ in a certain row i of $\boldsymbol{Q}^{D(t)}$ provides the impact induced by product k in the domestic sector i at the t-th tier of the supply chain. Similarly, element $q_{ik}^{D(t)}$ of $\boldsymbol{Q}^{F(t)}$ shows the potential impact induced by product k in a foreign production activity that corresponds to sector i at the t-th tier of the supply chain. At this point, the domestic and foreign ratios at the t-th tier are described by Equations (S7) and (S8), respectively.

$$\sum_i q_{ik}^{D(t)} \bigg/ \left(\sum_i q_{ik}^{D(t)} + \sum_i q_{ik}^{F(t)} \right) \tag{S7}$$

$$\sum_i q_{ik}^{F(t)} \bigg/ \left(\sum_i q_{ik}^{D(t)} + \sum_i q_{ik}^{F(t)} \right) \tag{S8}$$

2.4. Rates of Foreign Potential Impacts

As shown in Equation (S9) below, the column sum of $q_{ik}^{D(t)}$ as a ratio of the embodied environmental intensity Q_k under the DTA, is called the "rate of domestic impact" at the t-th tier for product k. Similarly, as shown in Equation (S10), the column sum of $q_{ik}^{F(t)}$ as a ratio of the embodied environmental intensity Q_k is called the "rate of foreign impact" at the t-th tier for product k. At this point, the total of these values, from direct to an infinite tier of the supply chain, matches the domestic and foreign ratios described by Equations (5) and (6) of the body text.

$$\sum_i q_{ik}^{D(t)} \bigg/ Q_k \tag{S9}$$

$$\sum_i q_{ik}^{F(t)} \bigg/ Q_k \tag{S10}$$

2.5. Potential Impacts Associated with the Import of Raw Materials

The underlying concept of the accounting method for determining the potential impacts associated with import is shown in Figure S1.
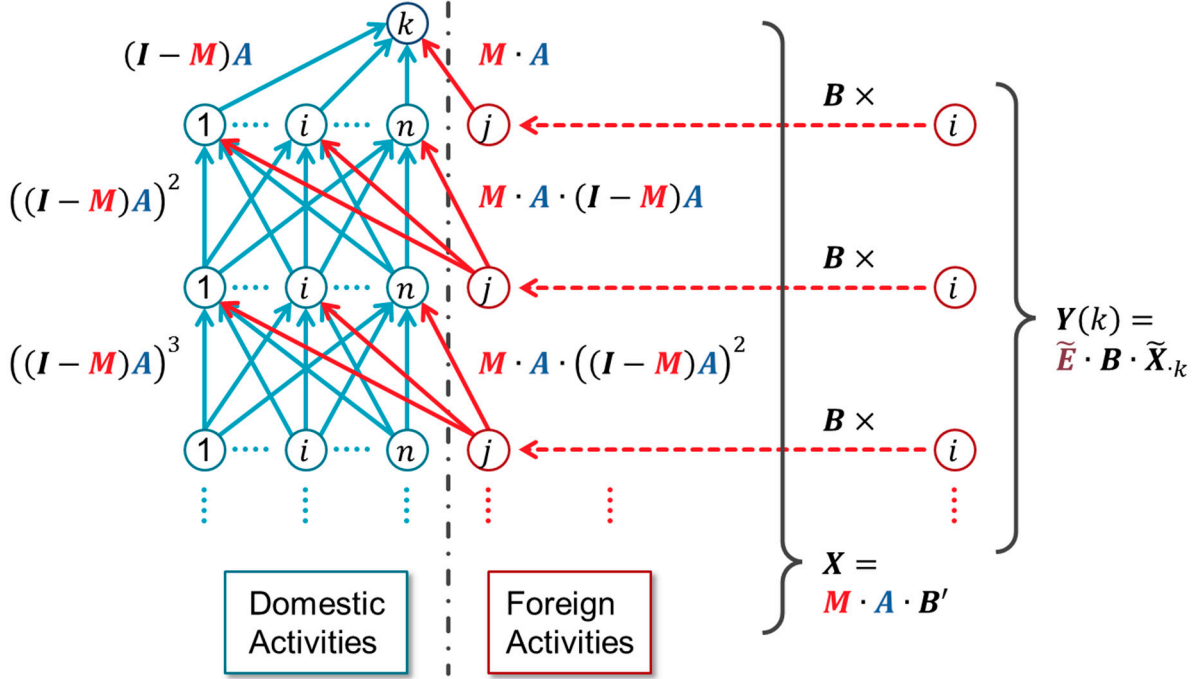
Figure S1. Conceptual schematic of the accounting method used to determine potential impacts associated with the import of raw materials. Note: k is the product subject to analysis, j is the imported raw material, i is the sector where potential impacts are induced. n is the number of sectors in the input-output table and in this study, there are 403 sectors. A is the input coefficient matrix, M is the import coefficient matrix, $\widetilde{E}$ is the diagonal matrix that deploys the unit impact in each sector as the diagonal component. B is the Leontief inverse matrix: $B = (I - A)^{-1}$ and $B' = (I - (I - M)A)^{-1}$. Refer to Equations (10) and (11) of the body text for X, $\widetilde{X}_{\cdot k}$ and $Y(k)$. The solid-line arrow shows that products from the sector at the end of the arrow are directly input to the sector at the root of the arrow. Dotted-line arrow shows that the sector at the root induces potential impacts to the sector at the end of the arrow.

3. Results

3.1. Domestic Ratios of Potential Impacts

We calculated the domestic ratio of the embodied intensities of the potential impacts under the DTA in each sector and compared the results across all impact categories. The domestic ratios of the GWP and DAP tend to be higher and are 0.6 or higher in the majority of sectors, while the domestic ratio of the WSI is low in some sectors. The domestic ratios in each sector for the GWP and DAP show similar values: in the above scatter chart of Figure S2, the distribution is located diagonally. This is due to a correlation of the unit impacts across sectors between the GWP and DAP, where the simple correlation coefficient is 0.714. On the other hand, when the domestic ratios of the GWP and WSI are compared, as shown in the below scatter chart of Figure S2, we see that many sectors have a greater GWP value. This relates to the weak correlation between the impact per unit of the GWP and WSI, where the simple correlation coefficient is –0.001.
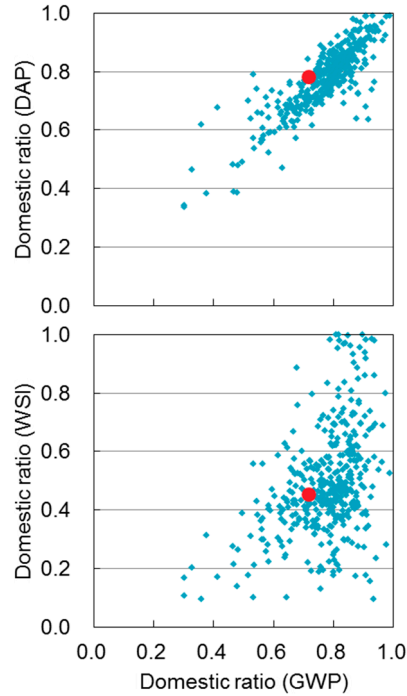
Figure S2. Domestic ratios of embodied environmental intensities for the 403 sectors of Japanese products: comparison of GWP with DAP and WSI. Note: The red dots show the domestic ratios of the *fiber yarns* sector.
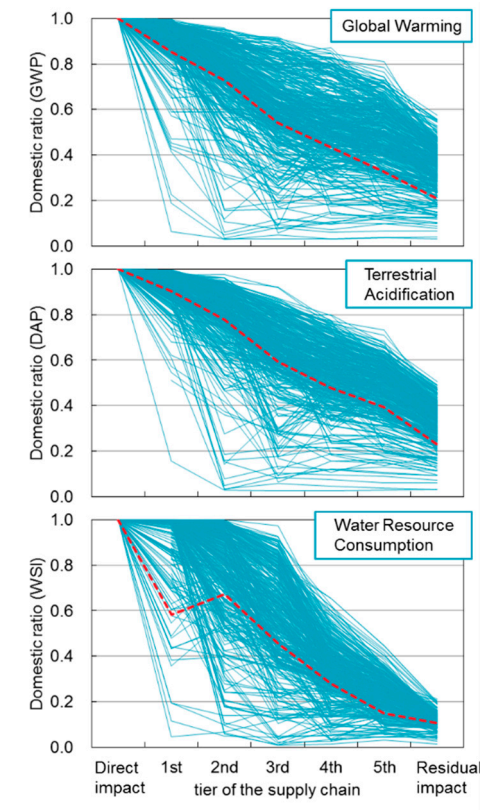

Figure S3. Domestic ratios of the potential impacts by each tier of the supply chain for the 403 sectors of Japanese products. Note: The red dotted lines show the domestic ratios of the *fiber yarns* sector.

3.2. Domestic Ratios by Each Tier of the Supply Chain

We derived domestic ratios by the tier of the supply chain for each sector. Although declining trends following the tier are common, generally, the WSI domestic ratio is lower than those of the GWP or DAP (Figure S3). Notably, in the deeper tiers (further upstream) of the supply chain, the domestic ratios for the WSI are low. In nearly all sectors, domestic ratios in the fourth tier were less than 0.6 and those in the fifth tier were less than 0.4.

3.3. Rates of Foreign Potential Impacts

The rates of foreign impacts in the GWP and DAP are generally low for all tiers (see Figure 1 of the body text). The causal factor for this result is the small import rates in sectors i with large unit impacts for the GWP and DAP and in sectors j which induce production in such sectors i. The top sectors i in terms of unit impacts and their import coefficients are *cement*: 0.015, *private power generation*: 0.000, *pig iron*: 0.018, and *electricity*: 0.000. The top sectors j in terms of elements b_{ij} in $\boldsymbol{B} = (\boldsymbol{I} - \boldsymbol{A})^{-1}$ and their import coefficients are *ready mixed concrete*: 0.000, *crude steel (converters)*: 0.000, *hot rolled steel*: 0.039, and *compressed gas and liquefied gas*: 0.022.

However, some exceptions include *copper* and *non-ferrous metals*, where the rates of foreign impacts in the second tier are approximately 0.45 to 0.50, and *petroleum refinery products* and *gas supply* where the rates of foreign impacts for the GWP in the first and second tiers are approximately 0.27. For *copper* and *non-ferrous metals*, *metallic ores* have an import coefficient of 0.989 and for *petroleum refinery products* and *gas supply*, the import coefficient for *coal mining, crude petroleum and natural gas* are very high, 0.991, thereby causing the high rates of foreign impacts.

3.4. Potential Impacts Associated with the Import of Raw Materials

For potential impacts induced by Japanese domestically produced fiber yarns in foreign production activities that correspond to sectors i, contributions from the import of raw materials j were identified as described in Section 3.5 of the body text. The top ten pairings for the *fiber yarns* sector are shown in Tables S1–S3. Contributions to the embodied GWP and DAP intensities claim more than 2% only for potential impacts that *other inedible crops* (including raw cotton) and *synthetic fibers* induce in their own sectors, respectively. According to trade statistics [35], the United States (10 billion JPY) was the top trading partner in 2005 for imports corresponding to raw cotton in the input-output table (HS code: 1404.20-000, 5201.00-000). Similarly, Taiwan (13 billion JPY) was at the top for imported products corresponding to *synthetic fibers*.

Foreign potential impacts of pairings between *wood chips*, *pulp*, *logs* as imported raw materials j and *silviculture* as sector i claim 6.3%, 2.1%, and 1.7% of the embodied WSI intensity under the DTA. Furthermore, the domestic and foreign potential impact that fiber yarns induced in silviculture is 15.883 m³ water eq/million JPY, and approximately half of this amount (30.3%, 10.1% and 8.0%, respectively) are induced through the import of wood chips, pulp, and logs. Of these raw materials j, the import coefficient of wood chips is 0.768. According to trade statistics [35], of all the trading partners in 2005 for imports that correspond to wood chips in the Japanese input-output table (HS

code: 4401.21-000, 4401.22-000, 4404.10-290, 4404.20-290), Australia (79 billion JPY) and South Africa (52 billion JPY) were at the top.

Table S1. Top ten pairings in terms of the GWP impacts associated with import of raw materials induced by Japanese fiber yarns.

Raw Material *j* Being Imported	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impacts ($t \cdot CO_2 \cdot eq$/million JPY)
Other inedible crops	Other inedible crops	0.243 (4.1%)
Coal mining, crude petroleum and natural gas	Coal mining, crude petroleum and natural gas	0.112 (1.9%)
Synthetic fibers	Synthetic fibers	0.082 (1.4%)
Coal mining, crude petroleum and natural gas	Private power generation	0.064 (1.1%)
Cyclic intermediates	Cyclic intermediates	0.051 (0.9%)
Synthetic fibers	Private power generation	0.050 (0.9%)
Synthetic dyes	Synthetic dyes	0.050 (0.8%)
Rayon and acetate	Rayon and acetate	0.040 (0.7%)
Coal mining, crude petroleum and natural gas	Electricity	0.040 (0.7%)
Other inedible crops	Chemical fertilizer	0.036 (0.6%)

Note: Figures within parentheses indicate percentages in terms of the embodied GWP intensity of the *fiber yarns* sector under the DTA.

Table S2. Top ten pairings in terms of the DAP impacts associated with import of raw materials induced by Japanese fiber yarns.

