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Research Article

Integrated open Leontief model for analysis of biomass pellet demand in Thailand

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Abstract. This study addresses the critical challenge of sustainably meeting the growing demand for biomass pellets in Thailand, particularly in light of increasing global interest in renewable energy sources. By introducing an innovative approach through the integration of the Open Leontief Model, this research constructs Input-Output Tables (IOTs) specific to the biomass pellet sector, encompassing 180 economic sectors. The study evaluates the economic impacts of varying domestic and international demand scenarios on Thailand's economy. Utilizing mass and energy balance methodologies, it provides a comprehensive analysis of the biomass pellet supply chain, from plantation to pelletization, for both corn and wood pellets. Findings reveal significant economic intersectoral linkages within Thailand's economy, indicating the biomass pellet sector's potential to substantially contribute to national renewable energy targets and reduce fossil fuel dependency. Notably, the sector is projected to require an increase in raw materials, energy, and other inputs by 3.8% in 2024 and 2.63% in 2036, following the trend of international biomass pellet demand. Additionally, employment in the sector is expected to increase by 3.8% annually under international demand scenarios and 4.6% annually under domestic and international demand scenarios. The research concludes with policy recommendations aimed at fostering sector growth, emphasizing the importance of government incentives, capacity building, and the establishment of biomass plantation communities to meet the increasing demand for biomass pellets. This study not only sheds light on the sector's current state but also charts a path forward for sustainable energy solutions in Thailand in line with Sustainable Development Goals 7, 8, and 9. Together, these initiatives aim to ensure a balanced transition toward renewable energy, benefiting both the economy and the environment.

Keywords: Biomass pellets; Renewable energy; Greenhouse gas emissions; Input–output analysis; Leontief input-output model

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1. Introduction

Significant increases in the demand for renewable energy (RE) have been observed since 1930, with an average annual increase of approximately 4% being recorded (Ritchie *et al.* 2021). Particularly, countries within the Asia Pacific Economic Cooperation (APEC) membership experienced a 6% rise in RE demand in 2022 compared to 2021, and it is predicted that RE demand will increase by 4% in 2023 (Wogan *et al.* 2022). Among APEC members, the power generation sector, which utilizes solid fuels such as coal and biomass pellets, was identified as having the highest RE demand. Projections for RE demand within APEC suggest an increase of more than 33% by 2050 (Key *et al.* 2021). This surge in RE demand is attributed to global climate change agendas under the Paris Agreement, including initiatives like Net Zero Emissions by 2050 and the carbon border tax (Fanara *et al.* 2012). As a result, countries listed in both Annex I and Non-Annex I of the United Nations Framework Convention on Climate Change (UNFCCC) are compelled to act in accordance with their greenhouse gas (GHG) reduction strategies to achieve their GHG reduction targets.

A significant quantity of biomass pellets was imported by Japan and South Korea for electricity production, positioning them as two of the major importers within the APEC countries (Korea International Trade Association 2021 and Ministry of Internal Affairs and Communications of Japan 2021). Between 2019 and 2021, Vietnam, Indonesia, Malaysia, and Thailand were identified as the top four exporters delivering biomass pellets to these countries. Through exports to Japan and South Korea during this period, Thailand was able to generate a total revenue of approximately 6 million USD, equivalent to around 2 million USD annually (Santander Trade 2021). It has been forecasted that the RE demand in Japan's power sector will see an increase in the consumption of RE from 22%-24% to 36%-38% within its energy system by 2030 (Ministry of Economy, Trade and Industry of Japan 2021). Similarly, a 20% increase in RE demand by 2030 is predicted for South Korea's power sector (Ministry of Trade Industry and Energy of Korea 2021). Conversely, the share of biomass consumption in South Korea's power sector is expected

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to decrease due to the country's plans to expand power generation capacity in the Solar PV system. In alignment with global trends, Thailand has also set its energy targets. The Power Development Plan (The Energy Policy and Planning Office of Thailand 2018) and the Alternative Energy Development Plan (The Energy Policy and Planning Office of Thailand 2018) have been revised to adjust the energy target, promoting an increase in biomass fuel consumption by approximately 5,790 MW by 2037.

Insight into the interdependencies and transactions of goods and services between different economic sectors, provided to policymakers and business owners, can be invaluable, especially when the economy undergoes positive and negative economic shocks. This insight also aids in the adjustment of implementing strategies upon the adoption of new policies. The Input and Output Tables (IOTs), a macroeconomic tool, are utilized for understanding the interconnectedness of economic sectors. Since 1975, Thailand's IOTs have been constructed by the Office of the National Economic and Social Development Council (Office of the National Economic and Social Development Council of Thailand 2010), featuring a comprehensive matrix of 180×180 economically significant sectors. Unfortunately, the integration of monetary data for the biomass pellets industry into these tables has not yet been accomplished. Consequently, this study aims to extend the existing IOT for the biomass pellet industry to examine the interdependencies among sectors and to analyze data for both environmental and economic aspects.

There exists a significant gap in comprehensive economic analysis concerning the biomass pellet industry, particularly in the context of Thailand. Although Thailand's Input and Output Tables (IOTs) are employed to analyze intersectoral economic relationships, they presently lack integration of data pertaining to the biomass pellet sector. This deficiency limits the capacity to evaluate how variations in biomass pellet demand influence broader economic indicators. Furthermore, there is a paucity of research investigating the economic repercussions of shifts in biomass pellet demand from principal importing countries, such as Japan and South Korea, on the Thai economy. This includes an examination of the impacts on national GDP and sectoral outputs related to biomass pellet production. Addressing these gaps, the main focus of this research is integrating the Open Leontief Model to analyze the economic impact within the biomass pellet sector, particularly concerning market demand. Moreover, this research also aims to understand how changes in market demand—particularly from importer countries—affect the broader Thai economy. One expected output is an analysis of the impact on national GDP and sectoral output related to biomass pellet production. Additionally, this research may lead to policy recommendations, such as enhancing infrastructure and improving supply chain efficiency. This approach serves as a model to highlight how fluctuations in biomass pellet demand from importer countries impact the Thai economy.

2. Methodology and analysis

Data on inputs and outputs across the supply chain were systematically collected through surveys and interviews, chosen for their effectiveness in capturing qualitative and quantitative insights from stakeholders directly involved in biomass pellet production. The specifics of this data are delineated in the results and discussion section. For constructing the corn pellet supply chain diagram, Nan province was selected as a case study due to its prominence as a hub for biomass pellet production, housing three major exporters, which provides a unique opportunity to analyze the entire production process in a concentrated area. A data collection template was distributed to groups of corn farmers to acquire detailed information on corn planting and sorting practices, as their firsthand knowledge was crucial for understanding operational efficiencies. Additionally, four interview sessions were conducted with both commercial and non-commercial corn pellet producers to elucidate their operational methodologies, allowing for a comparison of different production strategies and their impacts on supply chain dynamics. Data from the research conducted by Saosee et al. (Saosee *et al*. 2020). were integrated to develop a supply chain diagram for wood pellets, as their findings offer a robust framework that aligns well with this study's objectives. A survey form was developed and distributed to para-rubber and fast-growing tree (Acacia and Leucaena) cultivators to collect data on material inputs and associated expenses within their plantations, recognizing that these crops are integral to the biomass supply

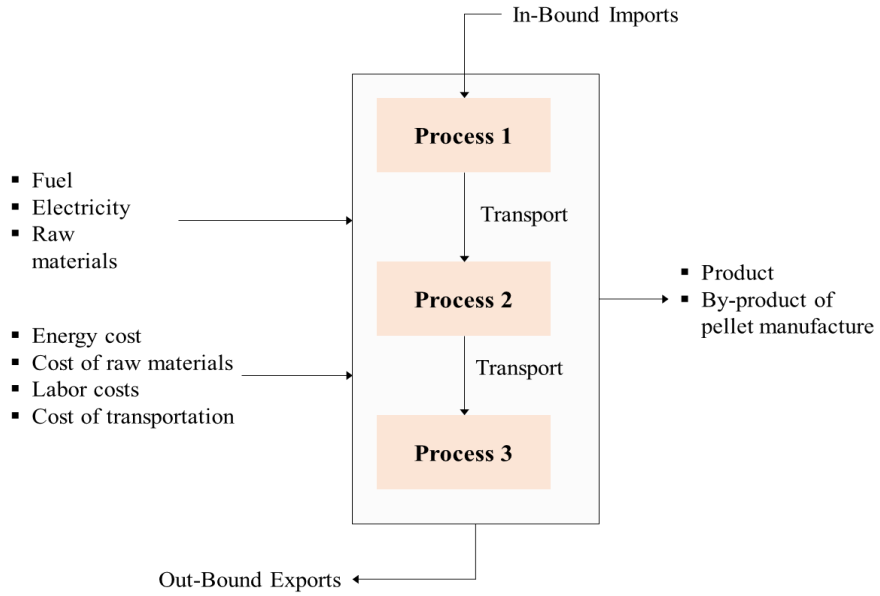

Fig 1 The categorization of input and output items.

chain. Life cycle data for biomass pellet production, covering from cradle to gate, were assembled based on the information gathered during this data collection phase. The operational data from each stage of the biomass pellet production process were systematically categorized into three primary groups: raw material usage, energy consumption, and water supply, which enables a clearer assessment of resource efficiency. Financial data were similarly organized into four categories: energy costs, raw material expenses, labor costs, and transportation expenditures, facilitating a comprehensive understanding of the economic factors influencing the biomass pellet supply chain. An illustrative inventory of these input and output items is presented in Figure 1.

Mass and energy balance approaches were applied to determine the requisite input quantities for the process and the resultant output generation. Thailand's biomass pellet IOTs were constructed following the guidelines outlined in the Eurostat Manual of Supply, Use, and Input-Output Tables. Data from the input-output table, sourced from the Office of the National Economic and Social Development Council (NESDC), is utilized for existing economic sectors in Thailand. The data provided by corn, para-rubber, and fast-growing tree planters underwent thorough analysis and integration into the development process of the biomass IOTs. The data contained within input-output tables (IOTs) serves as foundational raw data for the IO model. Considering Thailand's IOTs, a total of 180 distinct economic sectors are encompassed, with each sector being characterized by substantial intersectoral connections. These tables incorporate input and output transactions from all significant economic sectors, except the biomass sector. To analyze the economic impact on Thailand resulting from fluctuations in both domestic and international biomass pellet demand, it is necessary to develop IOTs for the biomass pellet sector. This will facilitate a thorough examination of the sector's role within the broader domestic economy.

The supplier sector for biomass pellets is identified based on initial activity data. Consumption sectors are determined using lists of industries with high solid fuel demand from Siam Quality Work Company Limited and biomass pellet demand from the Energy Policy and Planning Office (EPPO). Energy expenditure in identified industries is considered to allocate pellet demand value. The total expenditure of consumption sectors yields total energy costs, then each sector's energy expenditure is divided by this total to determine energy demand percentages. The Open Leontief methodology was employed to assess the effects of demand variations. A supply table arranges products by industry, showing supply by product and supplier type. It summarizes total output, imports, and supply by industry in the final row, and total supply by product in the last column. Primary output is directly produced by each industry, while secondary output comprises other products. The use table, depicted as a product by industry-based table, organizes products and components of value added in rows corresponding to industries. It can be subdivided into three tables: 1) the table of intermediate use, 2) the table of final

Table 1
Simplified supply and use framework.

Supply Framework

Products \ Industries	Industries			Import	Total
	Agriculture	Industry	Service activities		
Agricultural products Industrial products Services	Output by product and by industry			Import by product	Total supply by product
Total	Total output by industry			Total import	Total supply

Use Framework

Products \ Industries	Industries			Final uses			Total
	Agriculture	Industry	Service activities	Final consumption	Gross capital formation	Exports	
Agricultural products Industrial products Services	Intermediate consumption by product and by category			Final use by product and by category			Total supply by product
Value added	Value added by component and by industry						Value added
Total	Total output by industry			Total final use by category			Total supply

Supply and use framework

		Products			Industries			Final uses			Total
		Agricultural products	Industrial products	Services	Agricultural	Industrial	Services activities	Final consumption	Gross capital formation	Exports	
Product	Agricultural products Industrial products Services				Intermediate consumption by production and industry			Final use by product and by category			Total use by product
Industries	Agricultural Industrial Services activities	The output of industry by product									Total output by industry
Value added					Value added by component and by industry						Total value added
Imports		Total import by product									Total import
Total		Total supply by product			Total output by industry			Total final use by category			

Table 2
A simplified structure of the IO model.

Selling sector	Purchasing sector					Final demand (F)				Total output (X)
	1	2	3	…	n	H	G	I	E	
1	z_{11}	z_{12}	z_{13}	…	z_{1n}	h_1	g_1	i_1	e_1	X_1
2	z_{21}	z_{22}	z_{23}	…	z_{2n}	h_2	g_2	i_2	e_2	X_2
3	z_{31}	z_{32}	z_{33}	…	z_{3n}	h_3	g_3	i_3	e_3	X_3
…	…	…	…	…	…	…	…	…	…	…
N	z_{n1}	z_{n2}	z_{n3}	…	z_{nn}	h_n	g_n	i_n	e_n	X_n
Labor	l_1	l_2	l_3	…	l_n					L
Capital	k_1	k_2	k_3	…	k_n					K
Government	O_1	O_2	O_3	…	O_n					O
Import	m_1	m_2	m_3	…	m_n					M
Total supply (Z)	Z_1	Z_2	Z_3	…	Z_n	H	G	I	E	

uses, and 3) the table of value added. When compiling symmetric IOTs, consistency in statistical units of products and industries is essential. A simplified version of the symmetric IOTs, incorporating both supply and use tables, is illustrated in Table 1.

Input-output analysis (IOA) is a macroeconomic technique examining interdependencies among economic sectors. Developed by Nobel laureate Prof. Wassily W. Leontief, IOA explores these relationships. The input-output (IO) model is a multisectoral model which presents the flow of goods and services among industries. The model comprises four sections: 1) industries selling to other industries, 2) primary input factors (e.g., labor, capital, imports) of the selling sector, 3) intermediate user sectors purchasing from selling sectors, and 4) final demand sectors. Refer to Table 2 for the IO model structure.