Raw Material *j* Being Imported	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impacts ($kg \cdot SO_2 \cdot eq$/million JPY)
Synthetic fibers	Synthetic fibers	0.262 (2.5%)
Coal mining, crude petroleum and natural gas	Private power generation	0.148 (1.4%)
Synthetic fibers	Private power generation	0.117 (1.1%)
Other inedible crops	Other inedible crops	0.097 (0.9%)
Synthetic dyes	Private power generation	0.063 (0.6%)
Cyclic intermediates	Private power generation	0.062 (0.6%)
Cyclic intermediates	Cyclic intermediates	0.057 (0.5%)
Synthetic dyes	Synthetic dyes	0.055 (0.5%)
Coal mining, crude petroleum and natural gas	Electricity	0.050 (0.5%)
Cyclic intermediates	Petroleum refinery products	0.045 (0.4%)

Note: Figures within parentheses indicate percentages in terms of the embodied DAP intensity of the *fiber yarns* sector under the DTA.

Table S3. Top ten pairings in terms of the WSI impacts associated with import of raw materials induced by Japanese fiber yarns.

Raw Material j Being Imported	Sector i Where Potential Impacts are Induced	Foreign Potential Impacts (m³·water·eq/million JPY)
Other inedible crops	Other inedible crops	6.494 (8.6%)
Wood chips	Silviculture	4.810 (6.3%)
Other edible crops	Other edible crops	2.753 (3.6%)
Other livestock	Crops for feed and foraging	2.442 (3.2%)
Other inedible crops	Rice	1.886 (2.5%)
Coal mining, crude petroleum and natural gas	Silviculture	1.884 (2.5%)
Other livestock	Other edible crops	1.764 (2.3%)
Synthetic fibers	Industrial water supply	1.633 (2.2%)
Pulp	Silviculture	1.597 (2.1%)
Logs	Silviculture	1.269 (1.7%)

Note: Figures within parentheses indicate percentages in terms of the embodied WSI intensity of the *fiber yarns* sector under the DTA.

For Japanese products in all 403 sectors, the contribution from importing raw material j within all potential impacts induced in a foreign production activity that corresponds to sector i was identified using the method described in Section 2.5 of the body text. For the GWP, DAP, and WSI, the pairings of raw material j and sector i that carry the largest potential impacts are shown in Table S4.

Table S4. The pairing with the largest foreign potential impact associated with import of raw materials induced by Japanese products in each sector.

		GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)		
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
1	Rice	Chemical fertilizer	Chemical fertilizer	0.136 (2.2%)	Chemical fertilizer	Chemical fertilizer	0.125 (3.0%)	Edible crops *	Edible crops *	11.535 (0.5%)
2	Wheat, barley and the like	Chemical fertilizer	Chemical fertilizer	0.273 (4.6%)	Chemical fertilizer	Chemical fertilizer	0.251 (4.7%)	Wheat & barley *	Wheat & barley *	89.875 (2.3%)
3	Potatoes and sweet potatoes	Chemical fertilizer	Chemical fertilizer	0.223 (6.0%)	Chemical fertilizer	Chemical fertilizer	0.205 (5.8%)	Seeds & seedlings	Seeds & seedlings	7.894 (0.7%)
4	Pulses	Chemical fertilizer	Chemical fertilizer	0.171 (3.2%)	Chemical fertilizer	Chemical fertilizer	0.157 (4.3%)	Pulses	Pulses	109.643 (2.8%)
5	Vegetables	Chemical fertilizer	Chemical fertilizer	0.106 (2.5%)	CM, CP & NG *	Private PG *	0.117 (1.1%)	Seeds & seedlings	Seeds & seedlings	46.315 (12.3%)
6	Fruits	Chemical fertilizer	Chemical fertilizer	0.098 (2.9%)	CM, CP & NG *	Private PG *	0.091 (1.2%)	Edible crops *	Edible crops *	5.898 (0.6%)
7	Sugar crops	Chemical fertilizer	Chemical fertilizer	0.317 (7.6%)	Chemical fertilizer	Chemical fertilizer	0.291 (6.0%)	Seeds & seedlings	Seeds & seedlings	26.486 (0.7%)
8	Crops for beverages	Chemical fertilizer	Chemical fertilizer	0.291 (2.3%)	Chemical fertilizer	Chemical fertilizer	0.268 (5.8%)	Edible crops *	Edible crops *	9.145 (0.5%)
9	Other edible crops	Edible crops *	Edible crops *	0.966 (13.1%)	Chemical fertilizer	Chemical fertilizer	0.123 (3.0%)	Edible crops *	Edible crops *	862.093 (19.7%)
10	Crops for feed and foraging	Chemical fertilizer	Chemical fertilizer	0.181 (1.9%)	Chemical fertilizer	Chemical fertilizer	0.166 (5.0%)	Seeds & seedlings	Seeds & seedlings	61.012 (0.5%)
11	Seeds and seedlings	Chemical fertilizer	Chemical fertilizer	0.107 (5.7%)	Chemical fertilizer	Chemical fertilizer	0.098 (3.5%)	Seeds & seedlings	Seeds & seedlings	523.737 (10.9%)
12	Flowers and plants	CM, CP & NG *	CM, CP & NG *	0.201 (2.6%)	CM, CP & NG *	Private PG *	0.266 (0.8%)	Seeds & seedlings	Seeds & seedlings	47.766 (19.7%)

Table S4. *Cont*.

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
13 Other inedible crops	Chemical fertilizer	Chemical fertilizer	0.110 (2.5%)	Chemical fertilizer	Chemical fertilizer	0.101 (3.2%)	Edible crops *	Edible crops *	2.942 (2.5%)
14 Dairy cattle farming	Crops for feed *	Crops for feed *	0.394 (3.8%)	CM, CP & NG *	Private PG *	0.062 (1.5%)	Crops for feed *	Crops for feed *	690.084 (23.4%)
15 Hen eggs	Edible crops *	Edible crops *	0.565 (9.5%)	Feeds	Feeds	0.109 (2.0%)	Edible crops *	Edible crops *	504.225 (54.5%)
16 Fowls and broilers	Edible crops *	Edible crops *	0.604 (8.2%)	Feeds	Feeds	0.116 (1.8%)	Edible crops *	Edible crops *	538.887 (53.5%)
17 Hogs	Edible crops *	Edible crops *	0.502 (6.8%)	Feeds	Feeds	0.096 (1.8%)	Edible crops *	Edible crops *	447.564 (41.8%)
18 Beef cattle	Edible crops *	Edible crops *	0.330 (2.5%)	CM, CP & NG *	Private PG *	0.077 (1.6%)	Crops for feed *	Crops for feed *	458.844 (18.4%)
19 Other livestock	Edible crops *	Edible crops *	0.349 (8.0%)	CM, CP & NG *	Private PG *	0.071 (1.7%)	Edible crops *	Edible crops *	311.575 (29.0%)
20 Veterinary service	CM, CP & NG *	CM, CP & NG *	0.035 (2.8%)	CM, CP & NG *	Private PG *	0.047 (2.9%)	Edible crops *	Edible crops *	10.441 (19.2%)
21 Agricultural services (except veterinary service)	CM, CP & NG *	CM, CP & NG *	0.083 (2.7%)	CM, CP & NG *	Private PG *	0.109 (2.8%)	Edible crops *	Edible crops *	30.255 (28.7%)
22 Silviculture	CM, CP & NG *	CM, CP & NG *	0.018 (4.1%)	CM, CP & NG *	Private PG *	0.024 (4.6%)	Logs	Silviculture	1.582 (0.0%)
23 Logs	CM, CP & NG *	CM, CP & NG *	0.070 (4.1%)	CM, CP & NG *	Private PG *	0.092 (3.7%)	CM, CP & NG *	Silviculture	1.177 (0.0%)
24 Special forest products (including hunting)	CM, CP & NG *	CM, CP & NG *	0.159 (3.0%)	CM, CP & NG *	Private PG *	0.209 (1.2%)	Logs	Silviculture	520.981 (35.4%)
25 Marine fisheries	CM, CP & NG *	CM, CP & NG *	0.228 (2.4%)	Frozen fish *	Marine fisheries	0.497 (0.3%)	CM, CP & NG *	Silviculture	3.849 (22.3%)

Table S4. *Cont.*

		GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)	
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
26	Marine culture	Frozen fish *	Marine fisheries	0.222 (4.8%)	Frozen fish *	Marine fisheries	4.877 (7.0%)	Edible crops *	Edible crops *	40.430 (46.9%)
27	Inland water fisheries and culture	CM, CP & NG *	CM, CP & NG *	0.135 (2.7%)	IW fisheries *	IW fisheries *	1.822 (3.2%)	IW fisheries *	IW fisheries *	379.765 (3.7%)
28	Metallic ores	CM, CP & NG *	CM, CP & NG *	0.177 (2.3%)	CM, CP & NG *	Private PG *	0.234 (1.8%)	Logs	Silviculture	28.837 (32.7%)
29	Materials for ceramics	CM, CP & NG *	CM, CP & NG *	0.210 (2.7%)	CM, CP & NG *	Private PG *	0.277 (3.0%)	CM, CP & NG *	Silviculture	3.544 (16.2%)
30	Gravel and quarrying	CM, CP & NG *	CM, CP & NG *	0.239 (4.3%)	CM, CP & NG *	Private PG *	0.315 (4.6%)	CM, CP & NG *	Silviculture	4.031 (18.5%)
31	Crushed stones	CM, CP & NG *	CM, CP & NG *	0.218 (4.0%)	CM, CP & NG *	Private PG *	0.288 (4.3%)	CM, CP & NG *	Silviculture	3.677 (11.3%)
32	Other non-metallic ores	CM, CP & NG *	CM, CP & NG *	0.298 (3.1%)	CM, CP & NG *	Private PG *	0.394 (1.7%)	Logs	Silviculture	24.247 (27.9%)
33	Coal mining, crude petroleum and natural gas	CM, CP & NG *	CM, CP & NG *	0.094 (1.2%)	CM, CP & NG *	Private PG *	0.123 (1.6%)	Logs	Silviculture	23.558 (33.0%)
34	Slaughtering and meat processing	Edible crops *	Edible crops *	0.372 (4.4%)	CM, CP & NG *	Private PG *	0.078 (1.6%)	Edible crops *	Edible crops *	331.908 (23.4%)
35	Processed meat products	Slaughtering *	Beef cattle	0.430 (9.0%)	Slaughtering *	Electricity	0.141 (2.9%)	Slaughtering *	Crops for feed *	121.451 (20.2%)
36	Bottled or canned meat products	Slaughtering *	Beef cattle	0.099 (2.9%)	Frozen fish *	Marine fisheries	0.157 (2.8%)	Slaughtering *	Crops for feed *	28.018 (11.3%)
37	Dairy farm products	Crops for feed *	Crops for feed *	0.157 (2.4%)	CM, CP & NG *	Private PG *	0.099 (1.4%)	Crops for feed *	Crops for feed *	274.570 (21.9%)
38	Frozen fish and shellfish	Marine fisheries	Marine fisheries	0.640 (11.4%)	Marine fisheries	Marine fisheries	14.088 (16.2%)	CM, CP & NG *	Silviculture	2.049 (10.0%)
39	Salted, dried or smoked seafood	Frozen fish *	Marine fisheries	0.464 (10.9%)	Frozen fish *	Marine fisheries	10.215 (18.9%)	IW fisheries *	IW fisheries *	30.298 (24.6%)

Table S4. *Cont.*

	GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
40 Bottled or canned seafood	Frozen fish *	Marine fisheries	0.293 (6.8%)	Frozen fish *	Marine fisheries	6.451 (18.0%)	Edible crops *	Edible crops *	16.375 (24.1%)
41 Fish paste	Frozen fish *	Marine fisheries	0.350 (9.8%)	Frozen fish *	Marine fisheries	7.699 (30.3%)	Edible crops *	Edible crops *	29.430 (22.7%)
42 Other processed seafood	Frozen fish *	Marine fisheries	0.203 (6.0%)	Frozen fish *	Marine fisheries	4.465 (12.9%)	IW fisheries *	IW fisheries *	24.958 (20.6%)
43 Grain milling	Chemical fertilizer	Chemical fertilizer	0.096 (2.0%)	CM, CP & NG *	Private PG *	0.091 (2.3%)	Wheat & barley *	Wheat & barley *	14.805 (0.9%)
44 Flour and other grain milled products	Wheat & barley *	Wheat & barley *	0.613 (12.0%)	Wheat & barley *	Chemical fertilizer	0.247 (3.0%)	Wheat & barley *	Wheat & barley *	968.946 (45.2%)
45 Noodles	Wheat & barley *	Wheat & barley *	0.110 (3.1%)	CM, CP & NG *	Private PG *	0.103 (1.1%)	Wheat & barley *	Wheat & barley *	174.245 (35.4%)
46 Bread	Wheat & barley *	Wheat & barley *	0.078 (2.7%)	CM, CP & NG *	Private PG *	0.074 (1.6%)	Wheat & barley *	Wheat & barley *	123.949 (28.3%)
47 Confectionery	CM, CP & NG *	CM, CP & NG *	0.060 (2.0%)	CM, CP & NG *	Private PG *	0.079 (1.4%)	Edible crops *	Edible crops *	36.281 (11.1%)
48 Bottled or canned vegetables and fruits	CM, CP & NG *	CM, CP & NG *	0.075 (2.0%)	Fruits	Fruits	0.134 (1.6%)	Pulses	Pulses	53.454 (17.1%)
49 Preserved agricultural foodstuffs (other than bottled or canned)	CM, CP & NG *	CM, CP & NG *	0.061 (2.3%)	CM, CP & NG *	Private PG *	0.081 (1.4%)	Seeds & seedlings	Seeds & seedlings	9.374 (6.4%)
50 Sugar	CM, CP & NG *	CM, CP & NG *	0.142 (1.8%)	CM, CP & NG *	Private PG *	0.188 (1.5%)	Sugar	Sugar crops	28.232 (2.2%)
51 Starch	Edible crops *	Edible crops *	1.876 (27.0%)	Edible crops *	Private PG *	0.236 (2.5%)	Edible crops *	Edible crops *	1673.69 (87.9%)