In general, let X_1, X_2, . . ., X_n represent total output of industries S_1, S_2, . . ., S_n, respectively. z_{ij} denotes the monetary value of deliveries from industry i to industry j in a specific period and economic system, while Z_j represents the total input value for industry j. For primary input factors: l_j stands for labor costs, k_j for capital costs, O_j for government payments, and m_j for import costs of industry j. In the final demand section: h_i signifies household consumption, g_i denotes government purchases, i_i represents investments, and e_i stands for exports by industry i. In the IO model, the matrix equation provides the net output of goods and services needed to meet industrial demand, with inter-sectoral direct requirements being pivotal. Matrix calculation is employed to depict a commodity system. Following the approach of Leontief (1996), Miller, and Blair (1985), element z_{ij} of commodity sector A signifies the input value required in commodity sector I to produce sector J. To streamline the matrix, equation 1 forms A as the input-output matrix of an economic system, F as the external demand vector, and X as the production level vector.

$$A = \begin{bmatrix} z_{11} & \cdots & z_{13} \\ \cdots & \cdots & \cdots \\ z_{31} & \cdots & z_{33} \end{bmatrix}, \qquad X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, \qquad F = \begin{bmatrix} f_1 \\ f_2 \\ f_3 \end{bmatrix}$$

The compacted format of equation 1 can be written by equation 2.

$$X = AX + F \qquad (2)$$

The total output value of a commodity sector equals the sum of final demand F and intermediate demand *AX*, expressed by Equation 3.

$$X\text{-}AX = F$$

$$(I\text{-}A)X = F \qquad (3)$$

Where *I* is $n \times n$ Identify matrix represented by

$$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

The Leontief model addresses the economics of a country or region, with n industries producing n products, ensuring input equals output. In the open Leontief Model, some production is consumed internally by industries, with the remainder consumed externally. It yields production levels based on given external demand. Denoting industries as $S_1, S_2, \ldots, S_n$, product exchange is described by input and output data. Sectoral output in exogenous demand F is derived by multiplying equation 4 with $[I\text{-}A]^{-1}$.

$$X = [I\text{-}A]^{-1}F \qquad (4)$$

Two scenarios were formulated as demand matrix: the first scenario considered an increase in biomass pellet demand within the South Korean and Japanese markets. The projected biomass pellet demand for Japan and South Korea, as reported by the Kasikorn Research Center (2020) and the Office of Foreign Trade Promotion in Seoul (2020), was utilized to estimate international market demand. The second scenario was based on demand projections derived from national forecasts, which estimated that 10% of total production would be allocated to the domestic market, with the remaining 90% directed towards international markets. Percentage-based, country-specific demand projections were employed to forecast biomass pellet demand in both domestic and international markets from 2026 to 2036.

3. Results and Discussion

3.1. Supply Chain Diagram of Corn Pellets

A data collection survey form was designed and distributed to fifty-five members of the Na Noi Agriculture Cooperative in Nan Province, Thailand, to gather insights into their corn farming practices. This survey was complemented by an interview session with cooperative members and an officer from the Office of Agricultural Economics, which provided detailed information on corn cultivation methods and operational practices. The corn pellet production process was delineated into three key stages: corn cultivation, sorting, and pelletizing, based on the information gathered from these interviews. The production flow of corn pellets is illustrated in Figure 2.

Corn Cultivation: The cultivation process begins with preparing the planting areas. Farmers engage agricultural services to carry out groundwork, which involves clearing and tilling the soil. Once the land is prepared, corn seeds are sown. To support early growth, farmers apply fertilizers, while pesticides are used to control weeds. The corn typically requires approximately four

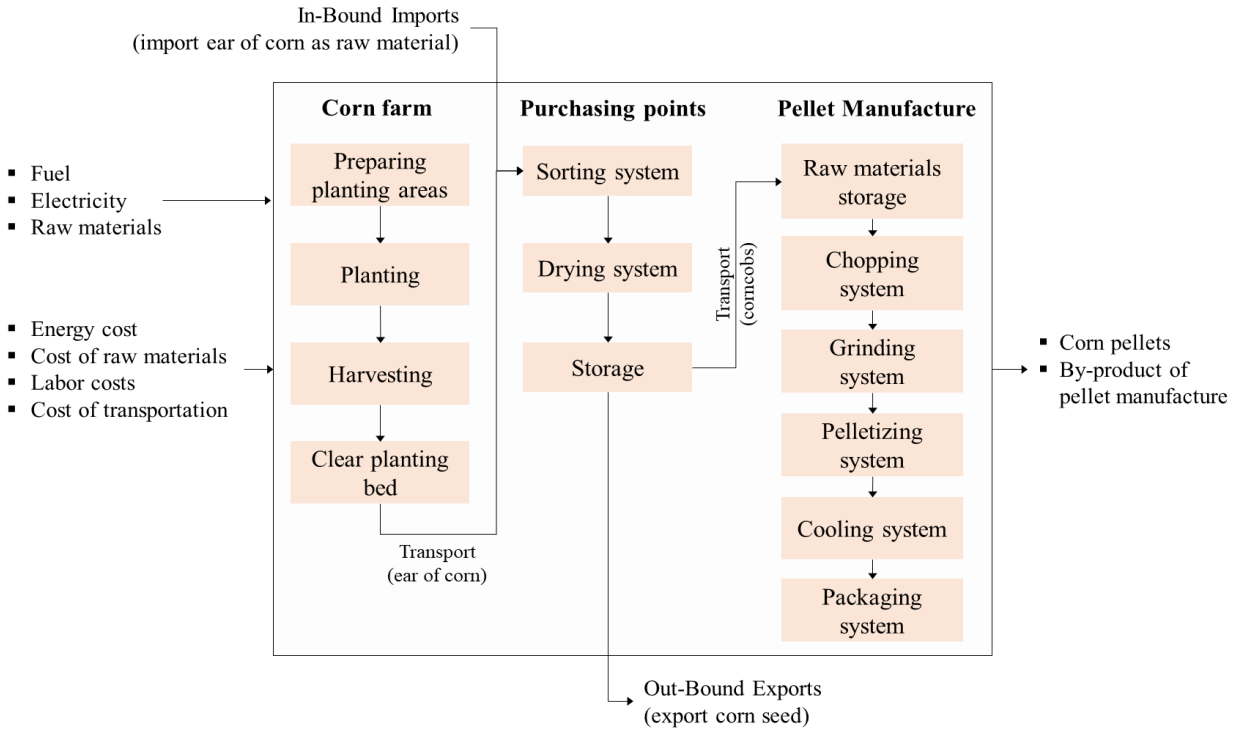

Fig 2 Production process for corn pellets.

months to reach maturity, with harvesting usually completed within four to five days. This stage involves a team of at least three individuals who work together to collect the corn ears from each field. After harvesting, the corn ears are transported to a sorting facility, while other workers clear the farm area in preparation for the subsequent planting cycle.

Sorting: Data on the sorting processes were obtained from two local plants, along with additional information from three pellet manufacturers. Within the sorting facility, corn is classified into two primary products: corn seeds (88%) and corncobs (12%). These products are then transferred to a drying system to reduce their moisture content prior to storage. When the quantity of raw materials is insufficient to sustain production capacity, plant operators procure additional corn ears from external regions to meet demand. In this study, it is assumed that all corncobs are utilized as raw material in the pelletization process.

Pelletizing: During the pellet manufacturing stage, corncobs undergo chopping and grinding to reduce their size. The resulting fine particulates are then conveyed to the pelletizing system, where the temperature of the product is maintained between 100 to 120°C. After pelletizing, the product is transferred to a cooling system to lower its temperature before being moved to the packaging system.

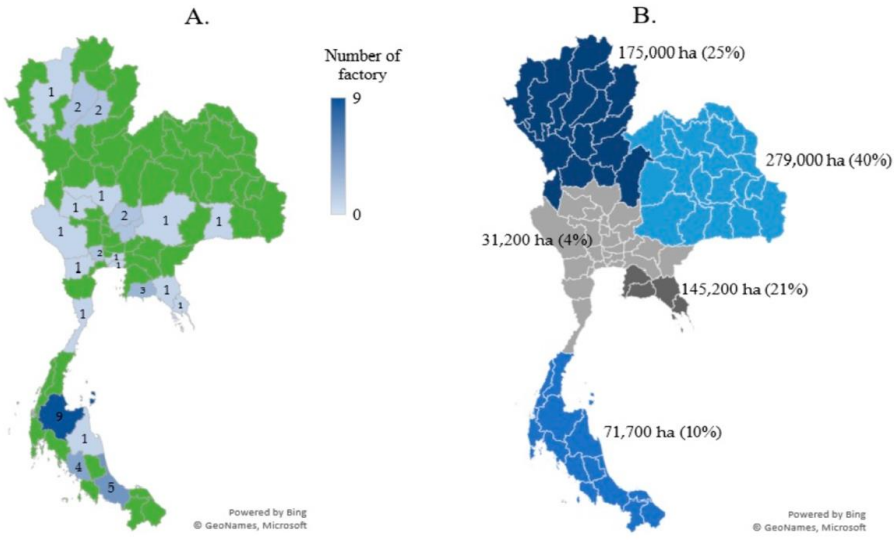

Fig 3 Location of wood pellet industries and the regional wasteland areas in Thailand.

3.2. Supply Chain Diagram of Wood Pellets

Based on research data derived from Saosee et al. (Saosee *et al*. 2020). Thailand has over forty-four registered pellet manufacturing factories. Figure 3 illustrates the distribution of wood pellet factories and regional wasteland areas in Thailand. Panel A shows the number of wood pellet factories across various provinces, indicated by numbers and shades of blue, where darker shades represent a higher concentration of factories. Notably, the southern region has the highest density, with up to nine factories in some areas. Panel B maps out the wasteland area available for potential use in each region, expressed in hectares and as a percentage of the national total. The eastern region has the largest wasteland area (279,000 ha or 40%), followed by the northeastern (175,000 ha or 25%) and southern regions (71,700 ha or 10%). This spatial analysis highlights regions with available land resources that could support biomass production and the existing distribution of pellet manufacturing facilities.

A questionnaire was distributed to these targeted manufacturers, and responses were received from eight of them: four utilizing fast-growing trees (Leucaena and Acacia) and four using waste wood from the para-rubber wood industry. The production of wood pellets encompasses tree plantation, wood processing, and pelletizing stages. The tree plantation process involves five key steps: soil preparation, acquisition of sprouts, application of fertilizers and pesticides, diesel consumption for transportation and machinery, and electricity use for storage. Para-rubber trees, which yield latex after seven years, are harvested for plywood production at 25 to 30 years of age. In contrast, fast-growing trees have a shorter life cycle, ranging from 5 to 15 years. This research specifically examined the production of wood pellets derived from fast-growing trees and para-rubber trees. Wood logs from fast-growing trees are directly transported to pellet manufacturing facilities. In contrast, logs from para-rubber trees are initially processed in the para-rubber wood industry for plywood production. Only wood waste, including woodchips and sawdust, is subsequently transported to pellet manufacturing facilities for further processing into pellets.

The wood pellet production process consists of six stages: treatment of raw materials, drying, comminution, pelletizing, cooling, and packaging and storage. The workforce requirements are contingent upon the scale of the plant. For instance, a plant with an annual production capacity of 7,840 tonnes needs the management of five workers. The production flow of wood pellets is illustrated in Figure 4.

3.3. Input and Output Inventory of Corn Pellets

To produce 55,125 tonnes of corn pellets annually, 1.93 million tonnes of corn seeds are needed, along with 0.03 million tonnes of fertilizer and 4.49 liters of diesel for machinery. Some farms incur costs for agricultural services and labor, totaling 24.56 million USD for corn plantation operations. The primary product is 0.61 million tonnes of corn ears, priced at 0.29 USD per kilogram (average annual exchange rate for 2023 was 34.77 USD/THB) based on moisture content and weight. Therefore, the total cost of one tonne of corn ear is 287.60 USD. Table 3 illustrates the input materials necessary for producing one tonne of corn ear. Additionally, it outlines the operational costs incurred for raw materials, fuel, agricultural services, and labor.

The plant's high electricity consumption (12,000 MWh annually) signifies the energy-intensive nature of sorting and drying processes essential for preparing corncobs for pelletization. Annual corn ear purchases totaling 176.16 million USD underscore the substantial raw material input necessary to achieve the plant's production targets. With corncobs priced at a comparatively low 0.09 USD per kilogram, optimizing production to increase higher-value outputs, such as corn seed, may enhance overall profitability. Furthermore, while labor costs remain modest at 0.06 million USD per year, they indicate a dependence on technical labor for efficient plant operations. The plant's total output of 606,199 tonnes, comprising 88% corn seed and 12% corncob, highlights the strategy of maximizing higher-value

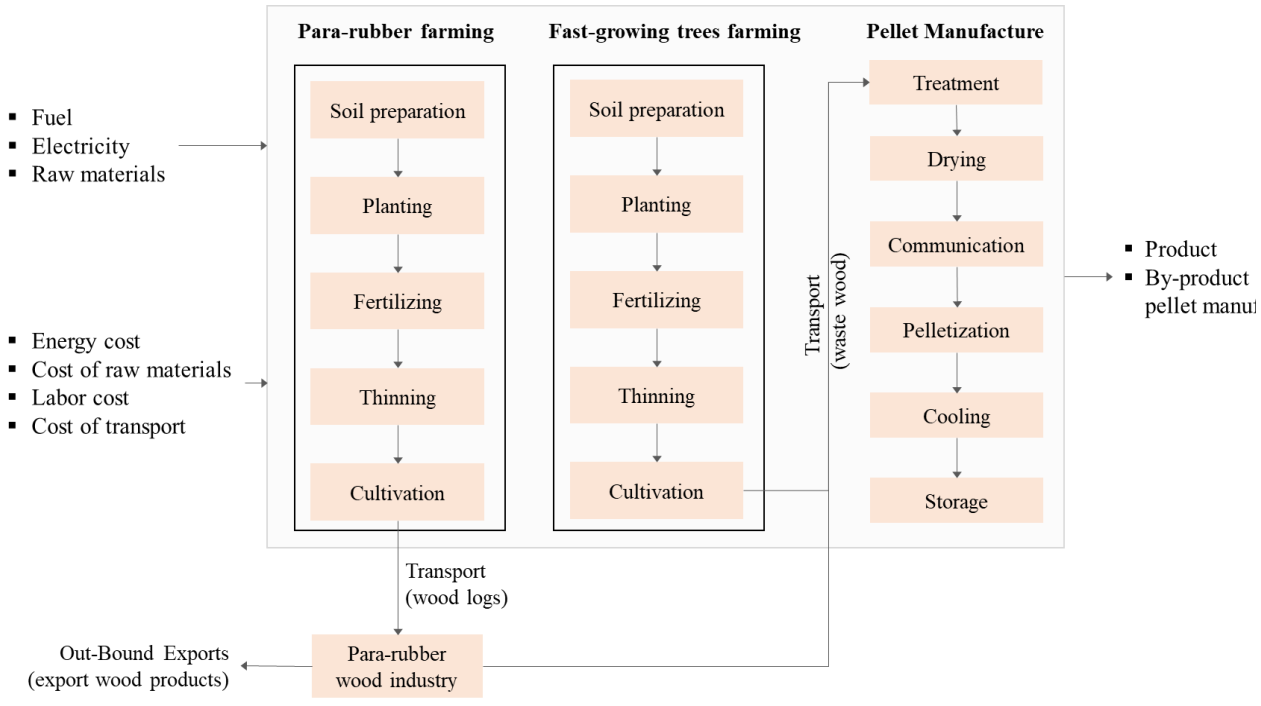

Fig 4 Production process for wood pellets.

Table 3
Resources and expenses needed to plant one tonne of ear of corn.

Input and output materials					
Items	Unit	Amount	Items	Unit	Amount
Corn seed	Tonne	3.15			
Fertilizer	Tonne	0.05	Ear of corn	Tonne	1
Diesel	Liter	7.33			
Expenditures					
Items	Unit	Value	Items	Unit	Value
Corn seed	USD	0.01			
Fertilizer	USD	14.50	Ear of corn	USD	287.60
Diesel	USD	7.36			
Labor	USD	18.23			

Table 4
Resources and expenses required for producing one tonne of product.

Input and output materials					
Items	Unit	Amount	Items	Unit	Amount
Ear of corn	Tonne	1.01	Corn seed	Tonne	0.88
Electricity	MWh	0.02	Corncob	Tonne	0.12
Expenditures					
Items	Unit	Value	Items	Unit	Value
Ear of corn	USD	287.60	Corn seed	USD	330.74
Electricity	USD	2.30	Corncob	USD	86.28
Labor	USD	0.09			

Table 5
Resources and expenses required for producing one tonne of corn pellets.