Table S4. *Cont.*

	GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
52 Dextrose, syrup and isomerized sugar	Edible crops *	Edible crops *	0.841 (9.4%)	Starch	Starch	0.213 (1.3%)	Edible crops *	Edible crops *	750.484 (76.2%)
53 Vegetable oils and meal	Edible crops *	Edible crops *	0.939 (15.9%)	Edible crops *	Private PG *	0.118 (1.7%)	Edible crops *	Edible crops *	837.475 (45.0%)
54 Animal oils and fats	Slaughtering *	Beef cattle	0.225 (3.0%)	Marine fisheries	Marine fisheries	0.729 (4.0%)	Slaughtering *	Crops for feed *	63.599 (15.9%)
55 Condiments and seasonings	Edible crops *	Edible crops *	0.083 (2.6%)	Salt	Salt	0.165 (2.4%)	Edible crops *	Edible crops *	74.138 (26.8%)
56 Prepared frozen foods	Slaughtering *	Beef cattle	0.105 (2.6%)	Frozen fish *	Marine fisheries	1.574 (14.3%)	Edible crops *	Edible crops *	33.996 (11.1%)
57 Retort foods	CM, CP & NG *	CM, CP & NG *	0.071 (1.9%)	Frozen fish *	Marine fisheries	0.282 (3.1%)	Edible crops *	Edible crops *	27.944 (11.2%)
58 Dishes, sushi and lunch boxes	Slaughtering *	Beef cattle	0.068 (2.0%)	Frozen fish *	Marine fisheries	0.755 (8.8%)	Edible crops *	Edible crops *	37.663 (9.1%)
59 School lunch (public)	CM, CP & NG *	CM, CP & NG *	0.055 (1.9%)	Frozen fish *	Marine fisheries	0.633 (11.0%)	Crops for feed *	Crops for feed *	28.355 (8.1%)
60 School lunch (private)	CM, CP & NG *	CM, CP & NG *	0.051 (1.8%)	Frozen fish *	Marine fisheries	0.734 (12.2%)	Edible crops *	Edible crops *	31.372 (8.5%)
61 Other foods	Pulses	Pulses	0.124 (3.1%)	CM, CP & NG *	Private PG *	0.108 (1.3%)	Pulses	Pulses	174.646 (30.1%)
62 Refined sake	CM, CP & NG *	CM, CP & NG *	0.053 (2.0%)	CM, CP & NG *	Private PG *	0.070 (1.9%)	Wood chips	Silviculture	4.633 (1.1%)
63 Beer	CM, CP & NG *	CM, CP & NG *	0.036 (2.2%)	CM, CP & NG *	Private PG *	0.047 (1.9%)	Edible crops *	Edible crops *	9.313 (17.0%)
64 Whiskey and brandy	CM, CP & NG *	CM, CP & NG *	0.047 (2.5%)	CM, CP & NG *	Private PG *	0.062 (1.6%)	Wood chips	Silviculture	3.712 (10.6%)
65 Other liquors	CM, CP & NG *	CM, CP & NG *	0.048 (2.1%)	CM, CP & NG *	Private PG *	0.064 (1.6%)	Edible crops *	Edible crops *	14.629 (11.7%)
66 Tea and roasted coffee	Crops for beverages	Crops for beverages	1.073 (22.8%)	Crops for beverages	Electricity	0.138 (3.3%)	Crops for beverages	Crops for beverages	219.019 (46.9%)
67 Soft drinks	Crops for beverages	Crops for beverages	0.074 (2.6%)	CM, CP & NG *	Private PG *	0.078 (1.6%)	Crops for beverages	Crops for beverages	15.027 (10.6%)
68 Manufactured ice	CM, CP & NG *	CM, CP & NG *	0.113 (2.4%)	CM, CP & NG *	Private PG *	0.150 (2.4%)	Wood chips	Silviculture	2.391 (2.1%)

Table S4. *Cont*.

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	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
69 Feeds	Edible crops *	Edible crops *	1.207 (26.0%)	Edible crops *	Private PG *	0.152 (2.3%)	Edible crops *	Edible crops *	1071.92 (64.2%)
70 Organic fertilizers	Edible crops *	Edible crops *	0.217 (5.8%)	Frozen fish *	Marine fisheries	0.379 (6.4%)	Edible crops *	Edible crops *	193.878 (18.0%)
71 Tobacco	Inedible crops *	Inedible crops *	0.108 (13.9%)	Inedible crops *	Inedible crops *	0.043 (4.0%)	Wood chips	Silviculture	3.515 (20.4%)
72 Fiber yarns	Inedible crops *	Inedible crops *	0.243 (4.1%)	Synthetic fibers	Synthetic fibers	0.262 (2.5%)	Inedible crops *	Inedible crops *	6.494 (8.6%)
73 Cotton and staple fiber fabrics (including fabrics of synthetic spun fibers)	CM, CP & NG *	CM, CP & NG *	0.119 (1.9%)	Synthetic fibers	Synthetic fibers	0.177 (1.5%)	Edible crops *	Edible crops *	4.501 (8.1%)
74 Silk and artificial silk fabrics (including fabrics of synthetic filament fibers)	Synthetic fibers	Synthetic fibers	0.134 (2.0%)	Synthetic fibers	Synthetic fibers	0.430 (3.3%)	Wood chips	Silviculture	6.070 (10.1%)
75 Woolen fabrics, hemp fabrics and other fabrics	Synthetic dyes	Synthetic dyes	0.143 (2.3%)	Synthetic dyes	Private PG *	0.181 (1.7%)	Wood chips	Silviculture	3.996 (7.2%)
76 Knitting fabrics	Synthetic fibers	Synthetic fibers	0.098 (2.0%)	Synthetic fibers	Synthetic fibers	0.314 (3.5%)	Wood chips	Silviculture	2.586 (5.6%)
77 Yarn and fabric dyeing and finishing (processing on commission only)	Synthetic dyes	Synthetic dyes	0.397 (4.3%)	Synthetic dyes	Private PG *	0.500 (3.3%)	Synthetic dyes	Industrial WS *	3.407 (4.9%)
78 Ropes and nets	Synthetic fibers	Synthetic fibers	0.166 (3.1%)	Synthetic fibers	Synthetic fibers	0.533 (5.0%)	Synthetic fibers	Industrial WS *	3.315 (6.1%)
79 Carpets and floor mats	CM, CP & NG *	CM, CP & NG *	0.114 (2.0%)	Synthetic fibers	Synthetic fibers	0.326 (3.1%)	Wood chips	Silviculture	3.851 (6.0%)
80 Fabricated textiles for medical use	Inedible crops *	Inedible crops *	0.103 (2.7%)	Paper	Paper	0.099 (1.4%)	Wood chips	Silviculture	26.096 (29.8%)

Table S4. *Cont*.

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81	Other fabricated textile products	CM, CP & NG *	CM, CP & NG *	0.113 (2.0%)	Synthetic fibers	Synthetic fibers	0.161 (1.7%)	Wood chips	Silviculture	8.332 (13.1%)
82	Woven fabric apparel	CM, CP & NG *	CM, CP & NG *	0.060 (1.8%)	CM, CP & NG *	Private PG *	0.079 (1.3%)	Wood chips	Silviculture	3.474 (10.4%)
83	Knitted apparel	CM, CP & NG *	CM, CP & NG *	0.082 (1.9%)	Synthetic fibers	Synthetic fibers	0.229 (2.8%)	Wood chips	Silviculture	3.017 (7.8%)
84	Other wearing apparel and clothing accessories	CM, CP & NG *	CM, CP & NG *	0.083 (2.0%)	CM, CP & NG *	Private PG *	0.109 (1.3%)	Wood chips	Silviculture	4.466 (8.5%)
85	Bedding	C&SF fabrics *	Electricity	0.107 (3.3%)	C&SF fabrics *	Private PG *	0.139 (2.9%)	Slaughtering *	Crops for feed *	23.870 (16.4%)
86	Other ready-made textile products	CM, CP & NG *	CM, CP & NG *	0.065 (1.9%)	Synthetic fibers	Synthetic fibers	0.120 (1.9%)	Wood chips	Silviculture	2.873 (8.0%)
87	Timber	Logs	Logs	0.086 (4.8%)	Logs	Logs	0.185 (7.0%)	Logs	Silviculture	3435.01 (45.9%)
88	Plywood	CM, CP & NG *	CM, CP & NG *	0.078 (2.6%)	CM, CP & NG *	Private PG *	0.103 (2.1%)	Logs	Silviculture	973.847 (39.8%)
89	Wood chips	Logs	Logs	0.081 (3.7%)	Logs	Logs	0.173 (6.0%)	Logs	Silviculture	3206.76 (44.6%)
90	Other wooden products	CM, CP & NG *	CM, CP & NG *	0.057 (2.5%)	CM, CP & NG *	Private PG *	0.075 (2.1%)	Logs	Silviculture	274.794 (27.1%)
91	Wooden furniture and fixtures	CM, CP & NG *	CM, CP & NG *	0.059 (2.4%)	CM, CP & NG *	Private PG *	0.078 (1.8%)	Logs	Silviculture	130.132 (27.8%)
92	Wooden fixtures	CM, CP & NG *	CM, CP & NG *	0.058 (2.3%)	CM, CP & NG *	Private PG *	0.077 (1.6%)	Logs	Silviculture	190.886 (28.3%)
93	Metallic furniture and fixture	CM, CP & NG *	CM, CP & NG *	0.076 (1.7%)	CM, CP & NG *	Private PG *	0.100 (1.8%)	Logs	Silviculture	12.376 (19.1%)
94	Pulp	CM, CP & NG *	CM, CP & NG *	0.222 (1.2%)	CM, CP & NG *	Private PG *	0.293 (0.9%)	Wood chips	Silviculture	2279.47 (71.8%)
95	Paper	Pulp	Pulp	0.564 (3.8%)	Pulp	Pulp	0.962 (1.8%)	Wood chips	Silviculture	488.081 (52.1%)
96	Paperboard	Pulp	Pulp	0.308 (3.0%)	Pulp	Pulp	0.525 (1.7%)	Wood chips	Silviculture	266.417 (45.7%)

Table S4. *Cont.*

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97	Corrugated cardboard	Pulp	Pulp	0.155 (2.5%)	Pulp	Pulp	0.265 (1.5%)	Wood chips	Silviculture	134.549 (41.7%)
98	Coated paper and building paper	Pulp	Pulp	0.109 (2.0%)	Paper	Paper	0.303 (2.1%)	Wood chips	Silviculture	95.070 (40.7%)
99	Corrugated card board boxes	CM, CP & NG *	CM, CP & NG *	0.070 (2.1%)	Pulp	Pulp	0.108 (1.2%)	Wood chips	Silviculture	54.832 (39.6%)
100	Other paper containers	Pulp	Pulp	0.086 (2.1%)	Paper	Paper	0.198 (1.8%)	Wood chips	Silviculture	74.759 (42.2%)
101	Paper textile for medical use	CM, CP & NG *	CM, CP & NG *	0.106 (2.2%)	Paper	Paper	0.219 (2.0%)	Wood chips	Silviculture	68.638 (43.1%)
102	Other pulp, paper and processed paper products	Pulp	Pulp	0.086 (2.1%)	Paper	Paper	0.222 (1.9%)	Wood chips	Silviculture	142.753 (54.9%)
103	Printing, plate making and book binding	Pulp	Pulp	0.061 (2.0%)	Paper	Paper	0.192 (2.5%)	Wood chips	Silviculture	52.984 (44.0%)
104	Chemical fertilizer	Chemical fertilizer	Chemical fertilizer	0.580 (3.3%)	CM, CP & NG *	Private PG *	0.587 (2.9%)	CM, CP & NG *	Silviculture	7.500 (11.3%)
105	Industrial soda chemicals	CM, CP & NG *	CM, CP & NG *	0.273 (1.4%)	Salt	Salt	1.316 (2.9%)	CM, CP & NG *	Silviculture	4.607 (8.7%)
106	Inorganic pigment	CM, CP & NG *	CM, CP & NG *	0.201 (2.3%)	Metallic ores	Private PG *	0.414 (2.4%)	Metallic ores	Silviculture	4.594 (5.6%)
107	Compressed gas and liquefied gas	CM, CP & NG *	CM, CP & NG *	0.236 (2.2%)	CM, CP & NG *	Private PG *	0.311 (2.2%)	CM, CP & NG *	Silviculture	3.979 (8.5%)
108	Salt	Salt	Salt	0.273 (2.2%)	Salt	Salt	1.334 (2.6%)	Wood chips	Silviculture	14.048 (24.3%)
109	Other industrial inorganic chemicals	Industrial IC *	Industrial IC *	0.201 (1.6%)	NM ores *	NM ores *	0.511 (2.3%)	Metallic ores	Silviculture	3.211 (4.7%)

Table S4. *Cont*.