Input and output materials					
Items	Unit	Amount	Items	Unit	Amount
Corncob	Tonne	1.33			
Electricity	MWh/year	0.22	Corn pellet	Tonne	1
Loss	Tonne	0.33			
Expenditures					
Items	Unit	Value	Items	Unit	Value
Corncob	USD	115.04			
Electricity	USD	2.04	Corn pellet	USD	120.79
Labor	USD	2.27			

outputs with broader industry applications, such as the corn seed used in animal feed and food processing. This dual-output production model facilitates integrated value streams that serve both the food industry and renewable energy markets, particularly as corncobs support biomass pellet production. Thus, the plant not only meets high demand for corn seed but also contributes to the renewable energy sector, emphasizing the economic and environmental value of a diversified product stream. The input materials and operating costs required for producing one tonne of the product are shown in Table 4.

The total amount of corncob generated from the sorting plant was transported to the pelletizing plant. The total production capacity of all plants was 55,125 tonnes per year. Most of the product was exported to international markets such as South Korea and Japan. The plant used 73,500 tonnes of corncob to produce corn pellets. Moreover, the plant consumes 12,128 MWh of electricity annually. Operating 8 to 9 hours a day for 288 days, with an efficiency of 20%, resulting in an annual production volume of 55,125 tonnes (or 4,594 tonnes per month). The total energy content of annual production is 880.35 TJ (energy content of corn pellets is 15.97 MJ/kg). The energy content of lignite produced at Mae Moh coal mine, which is normally consumed by power plants in Thailand, is 10.47 MJ/kg (The Department of Alternative Energy Development and Efficiency 2024). A modern lignite coal power plant with 33% efficiency requires an energy input of around 10.91 GJ to generate 1 MWh of electricity (The Department of Alternative Energy Development and Efficiency 2020). As a comparison, to generate the same amount of electricity, the power plant would need 1,042 kg of lignite coal or 683 kg of corn pellets. In this case, corn pellets seem to offer more benefits than lignite coal in terms of both energy content and the amount required for power production. This is because the energy content of lignite in Thailand is lower than average.

The operational costs totaled 6.53 million USD annually, with 97% allocated to corncob purchase, 2% to electricity, and 1% to labor. The plant employed 5 workers: 3 technicians, 1 team leader, and 1 team manager, with monthly salaries of 104 USD, 2,013 USD, and 3,451 USD respectively. Like the sorting process, the plant relied solely on electricity for operations, lacking a country-specific emission factor for corncob. The input materials and operating costs required for producing one tonne of corn pellets are detailed in Table 5. When considering all the above details, to meet the total heat required for the production process, consumers may need to invest more to purchase a significant amount of corn pellets. This is because, according to

this study, the unit cost of corn pellets is higher than that of lignite coal.

3.4. Input and Output Inventory of Wood Pellets

The production of wood pellets in Thailand is primarily derived from para-rubber and fast-growing trees (e.g., Leucaena and Acacia). This study builds a detailed input-output inventory based on data from seven factories, representing an annual production capacity of 234,232 tonnes of wood pellets. The wood pellet factory consumes 73% of para-rubber wood products and 27% of fast-growing tree products. Key inputs include raw material (3.56 million tonnes of para-rubber logs and approximately 9 million tonnes of rubber sprouts) alongside operational resources such as 3,603 tonnes of fertilizer, 52,794 MWh of electricity, and 6.38 million liters of diesel. The input-output analysis categorizes essential input materials into raw materials, fuel, and energy, forming the foundation for resource allocation analysis within the supply chain. The process yields two products: para-rubber latex and para-rubber logs. It takes at least five years for trees to produce latex, with yields declining over time. Trees are typically felled at 25 to 30 years old.

In terms of the material inputs and outputs, para-rubber and fast-growing tree plantations are integral to Thailand's biomass pellet industry, involving a structured approach to raw material processing. The cultivation of para-rubber trees not only yields logs used for wood pellet production but also latex as a secondary product, demonstrating the resource efficiency in leveraging plantation outputs. Logs from para-rubber and fast-growing trees are processed, with waste wood (sawdust, woodchips) constituting the primary input for pelletization. To produce 1 tonne of wood pellets, approximately 1.01 tonnes of raw material is required, reflecting the high material throughput necessary to maintain production efficiency. Regarding the energy and cost structure, the production process relies on substantial energy inputs, divided between 52,794 MWh of electricity and significant diesel usage to support transportation and machinery operations. Each tonne of wood pellets incurs raw material costs of approximately 34.45 USD, alongside operation and maintenance expenses of 3.45 USD per tonne. Electricity usage for pellet production is a critical component, as it sustains six stages of processing: raw material treatment, drying, comminution, pelletizing, cooling, and storage. Operational data indicate that electricity and diesel account for 74% of the total energy consumption, underscoring the industry's reliance on both resources for sustained production. Labor costs represent a significant portion of the production expenses, with an estimated 1.99 USD allocated per tonne of product for labor. Employment in the wood pellet industry is shown to support regional economies, particularly in rural areas where para-rubber plantations are prominent. The study's inventory provides an in-depth perspective on cost allocations across labor, raw materials, and energy, which collectively shape the economic viability of the wood pellet sector in Thailand. With a unit price of approximately 61.43 USD per tonne of wood pellets, the sector contributes an annual surplus of 376 million USD. The input materials and operating cost required for producing one tonne of para-rubber products as shown in Table 6.

Para-rubber logs are transported to the para-rubber wood industry, where they are processed into plywood, generating waste wood byproducts (such as sawdust and woodchips), which are subsequently supplied to pellet plants as raw material for wood pellet production. The cultivation of fast-growing tree

Table 6
Resources and expenses needed to plant one tonne of ear of para-rubber trees.

Input and output materials					
Items	Unit	Amount	Items	Unit	Amount
Sprout	Tonne/year	2.258			
Fertilizer	Tonne/year	0.001	Para-rubber logs	Tonne	0.89
Electricity	MWh/year	0.013	Latex	Tonne	0.11
Diesel	1000 Liter /year	0.002			
Expenditures					
Items	Unit	Value	Items	Unit	Value
Raw materials	USD	22.84	Para-rubber logs	USD	71.90
Electricity	USD	1.55	Latex	USD	59.68
Labor	USD	86.89			

Remark: Cost of Para-rubber latex is in USD/tonne/year

Table 7
Resources and expenses needed to plant one tonne of ear of fast-growing trees.

Input and output materials					
Items	Unit	Amount	Items	Unit	Amount
Raw materials	Tonne/year	6.49			
Water	m^3/year	147.02			
Manure	Tonne/year	0.22	Leucaena	Tonne	0.66
Electricity	MWh/year	13.50	Acacia	Tonne	0.34
Diesel	Liter/year	589.30			
Chemical fertilizer	Tonne/year	1.84			
Expenditures					
Items	Unit	Value	Items	Unit	Value
Raw materials	USD	15.25			
Electricity	USD	0.70	Leucaena	USD	23.01
Diesel	USD	2.31	Acacia	USD	23.01
Fertilizer	USD	0.78			

Remark: The cost of fertilizer included the cost of chemical fertilizer and organic fertilizer

Table 8
Resources and expenses required for producing one tonne of wood pellets.

Input and output materials					
Items	Unit	Amount	Items	Unit	Amount
Raw materials	Tonne/year	1.01	Wood pellets	Tonne	1
Diesel	Liter/year	0.75			
Firewood	Tonne/year	0.06			
Electricity	MWh/year	0.02			

Expenditures					
Items	Unit	Value	Items	Unit	Value
Raw materials	USD	34.45	Wood pellets	USD	61.43
Diesel	USD	0.76			
Fire wood	USD	2.25			
Electricity	USD	1.06			
Labor	USD	1.99			
O&M	USD	3.45			

Remark: The cost of fertilizer included the cost of chemical fertilizer and organic fertilizer

Table 9
Cost breakdown of Thailand's biomass pellet industry.

Activity	**Items**	**Operation Cost (million USD)**	**Cost of Product (million USD)**
Corn Pellets			
Plantation	085 Fertilizer and Pesticides	8.88	0
	093 Petroleum Refineries	4.51	0
	201 Wages and Salaries	0.01	0
	002 Maize (Corn seed)	0.01	0
	002 Maize (Ear of corn)	0	176
Sorting	002 Maize (Ear of corn)	176.16	0
	135 Electricity	0.14	0
	201 Wages and Salaries	0.05	0
	002 Maize (Corn seed)	0	178
	002 Maize (Corncob)	0	6
Pelletizing	002 Maize (Corncob)	6.34	0
	135 Electricity	0.11	0
	201 Wages and Salaries	0.08	0
	Corn pellet	0	7
Wood Pellets			
Plantation (FGT)	017 Other Agricultural Products	1	0
	093 Petroleum Refineries	0	0
	085 Fertilizer and Pesticides	0	0
	135 Electricity	0	0
	025 Logging (Leucaena)	0	1
	025 Logging (Acacia)	0	0
Plantation (Para-rubber trees)	017 Other Agricultural Products	91	0
	201 Wages and Salaries	43	0
	135 Electricity	6	0
	016 Rubber (Latex)	0	633
	025 Logging (Para rubber wood log)	0	256
Pelletizing	017 Other Agricultural Products	8	0
	113 Agricultural Machinery	1	0
	026 Charcoal and Firewood	1	0
	201 Wages and Salaries	0.47	0
	135 Electricity	0.25	0
	093 Petroleum Refineries	0.18	0
	Wood pellets	0	14

species like Leucaena and Acacia required substantial inputs, including 53 tonnes of fresh seed and significant applications of fertilizers and water, amounting to 13,108 tonnes, 117 million tonnes, and 9 million cubic meters, respectively. The fast-growing trees, harvested at 5 to 10 years, highlight a relatively short growth cycle aimed at optimizing biomass yield.The energy and operational inputs reflect the scale and intensity of the plantation process. Agricultural machinery consumed a substantial 37 million liters of diesel, and the associated warehousing operations required 842 GWh of electricity. This resulted in a total yield of 63,683 tonnes from fast-growing tree plantations, specifically 42,211 tonnes of Leucaena and 21,472 tonnes of Acacia, with respective energy contents of 999 and 8,128 toe. The total operational cost for the plantation was 1.24 million USD, with raw materials comprising the majority (78%) of this expenditure. Notably, Leucaena and Acacia logs were sold to the wood pellet plant at a rate of 32.01 USD per tonne, reinforcing the economic viability of integrating waste wood

into biomass pellet production as a renewable energy source. This approach not only maximizes resource utilization within the supply chain but also supports the sustainability of the wood pellet sector by efficiently repurposing byproducts for energy production. The input materials and operating cost required for producing one tonne of the product are shown in Table 7.

73% of para-rubber wood waste generated from the para-rubber wood industry (e.g., wood chips and sawdust) and 27% of fast-growing tree logs were consumed by the wood pellet factory. The total raw material required for producing 234,863 tonnes of wood pellets was 235,232 tonnes per year. The pellet plant consumed 14,640 tonnes of firewood to warm up the plant. Moreover, 174,840 liters of diesel were consumed in the diesel pellet mill and 4,375 MWh were consumed in the electric pellet mill. Raw materials loss during the process is 0.69% or equal to 1,631 tonnes of wood pellets. Input information derived from the interview did not mention the amount of by-product, a secondary product obtained from a production process, generated from the pellet production process. Therefore, this research assumed that there is no by-product produced by the process. The energy content in wood pellets is 3,801.61 TJ. These 7 factories can contribute to the national demand for biomass in heat application by approximately 1.17% (the total demand for biomass in the heat sector of Thailand in 2019 was 325,314 TJ). The input materials and operating cost required for producing one tonne of the product as shown in Table 8.

The operational costs within the biomass pellet sector are predominantly attributed to raw material procurement, at 34.45 USD per tonne of product, along with operation and maintenance expenses totaling 3.45 USD per tonne. These foundational costs contribute to the overall price of wood pellets, which stands at 61.43 USD per tonne. Within this economic framework, the biomass pellet sector demonstrates a strong market position, with a total sector value of 21 million USD and a notable annual operating surplus of 376 million USD, underscoring the sector's profitability. The cost per tonne of biomass pellets is calculated at 72.74 USD, reflecting a margin that supports sectoral growth and operational sustainability. This cost structure highlights the importance of raw material sourcing as a primary driver of production expenses, alongside consistent maintenance practices to ensure efficiency. The robust surplus emphasizes the sector's economic viability, suggesting potential for reinvestment and expansion within the renewable energy market.

Table 10
Economic sector involved in biomass pellet production.

Category	Sector
Supply	002 Maize
	016 Rubber
	017 Other Agricultural Products
	024 Agricultural Services
	025 Logging
	026 Charcoal and Firewood
	085 Fertilizer and Pesticides
	093 Petroleum Refineries
	094 Other Petroleum Products
	113 Agricultural Machinery
	137 Water Supply System
	145 Wholesale Trade
	151 Road Freight Transport
	152 Land Transport Supporting Services
	153 Ocean Transport
	154 Coastal & Inland Water Transport
	155 Water Transport Services
	157 Other Services
	Biomass Pellets
	180 Unclassified
	190 Total Intermediate Transaction
Demand industry	031 Petroleum and Natural Gas
	043 Canning Preserving of Meat
	045 Canning of Fruits and Vegetables
	046 Canning Preserving of Fish
	059 Coffee and Tea Processing
	060 Other Food Products
	061 Animal Feed
	067 Spinning
	069 Textile Bleaching and Finishing
	081 Pulp Paper and Paperboard
	082 Paper Products
	086 Synthetic Resins and Plastics
	095 Rubber Sheets and Block Rubber
	096 Tyres and Tubes
	097 Other Rubber Products
	098 Plastic Wares
	102 Cement
	103 Concrete and Cement Products
	104 Other Non-metallic Products
	105 Iron and Steel
	108 Cutlery and Hand Tools
	110 Structural Metal Products
	132 Other Manufacturing Goods

3.5. Thailand's biomass pellet IOTs

Fifty-five economic sectors have been identified as being closely associated with the biomass pellet industry. These sectors serve as both consumers and suppliers of products and services, playing a vital role in the industry's ecosystem. Consequently, the inter-industry transactions (IOTs) within Thailand's biomass pellet sector are encompassed by interactions among 45×45 economic sectors, indicating a significant level of interconnectedness. The biomass pellet sector is covered by wood and corn pellets generated by the targeted pelletizing plants (3 corn pelletizing plants and 8 wood pelletizing plants). The biomass pellet sector has a total value of 347.43 million USD, with an annual operating surplus reaching 248.35 million USD. Monetary data derived from the previous activity is classified according to Thailand's input-output identifier code to match new items obtained from the previous section with an existing sector. The summary table presents monetary data of the items related to the production of biomass pellets as shown in Table 9. Two sectors cannot be classified according to the definition which are corn pellets and wood pellets that represent a product of biomass pellet sector.

Twenty-one sectors serve as suppliers for the biomass pellet industry, providing essential goods and services. These sectors were selected based on survey data. Additionally, twenty-two sectors, identified as high-potential consumers (demand industries), are likely to utilize biomass pellets as fuel. Table 10 provides an overview of the economic sectors involved in the biomass pellet industry, separated into supply and demand categories. Key supply sectors include maize, rubber, logging, and fertilizers, reflecting the importance of agricultural and forestry products in the production of biomass pellets. The demand sectors span various manufacturing industries, such as food processing, textile, and construction materials, indicating that biomass pellets have potential applications across diverse sectors seeking energy alternatives.

Road Freight Transport is responsible for the physical transportation of raw materials like maize, rubber, and wood, as well as the distribution of final biomass pellet products to demand sectors. The reliance on agricultural and logging sectors highlights the significance of resource management in the supply chain, particularly for sustainable biomass production. Similarly, demand from industries like canning, cement, and animal feed shows a shift towards cleaner energy sources, with biomass serving as a substitute for traditional fuels like coal and petroleum.

The assumption used for selecting the demanding industry includes payment for energy purchases and identifying industrial sectors with biomass pellet potential. This research assumes biomass pellets can replace coal, electricity, petroleum, and natural gas consumption. Consequently, expenditure on energy consumption by the demand sector is factored in to calculate energy demand percentages by sector. The result of the percentage of biomass pellet demand by sector is shown in Table 11.

As shown in Table 11, the sectors with high demand include electricity (54.96%), plastic wares (7.72%), cement (7.43%), petroleum and natural gas (6.02%), and spinning (4.02%). The high demand from the electricity sector suggests a significant role for biomass in power generation, where it may serve as a renewable alternative to coal and other fossil fuels. Similarly, the demand in manufacturing sectors like plastics and cement highlights a growing shift toward integrating cleaner energy sources within industrial processes. This diverse demand across sectors underscores the potential for biomass pellets to support Thailand's renewable energy goals by reducing reliance on traditional fuels across industries. The value of the biomass pellets sector was distributed to each sector based on the percentage of energy demand. The purchase price of biomass pellets by sector is presented in Table 12.

Sectors with higher expenditures, such as electricity, plastics, and cement, reflect a strong integration of biomass

Table 11
Demand for biomass pellets by economic sector in Thailand.

Sector Name	Expenditure (million USD)			Total expenditure (million USD)	%
	Coal	Electricity	Petroleum and Natural gas		
135 Electricity	842	842	3,327	5,011	54.96%
098 Plastic Wares	0	704	0	704	7.72%
102 Cement	259	418	0	678	7.43%
031 Petroleum and Natural Gas	0	89	461	549	6.02%
067 Spinning	0	368	0	368	4.04%
086 Synthetic Resins and Plastics	0	303	3	306	3.35%
084 Basic Industrial Chemicals	47	192	0	239	2.62%
105 Iron and Steel	0	233	0	233	2.55%
132 Other Manufacturing Goods	0	205	0	205	2.24%
096 Tyres and Tubes	0	117	0	117	1.28%
081 Pulp Paper and Paperboard	0	88	0	88	0.96%
045 Canning of Fruits and Vegetables	0	87	0	87	0.96%
046 Canning Preserving of Fish	0	83	0	83	0.91%
095 Rubber Sheets and Block Rubber	0	65	0	65	0.71%
108 Cutlery and Hand Tools	0	62	0	62	0.68%
097 Other Rubber Products	0	53	0	53	0.58%
060 Other Food Products	0	49	0	49	0.54%
110 Structural Metal Products	0	48	0	48	0.53%
043 Canning Preserving of Meat	0	45	0	45	0.50%
103 Concrete and Cement Products	0	39	0	39	0.42%
061 Animal Feed	0	38	0	38	0.42%
104 Other Non-metallic Products	0	26	0	26	0.28%
059 Coffee and Tea Processing	0	13	0	13	0.14%
069 Textile Bleaching and Finishing	0	13	0	13	0.14%

Table 12
Biomass pellet purchase prices by sector.

Demand sector	Total Expenditure (million USD)	%	Biomass pellets (million USD)
135 Electricity	5,011.43	54.96%	11.57
098 Plastic Wares	704.07	7.72%	1.63
102 Cement	677.70	7.43%	1.56
031 Petroleum and Natural Gas	549.07	6.02%	1.27
067 Spinning	368.10	4.04%	0.85
086 Synthetic Resins and Plastics	305.74	3.35%	0.71
084 Basic Industrial Chemicals	238.82	2.62%	0.55
105 Iron and Steel	232.80	2.55%	0.54
132 Other Manufacturing Goods	204.62	2.24%	0.47
096 Tyres and Tubes	116.75	1.28%	0.27
081 Pulp Paper and Paperboard	87.95	0.96%	0.20
045 Canning of Fruits and Vegetables	87.15	0.96%	0.20
046 Canning Preserving of Fish	82.85	0.91%	0.19
095 Rubber Sheets and Block Rubber	64.52	0.71%	0.15
108 Cutlery and Hand Tools	62.30	0.68%	0.14
097 Other Rubber Products	52.80	0.58%	0.12
060 Other Food Products	49.10	0.54%	0.11
110 Structural Metal Products	48.25	0.53%	0.11
043 Canning Preserving of Meat	45.43	0.50%	0.10
103 Concrete and Cement Products	38.63	0.42%	0.09
061 Animal Feed	38.33	0.42%	0.09
104 Other Non-metallic Products	25.96	0.28%	0.06
059 Coffee and Tea Processing	13.05	0.14%	0.03
069 Textile Bleaching and Finishing	12.85	0.14%	0.03

energy into energy-intensive processes. The significant allocation of funds towards biomass pellets in these industries suggests both a commitment to renewable energy adoption and a recognition of biomass as a viable alternative to fossil fuels. This data implies a favorable economic environment for biomass in Thailand, as diverse sectors are willing to invest in renewable energy. Additionally, the distribution of pellet purchases across industries demonstrates biomass's role in supporting sustainable practices across the economy. This transition may not only drive demand but also encourage technological advancements in biomass production to meet sector-specific needs.

Symmetric input-output tables for Thailand's biomass pellet sector were developed based on the EUstat's IOTs principle (Department of Industrial Works 2024) is shown in the Table 13. The tables validate the feasibility of integrating the biomass pellet sector into Thailand's existing IOTs. The biomass pellet sector encompasses 45×45 inter-sectoral linkages. Sectors 002 to 190 cover intermediate transactions, while sectors 201 to 209 represent value-added activities. Sector 210 denotes total product cost. Final demand sectors (e.g., private consumption, government expenditure, and capital formation) are covered from sectors 301 to 309, with Sector 310 summarizing final demand.

The model of extending the national IOTs by adding a new sector was validated using 2 approaches. First, the differentiation between the original IOTs and the table integrating the biomass pellet sector was checked. The Gross Domestic Product (GDP) value was examined in the second approach. By examining supply and demand across sectors, these IOTs help illustrate how biomass pellets contribute to Thailand's economic system through direct and indirect linkages. For instance, sectors like agriculture (supplying raw materials) and manufacturing (using pellets for energy) would show strong ties to biomass production. This table emphasizes the biomass sector's economic significance, capturing its potential to stimulate growth and support other industries' transition to renewable energy. The presence of such linkages suggests that increased biomass pellet production could have broad positive effects across Thailand's economy, fostering a more integrated and resilient renewable energy sector.

The value of total intermediate transactions, representing financial exchanges between firms, increased by 0.03% compared to conventional IOTs in Thailand. Similarly, the control total, reflecting total financial transactions considering value-added, increased by 0.01%. No difference was found in the total demand value. This suggests that the input data and assumptions used in this research align with and apply to the current economic system. Full details of Thailand's input-output table which integrated monetary data of biomass pellet sector of Thailand as shown in the Appendix (Tables A1-A7).

Table 13
Symmetric input-output tables for Thailand's biomass pellet sector.

Industry / Product	002	…	031	043	045	046	059	060	061	…	Biomass pellets	…	190	…	310 Total demand
002 Maize										…	543	…	1,095	…	903
016 Rubber										…	0	…	4,068	…	4,863
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
025 Logging										…	258	…	1,479	…	-1447.315847
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
031 Petroleum and Natural Gas										…	0	…	0	…	0
043 Canning Preserving of Meat										…	0	…	0	…	0
045 Canning of Fruits and Vegetables										…	0	…	0	…	0
046 Canning Preserving of Fish										…	0	…	0	…	0
059 Coffee and Tea Processing										…	0	…	0	…	0
060 Other Food Products										…	0	…	0	…	0
061 Animal Feed										…	0	…	0	…	0
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
085 Fertilizer and Pesticides										…	9	…	6,647	…	-1,209
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
093 Petroleum Refineries										…	5	…	26,708	…	33,687
										…	0	…	0	…	0
102 Cement										…	0	…	0	…	0
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
135 Electricity										…	1	…	23,191	…	12,382
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
Other Metal, Metal Products and Machinery (105-128)										…	0.1	…	108,155.0	…	357,069.8
Other Manufacturing (075-077, 129-134)										…	8	…	14,247	…	62,769
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
Biomass Pellets			3	0.12	0.14	0.20	0.05	25	4	…	0	…	0	…	0
190 Total Intermediate Transaction										…	101	…	547,815	…	1,298,512
201 Wages and Salaries										…	684	…	138,842	…	0
…	…	…	…	…	…	…	…	…	…	…	0	…	0	…	0
209 Total Value Added											684		401,051		0
210 Control Total										…	785	…	948,765	…	1,298,512

3.6. Applying the Open Leontief Model to analyze the demand for biomass pellets.

Biomass pellet demand in Japan and South Korea is considered as international demand, while biomass pellet demand in Thailand is regarded as domestic demand. In general, the result of the Leontief Open Model displays the value of intermediate demand required to be spent by the producer to produce one unit of output. The Leontief inverse matrix, also known as $(I\text{-}A)^{-1}$, was developed according to equation 4 to analyze the interdependencies between industry and final demand. The results of the inverse IOTs reveal the impacts of satisfying the industry's demand on the sectors of the economy and also provide insights into the industry-wide direct and indirect effects. Two scenarios were defined as matrix F to analyze the impact of changing demand in biomass pellet consumption. Scenario 1 denoted biomass pellet demand in the international market. It was assumed in this scenario that all biomass pellets produced in Thailand would be exported to the international market. The international market in this study was focused on biomass pellet demand in Japan and South Korea, which have high pellet demand compared with other importer countries. Forecasted data by the Kasikorn Research Center (2020) and the Office of Foreign Trade Promotion in Seoul (2020)

Table 14
Forecasted biomass pellet consumption for each country under Scenarios 1 and 2.

Year	Scenario 1: Demand in international market (tonnes)			Scenario 2: Demand in domestic market (tonnes)
	Japan	South Korea	Total	Thailand
2023	171,000	232,000	403,000	116,000
2024	198,000	232,000	430,000	128,000
2025	209,000	232,000	441,000	141,000
2026	228,750	232,000	460,750	154,000
2027	250,366	232,000	482,366	168,199
2028	274,025	232,000	506,025	183,706
2029	299,920	232,000	531,920	200,644
2030	328,262	232,000	560,262	219,143
2031	359,282	232,000	591,282	239,347
2032	393,233	232,000	625,233	261,415
2033	430,393	232,000	662,393	285,517
2034	471,064	232,000	703,064	311,841
2035	515,578	232,000	747,578	340,593
2036	564,299	232,000	796,299	371,995

reveal that both markets required approximately 403,000 tonnes biomass pellets from Thailand in 2024 and 441,000 tonnes in 2025. When considering the amount of biomass pellet demand by country, demand from South Korea was fixed at 232,000 tonnes per year, while demand from Japan increased slightly, by approximately 9% each year. The demand for each country was used to forecast biomass pellet demand from 2026 to 2030.

The second scenario was assumed to distribute 10% of total production to the domestic market, with 90% being exported to international markets. This scenario was defined based on the evaluation of wood pellet demand by importers' policies and the Thai government, which indicated that biomass pellet demand in Thailand would increase by 10% each year from 2020 to 2025. The proportion of biomass demand in the domestic market was used to forecast biomass pellet demand in Thailand for the period from 2026 to 2030. The amount of biomass pellets requires for the Scenarios 1 and 2 is shown in Table 14.

The amount of biomass pellet demand, presented in physical units in Tables 14, was converted into monetary terms by multiplying the unit cost of biomass pellets (72.74 USD per tonne of product) derived from the input-output inventory section to determine the expenditure for producing biomass pellets based

Table 15
Forecasted expenditure for producing biomass pellets based on the demand.

Year	Scenario 1: Expenditure for international market (million USD)			Scenario 2: Expenditure for domestic market (million USD)
	Japan	South Korea	Total	Thailand
2023	12	17	29	8
2024	14	17	31	9
2025	15	17	32	10
2026	17	17	34	11
2027	18	17	35	12
2028	20	17	37	13
2029	22	17	39	15
2030	24	17	41	16
2031	26	17	43	17
2032	29	17	45	19
2033	31	17	48	21
2034	34	17	51	23
2035	38	17	54	25
2036	41	17	58	27

on the demand. Table 15 shows the expenditure for producing biomass pellets to meet demand from international and domestic markets from 2025 to 2037.

For the Scenario 1, the forecasted expenditures for Japan and South Korea show annual increases, with Japan's expenditure growing more significantly while South Korea's remains constant at 17 million USD. By 2036, Japan's expenditure is expected to reach 41 million USD, while South Korea's remains at 17 million USD, resulting in a combined total of 58 million USD for the international market. Japan's expenditure starts at 12 million USD in 2023 and steadily increases by approximately 1 to 3 million USD annually. Over the 14 years period from 2023 to 2036, Japan's expenditure grows by a total of 29 million USD, reaching 41 million USD, with an average annual increase of about 2.07 million USD. For Scenario 2, the expenditure for Thailand's domestic market grows consistently, starting at 8 million USD in 2023 and reaching 27 million USD by 2036, with an average annual increase of about 1.36 million USD. From 2023 to 2036, Thailand's expenditure for biomass pellet production increases by 19 million USD, reflecting a gradual rise in domestic demand and demonstrating a steady commitment to supporting renewable energy initiatives domestically. The cost of biomass pellets was integrated into the cost of final demand to represent the distribution of products. The results of each scenario are elaborated on in the following details:

Scenario 1: To estimate the value of supply needed for producing biomass pellets, the total cost of biomass pellets required by the international market was integrated into the value of the export sector to observe the interlinkage between sectors ((I-A)-1) when demand (F) was increased. Details of the biomass pellet sector (X) when changing according to international demand are shown in Table 16.

Figure 5 illustrates projected employment growth within Thailand's wood pellet industry under Scenario 1, which assumes a steady increase in international demand from primary importers, notably Japan and South Korea. The data demonstrates an annual employment growth rate of 3.8%, which is directly influenced by escalating demand for wood pellets in

Table 16
Details of the biomass pellet sector in relation to international demand.