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110 Petrochemical basic products	CM, CP & NG *	CM, CP & NG *	1.474 (15.3%)	CM, CP & NG *	Private PG *	1.945 (13.4%)	CM, CP & NG *	Silviculture	24.855 (42.3%)
111 Petrochemical aromatic products (except synthetic resin)	CM, CP & NG *	CM, CP & NG *	1.230 (14.9%)	CM, CP & NG *	Private PG *	1.623 (12.7%)	CM, CP & NG *	Silviculture	20.739 (37.7%)
112 Aliphatic intermediates	CM, CP & NG *	CM, CP & NG *	0.773 (5.3%)	CM, CP & NG *	Private PG *	1.019 (4.3%)	CM, CP & NG *	Silviculture	13.028 (10.9%)
113 Cyclic intermediates	CM, CP & NG *	CM, CP & NG *	0.689 (6.6%)	CM, CP & NG *	Private PG *	0.909 (6.0%)	CM, CP & NG *	Silviculture	11.619 (13.2%)
114 Synthetic rubber	CM, CP & NG *	CM, CP & NG *	0.547 (3.1%)	CM, CP & NG *	Private PG *	0.722 (3.0%)	CM, CP & NG *	Silviculture	9.223 (13.7%)
115 Methane derivatives	CM, CP & NG *	CM, CP & NG *	0.356 (2.4%)	Methane derivatives	Methane derivatives	0.538 (1.9%)	CM, CP & NG *	Silviculture	5.995 (7.3%)
116 Oil and fat industrial chemicals	Animal oils & fats	Animal oils & fats	0.149 (2.7%)	Animal oils & fats	Animal oils & fats	0.472 (5.1%)	Edible crops *	Edible crops *	71.260 (25.1%)
117 Plasticizers	Cyclic intermediates	Cyclic intermediates	0.273 (2.6%)	CM, CP & NG *	Private PG *	0.354 (1.8%)	Cyclic intermediates	Industrial WS *	4.894 (6.1%)
118 Synthetic dyes	Cyclic intermediates	Cyclic intermediates	0.492 (3.5%)	Cyclic intermediates	Private PG *	0.591 (2.8%)	Cyclic intermediates	Industrial WS *	8.824 (8.1%)
119 Other industrial organic chemicals	CM, CP & NG *	CM, CP & NG *	0.338 (3.7%)	CM, CP & NG *	Private PG *	0.446 (3.2%)	Edible crops *	Edible crops *	5.705 (6.7%)
120 Thermo-setting resins	Cyclic intermediates	Cyclic intermediates	0.540 (6.6%)	Cyclic intermediates	Private PG *	0.647 (4.9%)	Cyclic intermediates	Industrial WS *	9.671 (11.8%)
121 Thermoplastics resins	CM, CP & NG *	CM, CP & NG *	0.726 (8.4%)	CM, CP & NG *	Private PG *	0.958 (6.9%)	CM, CP & NG *	Silviculture	12.237 (15.7%)
122 High function resins	Cyclic intermediates	Cyclic intermediates	0.626 (7.8%)	Cyclic intermediates	Private PG *	0.751 (5.8%)	Cyclic intermediates	Industrial WS *	11.211 (13.5%)

Table S4. Cont.

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123 Other resins	Cyclic intermediates	Cyclic intermediates	0.438 (4.7%)	Cyclic intermediates	Private PG *	0.526 (3.9%)	Wood chips	Silviculture	16.984 (11.3%)
124 Rayon and acetate	CM, CP & NG *	CM, CP & NG *	0.183 (1.1%)	Pulp	Pulp	0.248 (1.4%)	Wood chips	Silviculture	126.331 (43.0%)
125 Synthetic fibers	Cyclic intermediates	Cyclic intermediates	0.362 (3.1%)	Cyclic intermediates	Private PG *	0.434 (1.7%)	Cyclic intermediates	Industrial WS *	6.489 (5.9%)
126 Medicaments	CM, CP & NG *	CM, CP & NG *	0.066 (2.4%)	CM, CP & NG *	Private PG *	0.087 (1.7%)	Edible crops *	Edible crops *	5.373 (10.6%)
127 Soap, synthetic detergents and surface active agents	CM, CP & NG *	CM, CP & NG *	0.129 (2.4%)	CM, CP & NG *	Private PG *	0.170 (1.6%)	Wood chips	Silviculture	8.699 (11.9%)
128 Cosmetics, toilet preparations and dentifrices	CM, CP & NG *	CM, CP & NG *	0.083 (2.1%)	CM, CP & NG *	Private PG *	0.109 (1.6%)	Wood chips	Silviculture	11.098 (21.9%)
129 Paint and varnishes	CM, CP & NG *	CM, CP & NG *	0.210 (3.5%)	CM, CP & NG *	Private PG *	0.277 (2.9%)	CM, CP & NG *	Silviculture	3.545 (5.1%)
130 Printing ink	CM, CP & NG *	CM, CP & NG *	0.192 (3.6%)	CM, CP & NG *	Private PG *	0.253 (3.0%)	Edible crops *	Edible crops *	13.066 (14.2%)
131 Photographic sensitive materials	Industrial IC *	Industrial IC *	0.158 (2.7%)	Industrial IC *	Industrial IC *	0.243 (1.6%)	Wood chips	Silviculture	20.507 (30.1%)
132 Agricultural chemicals	CM, CP & NG *	CM, CP & NG *	0.118 (1.6%)	CM, CP & NG *	Private PG *	0.156 (1.2%)	Wood chips	Silviculture	3.914 (5.2%)
133 Gelatin and adhesives	CM, CP & NG *	CM, CP & NG *	0.186 (3.1%)	CM, CP & NG *	Private PG *	0.245 (2.2%)	Logs	Silviculture	4.307 (5.8%)
134 Other final chemical products	CM, CP & NG *	CM, CP & NG *	0.180 (2.6%)	Final CP *	Final CP *	0.286 (2.0%)	Edible crops *	Edible crops *	7.758 (10.9%)

Table S4. *Cont*.

	GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
135 Petroleum refinery products (including greases)	CM, CP & NG *	CM, CP & NG *	2.185 (28.5%)	CM, CP & NG *	Private PG *	2.883 (22.5%)	CM, CP & NG *	Silviculture	36.840 (73.4%)
136 Coal products	CM, CP & NG *	CM, CP & NG *	2.380 (15.7%)	CM, CP & NG *	Private PG *	3.140 (22.6%)	CM, CP & NG *	Silviculture	40.132 (71.6%)
137 Paving materials	CM, CP & NG *	CM, CP & NG *	0.480 (12.4%)	CM, CP & NG *	Private PG *	0.634 (9.3%)	CM, CP & NG *	Silviculture	8.100 (33.7%)
138 Plastic products	CM, CP & NG *	CM, CP & NG *	0.159 (3.8%)	CM, CP & NG *	Private PG *	0.209 (3.0%)	Wood chips	Silviculture	3.326 (7.7%)
139 Tires and inner tubes	Inedible crops *	Inedible crops *	0.179 (2.8%)	CM, CP & NG *	Private PG *	0.201 (2.0%)	Inedible crops *	Inedible crops *	4.797 (10.8%)
140 Rubber footwear	CM, CP & NG *	CM, CP & NG *	0.077 (2.5%)	CM, CP & NG *	Private PG *	0.102 (1.2%)	Wood chips	Silviculture	2.906 (12.1%)
141 Plastic footwear	CM, CP & NG *	CM, CP & NG *	0.098 (2.5%)	CM, CP & NG *	Private PG *	0.129 (1.7%)	Wood chips	Silviculture	3.647 (14.6%)
142 Other rubber products	CM, CP & NG *	CM, CP & NG *	0.103 (2.5%)	CM, CP & NG *	Private PG *	0.135 (2.1%)	Wood chips	Silviculture	3.255 (10.0%)
143 Leather footwear	Leather & fur skins	Electricity	0.050 (2.1%)	Rubber footwear	Rubber footwear	0.235 (5.8%)	Leather & fur skins	Crops for feed *	13.401 (10.7%)
144 Leather and fur skins	Slaughtering *	Beef cattle	0.339 (6.8%)	Slaughtering *	Electricity	0.111 (2.0%)	Slaughtering *	Crops for feed *	95.758 (18.3%)
145 Miscellaneous leather products	CM, CP & NG *	CM, CP & NG *	0.063 (2.4%)	CM, CP & NG *	Private PG *	0.084 (2.0%)	Leather & fur skins	Crops for feed *	10.044 (10.3%)
146 Sheet glass and safety glass	CM, CP & NG *	CM, CP & NG *	0.096 (1.8%)	CM, CP & NG *	Private PG *	0.127 (0.9%)	Logs	Silviculture	5.407 (10.1%)
147 Glass fiber and glass fiber products	CM, CP & NG *	CM, CP & NG *	0.190 (2.0%)	CM, CP & NG *	Private PG *	0.251 (1.7%)	Wood chips	Silviculture	4.313 (10.9%)
148 Other glass products	CM, CP & NG *	CM, CP & NG *	0.131 (2.3%)	CM, CP & NG *	Private PG *	0.173 (1.6%)	Wood chips	Silviculture	5.919 (17.4%)

Table S4. *Cont*.

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
149 Cement	CM, CP & NG *	CM, CP & NG *	0.509 (0.4%)	CM, CP & NG *	Private PG *	0.672 (0.3%)	CM, CP & NG *	Silviculture	8.588 (19.1%)
150 Ready mixed concrete	Cement	Cement	0.349 (1.3%)	Cement	Cement	0.542 (1.3%)	CM, CP & NG *	Silviculture	3.110 (13.4%)
151 Cement products	CM, CP & NG *	CM, CP & NG *	0.096 (0.9%)	Cement	Cement	0.139 (0.7%)	CM, CP & NG *	Silviculture	1.616 (7.0%)
152 Pottery, china and earthenware	CM, CP & NG *	CM, CP & NG *	0.162 (2.4%)	CM, CP & NG *	Private PG *	0.214 (1.9%)	Wood chips	Silviculture	9.472 (16.5%)
153 Clay refractories	CM, CP & NG *	CM, CP & NG *	0.125 (1.6%)	Aluminum *	Aluminum *	0.215 (1.0%)	Logs	Silviculture	2.802 (8.5%)
154 Other structural clay products	CM, CP & NG *	CM, CP & NG *	0.205 (2.1%)	CM, CP & NG *	Private PG *	0.271 (0.2%)	Wood chips	Silviculture	17.045 (21.7%)
155 Carbon and graphite products	CM, CP & NG *	CM, CP & NG *	0.180 (2.3%)	CM, CP & NG *	Private PG *	0.237 (1.5%)	CM, CP & NG *	Silviculture	3.032 (6.9%)
156 Abrasive	CM, CP & NG *	CM, CP & NG *	0.078 (2.0%)	Aluminum *	Aluminum *	0.110 (1.0%)	Wood chips	Silviculture	4.779 (14.7%)
157 Miscellaneous ceramic, stone and clay products	CM, CP & NG *	CM, CP & NG *	0.117 (1.8%)	NM ores *	NM ores *	0.206 (2.4%)	Edible crops *	Edible crops *	3.527 (10.5%)
158 Pig iron	Metallic ores	Private PG *	0.800 (1.2%)	Metallic ores	Private PG *	1.859 (4.6%)	Metallic ores	Silviculture	20.625 (42.2%)
159 Ferro alloys	Metallic ores	Private PG *	0.611 (3.5%)	Metallic ores	Private PG *	1.420 (4.5%)	Metallic ores	Silviculture	15.759 (12.2%)
160 Crude steel (converters)	Pig iron	Pig iron	0.613 (1.4%)	Metallic ores	Private PG *	1.087 (3.8%)	Metallic ores	Silviculture	12.066 (30.9%)
161 Crude steel (electric furnaces)	Ferro alloys	Ferro alloys	1.367 (12.6%)	Ferro alloys	Ferro alloys	2.669 (17.9%)	Ferro alloys	Industrial WS *	11.484 (21.2%)
162 Scrap iron	-	-		-	-		-	-	
163 Hot rolled steel	Ferro alloys	Ferro alloys	0.395 (1.6%)	Ferro alloys	Ferro alloys	0.771 (4.1%)	Metallic ores	Silviculture	6.338 (14.0%)
164 Steel pipes and tubes	Hot rolled steel	Pig iron	0.383 (2.3%)	Ferro alloys	Ferro alloys	0.432 (3.2%)	Metallic ores	Silviculture	3.646 (8.1%)

Table S4. *Cont.*

	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
165 Cold-finished steel	Hot rolled steel	Pig iron	0.399 (2.1%)	Ferro alloys	Ferro alloys	0.444 (2.8%)	Metallic ores	Silviculture	4.072 (7.8%)
166 Coated steel	Hot rolled steel	Pig iron	0.239 (1.7%)	Ferro alloys	Ferro alloys	0.265 (2.0%)	CM, CP & NG *	Silviculture	3.134 (6.3%)
167 Cast and forged steel	Ferro alloys	Ferro alloys	0.382 (3.6%)	Ferro alloys	Ferro alloys	0.745 (7.2%)	Ferro alloys	Industrial WS *	3.204 (8.2%)
168 Cast iron pipes and tubes	CM, CP & NG *	CM, CP & NG *	0.176 (1.4%)	CM, CP & NG *	Private PG *	0.233 (1.6%)	CM, CP & NG *	Silviculture	2.973 (8.8%)
169 Cast and forged materials (iron)	CM, CP & NG *	CM, CP & NG *	0.206 (1.3%)	CM, CP & NG *	Private PG *	0.272 (1.7%)	CM, CP & NG *	Silviculture	3.470 (11.8%)
170 Iron and steel shearing and slitting	Hot rolled steel	Pig iron	0.285 (2.1%)	Ferro alloys	Ferro alloys	0.317 (2.7%)	CM, CP & NG *	Silviculture	2.838 (8.3%)
171 Other iron or steel products	CM, CP & NG *	CM, CP & NG *	0.128 (1.4%)	CM, CP & NG *	Private PG *	0.176 (1.9%)	CM, CP & NG *	Silviculture	2.162 (5.7%)
172 Copper	Metallic ores	Private PG *	1.888 (24.0%)	Metallic ores	Private PG *	4.388 (31.4%)	Metallic ores	Silviculture	48.690 (67.6%)
173 Lead and zinc (including regenerated lead)	Metallic ores	Private PG *	0.837 (10.9%)	Metallic ores	Private PG *	1.945 (16.0%)	Metallic ores	Silviculture	21.585 (47.8%)
174 Aluminum (including regenerated aluminum)	Aluminum *	Aluminum *	0.263 (5.0%)	Aluminum *	Aluminum *	1.226 (7.6%)	Metallic ores	Silviculture	4.240 (11.4%)
175 Other non-ferrous metals	Metallic ores	Private PG *	1.471 (23.4%)	Metallic ores	Private PG *	3.419 (30.3%)	Metallic ores	Silviculture	37.935 (60.7%)
176 Non-ferrous metal scrap	-	-	-	-	-	-	-	-	-