Unit: million USD

Code	Sector	2023	2025	2027	2029	2031	2033	2035	2036
002	Maize	1,300	1,371	1,444	1,521	1,561	1,688	1,732	1,778
016	Rubber	1,515	1,598	1,683	1,773	1,820	1,967	2,019	2,072
017	Other Agricultural Products	220	232	245	258	264	286	293	301
024	Agricultural Services	0	0	0	0	0	0	0	0
025	Logging	617	651	685	722	741	801	822	843
026	Charcoal and Firewood	0	0	0	0	0	0	0	0
031	Petroleum and Natural Gas	0	0	0	0	0	0	0	0
043	Canning Preserving of Meat	0	0	0	0	0	0	0	0
045	Canning of Fruits and Vegetables	0	0	0	0	0	0	0	0
046	Canning Preserving of Fish	0	0	0	0	0	0	0	0
059	Coffee and Tea Processing	0	0	0	0	0	0	0	0
060	Other Food Products	0	0	0	0	0	0	0	0
061	Animal Feed	0	0	0	0	0	0	0	0
067	Spinning	0	0	0	0	0	0	0	0
069	Textile Bleaching and Finishing	0	0	0	0	0	0	0	0
081	Pulp Paper and Paperboard	0	0	0	0	0	0	0	0
084	Basic Industrial Chemicals	0	0	0	0	0	0	0	0
085	Fertilizer and Pesticides	21	23	24	25	26	28	29	29
086	Synthetic Resins and Plastics	0	0	0	0	0	0	0	0
093	Petroleum Refineries	11	12	12	13	13	14	15	15
094	Other Petroleum Products	0	0	0	0	0	0	0	0
095	Rubber Sheets and Block Rubber	0	0	0	0	0	0	0	0
096	Tyres and Tubes	0	0	0	0	0	0	0	0
097	Other Rubber Products	0	0	0	0	0	0	0	0
098	Plastic Wares	0	0	0	0	0	0	0	0
102	Cement	0	0	0	0	0	0	0	0
103	Concrete and Cement Products	0	0	0	0	0	0	0	0
106	Secondary Steel Products	0	0	0	0	0	0	0	0
107	Non-ferrous Metal	0	0	0	0	0	0	0	0
108	Cutlery and Hand Tools	0	0	0	0	0	0	0	0
110	Structural Metal Products	0	0	0	0	0	0	0	0
113	Agricultural Machinery	2	2	2	2	2	3	3	3
134	Other Manufacturing Goods	19	20	21	23	23	25	26	26
135	Electricity	1	1	1	1	1	2	2	2
137	Water Supply System	0	0	0	0	0	0	0	0
145	Wholesale Trade	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	0	0	0	0	0
152	Land Transport Supporting Services	0	0	0	0	0	0	0	0
153	Ocean Transport	0	0	0	0	0	0	0	0
154	Coastal & Inland Water Transport	0	0	0	0	0	0	0	0
155	Water Transport Services	0	0	0	0	0	0	0	0
157	Other Services	0	0	0	0	0	0	0	0
BIO	Biomass Pellets	50	53	55	56	57	59	60	62
180	Unclassified	0	0	0	0	0	0	0	0
190	Total Intermediate Transaction	290	306	314	322	331	339	348	357
201	Wages and Salaries	831	876	899	923	947	972	998	1,024
202	Operating Surplus	594	627	643	660	678	695	714	732
203	Depreciation	0	0	0	0	0	0	0	0
204	Indirect Taxes less Subsidies	0	0	0	0	0	0	0	0
209	Total Value Added	1,425	1,503	1,543	1,583	1,625	1,667	1,711	1,756
210	Control Total	1,715	1,809	1,856	1,905	1,955	2,007	2,059	2,114

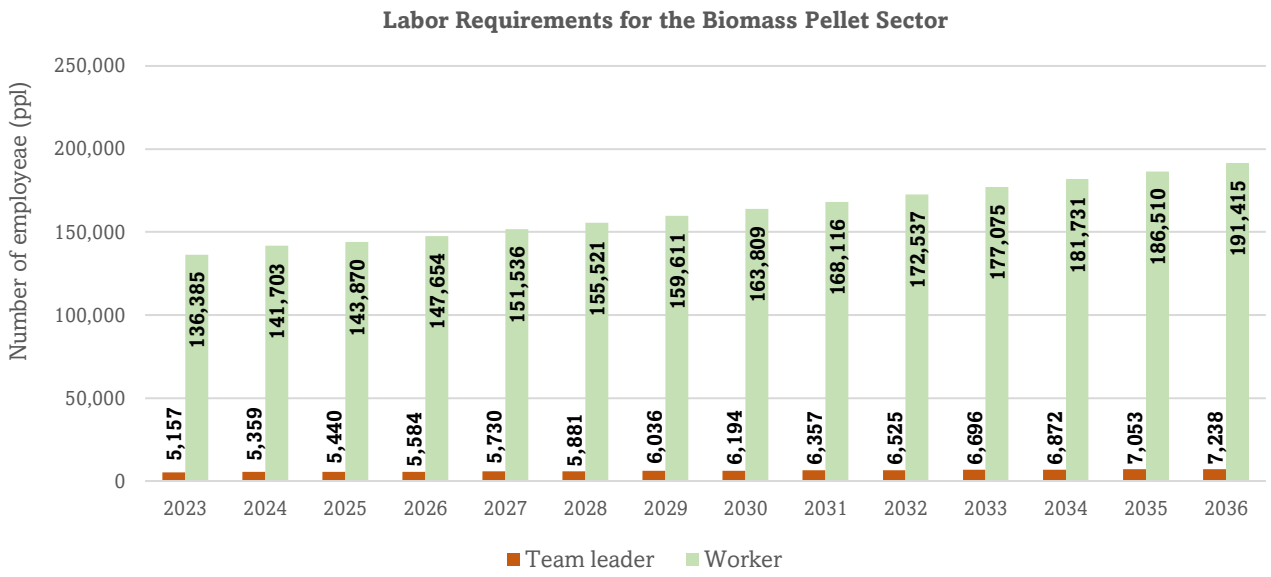

Fig 5 Number of employees in 2023 to 2036 (Scenario 1).

these export markets. This trend highlights the potential for substantial employment generation as the sector expands production to meet international requirements. Considering the cost of wages and salaries, the biomass pellet sector pays higher wages to workers operating pelletizing plants than usual. Based on an average wage of 431.41 USD per worker per month and a team leader salary of 2,013.23 USD per month. The number of employees required was projected for the period from 2023 to 2036. According to survey data, 15% of the total labor cost is allocated to the team leader, while 85% is designated for workers.

In this scenario, employment growth is primarily driven by labor-intensive operations across the production cycle, which include raw material sourcing, pellet manufacturing, and logistics. As production volume rises, the sector's dependence on a skilled workforce for efficient handling of both para-rubber and fast-growing tree resources becomes increasingly evident. Employment projections reflect an emphasis on roles specific to technical operations and quality control within the pelletizing process, indicating that sustained demand could necessitate enhanced workforce training and capacity-building measures to support sectoral resilience. The projected increase in workforce demand also underscores the socio-economic implications for rural regions, where para-rubber plantations are prominent and labor is accessible. With an increase of approximately 3-4% annually in employment, regional economies are expected to benefit from higher income levels and greater job stability, fostering localized economic growth. Furthermore, the sector's labor demands align with Thailand's national goals of enhancing

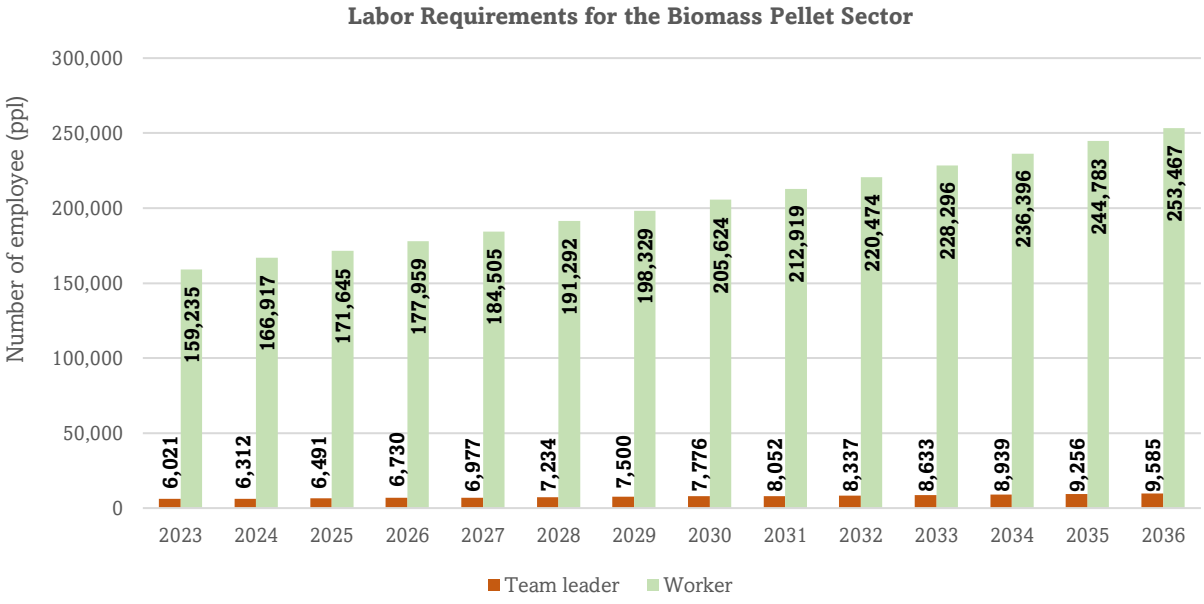

Fig 6 Number of employees in 2023 to 2036 (Scenario 2).

Table 17
Details of the biomass pellet sector: domestic and international demand.

Unit: million USD

Code	Sector	2023	2025	2027	2029	2031	2033	2035	2036
002	Maize	1,518	1,636	1,696	1,759	1,823	1,890	1,960	2,029
016	Rubber	1,769	1,907	1,977	2,050	2,125	2,203	2,284	2,365
017	Other Agricultural Products	257	277	287	298	309	320	332	344
024	Agricultural Services	0	0	0	0	0	0	0	0
025	Logging	720	776	805	834	865	897	930	963
026	Charcoal and Firewood	0	0	0	0	0	0	0	0
031	Petroleum and Natural Gas	0	0	0	0	0	0	0	0
043	Canning Preserving of Meat	0	0	0	0	0	0	0	0
045	Canning of Fruits and Vegetables	0	0	0	0	0	0	0	0
046	Canning Preserving of Fish	0	0	0	0	0	0	0	0
059	Coffee and Tea Processing	0	0	0	0	0	0	0	0
060	Other Food Products	0	0	0	0	0	0	0	0
061	Animal Feed	0	0	0	0	0	0	0	0
067	Spinning	0	0	0	0	0	0	0	0
069	Textile Bleaching and Finishing	0	0	0	0	0	0	0	0
081	Pulp Paper and Paperboard	0	0	0	0	0	0	0	0
084	Basic Industrial Chemicals	0	0	0	0	0	0	0	0
085	Fertilizer and Pesticides	25	27	28	29	30	31	32	33
086	Synthetic Resins and Plastics	0	0	0	0	0	0	0	0
093	Petroleum Refineries	13	14	15	15	16	16	17	17
094	Other Petroleum Products	0	0	0	0	0	0	0	0
095	Rubber Sheets and Block Rubber	0	0	0	0	0	0	0	0
096	Tyres and Tubes	0	0	0	0	0	0	0	0
097	Other Rubber Products	0	0	0	0	0	0	0	0
098	Plastic Wares	0	0	0	0	0	0	0	0
102	Cement	0	0	0	0	0	0	0	0
103	Concrete and Cement Products	0	0	0	0	0	0	0	0
106	Secondary Steel Products	0	0	0	0	0	0	0	0
107	Non-ferrous Metal	0	0	0	0	0	0	0	0
108	Cutlery and Hand Tools	0	0	0	0	0	0	0	0
110	Structural Metal Products	0	0	0	0	0	0	0	0
113	Agricultural Machinery	2	2	3	3	3	3	3	3
134	Other Manufacturing Goods	23	24	25	26	27	28	29	30
135	Electricity	1	2	2	2	2	2	2	2
137	Water Supply System	0	0	0	0	0	0	0	0
145	Wholesale Trade	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	0	0	0	0	0
152	Land Transport Supporting Services	0	0	0	0	0	0	0	0
153	Ocean Transport	0	0	0	0	0	0	0	0
154	Coastal & Inland Water Transport	0	0	0	0	0	0	0	0
155	Water Transport Services	0	0	0	0	0	0	0	0
157	Other Services	0	0	0	0	0	0	0	0
BIO	Biomass Pellets	59	63	66	68	71	73	76	79
180	Unclassified	0	0	0	0	0	0	0	0
190	Total Intermediate Transaction	338	365	378	392	407	422	437	453
201	Wages and Salaries	970	1,045	1,084	1,124	1,165	1,208	1,252	1,297
202	Operating Surplus	694	748	775	804	833	864	896	928
203	Depreciation	0	0	0	0	0	0	0	0
204	Indirect Taxes less Subsidies	0	0	0	0	0	0	0	0
209	Total Value Added	1,664	1,793	1,859	1,928	1,998	2,072	2,148	2,224
210	Control Total	2,002	2,158	2,237	2,320	2,405	2,493	2,585	2,677

employment within renewable energy sectors. For instance, the government aims for a substantial increase in renewable energy capacity by 2037, which is expected to generate approximately 200,000 jobs in related fields.

In summary, the Figure 5 reflects a progressive trend in workforce expansion, essential for accommodating the projected output levels under Scenario 1. These findings support the case for targeted investments in training and infrastructure to ensure that Thailand's wood pellet industry can effectively meet international demand while contributing positively to national employment objectives.

For the Scenario 2, the total cost of biomass pellets (F) was distributed to the final demand sector based on domestic and international demand percentages. The biomass pellet sector ((I-A)-1) was recalculated to determine the value of the supply sector and sectors required for pellet production. Details of the biomass pellet sector (X) changing according to domestic and international demand are in Table 17.

The primary inputs for biomass pellet production include maize and rubber, which are major agricultural components with costs projected to rise over time to meet increasing production demands. Logging is also essential due to the industry's dependence on wood-based biomass, while agricultural services and other products play a smaller, indirect role. Both domestic and international demand for biomass pellets is expected to grow steadily, with notable increases in each input sector by 2036 compared to 2023 levels. For instance, maize demand is projected to rise from around 1,518 million USD in 2023 to 2,029

million USD by 2036, while rubber is expected to grow from 1,769 million to 2,365 million USD, supporting expanded biomass pellet production, particularly for export.

As demand for biomass pellets grows, workforce expansion and infrastructure development will become increasingly necessary, with employment in technical and labor-intensive roles projected to grow at around 4.6% annually. This sector's growth aligns with broader renewable energy goals and could strengthen Thailand's energy transition, especially as export demand rises from markets like Japan and South Korea.

In this scenario, the total value-added rises in tandem with the projected increase in biomass pellet demand, preserving the allocation strategy of 10% for the domestic market and 90% for international markets. The employee projections for Scenario 2, spanning from 2023 to 2030, are shown in Figure 6. As the biomass pellet demand steadily escalates in this scenario, there is a corresponding annual growth in employment within the sector, calculated at a rate of 4.6% per year. This consistent increase in workforce demand aligns with the sector's expansion goals and underscores the labor-intensive nature of biomass pellet production. The growth rate in employment not only reflects the sector's response to rising market demands but also indicates potential economic benefits through job creation, especially in rural areas where biomass production facilities are typically located. The employment expansion supports a sustainable economic model, addressing both industry needs and socio-economic goals through workforce growth that matches demand projections.

4. Conclusions and Policy Recommendations

4.1. Conclusions

This research demonstrates the critical role that the biomass pellet sector plays in Thailand's transition towards renewable energy, highlighting its economic and environmental benefits. By integrating the Open Leontief Model into the analysis, the study revealed the significant intersectoral linkages of the biomass pellet industry, emphasizing its potential to boost national GDP, create employment, and reduce dependency on fossil fuels. The analysis of both domestic and international demand for biomass pellets, particularly from major importers like Japan and South Korea, shows a steady increase in demand, which necessitates a robust supply chain and policy support. The findings suggest that with proper incentives, the biomass pellet industry could be a cornerstone in achieving Thailand's energy and sustainability goals, aligning with global initiatives such as the Paris Agreement and the United Nations' Sustainable Development Goals (SDGs). Furthermore, the research underscores the importance of aligning Thailand's biomass sector development with national policies like the Power Development Plan and the Alternative Energy Development Plan. A strategic approach to expanding biomass pellet production, supported by government incentives, capacity-building, and public-private partnerships, will ensure that Thailand can meet both domestic and international renewable energy targets.

The insights gained from this research not only highlight the economic and environmental potential of Thailand's biomass pellet sector but also point out the necessity for well-structured policies to realize this potential. To support the projected growth in domestic and international demand, it is imperative that the government and relevant stakeholders take strategic actions to address key challenges in supply chain efficiency, raw material availability, and workforce development. Therefore, aligning these economic findings with robust policy recommendations is critical to ensuring the sustainable growth of the biomass pellet sector. Building upon these conclusions, the following policy recommendations aim to foster the sector's development by leveraging Thailand's agricultural strengths, encouraging public-private partnerships, and enhancing technological and infrastructure capacities.

4.2. Policy Recommendations

The government should implement incentive schemes to attract individuals with high potential to work in the biomass pellet sector. For example, international work exchange programs offer valuable opportunities for employees to gain diverse experiences. Additionally, capacity-building programs focusing on business management and technical operations should be promoted by academic institutions to enhance the quality of the workforce in this industry. This could be aligned with SDG 8, which advocates for decent work and economic growth, ensuring that employment opportunities in the biomass sector contribute to sustainable economic development while fostering innovation and skill enhancement. An abrupt adjustment of the import share without a comprehensive transition plan could have severe negative consequences for the country. Therefore, Thailand must develop a strategic transition plan to gradually increase biomass pellet imports. This plan should align with the national goal of increasing renewable energy consumption, as outlined in the Alternative Energy Development Plan, which targets a 30% increase in renewable energy by 2036. Additionally, this strategy should reflect the objectives of SDG 7, ensuring that the transition promotes affordable, reliable, sustainable, and modern energy access for all, contributing to both energy security and environmental sustainability. Furthermore, it must support the national climate change objectives, which aim to reduce greenhouse gas emissions by 40% with international assistance by 2030. Achieving these targets will necessitate a larger workforce in the biomass sector to support the shift from fossil fuels to clean energy, thus contributing to the reduction of greenhouse gas emissions in Thailand's energy sector.

The establishment of a biomass plantation community should be a primary action for the country to consider. This community should have two key objectives: (1) employing smart technologies to monitor and estimate biomass potential, and (2) expanding the community to scale up production in high-potential areas. The government could prioritize potential farmers or regions to serve as pioneers in solid biomass production, offering financial support and technology transfer to ensure the initiative operates in line with its objectives. To enhance the efficiency of this scheme, the government should foster collaboration with the private sector, engaging them as business partners to increase impact and minimize delays in providing necessary support. In addition to financial and technical assistance, existing policies and regulations must be reassessed to establish specific standards for the scheme, including planting conditions, plantation monitoring systems, biomass heating values, and benchmark prices for products. This initiative should also align with SDG 9, which emphasizes the importance of building resilient infrastructure, promoting sustainable industrialization, and fostering innovation, ensuring that the biomass sector develops into a modern, efficient, and technologically advanced industry.

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supervision, B.S., T.B. and G.H.; All authors have read and agreed to the published version of the manuscript.

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Appendix

Table A1 Input and output table of biomass pellet sector (sector 002 to 046) Unit: 1,000 Baht

ID	Sector	002 Maize	016 Rubber	017 Other Agricultural Products	024 Agricultural Services	025 Logging	026 Charcoal and Firewood	031 Petroleum and Natural Gas	043 Canning Preserving of Meat	045 Canning of Fruits and Vegetables	046 Canning Preserving of Fish
002	Maize	3,540,263	0	0	0	0	0	0	0	385,611	0
016	Rubber	0	9,641,619	0	0	0	0	0	0	0	0
017	Other Agricultural Products	0	0	2,861,250	137,543	0	0	0	426,040	105,082	0
024	Agricultural Services	1,321,168	2,465,197	355,933	0	475,700	17,152	0	0	0	0
025	Logging	0	0	0	0	0	759,082	0	0	0	0
026	Charcoal and Firewood	0	0	1,812	0	0	0	0	0	97	0
031	Petroleum and Natural Gas	0	0	0	0	0	0	16,013,170	0	0	0
043	Canning Preserving of Meat	0	0	0	0	0	0	0	126,914	0	0
045	Canning of Fruits and Vegetables	0	0	0	0	0	0	0	1,886	425,747	0
046	Canning Preserving of Fish	0	0	0	0	0	0	0	0	0	43,162,955
059	Coffee and Tea Processing	0	0	0	0	0	0	0	0	0	0
060	Other Food Products	0	0	0	0	0	0	0	4,478,726	1,339,158	5,814,733
061	Animal Feed	0	0	0	0	0	0	0	0	0	0
067	Spinning	0	0	0	0	0	0	0	0	0	0
069	Textile Bleaching and Finishing	0	0	0	0	0	0	0	0	0	0
081	Pulp Paper and Paperboard	0	0	0	0	0	0	7,646	0	29,398	29,400
084	Basic Industrial Chemicals	0	1,079,720	5,437	0	0	0	190,932	216,799	654,208	822,264
085	Fertilizer and Pesticides	5,131,407	21,602,116	3,479,050	6,725,303	43,228	0	0	0	0	0
086	Synthetic Resins and Plastics	0	0	0	0	0	0	0	0	0	0
093	Petroleum Refineries	531,135	1,667,693	825,552	5,663,978	163,898	32,258	52,086,417	1,519,988	723,912	2,457,518
094	Other Petroleum Products	94,192	401,459	73,812	82,136	72,824	78,546	6,737,060	16,360	23,624	37,424
095	Rubber Sheets and Block Rubber	0	0	0	0	0	0	0	0	0	0
096	Tyres and Tubes	0	0	0	4,571	0	0	0	0	0	0
097	Other Rubber Products	204	2,859	7,551	10,097	160	0	50,819	0	491	0
098	Plastic Wares	13,843	1,270,394	1,155,686	197,827	0	157,575	349,063	1,418,905	1,523,756	1,697,775
102	Cement	0	211	7,889	0	0	0	0	0	0	0
103	Concrete and Cement Products	0	0	0	0	0	0	0	0	0	0
106	Secondary Steel Products	0	0	7,551	0	18,947	0	0	0	0	0
107	Non-ferrous Metal	0	3,144	0	0	0	0	0	7,840	469,036	1,081
108	Cutlery and Hand Tools	193,389	776,251	240,567	34,419	817,509	42,858	0	4,218	38,981	5,181
110	Structural Metal Products	0	0	0	0	0	0	0	0	0	0
113	Agricultural Machinery	772,129	716,824	454,706	606,150	85,675	0	0	0	0	0
134	Other Manufacturing Goods	403	7,785	1,223	28,767	4,759	0	138,541	15,862	21,169	14,785
135	Electricity	2,021	431,026	470,416	131,501	19,743	0	3,078,083	1,579,668	3,030,187	2,880,866
137	Water Supply System	32,413	28,382	153,459	16,970	2,838	1,758	2,969	52,546	96,174	209,009
145	Wholesale Trade	0	0	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	0	0	0	0	0	0	0
152	Land Transport Supporting Services	0	0	3,171	8,121	0	5,654	200,507	0	18,809	79,881
153	Ocean Transport	0	0	0	0	0	0	0	0	0	0
154	Coastal & Inland Water Transport	0	0	0	0	0	0	27,942	0	0	0
155	Water Transport Services	0	0	0	0	0	0	0	0	0	0
157	Other Services	0	0	198,458	35,629	0	0	0	113,910	682,503	390,147

ID	Sector	002 Maize	016 Rubber	017 Other Agricultural Products	024 Agricultural Services	025 Logging	026 Charcoal and Firewood	031 Petroleum and Natural Gas	043 Canning Preserving of Meat	045 Canning of Fruits and Vegetables	046 Canning Preserving of Fish
OTH	Other Agriculture (001-029)	4,195	0	237,540	7,698	121,201	0	0	932,571	56,078,669	88,413,056
OTH	Other Mining and Quarrying (030-041)	0	0	53,331	25,478	0	0	224,302	0	149,187	119,515
OTH	Other Food Manufacturing (042-066)	0	0	17,389	66	0	0	0	48,540,561	8,927,064	6,246,689
OTH	Other Textile Industry (067-074)	196,911	0	51,949	28,410	0	79,687	0	290	0	0
OTH	Other Saw Mills and Wood Products (078-080)	31,957	0	707,021	0	0	141,676	0	2,483	13,173	0
OTH	Other Paper Industries and Printing (081-083)	604	2,860	70,730	20,576	25,442	0	141,100	49,165	716,894	618,088
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	0	1,326	27,902	102,963	0	0	561,525	6,611	358,552	1,001
OTH	Other Non-metallic Products (099-104)	0	17,537	308,943	5,039	0	202,257	0	417	1,489	130,419
OTH	Other Metal, Metal Products and Machinery (105-128)	66,873	390,707	611,321	1,126,346	556,550	224,836	12,670,848	931,946	4,904,733	6,965,664
OTH	Other Manufacturing (075-077, 129-134)	0	0	0	34,117	0	0	933,747	0	422	0
OTH	Other Public Utilities (135-137)	0	0	10,270	336	0	0	0	292,788	42,159	524,543
OTH	Other Construction (138-144)	4,968	1,930	154,950	6,440	739	1,302	58,254	59,671	126,671	116,703
OTH	Other Trades (145-146)	0	0	0	0	0	0	0	0	0	0
OTH	Other Transportation and Communication (149-159)	188,513	1,247,024	769,594	112,232	91,446	3,431	1,644,837	203,884	284,685	636,606
OTH	Other Services (147-148, 160-178)	870,519	6,598,385	1,553,268	431,910	500,613	148,217	77,678,075	2,934,961	2,127,180	3,240,449
BIO	Biomass Pellets	0	0	0	0	0	0	44,065	3,646	6,994	6,649
180	Unclassified	19,952	19,496	51,099	59,979	4,654	9,176	465,083	1,692,493	969,947	845,798
190	Total Intermediate Transaction	13,017,059	48,373,945	14,928,830	15,644,602	3,005,926	1,905,465	173,260,920	65,627,503	84,268,768	165,461,550
201	Wages and Salaries	8,242,308	64,504,739	8,373,176	5,469,604	6,637,469	1,113,272	79,194,226	6,592,255	8,868,218	12,870,343
202	Operating Surplus	9,321,306	84,004,136	17,964,088	13,567,850	2,058,329	5,009,904	94,377,763	7,235,501	12,202,420	13,522,442
203	Depreciation	1,017,126	4,369,757	990,644	2,763,042	356,288	253,049	62,518,875	2,474,313	3,874,011	5,585,776
204	Indirect Taxes less Subsidies	10,045	476,356	59,280	65,151	214,869	14,680	57,038,911	725,476	5,639,951	5,437,996
209	Total Value Added	18,590,785	153,354,988	27,387,188	21,865,647	9,266,955	6,390,905	293,129,775	17,027,545	30,584,600	37,416,557
210	Control Total	31,607,844	201,728,933	42,316,018	37,510,249	12,272,881	8,296,370	466,390,695	82,655,048	114,853,368	202,878,107

Table A2 Input and output table of biomass pellet sector (sector 059 to 093) Unit: 1,000 Baht

ID	Sector	059 Coffee and Tea Processing	060 Other Food Products	061 Animal Feed	067 Spinning	069 Textile Bleaching and Finishing	081 Pulp Paper and Paperboard	084 Basic Industrial Chemicals	085 Fertilizer and Pesticides	086 Synthetic Resins and Plastics	093 Petroleum Refineries
002	Maize	0	0	11,050,506	0	0	0	0	21,916	0	0
016	Rubber	0	0	0	0	0	0	0	0	0	0
017	Other Agricultural Products	36,942	400,708	25,840	0	0	0	0	36,848	0	0
024	Agricultural Services	0	0	0	0	0	0	0	0	0	0
025	Logging	0	0	0	0	0	3,859,694	0	0	0	0
026	Charcoal and Firewood	0	27	27,617	0	0	49,829	0	11,723	0	0
031	Petroleum and Natural Gas	0	0	0	0	0	0	0	0	88,687	886,520,648
043	Canning Preserving of Meat	0	761,435	0	0	0	0	0	0	0	0
045	Canning of Fruits and Vegetables	0	77,932	0	0	0	0	0	0	0	0
046	Canning Preserving of Fish	0	1,285,602	85,113	0	0	0	0	0	0	0
059	Coffee and Tea Processing	10,318,491	0	0	0	0	0	0	3,367	0	0
060	Other Food Products	712,458	6,331,415	45,543	0	0	10,116	0	36,230	0	0
061	Animal Feed	0	0	2,178,061	0	0	0	0	0	0	0
067	Spinning	0	0	0	6,471,049	169,800	0	0	1,266	1,107,461	0
069	Textile Bleaching and Finishing	0	0	0	405,377	0	0	0	0	0	0
081	Pulp Paper and Paperboard	0	36,407	0	8,897	5,811	38,206,708	0	17,714	751,736	0
084	Basic Industrial Chemicals	20,023	373,131	285,089	1,790,871	1,096,721	6,658,789	66,744,571	18,608,617	17,534,124	40,235,605
085	Fertilizer and Pesticides	0	0	0	0	0	0	0	7,134,554	0	0
086	Synthetic Resins and Plastics	0	0	0	32,271,800	81,030	45,316	12,765,468	36,451	161,460,653	0
093	Petroleum Refineries	898,553	742,718	187,638	787,677	579,815	1,284,012	12,429,264	762,210	52,144,440	8,758,314
094	Other Petroleum Products	3,732	38,680	29,104	306,290	15,718	40,402	1,085,186	30,878	549,586	45,210
095	Rubber Sheets and Block Rubber	0	0	0	0	0	0	0	0	0	287,315
096	Tyres and Tubes	0	0	0	0	0	0	0	0	0	0
097	Other Rubber Products	502	0	0	5,398	2	0	0	0	0	0
098	Plastic Wares	179,560	1,887,678	878,574	662,213	104,990	698,368	2,544,980	913,729	2,030,489	35,981
102	Cement	0	0	0	0	0	0	514,350	81,009	0	0
103	Concrete and Cement Products	0	0	0	0	0	0	0	0	0	0
106	Secondary Steel Products	0	0	0	0	0	0	0	0	0	0
107	Non-ferrous Metal	0	0	0	0	0	0	58,046	0	6,222	0
108	Cutlery and Hand Tools	0	0	0	0	230	0	0	0	0	0
110	Structural Metal Products	0	0	0	0	0	0	0	0	0	0
113	Agricultural Machinery	0	0	0	0	0	0	0	0	0	0
134	Other Manufacturing Goods	5,329	31,342	5,283	15,963	3,564	62,312	93,746	24,773	486,876	59,848
135	Electricity	453,652	1,707,257	1,332,828	12,798,704	446,736	3,057,984	6,667,198	736,393	10,541,781	4,544,886
137	Water Supply System	10,879	111,696	19,405	83,064	4,013	223,033	802,721	51,720	130,719	117,786
145	Wholesale Trade	0	0	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	0	0	0	0	0	0	0
152	Land Transport Supporting Services	5,648	61,666	17,087	56,147	1,180	100,409	127,894	50,930	333,112	83,725
153	Ocean Transport	0	0	0	0	0	0	0	0	0	0
154	Coastal & Inland Water Transport	0	0	0	0	0	0	0	0	0	0
155	Water Transport Services	0	0	0	0	0	0	0	0	0	214,352
157	Other Services	20,715	440,555	767,716	610,567	4,911	151,856	1,181,815	306,145	1,252,736	577,738