Table S4. *Cont.*

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)	
	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact
177 Electric wires and cables	Metallic ores	Private PG *	0.503 (11.2%)	Metallic ores	Private PG *	1.169 (15.0%)	Metallic ores	Silviculture	12.974 (26.5%)
178 Optical fiber cables	CM, CP & NG *	CM, CP & NG *	0.134 (2.6%)	CM, CP & NG *	Private PG *	0.176 (2.2%)	Wood chips	Silviculture	6.835 (12.9%)
179 Rolled and drawn copper and copper alloys	Metallic ores	Private PG *	0.716 (13.7%)	Metallic ores	Private PG *	1.663 (18.2%)	Metallic ores	Silviculture	18.451 (39.2%)
180 Rolled and drawn aluminum	Aluminum *	Aluminum *	0.627 (16.6%)	Aluminum *	Aluminum *	2.921 (28.8%)	Aluminum *	Industrial WS *	4.155 (13.0%)
181 Non-ferrous metal castingsand forgings	Aluminum *	Aluminum *	0.461 (8.5%)	Aluminum *	Aluminum *	2.147 (23.5%)	Aluminum *	Industrial WS *	3.053 (9.8%)
182 Nuclear fuels	NF metals *	Private PG *	0.276 (12.2%)	NF metals *	Private PG *	0.641 (19.4%)	NF metals *	Silviculture	5.134 (35.1%)
183 Other non-ferrous metal products	NF metals *	Private PG *	0.706 (13.8%)	NF metals *	Private PG *	1.641 (17.7%)	NF metals *	Silviculture	13.139 (25.0%)
184 Metal products for construction	Hot rolled steel	Pig iron	0.151 (1.9%)	Ferro alloys	Ferro alloys	0.175 (2.4%)	CM, CP & NG *	Silviculture	1.871 (8.0%)
185 Metal products for architecture	Aluminum *	Aluminum *	0.100 (2.1%)	Aluminum *	Aluminum *	0.465 (7.9%)	Logs	Silviculture	3.651 (10.6%)
186 Gas and oil appliances and heating and cooking apparatus	Hot rolled steel	Pig iron	0.091 (1.5%)	Aluminum *	Aluminum *	0.153 (2.3%)	Wood chips	Silviculture	4.436 (12.7%)
187 Bolts, nuts, rivets and springs	Hot rolled steel	Pig iron	0.115 (1.8%)	Metallic ores	Private PG *	0.148 (2.4%)	Metallic ores	Silviculture	1.643 (7.3%)

Table S4. *Cont.*

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
188 Metal containers, fabricated plate and sheet metal	CM, CP & NG *	CM, CP & NG *	0.088 (1.5%)	CM, CP & NG *	Private PG *	0.116 (2.0%)	Logs	Silviculture	2.348 (8.6%)
189 Plumber's supplies, powder metallurgy products and tools	NF metals *	Private PG *	0.075 (1.7%)	NF metals *	Private PG *	0.175 (3.2%)	Wood chips	Silviculture	1.854 (7.9%)
190 Other metal products	CM, CP & NG *	CM, CP & NG *	0.076 (1.6%)	Aluminum *	Aluminum *	0.208 (3.6%)	Wood chips	Silviculture	1.493 (7.2%)
191 Boilers	CM, CP & NG *	CM, CP & NG *	0.051 (1.8%)	CM, CP & NG *	Private PG *	0.067 (1.8%)	Wood chips	Silviculture	1.533 (11.0%)
192 Turbines	CM, CP & NG *	CM, CP & NG *	0.063 (1.6%)	CM, CP & NG *	Private PG *	0.083 (1.7%)	Wood chips	Silviculture	1.459 (7.8%)
193 Engines	CM, CP & NG *	CM, CP & NG *	0.072 (1.6%)	Aluminum *	Aluminum *	0.101 (1.9%)	Wood chips	Silviculture	1.667 (8.6%)
194 Conveyors	CM, CP & NG *	CM, CP & NG *	0.062 (1.6%)	CM, CP & NG *	Private PG *	0.081 (1.9%)	Wood chips	Silviculture	1.900 (9.6%)
195 Refrigerators and air conditioning apparatus	CM, CP & NG *	CM, CP & NG *	0.054 (0.8%)	CM, CP & NG *	Private PG *	0.071 (1.8%)	Wood chips	Silviculture	2.310 (10.9%)
196 Pumps and compressors	CM, CP & NG *	CM, CP & NG *	0.065 (1.5%)	Aluminum *	Aluminum *	0.094 (2.0%)	Wood chips	Silviculture	1.612 (8.6%)
197 Machinists' precision tools	CM, CP & NG *	CM, CP & NG *	0.060 (1.6%)	CM, CP & NG *	Private PG *	0.079 (1.7%)	Wood chips	Silviculture	2.028 (10.4%)
198 Other general industrial machinery and equipment	CM, CP & NG *	CM, CP & NG *	0.065 (1.6%)	CM, CP & NG *	Private PG *	0.086 (1.7%)	Wood chips	Silviculture	1.530 (7.8%)
199 Machinery and equipment for construction and mining	CM, CP & NG *	CM, CP & NG *	0.067 (1.7%)	CM, CP & NG *	Private PG *	0.088 (1.8%)	Wood chips	Silviculture	1.824 (9.2%)

Table S4. *Cont.*

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
200 Chemical machinery	CM, CP & NG *	CM, CP & NG *	0.054 (1.8%)	CM, CP & NG *	Private PG *	0.071 (2.0%)	Wood chips	Silviculture	1.692 (9.8%)
201 Industrial robots	CM, CP & NG *	CM, CP & NG *	0.060 (1.8%)	CM, CP & NG *	Private PG *	0.079 (2.1%)	Wood chips	Silviculture	2.159 (5.8%)
202 Metal machine tools	CM, CP & NG *	CM, CP & NG *	0.053 (1.6%)	CM, CP & NG *	Private PG *	0.071 (2.0%)	Wood chips	Silviculture	1.748 (9.8%)
203 Metal processing machinery	CM, CP & NG *	CM, CP & NG *	0.064 (1.6%)	CM, CP & NG *	Private PG *	0.084 (2.0%)	Wood chips	Silviculture	1.507 (8.6%)
204 Machinery for agricultural use	CM, CP & NG *	CM, CP & NG *	0.065 (1.7%)	CM, CP & NG *	Private PG *	0.086 (1.9%)	Wood chips	Silviculture	1.650 (9.7%)
205 Textile machinery	CM, CP & NG *	CM, CP & NG *	0.057 (1.6%)	CM, CP & NG *	Private PG *	0.075 (1.7%)	Wood chips	Silviculture	1.982 (9.9%)
206 Food processing machinery and equipment	CM, CP & NG *	CM, CP & NG *	0.066 (1.5%)	CM, CP & NG *	Private PG *	0.088 (1.8%)	Wood chips	Silviculture	1.587 (8.6%)
207 Semiconductor making equipment	SM equipment *	Electricity	0.073 (2.6%)	SM equipment *	Electricity	0.091 (2.6%)	Wood chips	Silviculture	1.877 (9.7%)
208 Vacuum equipment and vacuum component	CM, CP & NG *	CM, CP & NG *	0.061 (1.6%)	CM, CP & NG *	Private PG *	0.081 (1.8%)	Wood chips	Silviculture	1.561 (9.2%)
209 Other special machinery for industrial use	Special machinery *	Pig iron	0.057 (1.7%)	CM, CP & NG *	Private PG *	0.070 (1.7%)	Wood chips	Silviculture	1.558 (8.8%)
210 Metal molds	CM, CP & NG *	CM, CP & NG *	0.060 (1.5%)	CM, CP & NG *	Private PG *	0.079 (1.8%)	Wood chips	Silviculture	1.604 (9.8%)
211 Bearings	Hot rolled steel	Pig iron	0.111 (1.8%)	CM, CP & NG *	Private PG *	0.126 (1.9%)	Wood chips	Silviculture	2.021 (9.7%)
212 Other general machines and parts	CM, CP & NG *	CM, CP & NG *	0.061 (1.6%)	Metallic ores	Private PG *	0.138 (2.8%)	Wood chips	Silviculture	1.645 (8.5%)
213 Copy machine	Integrated circuits	Electricity	0.112 (3.5%)	Integrated circuits	Electricity	0.140 (3.1%)	Wood chips	Silviculture	3.256 (11.0%)

Table S4. *Cont*.

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* wheRe Potential Impacts are Induced	Foreign Potential Impact
214	Other office machines	Integrated circuits	Electricity	0.073 (2.7%)	Integrated circuits	Electricity	0.091 (2.4%)	Wood chips	Silviculture	3.495 (13.8%)
215	Machinery for service industry	CM, CP & NG *	CM, CP & NG *	0.055 (1.7%)	CM, CP & NG *	Private PG *	0.073 (1.8%)	Logs	Silviculture	4.049 (11.7%)
216	Rotating electrical equipment	CM, CP & NG *	CM, CP & NG *	0.069 (1.6%)	Aluminum *	Aluminum *	0.102 (2.0%)	Wood chips	Silviculture	2.596 (10.1%)
217	Transformers and reactors	CM, CP & NG *	CM, CP & NG *	0.062 (1.6%)	Metallic ores	Private PG *	0.096 (2.0%)	Wood chips	Silviculture	5.002 (15.6%)
218	Relay switches and switchboards	CM, CP & NG *	CM, CP & NG *	0.055 (1.5%)	CM, CP & NG *	Private PG *	0.073 (1.9%)	Wood chips	Silviculture	2.486 (9.7%)
219	Wiring devices and supplies	CM, CP & NG *	CM, CP & NG *	0.056 (2.0%)	Metallic ores	Private PG *	0.103 (2.8%)	Wood chips	Silviculture	2.628 (11.4%)
220	Electrical equipment for internal combustion engines	CM, CP & NG *	CM, CP & NG *	0.057 (1.8%)	Aluminum *	Aluminum *	0.110 (2.7%)	Wood chips	Silviculture	2.738 (9.5%)
221	Other electrical devices and parts	CM, CP & NG *	CM, CP & NG *	0.059 (1.9%)	Aluminum *	Aluminum *	0.122 (2.8%)	Wood chips	Silviculture	5.322 (16.4%)
222	Applied electronic equipment	Integrated circuits	Electricity	0.116 (4.8%)	Integrated circuits	Electricity	0.145 (4.5%)	Wood chips	Silviculture	2.776 (10.2%)
223	Electric measuring instruments	Integrated circuits	Electricity	0.098 (4.5%)	Integrated circuits	Electricity	0.122 (4.3%)	Wood chips	Silviculture	2.324 (10.2%)
224	Electric bulbs	CM, CP & NG *	CM, CP & NG *	0.059 (2.2%)	CM, CP & NG *	Private PG *	0.078 (2.0%)	Wood chips	Silviculture	4.938 (17.4%)
225	Electric lighting fixtures and apparatus	CM, CP & NG *	CM, CP & NG *	0.065 (2.2%)	CM, CP & NG *	Private PG *	0.086 (2.3%)	Wood chips	Silviculture	3.122 (10.8%)
226	Batteries	Metallic ores	Private PG *	0.099 (2.3%)	Metallic ores	Private PG *	0.231 (3.5%)	Wood chips	Silviculture	3.547 (9.5%)

Table S4. *Cont*.

		GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)		
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
227	Other electrical devices and parts	NF metals *	Private PG *	0.220 (6.2%)	NF metals *	Private PG *	0.512 (9.8%)	NF metals *	Silviculture	4.096 (12.5%)
228	Household air conditioners	Integrated circuits	Electricity	0.062 (1.8%)	Integrated circuits	Electricity	0.078 (1.9%)	Wood chips	Silviculture	3.420 (12.5%)
229	Household electric appliances (except air-conditioners)	CM, CP & NG *	CM, CP & NG *	0.057 (1.8%)	CM, CP & NG *	Private PG *	0.075 (1.9%)	Wood chips	Silviculture	3.218 (11.7%)
230	Video recording and playback equipment	Integrated circuits	Electricity	0.114 (3.7%)	Integrated circuits	Electricity	0.142 (3.4%)	Wood chips	Silviculture	3.802 (10.4%)
231	Electric audio equipment	Integrated circuits	Electricity	0.098 (3.4%)	Integrated circuits	Electricity	0.122 (3.1%)	Wood chips	Silviculture	3.738 (10.4%)
232	Radio and television sets	Integrated circuits	Electricity	0.084 (2.8%)	Integrated circuits	Electricity	0.104 (2.7%)	Wood chips	Silviculture	3.298 (10.5%)
233	Wired communication equipment	Integrated circuits	Electricity	0.069 (2.6%)	Integrated circuits	Electricity	0.086 (2.3%)	Wood chips	Silviculture	3.916 (12.8%)
234	Cellular phones	Integrated circuits	Electricity	0.121 (4.4%)	Integrated circuits	Electricity	0.151 (4.1%)	Wood chips	Silviculture	2.952 (10.3%)
235	Radio communication equipment (except cellular phones)	Integrated circuits	Electricity	0.083 (3.0%)	Integrated circuits	Electricity	0.103 (2.8%)	Wood chips	Silviculture	3.500 (12.1%)
236	Other communication equipment	S devices *	S devices *	0.069 (2.8%)	Integrated circuits	Electricity	0.067 (2.1%)	Wood chips	Silviculture	3.080 (12.4%)
237	Personal Computers	Integrated circuits	Electricity	0.151 (5.6%)	Integrated circuits	Electricity	0.189 (5.2%)	Wood chips	Silviculture	2.880 (9.7%)

Table S4. *Cont*.

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
238 Electronic computing equipment (except personal computers)	Integrated circuits	Electricity	0.125 (5.7%)	Integrated circuits	Electricity	0.156 (5.3%)	Wood chips	Silviculture	2.374 (10.6%)
239 Electronic computing equipment (accessory equipment)	Integrated circuits	Electricity	0.139 (5.3%)	Integrated circuits	Electricity	0.173 (5.0%)	Wood chips	Silviculture	2.378 (9.2%)
240 Semiconductor devices	CM, CP & NG *	CM, CP & NG *	0.053 (0.6%)	NF metals *	Private PG *	0.083 (2.3%)	Wood chips	Silviculture	2.389 (8.6%)
241 Integrated circuits	Integrated circuits	Electricity	0.072 (1.9%)	Integrated circuits	Electricity	0.090 (1.9%)	Wood chips	Silviculture	3.187 (8.7%)
242 Electron tubes	Glass products *	Glass products *	0.141 (3.6%)	Glass products *	Glass products *	0.269 (4.4%)	Wood chips	Silviculture	3.309 (12.3%)
243 Liquid crystal element	S devices *	S devices *	0.241 (5.8%)	Integrated circuits	Electricity	0.175 (4.0%)	Wood chips	Silviculture	3.062 (5.8%)
244 Magnetic tapes and discs	CM, CP & NG *	CM, CP & NG *	0.139 (2.8%)	CM, CP & NG *	Private PG *	0.183 (2.8%)	Wood chips	Silviculture	6.879 (16.8%)
245 Other electronic components	E components *	Electricity	0.075 (2.3%)	E components *	Electricity	0.093 (1.9%)	Wood chips	Silviculture	3.776 (11.4%)
246 Passenger motor cars	CM, CP & NG *	CM, CP & NG *	0.073 (1.9%)	CM, CP & NG *	Private PG *	0.097 (1.8%)	Wood chips	Silviculture	2.320 (9.4%)
247 Trucks, buses and other cars	CM, CP & NG *	CM, CP & NG *	0.074 (1.9%)	CM, CP & NG *	Private PG *	0.098 (1.8%)	Wood chips	Silviculture	2.176 (9.2%)
248 Two-wheel motor vehicles	CM, CP & NG *	CM, CP & NG *	0.070 (2.1%)	CM, CP & NG *	Private PG *	0.092 (1.9%)	Wood chips	Silviculture	2.298 (9.5%)
249 Motor vehicle bodies	CM, CP & NG *	CM, CP & NG *	0.089 (1.6%)	CM, CP & NG *	Private PG *	0.117 (1.9%)	Wood chips	Silviculture	1.693 (6.7%)
250 Internal combustion engines for motor vehicles and parts	CM, CP & NG *	CM, CP & NG *	0.078 (1.9%)	Aluminum *	Aluminum *	0.125 (2.1%)	Wood chips	Silviculture	2.158 (9.7%)

Table S4. *Cont*.

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)	
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
251 Motor vehicle parts and accessories	CM, CP & NG *	CM, CP & NG *	0.076 (1.9%)	CM, CP & NG *	Private PG *	0.101 (1.8%)	Wood chips	Silviculture	2.113 (8.7%)
252 Steel ships	Hot rolled steel	Pig iron	0.132 (1.8%)	Ferro alloys	Ferro alloys	0.154 (2.0%)	Logs	Silviculture	7.030 (15.21)
253 Ships (except steel ships)	CM, CP & NG *	CM, CP & NG *	0.070 (2.2%)	CM, CP & NG *	Private PG *	0.093 (1.9%)	Logs	Silviculture	34.047 (29.2%)
254 Internal combustion engines for vessels	CM, CP & NG *	CM, CP & NG *	0.104 (1.8%)	CM, CP & NG *	Private PG *	0.137 (1.2%)	Wood chips	Silviculture	1.774 (9.4%)
255 Repair of ships	CM, CP & NG *	CM, CP & NG *	0.068 (1.7%)	CM, CP & NG *	Private PG *	0.090 (1.8%)	Logs	Silviculture	3.847 (13.1%)
256 Rolling stock	CM, CP & NG *	CM, CP & NG *	0.076 (1.6%)	CM, CP & NG *	Private PG *	0.100 (1.6%)	Logs	Silviculture	4.691 (11.8%)
257 Repair of rolling stock	CM, CP & NG *	CM, CP & NG *	0.131 (1.9%)	CM, CP & NG *	Private PG *	0.173 (2.4%)	Logs	Silviculture	4.910 (12.0%)
258 Aircrafts	Aircrafts	Electricity	0.110 (4.3%)	Aircrafts	Aircrafts	0.676 (9.4%)	Wood chips	Silviculture	1.463 (9.5%)
259 Repair of aircrafts	Aircrafts	Electricity	0.258 (11.8%)	Aircrafts	Aircrafts	1.590 (32.2%)	Aircrafts	Silviculture	2.884 (24.1%)
260 Bicycles	Bicycles	Bicycles	0.434 (9.1%)	Bicycles	Private PG *	0.382 (7.0%)	Bicycles	Silviculture	2.252 (12.1%)
261 Other transport equipment	CM, CP & NG *	CM, CP & NG *	0.075 (1.7%)	CM, CP & NG *	Private PG *	0.099 (1.7%)	Wood chips	Silviculture	1.743 (9.5%)
262 Cameras	Integrated circuits	Electricity	0.097 (3.9%)	Integrated circuits	Electricity	0.121 (3.3%)	Wood chips	Silviculture	2.645 (10.7%)
263 Other photographic and optical instruments	CM, CP & NG *	CM, CP & NG *	0.060 (2.2%)	Glass products *	Glass products *	0.104 (2.4%)	Wood chips	Silviculture	2.331 (10.4%)
264 Watches and clocks	CM, CP & NG *	CM, CP & NG *	0.050 (1.9%)	Jewelry *	Marine culture	0.156 (4.1%)	Wood chips	Silviculture	2.204 (8.8%)
265 Professional and scientific instruments	CM, CP & NG *	CM, CP & NG *	0.049 (2.0%)	CM, CP & NG *	Private PG *	0.064 (2.1%)	Wood chips	Silviculture	2.354 (11.5%)

Table S4. *Cont.*

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
266 Analytical instruments, testing machines, measuring instruments	Integrated circuits	Electricity	0.070 (3.0%)	Integrated circuits	Electricity	0.087 (2.8%)	Wood chips	Silviculture	2.618 (9.1%)
267 Medical instruments	Integrated circuits	Electricity	0.055 (2.0%)	CM, CP & NG *	Private PG *	0.072 (1.8%)	Wood chips	Silviculture	2.913 (10.5%)
268 Toys and games	Integrated circuits	Electricity	0.130 (4.7%)	Integrated circuits	Electricity	0.162 (3.4%)	Logs	Silviculture	5.920 (12.5%)
269 Sporting and athletic goods	CM, CP & NG *	CM, CP & NG *	0.093 (2.5%)	CM, CP & NG *	Private PG *	0.123 (2.0%)	Logs	Silviculture	12.299 (16.5%)
270 Musical instruments	Integrated circuits	Electricity	0.093 (3.8%)	Integrated circuits	Electricity	0.116 (3.6%)	Logs	Silviculture	62.127 (27.2%)
271 Audio and video records, other information recording media	CM, CP & NG *	CM, CP & NG *	0.072 (3.1%)	CM, CP & NG *	Private PG *	0.095 (2.7%)	Wood chips	Silviculture	5.764 (20.9%)
272 Stationery	CM, CP & NG *	CM, CP & NG *	0.077 (2.8%)	CM, CP & NG *	Private PG *	0.101 (2.5%)	Logs	Silviculture	7.662 (14.2%)
273 Jewelry and adornments	NF metals *	Private PG *	0.170 (5.7%)	Marine culture	Marine culture	0.549 (4.8%)	Wood chips	Silviculture	4.972 (9.5%)
274 "Tatami" (straw matting) and straw products	Inedible crops *	Inedible crops *	0.135 (5.6%)	CM, CP & NG *	Private PG *	0.055 (2.3%)	Tatami and straw products	Rice	16.997 (3.4%)
275 Ordnance	CM, CP & NG *	CM, CP & NG *	0.060 (1.9%)	Aluminum *	Aluminum *	0.131 (2.9%	Wood chips	Silviculture	1.961 (5.8%)
276 Miscellaneous manufacturing products	CM, CP & NG *	CM, CP & NG *	0.071 (2.6%)	CM, CP & NG *	Private PG *	0.093 (2.1%)	Logs	Silviculture	18.653 (18.3%)
277 Reuse and recycling	CM, CP & NG *	CM, CP & NG *	0.103 (3.0%)	Harbor transport *	Harbor transport *	0.262 (2.1%)	CM, CP & NG *	Silviculture	1.731 (6.6%)

Table S4. *Cont.*

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
278	Residential construction (wooden)	CM, CP & NG *	CM, CP & NG *	0.049 (2.1%)	CM, CP & NG *	Private PG *	0.065 (1.7%)	Logs	Silviculture	156.033 (28.8%)
279	Residential construction (non-wooden)	CM, CP & NG *	CM, CP & NG *	0.067 (1.9%)	CM, CP & NG *	Private PG *	0.088 (1.7%)	Logs	Silviculture	41.081 (26.2%)
280	Non-residential construction (wooden)	CM, CP & NG *	CM, CP & NG *	0.082 (2.1%)	CM, CP & NG *	Private PG *	0.069 (1.6%)	Timber	Silviculture	114.081 (30.2%)
281	Non-residential construction (non-wooden)	CM, CP & NG *	CM, CP & NG *	0.069 (2.0%)	CM, CP & NG *	Private PG *	0.091 (1.8%)	Logs	Silviculture	21.751 (25.0%)
282	Repair of construction	CM, CP & NG *	CM, CP & NG *	0.063 (2.0%)	CM, CP & NG *	Private PG *	0.083 (1.6%)	Logs	Silviculture	18.446 (22.7%)
283	Public construction of roads	CM, CP & NG *	CM, CP & NG *	0.105 (2.4%)	CM, CP & NG *	Private PG *	0.138 (2.3%)	Logs	Silviculture	3.409 (14.3%)
284	Public construction of rivers, drainages and others	CM, CP & NG *	CM, CP & NG *	0.082 (2.0%)	CM, CP & NG *	Private PG *	0.108 (1.8%)	Logs	Silviculture	3.220 (13.6%)
285	Agricultural public construction	CM, CP & NG *	CM, CP & NG *	0.106 (2.2%)	CM, CP & NG *	Private PG *	0.140 (2.2%)	Logs	Silviculture	10.053 (21.9%)
286	Railway construction	CM, CP & NG *	CM, CP & NG *	0.080 (1.8%)	CM, CP & NG *	Private PG *	0.106 (1.7%)	Logs	Silviculture	5.816 (17.7%)
287	Electric power facilities construction	CM, CP & NG *	CM, CP & NG *	0.072 (2.0%)	CM, CP & NG *	Private PG *	0.095 (2.1%)	Logs	Silviculture	4.192 (15.3%)
288	Telecommunication facilities construction	CM, CP & NG *	CM, CP & NG *	0.072 (2.2%)	CM, CP & NG *	Private PG *	0.094 (2.2%)	Logs	Silviculture	7.185 (20.7%)

Table S4. *Cont.*

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)	
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
289 Other civil engineering and construction	CM, CP & NG *	CM, CP & NG *	0.080 (2.0%)	CM, CP & NG *	Private PG *	0.106 (1.9%)	Logs	Silviculture	5.005 (16.6%)
290 Electricity	CM, CP & NG *	CM, CP & NG *	0.660 (2.3%)	CM, CP & NG *	Private PG *	0.871 (2.5%)	CM, CP & NG *	Silviculture	11.127 (31.8%)
291 Private power generation	CM, CP & NG *	CM, CP & NG *	0.828 (1.2%)	CM, CP & NG *	Private PG *	1.093 (0.7%)	CM, CP & NG *	Silviculture	13.966 (41.8%)
292 Gas supply	CM, CP & NG *	CM, CP & NG *	1.356 (28.2%)	CM, CP & NG *	Private PG *	1.789 (28.8%)	CM, CP & NG *	Silviculture	22.858 (51.3%)
293 Steam and hot water supply	CM, CP & NG *	CM, CP & NG *	0.381 (2.4%)	CM, CP & NG *	Private PG *	0.503 (4.3%)	CM, CP & NG *	Silviculture	6.428 (6.6%)
294 Water supply	CM, CP & NG *	CM, CP & NG *	0.034 (2.5%)	CM, CP & NG *	Private PG *	0.045 (2.4%)	Logs	Silviculture	1.294 (0.1%)
295 Industrial water supply	CM, CP & NG *	CM, CP & NG *	0.039 (2.5%)	CM, CP & NG *	Private PG *	0.051 (2.6%)	Logs	Silviculture	0.841 (0.0%)
296 Sewage disposal	CM, CP & NG *	CM, CP & NG *	0.226 (1.9%)	CM, CP & NG *	Private PG *	0.299 (1.2%)	CM, CP & NG *	Silviculture	3.817 (5.6%)
297 Waste management services (public)	CM, CP & NG *	CM, CP & NG *	0.103 (0.6%)	CM, CP & NG *	Private PG *	0.136 (1.8%)	Wood chips	Silviculture	1.831 (4.5%)
298 Waste management services (private)	CM, CP & NG *	CM, CP & NG *	0.062 (0.8%)	CM, CP & NG *	Private PG *	0.082 (2.0%)	Wood chips	Silviculture	1.342 (7.6%)
299 Wholesale trade	CM, CP & NG *	CM, CP & NG *	0.036 (3.4%)	CM, CP & NG *	Private PG *	0.048 (4.1%)	Wood chips	Silviculture	2.019 (17.7%)
300 Retail trade	CM, CP & NG *	CM, CP & NG *	0.065 (3.0%)	CM, CP & NG *	Private PG *	0.086 (3.1%)	Wood chips	Silviculture	2.963 (20.2%)
301 Financial service	CM, CP & NG *	CM, CP & NG *	0.016 (2.7%)	CM, CP & NG *	Private PG *	0.022 (2.2%)	Wood chips	Silviculture	3.257 (27.4%)
302 Life insurance	CM, CP & NG *	CM, CP & NG *	0.021 (2.9%)	CM, CP & NG *	Private PG *	0.028 (2.5%)	Wood chips	Silviculture	2.957 (21.3%)
303 Non-life insurance	CM, CP & NG *	CM, CP & NG *	0.017 (2.5%)	CM, CP & NG *	Private PG *	0.022 (2.1%)	Wood chips	Silviculture	2.908 (22.9%)
304 Real estate agencies and managers	CM, CP & NG *	CM, CP & NG *	0.028 (2.7%)	CM, CP & NG *	Private PG *	0.037 (2.6%)	Wood chips	Silviculture	1.755 (14.7%)
305 Real estate rental service	CM, CP & NG *	CM, CP & NG *	0.028 (2.8%)	CM, CP & NG *	Private PG *	0.037 (3.0%)	Wood chips	Silviculture	0.775 (7.0%)

Table S4. *Cont*.

		GWP (t·CO₂·eq/million JPY)			DAP (kg·SO₂·eq/million JPY)			WSI (m³·water·eq/million JPY)	
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
306 House rent	CM, CP & NG *	CM, CP & NG *	0.013 (2.6%)	CM, CP & NG *	Private PG *	0.017 (2.1%)	Logs	Silviculture	1.440 (16.4%)
307 House rent (imputed house rent)	CM, CP & NG *	CM, CP & NG *	0.005 (2.2%)	CM, CP & NG *	Private PG *	0.006 (1.9%)	Logs	Silviculture	0.933 (19.8%)
308 Railway transport (passengers)	CM, CP & NG *	CM, CP & NG *	0.062 (2.2%)	CM, CP & NG *	Private PG *	0.082 (2.3%)	Wood chips	Silviculture	1.601 (7.5%)
309 Railway transport (freight)	CM, CP & NG *	CM, CP & NG *	0.117 (2.5%)	CM, CP & NG *	Private PG *	0.154 (3.2%)	Wood chips	Silviculture	2.052 (9.4%)
310 Bus transport service	CM, CP & NG *	CM, CP & NG *	0.133 (4.4%)	CM, CP & NG *	Private PG *	0.176 (4.5%)	CM, CP & NG *	Silviculture	2.250 (19.1%)
311 Hired car and taxi transport	CM, CP & NG *	CM, CP & NG *	0.134 (4.1%)	CM, CP & NG *	Private PG *	0.177 (11.0%)	CM, CP & NG *	Silviculture	2.257 (21.0%)
312 Road freight transport (except self-transport by private cars)	CM, CP & NG *	CM, CP & NG *	0.164 (4.3%)	CM, CP & NG *	Private PG *	0.217 (4.4%)	CM, CP & NG *	Silviculture	2.770 (20.5%)
313 Self-transport by private cars (passengers)	CM, CP & NG *	CM, CP & NG *	0.640 (5.4%)	CM, CP & NG *	Private PG *	0.844 (10.9%)	CM, CP & NG *	Silviculture	10.784 (37.4%)
314 Self-transport by private cars (freight)	CM, CP & NG *	CM, CP & NG *	0.552 (4.9%)	CM, CP & NG *	Private PG *	0.729 (6.1%)	CM, CP & NG *	Silviculture	9.313 (36.0%)
315 Ocean transport	Ocean transport	Ocean transport	11.241 (40.4%)	Ocean transport	Ocean transport	23.005 (38.5%)	Ocean transport	Silviculture	5.021 (21.0%)
316 Coastal and inland water transport	CM, CP & NG *	CM, CP & NG *	0.264 (2.0%)	CM, CP & NG *	Private PG *	0.348 (0.3%)	CM, CP & NG *	Silviculture	4.449 (15.6%)
317 Harbor transport service	CM, CP & NG *	CM, CP & NG *	0.047 (2.8%)	CM, CP & NG *	Private PG *	0.062 (0.6%)	Wood chips	Silviculture	1.164 (11.6%)
318 Air transport	CM, CP & NG *	CM, CP & NG *	0.244 (2.2%)	CM, CP & NG *	Private PG *	0.322 (9.3%)	CM, CP & NG *	Silviculture	4.110 (20.3%)

Table S4. *Cont*.

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
319	Consigned freight forwarding	CM, CP & NG *	CM, CP & NG *	0.052 (3.6%)	CM, CP & NG *	Private PG *	0.069 (3.7%)	Wood chips	Silviculture	2.053 (14.9%)
320	Storage facility service	CM, CP & NG *	CM, CP & NG *	0.054 (2.5%)	CM, CP & NG *	Private PG *	0.071 (2.4%)	Wood chips	Silviculture	3.512 (16.4%)
321	Packing service	CM, CP & NG *	CM, CP & NG *	0.048 (2.3%)	CM, CP & NG *	Private PG *	0.064 (1.7%)	Logs	Silviculture	62.359 (25.1%)
322	Facility service for road transport	CM, CP & NG *	CM, CP & NG *	0.032 (2.5%)	CM, CP & NG *	Private PG *	0.042 (2.6%)	Wood chips	Silviculture	1.190 (6.8%)
323	Port and water traffic control	CM, CP & NG *	CM, CP & NG *	0.043 (2.4%)	CM, CP & NG *	Private PG *	0.057 (0.4%)	Logs	Silviculture	2.995 (1.9%)
324	Services relating to water transport	CM, CP & NG *	CM, CP & NG *	0.017 (2.4%)	CM, CP & NG *	Private PG *	0.022 (1.1%)	Wood chips	Silviculture	0.854 (2.7%)
325	Airport and air traffic control (public)	CM, CP & NG *	CM, CP & NG *	0.051 (2.7%)	CM, CP & NG *	Private PG *	0.068 (2.5%)	Wood chips	Silviculture	3.718 (17.9%)
326	Airport and air traffic control (industrial)	CM, CP & NG *	CM, CP & NG *	0.065 (2.7%)	CM, CP & NG *	Private PG *	0.086 (2.8%)	Wood chips	Silviculture	4.699 (21.7%)
327	Services relating to air transport	CM, CP & NG *	CM, CP & NG *	0.032 (2.7%)	CM, CP & NG *	Private PG *	0.042 (2.6%)	Wood chips	Silviculture	1.923 (6.0%)
328	Travel agency and other services relating to transport	CM, CP & NG *	CM, CP & NG *	0.023 (2.8%)	CM, CP & NG *	Private PG *	0.030 (2.7%)	Wood chips	Silviculture	3.201 (11.4%)
329	Postal service and mail delivery	Air transport	Air transport	0.065 (5.7%)	Ocean transport	Ocean transport	0.055 (4.6%)	Wood chips	Silviculture	1.160 (16.2%)

Table S4. *Cont.*

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	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
330 Fixed telecommunication	CM, CP & NG *	CM, CP & NG *	0.028 (2.7%)	CM, CP & NG *	Private PG *	0.037 (2.8%)	Wood chips	Silviculture	2.122 (14.5%)
331 Mobile telecommunication	CM, CP & NG *	CM, CP & NG *	0.020 (2.6%)	CM, CP & NG *	Private PG *	0.026 (2.8%)	Wood chips	Silviculture	1.463 (9.9%)
332 Other telecommunication	CM, CP & NG *	CM, CP & NG *	0.035 (2.7%)	CM, CP & NG *	Private PG *	0.046 (2.8%)	Wood chips	Silviculture	2.578 (16.5%)
333 Other services relating to communication	CM, CP & NG *	CM, CP & NG *	0.034 (2.6%)	CM, CP & NG *	Private PG *	0.044 (2.9%)	Wood chips	Silviculture	1.585 (11.1%)
334 Public broadcasting	Air transport	Air transport	0.055 (3.6%)	CM, CP & NG *	Private PG *	0.046 (2.8%)	Wood chips	Silviculture	1.986 (10.8%)
335 Private broadcasting	CM, CP & NG *	CM, CP & NG *	0.032 (2.7%)	CM, CP & NG *	Private PG *	0.043 (2.8%)	Wood chips	Silviculture	2.357 (9.8%)
336 Cable broadcasting	CM, CP & NG *	CM, CP & NG *	0.029 (2.7%)	CM, CP & NG *	Private PG *	0.039 (2.7%)	Logs	Silviculture	2.050 (12.0%)
337 Information services	CM, CP & NG *	CM, CP & NG *	0.026 (2.8%)	CM, CP & NG *	Private PG *	0.034 (2.5%)	Wood chips	Silviculture	4.691 (32.4%)
338 Internet based services	CM, CP & NG *	CM, CP & NG *	0.033 (2.7%)	CM, CP & NG *	Private PG *	0.043 (2.7%)	Wood chips	Silviculture	2.400 (16.4%)
339 Image information production and distribution industry	CM, CP & NG *	CM, CP & NG *	0.044 (3.1%)	CM, CP & NG *	Private PG *	0.058 (2.4%)	Wood chips	Silviculture	2.436 (9.6%)
340 Newspaper	Pulp	Pulp	0.100 (2.7%)	Paper	Paper	0.351 (3.2%)	Wood chips	Silviculture	87.056 (47.1%)
341 Publication	Pulp	Pulp	0.065 (2.3%)	Paper	Paper	0.220 (2.9%)	Wood chips	Silviculture	56.298 (45.6%)
342 News syndicates and private detective agencies	Air transport	Air transport	0.050 (5.5%)	CM, CP & NG *	Private PG *	0.032 (2.6%)	Wood chips	Silviculture	3.202 (26.2%)
343 Public administration (central)	CM, CP & NG *	CM, CP & NG *	0.053 (3.5%)	Aircrafts	Aircrafts	0.120 (5.6%)	Wood chips	Silviculture	1.790 (10.4%)
344 Public administration (local)	CM, CP & NG *	CM, CP & NG *	0.037 (2.7%)	CM, CP & NG *	Private PG *	0.049 (3.0%)	Wood chips	Silviculture	1.746 (11.6%)

Table S4. *Cont*.