ID	Sector	059 Coffee and Tea Processing	060 Other Food Products	061 Animal Feed	067 Spinning	069 Textile Bleaching and Finishing	081 Pulp Paper and Paperboard	084 Basic Industrial Chemicals	085 Fertilizer and Pesticides	086 Synthetic Resins and Plastics	093 Petroleum Refineries
OTH	Other Agriculture (001-029)	7,454,548	24,411,330	4,114,085	2,627,040	0	250,137	3,237,834	849,169	0	0
OTH	Other Mining and Quarrying (030-041)	0	4,449,805	32,659	0	66	314,604	6,807,661	2,879,876	0	8,916
OTH	Other Food Manufacturing (042-066)	3,477,272	16,057,889	24,401,976	2,351	215,465	1,502,690	4,130,537	581,384	0	72,289
OTH	Other Textile Industry (067-074)	0	0	0	14,982	1,553,687	17,522	825,305	27,180	6,418,132	0
OTH	Other Saw Mills and Wood Products (078-080)	0	1,715	0	0	2,754	0	0	243,401	279,447	0
OTH	Other Paper Industries and Printing (081-083)	198,167	540,948	54,258	809,803	19,236	643,686	908,263	211,693	443,934	156,241
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	379	1,072,937	2,034,464	866,027	1,408,540	2,745,740	383,348	1,023,502	1,554,243	537,221
OTH	Other Non-metallic Products (099-104)	15,552	1,270,570	0	0	0	0	97,483	129,410	0	0
OTH	Other Metal, Metal Products and Machinery (105-128)	384,630	1,255,111	279,909	1,507,520	127,731	1,932,893	5,443,026	720,084	5,647,159	4,831,031
OTH	Other Manufacturing (075-077, 129-134)	0	1,408	0	0	0	0	0	0	0	0
OTH	Other Public Utilities (135-137)	13,448	261,297	117,007	327,995	37,960	197,075	1,977,312	112,728	32,738,778	17,968,015
OTH	Other Construction (138-144)	8,415	25,447	23,292	18,850	3,062	76,955	245,417	29,946	329,518	45,828
OTH	Other Trades (145-146)	0	0	0	0	0	0	0	0	0	0
OTH	Other Transportation and Communication (149-159)	113,386	520,593	144,290	217,919	19,080	751,318	1,441,016	1,111,052	1,702,114	836,054
OTH	Other Services (147-148, 160-178)	1,320,305	3,316,133	455,298	3,038,093	173,836	4,679,679	8,341,221	2,725,155	13,898,172	9,073,025
BIO	Biomass Pellets	1,047	3,941	3,076	29,541	1,031	7,058	19,166	0	24,537	0
180	Unclassified	39,743	878,459	126,461	995,309	60,046	988,065	1,114,228	1,634	829,970	196,702
190	Total Intermediate Transaction	25,692,329	68,351,891	48,719,103	66,699,906	6,135,984	68,549,192	139,967,890	39,512,687	312,260,089	975,206,730
201	Wages and Salaries	3,345,696	8,990,674	2,114,782	9,790,486	626,190	7,863,518	20,402,234	3,892,037	48,187,949	12,879,361
202	Operating Surplus	2,949,249	11,388,017	5,058,509	18,008,579	1,112,115	16,641,626	31,021,171	4,713,857	56,592,256	16,358,745
203	Depreciation	1,371,796	4,404,140	906,673	8,526,271	194,618	5,132,330	16,837,252	1,344,930	15,959,238	24,229,420
204	Indirect Taxes less Subsidies	915,033	1,358,930	727,940	2,696,631	190,180	3,065,044	8,802,266	1,369,898	12,530,770	161,649,109
209	Total Value Added	8,581,774	26,141,761	8,807,904	39,021,967	2,123,103	32,702,518	77,062,923	11,320,722	133,270,213	215,116,635
210	Control Total	34,274,103	94,493,652	57,527,007	105,721,873	8,259,087	101,251,710	217,030,813	50,833,409	445,530,302	1,190,323,365

Table A3 Input and output table of biomass pellet sector (sector 094 to 108) Unit: 1,000 Baht

ID	Sector	094 Other Petroleum Products	095 Rubber Sheets and Block Rubber	096 Tyres and Tubes	097 Other Rubber Products	098 Plastic Wares	102 Cement	103 Concrete and Cement Products	106 Secondary Steel Products	107 Non-ferrous Metal	108 Cutlery and Hand Tools
002	Maize	0	0	0	0	0	0	0	0	0	0
016	Rubber	0	121,268,596	4,325,690	5,963,663	0	0	0	0	0	0
017	Other Agricultural Products	0	0	0	0	0	0	0	0	0	0
024	Agricultural Services	0	0	0	0	0	0	0	0	0	0
025	Logging	0	0	0	0	0	0	0	0	0	0
026	Charcoal and Firewood	0	11,573	0	0	0	0	0	0	0	0
031	Petroleum and Natural Gas	0	0	0	0	0	0	0	0	0	0
043	Canning Preserving of Meat	0	0	0	0	0	0	0	0	0	0
045	Canning of Fruits and Vegetables	0	0	0	0	0	0	0	0	0	0
046	Canning Preserving of Fish	0	0	0	0	0	0	0	0	0	0
059	Coffee and Tea Processing	0	0	0	0	0	0	0	0	0	0
060	Other Food Products	0	0	0	0	0	0	0	0	0	0
061	Animal Feed	0	0	0	0	0	0	0	0	0	0
067	Spinning	0	0	0	338,894	555,228	0	0	0	0	0
069	Textile Bleaching and Finishing	0	0	0	0	0	0	0	0	0	0
081	Pulp Paper and Paperboard	0	0	0	0	88,492	495,320	33,463	60,045	0	0
084	Basic Industrial Chemicals	2,061,962	11,265,614	9,547,920	5,487,422	13,768,692	805,823	815,897	2,603,411	1,233,874	2,696,019
085	Fertilizer and Pesticides	0	0	0	0	0	0	0	0	0	0
086	Synthetic Resins and Plastics	0	0	14,995,612	5,105,212	190,498,491	0	0	0	55,592	333,831
093	Petroleum Refineries	3,469,688	1,170,733	3,481,945	467,185	5,881,558	5,708,615	581,879	2,639,020	4,126,720	478,842
094	Other Petroleum Products	25,468,481	26,269	421,723	292,542	276,441	708,826	461,518	212,286	13,319	231,221
095	Rubber Sheets and Block Rubber	0	26,269	43,719,684	14,174,884	5,908,386	0	0	0	0	0
096	Tyres and Tubes	0	0	61,099	0	0	0	0	0	0	0
097	Other Rubber Products	0	0	0	455,607	16,216	0	1,951	0	19,292	2,996
098	Plastic Wares	672,734	901,283	1,970,966	1,484,045	13,770,391	98,955	28,068	134,438	240,538	3,103,723
102	Cement	0	0	0	0	0	3,720,653	18,087,381	0	132,474	0
103	Concrete and Cement Products	0	0	0	0	0	0	698,102	0	0	0
106	Secondary Steel Products	0	0	864,562	75,352	141,791	0	11,357,661	25,824,479	473,498	21,905,891
107	Non-ferrous Metal	0	0	0	0	108,076	0	0	1,088,113	25,597,684	9,932,648
108	Cutlery and Hand Tools	0	49,630	38,509	0	66,965	0	7,604	0	1,078	124,201
110	Structural Metal Products	0	0	0	0	0	0	0	0	0	0
113	Agricultural Machinery	0	0	0	0	0	0	0	0	0	0
134	Other Manufacturing Goods	7,289	16,089	232,078	263,235	641,643	52,448	228,648	36,673	36,649	20,720
135	Electricity	1,002,860	2,243,528	4,059,257	1,835,886	24,480,683	14,545,637	1,343,113	5,164,892	2,403,556	2,166,207
137	Water Supply System	17,012	89,304	57,608	27,312	272,272	148,431	191,422	45,356	11,529	27,041
145	Wholesale Trade	0	0	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	0	0	0	0	0	0	0
152	Land Transport Supporting Services	17,148	18,775	35,097	49,791	269,968	281,903	50,358	45,445	14,882	23,703
153	Ocean Transport	0	0	0	0	0	0	0	0	0	0
154	Coastal & Inland Water Transport	0	0	0	0	0	0	0	0	0	0
155	Water Transport Services	0	0	0	0	0	0	0	0	0	0
157	Other Services	2,759	866,379	827,998	843,935	1,295,337	211,272	1,793	483,968	171,003	224,413

ID	Sector	094 Other Petroleum Products	095 Rubber Sheets and Block Rubber	096 Tyres and Tubes	097 Other Rubber Products	098 Plastic Wares	102 Cement	103 Concrete and Cement Products	106 Secondary Steel Products	107 Non-ferrous Metal	108 Cutlery and Hand Tools
OTH	Other Agriculture (001-029)	0	0	0	0	0	0	0	0	0	0
OTH	Other Mining and Quarrying (030-041)	206	37,937	117,006	1,745	0	35,251,804	14,744,616	984,851	25,651,176	218,775
OTH	Other Food Manufacturing (042-066)	106,958	257,956	0	629,491	120,191	0	0	0	19	0
OTH	Other Textile Industry (067-074)	0	4,157	9,712,278	207,577	45,224	3,823	1,537	0	0	1,500
OTH	Other Saw Mills and Wood Products (078-080)	0	0	61,167	12,765	349,315	0	23,505	57,502	5,231	447,145
OTH	Other Paper Industries and Printing (081-083)	235,687	42,558	74,524	425,433	1,952,132	1,938,594	78,765	43,073	156,076	564,855
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	761,068	31,580	1,415,813	1,338,747	11,995,054	20,880	2,494,476	713,875	210,427	3,005,031
OTH	Other Non-metallic Products (099-104)	0	0	0	0	0	0	32,734	63,849	4,257	703,617
OTH	Other Metal, Metal Products and Machinery (105-128)	217,666	1,864,525	2,989,763	467,527	6,532,857	1,849,470	1,231,474	43,497,136	673,759	2,610,771
OTH	Other Manufacturing (075-077, 129-134)	0	0	0	0	0	0	0	0	0	25,430
OTH	Other Public Utilities (135-137)	23,062	80,031	98,293	94,006	896,101	865,983	77,405	224,403	512,105	62,724
OTH	Other Construction (138-144)	63,806	97,188	88,523	16,837	261,612	78,399	68,430	78,099	26,365	99,990
OTH	Other Trades (145-146)	0	0	0	0	0	0	0	0	0	0
OTH	Other Transportation and Communication (149-159)	119,801	417,200	433,264	345,655	3,064,757	475,143	491,055	309,853	158,259	501,346
OTH	Other Services (147-148, 160-178)	707,408	2,904,621	3,600,794	1,198,377	14,134,333	4,329,060	2,312,756	2,522,373	1,613,177	1,643,317
BIO	Biomass Pellets	0	0	9,369	0	56,505	54,389	3,100	5,000	0	0
180	Unclassified	25,915	542,397	257,247	61,785	812,875	673,548	683,916	741,576	261,308	179,190
190	Total Intermediate Transaction	34,981,510	144,234,192	103,488,420	41,664,910	298,205,081	72,264,587	56,129,527	87,574,716	63,803,847	51,335,147
201	Wages and Salaries	6,675,359	6,139,337	9,573,265	7,159,929	30,555,145	10,081,827	8,313,724	10,121,584	9,782,679	7,297,024
202	Operating Surplus	8,475,483	12,909,143	15,300,027	6,219,144	38,356,140	26,166,206	8,423,177	11,152,661	13,589,525	9,132,907
203	Depreciation	3,103,192	3,800,918	7,680,891	2,656,163	20,037,432	8,208,715	3,456,135	3,961,141	3,581,759	2,683,550
204	Indirect Taxes less Subsidies	4,621,535	5,610,453	2,817,577	1,358,341	10,449,643	3,241,537	2,161,591	3,308,900	3,028,792	1,578,772
209	Total Value Added	22,875,569	28,459,851	35,371,760	17,393,577	99,398,360	47,698,285	22,354,627	28,544,286	29,982,755	20,692,253
210	Control Total	57,857,079	172,694,043	138,860,180	59,058,487	397,603,441	119,962,872	78,484,154	116,119,002	93,786,602	72,027,400

Table A4 Input and output table of biomass pellet sector (sector 110 to 154) Unit: 1,000 Baht

ID	Sector	110 Structural Metal Products	113 Agricultural Machinery	134 Other Manufacturing Goods	135 Electricity	137 Water Supply System	145 Wholesale Trade	151 Road Freight Transport	152 Land Transport Supporting Services	153 Ocean Transport	154 Coastal & Inland Water Transport
002	Maize	0	0	0	0	0	0	0	0	0	0
016	Rubber	0	0	37,882	0	0	0	0	0	0	0
017	Other Agricultural Products	0	0	258,742	0	0	0	0	0	0	0
024	Agricultural Services	0	0	0	0	0	0	0	0	0	0
025	Logging	0	0	0	0	0	0	0	0	0	0
026	Charcoal and Firewood	0	0	0	391,631	0	0	0	0	0	0
031	Petroleum and Natural Gas	0	0	0	115,693,142	0	0	0	0	0	0
043	Canning Preserving of Meat	0	0	0	0	0	0	0	0	0	0
045	Canning of Fruits and Vegetables	0	0	0	0	0	0	0	0	0	0
046	Canning Preserving of Fish	0	0	0	0	0	0	0	0	0	0
059	Coffee and Tea Processing	0	0	0	0	0	49,122	0	0	0	0
060	Other Food Products	0	0	1,980	0	0	0	0	0	0	0
061	Animal Feed	0	0	0	0	0	0	0	0	0	0
067	Spinning	0	0	4,169,367	0	0	872,419	0	0	0	0
069	Textile Bleaching and Finishing	0	0	233,041	0	0	0	0	0	0	0
081	Pulp Paper and Paperboard	51,060	0	3,393,860	0	0	2,568,455	0	0	8,994	0
084	Basic Industrial Chemicals	737,074	101,219	2,518,975	2,497,844	3,313,125	0	171,479	14	14,675	8,029
085	Fertilizer and Pesticides	0	0	1,777	0	0	0	0	0	0	0
086	Synthetic Resins and Plastics	0	837,663	8,620,951	0	0	0	0	0	0	0
093	Petroleum Refineries	670,720	244,443	2,199,749	89,760,051	393,342	21,178,352	42,784,419	390,350	18,335,443	70,436,068
094	Other Petroleum Products	81,202	21,375	78,075	105,714	11,784	673,140	5,132,573	177,877	690,858	2,899,824
095	Rubber Sheets and Block Rubber	0	0	1,012,879	0	0	0	0	0	0	0
096	Tyres and Tubes	0	85,452	0	0	0	0	9,116,965	235,554	0	0
097	Other Rubber Products	47,519	35,799	489,490	390	5,348	389,149	967,193	59,024	110,081	124,522
098	Plastic Wares	890,415	1,094,351	7,197,777	486,978	545,410	22,822,242	74,082	10,545	23,517	0
102	Cement	0	0	4,569	0	508,310	0	0	0	0	0
103	Concrete and Cement Products	0	0	0	0	114,827	0	0	0	0	0
106	Secondary Steel Products	39,928,533	3,065,197	3,255,671	0	12,520	141,394	140,763	704	109,494	353,498
107	Non-ferrous Metal	12,821,789	1,195,495	5,543,935	0	5,020	0	0	0	0	0
108	Cutlery and Hand Tools	0	70,769	72,840	0	6,459	88,040	0	24,595	78,665	0
110	Structural Metal Products	165,706	0	0	0	0	0	0	0	0	0
113	Agricultural Machinery	0	8,195,366	0	0	0	0	0	0	0	0
134	Other Manufacturing Goods	116,215	11,018	5,345,510	573,470	215,041	1,169,704	181,230	90,449	31,567	182,654
135	Electricity	1,677,512	593,885	2,125,375	29,277,094	10,398,976	39,407,603	441,344	724,940	127,763	445,655
137	Water Supply System	14,099	9,884	69,924	81,263	2,464,188	2,756,632	56,867	16,322	7,237	14,123
145	Wholesale Trade	0	0	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	0	0	0	0	0	0	20,067
152	Land Transport Supporting Services	137,085	2,719	59,994	336,617	846	2,381,473	4,953,894	32,051	232,231	162,655
153	Ocean Transport	0	0	0	0	0	0	0	0	12,086,355	0
154	Coastal & Inland Water Transport	0	0	0	0	0	0	0	0	0	0
155	Water Transport Services	0	0	0	0	0	2,704,101	0	0	2,552,767	9,188,919
157	Other Services	77,814	17,682	266,808	0	0	5,124,995	0	0	74,456	169,492
OTH	Other Agriculture (001-029)	0	0	534,296	396,489	0	0	0	0	0	0
OTH	Other Mining and Quarrying (030-041)	0	0	1,146,940	44,997,543	32,539	0	0	0	0	0