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact
345 School education (public)	CM, CP & NG *	CM, CP & NG *	0.019 (2.7%)	CM, CP & NG *	Private PG *	0.025 (2.8%)	Wood chips	Silviculture	1.013 (7.5%)
346 School education (private)	CM, CP & NG *	CM, CP & NG *	0.036 (3.0%)	CM, CP & NG *	Private PG *	0.048 (2.8%)	Wood chips	Silviculture	3.334 (9.2%)
347 Social education (public)	CM, CP & NG *	CM, CP & NG *	0.048 (2.5%)	CM, CP & NG *	Private PG *	0.063 (2.1%)	Crops for feed *	Crops for feed *	5.557 (6.9%)
348 Social education (private, non-profit)	CM, CP & NG *	CM, CP & NG *	0.074 (2.8%)	CM, CP & NG *	Private PG *	0.098 (2.4%)	Wood chips	Silviculture	7.743 (8.3%)
349 Other educational and training institutions (public)	CM, CP & NG *	CM, CP & NG *	0.127 (2.8%)	CM, CP & NG *	Private PG *	0.168 (4.5%)	Wood chips	Silviculture	4.194 (3.7%)
350 Other educational and training institutions (profit-making)	CM, CP & NG *	CM, CP & NG *	0.085 (3.3%)	CM, CP & NG *	Private PG *	0.112 (4.5%)	Wood chips	Silviculture	2.515 (13.5%)
351 Research institutes for natural science (pubic)	CM, CP & NG *	CM, CP & NG *	0.102 (3.0%)	CM, CP & NG *	Private PG *	0.134 (3.1%)	Wood chips	Silviculture	4.607 (6.3%)
352 Research institutes for cultural and social science (public)	CM, CP & NG *	CM, CP & NG *	0.097 (3.6%)	CM, CP & NG *	Private PG *	0.127 (2.9%)	Wood chips	Silviculture	12.430 (32.8%)
353 Research institutes for natural sciences (private, non-profit)	CM, CP & NG *	CM, CP & NG *	0.079 (3.5%)	CM, CP & NG *	Private PG *	0.105 (3.7%)	Wood chips	Silviculture	5.905 (13.0%)
354 Research institutes for cultural and social science (private, non-profit)	CM, CP & NG *	CM, CP & NG *	0.045 (3.2%)	CM, CP & NG *	Private PG *	0.059 (3.1%)	Wood chips	Silviculture	7.301 (27.9%)
355 Research institutes for natural sciences (profit-making)	CM, CP & NG *	CM, CP & NG *	0.176 (3.4%)	CM, CP & NG *	Private PG *	0.233 (3.7%)	Wood chips	Silviculture	5.456 (11.0%)

Table S4. *Cont.*

		GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)	
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
356 Research institutes for cultural and social science (profit-making)	CM, CP & NG *	CM, CP & NG *	0.041 (3.2%)	CM, CP & NG *	Private PG *	0.054 (3.0%)	Wood chips	Silviculture	7.722 (30.7%)
357 Research and development (intra-enterprise)	CM, CP & NG *	CM, CP & NG *	0.068 (2.9%)	CM, CP & NG *	Private PG *	0.090 (2.6%)	Wood chips	Silviculture	5.941 (16.6%)
358 Medical service (public)	CM, CP & NG *	CM, CP & NG *	0.050 (2.6%)	CM, CP & NG *	Private PG *	0.066 (2.2%)	Wood chips	Silviculture	2.050 (4.5%)
359 Medical service (non-profit foundations, *etc.*)	CM, CP & NG *	CM, CP & NG *	0.040 (2.6%)	CM, CP & NG *	Private PG *	0.053 (2.0%)	Wood chips	Silviculture	1.636 (4.6%)
360 Medical service (medical corporations, *etc.*)	CM, CP & NG *	CM, CP & NG *	0.040 (2.5%)	CM, CP & NG *	Private PG *	0.053 (2.1%)	Wood chips	Silviculture	1.897 (6.9%)
361 Health and hygiene (public)	CM, CP & NG *	CM, CP & NG *	0.038 (2.6%)	CM, CP & NG *	Private PG *	0.050 (2.1%)	Wood chips	Silviculture	3.448 (21.4%)
362 Health and hygiene (profit-making)	CM, CP & NG *	CM, CP & NG *	0.045 (2.5%)	CM, CP & NG *	Private PG *	0.060 (2.0%)	Wood chips	Silviculture	3.308 (13.5%)
363 Social insurance (public)	CM, CP & NG *	CM, CP & NG *	0.039 (2.7%)	CM, CP & NG *	Private PG *	0.052 (3.0%)	Wood chips	Silviculture	2.732 (11.0%)
364 Social insurance (private, non-profit)	CM, CP & NG *	CM, CP & NG *	0.047 (2.8%)	CM, CP & NG *	Private PG *	0.062 (3.1%)	Wood chips	Silviculture	2.634 (17.6%)
365 Social welfare (public)	CM, CP & NG *	CM, CP & NG *	0.034 (2.7%)	Frozen fish *	Marine fisheries	0.161 (5.2%)	Wood chips	Silviculture	2.843 (5.0%)
366 Social welfare (private, non-profit)	CM, CP & NG *	CM, CP & NG *	0.033 (2.6%)	Frozen fish *	Marine fisheries	0.181 (6.1%)	Wood chips	Silviculture	2.959 (5.0%)
367 Social welfare (profit-making)	CM, CP & NG *	CM, CP & NG *	0.039 (2.7%)	Frozen fish *	Marine fisheries	0.169 (4.9%)	Wood chips	Silviculture	2.830 (4.7%)
368 Nursing care (In-home)	CM, CP & NG *	CM, CP & NG *	0.032 (2.7%)	Frozen fish *	Marine fisheries	0.189 (6.9%)	Edible crops *	Edible crops *	2.684 (4.8%)
369 Nursing care (In-facility)	CM, CP & NG *	CM, CP & NG *	0.037 (2.6%)	Frozen fish *	Marine fisheries	0.241 (7.3%)	Edible crops *	Edible crops *	3.444 (5.3%)

Table S4. *Cont.*

		GWP (t·CO₂eq/million JPY)			DAP (kg·SO₂eq/million JPY)			WSI (m³·water·eq/million JPY)		
		Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
370	Private non-profit institutions serving enterprises	CM, CP & NG *	CM, CP & NG *	0.045 (2.7%)	CM, CP & NG *	Private PG *	0.060 (2.1%)	Wood chips	Silviculture	4.377 (16.0%)
371	Private non-profit institutions serving households	CM, CP & NG *	CM, CP & NG *	0.032 (2.9%)	CM, CP & NG *	Private PG *	0.042 (1.9%)	Wood chips	Silviculture	5.419 (19.0%)
372	Advertising services	CM, CP & NG *	CM, CP & NG *	0.040 (2.4%)	Paper	Paper	0.072 (2.2%)	Wood chips	Silviculture	18.490 (38.0%)
373	Goods rental and leasing (except car rental)	CM, CP & NG *	CM, CP & NG *	0.020 (2.6%)	CM, CP & NG *	Private PG *	0.026 (2.7%)	Wood chips	Silviculture	1.055 (14.8%)
374	Car rental and leasing	CM, CP & NG *	CM, CP & NG *	0.034 (3.8%)	CM, CP & NG *	Private PG *	0.045 (4.3%)	Wood chips	Silviculture	0.883 (10.9%)
375	Repair of motor vehicles	CM, CP & NG *	CM, CP & NG *	0.053 (2.3%)	CM, CP & NG *	Private PG *	0.070 (2.1%)	Wood chips	Silviculture	1.537 (8.4%)
376	Repair of machine	CM, CP & NG *	CM, CP & NG *	0.050 (1.9%)	CM, CP & NG *	Private PG *	0.066 (2.0%)	Wood chips	Silviculture	1.803 (10.0%)
377	Building maintenance services	CM, CP & NG *	CM, CP & NG *	0.022 (3.0%)	CM, CP & NG *	Private PG *	0.029 (2.4%)	Wood chips	Silviculture	2.016 (11.3%)
378	Judicial, financial and accounting services	CM, CP & NG *	CM, CP & NG *	0.018 (3.1%)	CM, CP & NG *	Private PG *	0.024 (1.9%)	Wood chips	Silviculture	2.214 (25.1%)
379	Civil engineering and construction services	CM, CP & NG *	CM, CP & NG *	0.030 (2.5%)	Paper	Paper	0.041 (1.4%)	Wood chips	Silviculture	11.156 (40.3%)
380	Worker dispatching services	CM, CP & NG *	CM, CP & NG *	0.004 (2.8%)	CM, CP & NG *	Private PG *	0.005 (2.3%)	Wood chips	Silviculture	0.625 (29.0%)
381	Other business services	CM, CP & NG *	CM, CP & NG *	0.018 (2.9%)	CM, CP & NG *	Private PG *	0.024 (2.4%)	Wood chips	Silviculture	1.457 (18.1%)

Table S4. *Cont*.

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material j	Sector i Where Potential Impacts are Induced	Foreign Potential Impact
382 Movie theaters	CM, CP & NG *	CM, CP & NG *	0.076 (2.8%)	CM, CP & NG *	Private PG *	0.100 (3.2%)	Wood chips	Silviculture	2.530 (6.4%)
383 Performances (except otherwise classified), theatrical companies	CM, CP & NG *	CM, CP & NG *	0.038 (3.1%)	CM, CP & NG *	Private PG *	0.050 (3.6%)	Crops for feed *	Crops for feed *	20.563 (22.3%)
384 Amusement and recreation facilities	CM, CP & NG *	CM, CP & NG *	0.072 (2.8%)	CM, CP & NG *	Private PG *	0.095 (2.3%)	Wood chips	Silviculture	3.163 (10.9%)
385 Stadiums and companies of bicycle, horse, motorcar and motorboat races	CM, CP & NG *	CM, CP & NG *	0.042 (2.9%)	CM, CP & NG *	Private PG *	0.055 (3.0%)	Crops for feed *	Crops for feed *	31.109 (22.0%)
386 Sport facility service, public gardens and amusement parks	CM, CP & NG *	CM, CP & NG *	0.047 (3.0%)	CM, CP & NG *	Private PG *	0.062 (3.0%)	Crops for feed *	Crops for feed *	2.514 (8.1%)
387 Other amusement and recreation services	CM, CP & NG *	CM, CP & NG *	0.062 (3.5%)	CM, CP & NG *	Private PG *	0.082 (3.4%)	Wood chips	Silviculture	1.534 (7.9%)
388 General eating and drinking places (except coffee shops)	CM, CP & NG *	CM, CP & NG *	0.063 (2.3%)	Frozen fish *	Marine fisheries	0.718 (10.7%)	Edible crops *	Edible crops *	18.439 (8.4%)
389 Coffee shops	CM, CP & NG *	CM, CP & NG *	0.069 (2.6%)	Frozen fish *	Marine fisheries	0.282 (6.3%)	Edible crops *	Edible crops *	13.656 (7.5%)
390 Eating and drinking places for pleasure	CM, CP & NG *	CM, CP & NG *	0.054 (2.6%)	Frozen fish *	Marine fisheries	0.361 (9.2%)	Edible crops *	Edible crops *	10.535 (8.1%)
391 Accommodation	CM, CP & NG *	CM, CP & NG *	0.073 (2.6%)	Frozen fish *	Marine fisheries	0.386 (7.1%)	Edible crops *	Edible crops *	8.459 (6.4%)
392 Cleaning	CM, CP & NG *	CM, CP & NG *	0.063 (2.9%)	CM, CP & NG *	Private PG *	0.083 (1.5%)	Wood chips	Silviculture	1.981 (4.5%)
393 Barber shops	CM, CP & NG *	CM, CP & NG *	0.042 (3.2%)	CM, CP & NG *	Private PG *	0.055 (5.3%)	Wood chips	Silviculture	1.207 (5.2%)
394 Beauty shops	CM, CP & NG *	CM, CP & NG *	0.032 (2.9%)	CM, CP & NG *	Private PG *	0.042 (3.5%)	Wood chips	Silviculture	1.922 (5.3%)

Table S4. *Cont*.

	GWP (t·CO$_2$·eq/million JPY)			DAP (kg·SO$_2$·eq/million JPY)			WSI (m^3·water·eq/million JPY)		
	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact	Imported Raw Material *j*	Sector *i* Where Potential Impacts are Induced	Foreign Potential Impact
395 Public baths	CM, CP & NG *	CM, CP & NG *	0.145 (3.0%)	CM, CP & NG *	Private PG *	0.191 (5.5%)	CM, CP & NG *	Silviculture	2.437 (1.6%)
396 Other cleaning, barber shops, beauty shops and public baths	CM, CP & NG *	CM, CP & NG *	0.046 (2.7%)	CM, CP & NG *	Private PG *	0.061 (3.2%)	Wood chips	Silviculture	3.589 (7.2%)
397 Photographic studios	CM, CP & NG *	CM, CP & NG *	0.041 (3.2%)	CM, CP & NG *	Private PG *	0.055 (2.5%)	Wood chips	Silviculture	2.879 (14.9%)
398 Ceremonial occasions	CM, CP & NG *	CM, CP & NG *	0.080 (3.1%)	CM, CP & NG *	Private PG *	0.106 (2.1%)	Wood chips	Silviculture	1.799 (3.9%)
399 Miscellaneous repairs	CM, CP & NG *	CM, CP & NG *	0.059 (3.0%)	CM, CP & NG *	Private PG *	0.078 (2.7%)	Logs	Silviculture	5.971 (16.9%)
400 Supplementary tutorial schools, instruction services for arts, culture and technical skills	CM, CP & NG *	CM, CP & NG *	0.035 (3.0%)	CM, CP & NG *	Private PG *	0.046 (2.7%)	Wood chips	Silviculture	1.804 (11.8%)
401 Other personal services	CM, CP & NG *	CM, CP & NG *	0.038 (3.2%)	CM, CP & NG *	Private PG *	0.050 (2.5%)	Wood chips	Silviculture	1.649 (11.0%)
402 Office supplies	Pulp	Pulp	0.081 (1.8%)	Paper	Paper	0.251 (2.2%)	Wood chips	Silviculture	91.748 (46.7%)
403 Activities not elsewhere classified	CM, CP & NG *	CM, CP & NG *	0.091 (3.0%)	CM, CP & NG *	Private PG *	0.120 (2.9%)	Wood chips	Silviculture	5.455 (16.3%)

*: Figures within parentheses indicate percentages in terms of the embodied GWP, DAP and WSI intensity of each sector under the DTA. Edible crops: other edible crops. Wheat & barley: wheat, barley and the like. CM, CP & NG: coal mining, crude petroleum and natural gas. Private PG: private power generation. Crops for feed: crops for feed and foraging. Frozen fish: frozen fish and shellfish. IW fisheries: inland water fisheries and culture. Slaughtering: slaughtering and meat processing. Industrial IC: other industrial inorganic chemicals. Final CP: other final chemical products. Inedible crops: other inedible crops. Aluminum: aluminum (including regenerated aluminum). NM ores: other non-metallic ores. Industrial WS: industrial water supply. NF metals: other non-ferrous metals. SM equipment: semiconductor making equipment. Special machinery: other special machinery for industrial use. S devices: semiconductor devices. Glass products: other glass products. E components: other electronic components. Jewelry: jewelry and adornments. Harbor transport: harbor transport service.

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