ID	Sector	110 Structural Metal Products	113 Agricultural Machinery	134 Other Manufacturing Goods	135 Electricity	137 Water Supply System	145 Wholesale Trade	151 Road Freight Transport	152 Land Transport Supporting Services	153 Ocean Transport	154 Coastal & Inland Water Transport
OTH	Other Food Manufacturing (042-066)	0	0	2,723,058	2,245,629	0	3,636,038	0	18,005	0	0
OTH	Other Textile Industry (067-074)	0	0	7,707,966	248,208	22,906	4,929,625	0	35,833	209,643	977,677
OTH	Other Saw Mills and Wood Products (078-080)	491,611	52,506	3,993,277	119,339	0	3,761,828	0	0	0	0
OTH	Other Paper Industries and Printing (081-083)	63,370	25,276	798,687	803,215	46,415	8,487,320	178,998	72,916	26,563	488,835
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	1,012,841	271,515	4,222,829	62,913	10,431	2,182,364	257,256	89,309	74,886	465,747
OTH	Other Non-metallic Products (099-104)	670,872	387,545	1,083,539	0	0	515,190	2,325	0	0	0
OTH	Other Metal, Metal Products and Machinery (105-128)	5,308,135	4,524,989	2,371,219	36,289,419	318,457	23,617,184	53,526,239	1,180,169	3,887,324	9,604,096
OTH	Other Manufacturing (075-077, 129-134)	0	6,718	528,560	0	257,841	5,266,344	0	0	0	0
OTH	Other Public Utilities (135-137)	26,339	109,683	44,666	210,146,960	0	249,524	67,821,979	166,908	78,801	542,114
OTH	Other Construction (138-144)	106,621	12,762	70,366	834,563	2,104	5,890,947	226,646	0	940	64,182
OTH	Other Trades (145-146)	0	0	0	0	0	0	0	0	0	0
OTH	Other Transportation and Communication (149-159)	1,287,778	100,219	692,067	3,037,547	25,672	62,403,424	1,000,253	164,753	320,558	3,135,877
OTH	Other Services (147-148, 160-178)	1,829,837	749,864	1,851,437	48,440,946	6,247,029	198,787,904	9,357,365	5,411,331	4,153,654	16,070,656
BIO	Biomass Pellets	3,872	0	16,421	402,187	0	0	0	0	0	0
180	Unclassified	111,082	765,099	203,658	2,296,209	773,284	3,399,334	1,523,499	673,961	134,800	180,272
190	Total Intermediate Transaction	68,325,229	22,588,493	74,931,736	589,123,174	25,731,874	425,453,847	197,915,369	9,575,610	43,371,272	115,534,962
201	Wages and Salaries	8,217,904	4,011,291	10,392,168	160,113,584	17,979,872	352,274,535	22,456,537	7,559,096	5,568,114	39,864,651
202	Operating Surplus	21,860,907	3,198,903	15,557,847	116,968,883	15,704,861	830,168,361	31,531,830	14,267,236	3,789,134	47,622,066
203	Depreciation	2,627,745	1,304,937	3,675,779	116,567,298	11,962,796	132,335,229	12,324,703	7,827,181	2,678,354	18,742,946
204	Indirect Taxes less Subsidies	2,176,105	619,645	3,193,975	17,543,643	1,358,105	74,464,995	7,889,262	978,255	1,380,984	4,487,235
209	Total Value Added	34,882,661	9,134,776	32,819,769	411,193,408	47,005,634	1,389,243,120	74,202,332	30,631,768	13,416,586	110,716,898
210	Control Total	103,207,890	31,723,269	107,751,505	1,000,316,582	72,737,508	1,814,696,967	272,117,701	40,207,378	56,787,858	226,251,860

Table A5 Input and output table of biomass pellet sector (sector 155 to OTH 099-104) Unit: 1,000 Baht

ID	Sector	155 Water Transport Services	157 Other Services	Other Agriculture (001-029)	Other Mining and Quarrying (030-041)	Other Food Manufacturing (042-066)	Other Textile Industry (067-074)	Other Saw Mills and Wood Products (078-080)	Other Paper Industries and Printing (081-083)	Other Rubber, Chemical and Petroleum Industries (084-098)	Other Non-metallic Products (099-104)
002	Maize	0	0	1,223,348	0	1,614,736	0	0	0	0	0
016	Rubber	0	0	0	0	0	0	0	0	157,416	0
017	Other Agricultural Products	0	0	29,178,926	0	11,562,108	5,634	75,361	0	3,871,479	0
024	Agricultural Services	0	0	32,875,099	0	0	0	0	0	0	0
025	Logging	0	0	93,864	263,058	0	0	30,859,471	0	0	0
026	Charcoal and Firewood	0	0	29,514	83	42,947	0	6,419	0	2,621	128,618
031	Petroleum and Natural Gas	0	0	0	0	0	0	0	0	6,719,194	0
043	Canning Preserving of Meat	0	0	0	0	362,609	0	0	0	0	0
045	Canning of Fruits and Vegetables	0	0	0	0	5,851,699	0	0	0	0	0
046	Canning Preserving of Fish	0	0	0	0	706,761	0	0	0	35,273	0
059	Coffee and Tea Processing	0	23,823	0	0	2,718,975	0	0	0	0	0
060	Other Food Products	0	0	0	0	24,333,636	0	0	0	1,224,733	0
061	Animal Feed	0	0	106,268,237	0	0	0	0	0	39,073	0
067	Spinning	0	0	1,086	0	7,938	104,505,799	89,074	42,260	2,195	0
069	Textile Bleaching and Finishing	0	0	0	0	0	7,316,786	0	0	0	0
081	Pulp Paper and Paperboard	1,716	364,081	0	0	2,130,817	450,359	418,636	73,146,765	2,379,742	229,001
084	Basic Industrial Chemicals	0	0	3,021,546	1,813,409	26,539,392	4,659,390	509,268	1,847,914	74,326,697	13,918,813
085	Fertilizer and Pesticides	0	0	161,470,075	161,438	123,450	0	62,994	0	0	0
086	Synthetic Resins and Plastics	0	0	486	0	124,433	8,385,543	400,760	135,672	4,826,706	6,218,402
093	Petroleum Refineries	1,107,662	8,684,705	63,248,143	10,346,480	17,317,388	7,122,584	1,448,114	797,343	3,065,071	10,110,786
094	Other Petroleum Products	147,331	186,132	4,798,046	2,572,637	662,963	709,324	158,164	138,634	111,583	460,381
095	Rubber Sheets and Block Rubber	3,730	0	0	0	0	78,042	0	0	0	0
096	Tyres and Tubes	5,118	0	0	0	0	0	0	0	0	0
097	Other Rubber Products	546	2,165	639,293	814,546	217,212	5,152,464	67,566	48,652	53,470	58,357
098	Plastic Wares	767	969,339	13,029,292	104,454	28,160,318	5,981,890	2,517,970	3,499,034	9,434,010	1,903,113
102	Cement	0	0	854,532	9,533	1,447,355	0	115,461	0	0	15,675,669
103	Concrete and Cement Products	0	0	36	0	0	0	0	0	0	1,012,920
106	Secondary Steel Products	5,980	0	190,066	27,207	0	0	137,558	0	91,645	624,961
107	Non-ferrous Metal	0	0	0	0	130,139	455	193,379	344,104	1,100	189,174
108	Cutlery and Hand Tools	1,238	56,043	9,800,990	2,228,153	1,867,242	606,350	595,680	29,927	54,676	159,388
110	Structural Metal Products	0	0	3,042	0	0	0	289,964	0	0	90,318
113	Agricultural Machinery	0	0	10,431,020	0	2,297	0	0	0	0	0
134	Other Manufacturing Goods	77,300	455,122	435,919	288,366	603,503	13,706,300	579,674	904,898	438,123	192,614
135	Electricity	326,276	1,654,364	7,754,648	2,434,705	49,768,182	30,302,712	5,561,410	3,913,376	6,796,954	9,456,601
137	Water Supply System	13,835	136,171	2,352,484	83,888	3,159,896	418,028	82,400	89,894	347,068	161,156
145	Wholesale Trade	0	0	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	5,401,802	0	0	0	0	0	0
152	Land Transport Supporting Services	9,799	330,655	233,246	339,704	919,037	282,654	118,919	283,032	375,423	192,283
153	Ocean Transport	0	14,798	0	0	0	0	0	0	0	0
154	Coastal & Inland Water Transport	0	462,247	0	1,058,146	720	91	0	0	954	0
155	Water Transport Services	41,637	826,923	26,873	0	0	0	0	0	0	0

ID	Sector	155 Water Transport Services	157 Other Services	Other Agriculture (001-029)	Other Mining and Quarrying (030-041)	Other Food Manufacturing (042-066)	Other Textile Industry (067-074)	Other Saw Mills and Wood Products (078-080)	Other Paper Industries and Printing (081-083)	Other Rubber, Chemical and Petroleum Industries (084-098)	Other Non-metallic Products (099-104)
157	Other Services	0	10,459,623	0	186	4,011,627	2,671,351	776,418	213,018	1,207,657	949,507
OTH	Other Agriculture (001-029)	0	0	95,366,693	3,329	846,133,569	83,660	2,085,624	0	7,963,247	0
OTH	Other Mining and Quarrying (030-041)	0	0	636,886	148,167	264,172	6,438	0	126,310	2,709,375	40,842,459
OTH	Other Food Manufacturing (042-066)	5,758	411,362	42,454,550	0	263,758,496	92,916	402,811	24,073	12,768,280	741,677
OTH	Other Textile Industry (067-074)	662	305,410	1,281,042	65,044	998,552	171,335,555	20,744	228,279	631,152	589,090
OTH	Other Saw Mills and Wood Products (078-080)	1,391	1,064,777	5,982,463	325,418	254,454	34,615	42,127,215	0	305,572	730,452
OTH	Other Paper Industries and Printing (081-083)	12,806	2,622,997	707,954	93,753	6,795,295	2,253,748	497,517	3,407,128	2,954,008	1,119,946
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	11,821	249,883	14,350,581	3,698,065	7,538,830	10,552,204	11,707,977	19,795,212	63,775,502	22,083,959
OTH	Other Non-metallic Products (099-104)	0	1,505	638	29,320	16,775,847	0	182,630	0	3,086,574	34,456,716
OTH	Other Metal, Metal Products and Machinery (105-128)	652,908	5,912,846	11,783,867	12,387,461	64,349,101	8,910,138	5,699,576	3,310,671	5,418,380	4,477,250
OTH	Other Manufacturing (075-077, 129-134)	8,652	29,313	162,621	1,815	17,552	129,159	478,316	0	372,466	0
OTH	Other Public Utilities (135-137)	733	133,883	174,507	548,407	6,032,549	496,656	45,043	138,468	2,544,247	5,543,441
OTH	Other Construction (138-144)	15,914	106,397	1,701,742	151,798	1,077,342	386,105	113,259	158,851	272,664	268,240
OTH	Other Trades (145-146)	0	0	0	0	0	0	0	0	0	0
OTH	Other Transportation and Communication (149-159)	46,517	16,173,371	8,981,038	674,075	7,579,435	3,708,525	1,079,154	716,827	2,100,768	2,813,684
OTH	Other Services (147-148, 160-178)	1,335,449	41,792,654	38,847,123	3,703,479	56,616,747	18,226,165	6,963,157	5,446,301	15,481,215	17,806,541
BIO	Biomass Pellets	0	0	0	-94,520	-23,259	-19,405	0	-5,766	-161,227	-41,428
180	Unclassified	261,704	693,895	1,801,260	116,318	8,132,555	2,637,629	654,519	1,245,249	3,586,626	3,225,586
190	Total Intermediate Transaction	4,097,250	94,124,484	672,192,776	49,894,244	1,470,711,876	411,209,269	117,122,202	120,031,892	239,532,939	196,431,103
201	Wages and Salaries	3,595,118	28,633,037	251,148,052	19,656,044	149,267,170	60,419,305	24,690,213	15,461,053	33,901,149	24,959,906
202	Operating Surplus	4,120,251	43,903,743	583,388,219	38,989,712	264,155,921	68,900,642	25,505,302	17,818,632	56,559,512	30,580,634
203	Depreciation	2,337,152	6,755,650	47,637,687	6,347,219	68,693,741	23,944,918	8,637,488	7,374,435	13,499,111	16,934,673
204	Indirect Taxes less Subsidies	273,653	2,661,988	-11,321,705	1,760,132	247,830,750	16,893,278	4,268,149	4,635,725	9,280,151	6,011,338
209	Total Value Added	10,326,174	81,954,418	870,852,253	66,753,107	729,947,582	170,158,143	63,101,152	45,289,845	113,239,923	78,486,551
210	Control Total	14,423,424	176,078,902	1,543,045,029	116,647,351	2,200,659,458	581,367,412	180,223,354	165,321,737	352,772,862	274,917,654

Table A6 Input and output table of biomass pellet sector (sector OTH 105-128 to 190) Unit: 1,000 Baht

ID	Sector	Other Metal, Metal Products &Machinery (105-128)	Other Manufacturing (075-077, 129-134)	Other Public Utilities (135-137)	Other Construction (138-144)	Other Trades (145-146)	Other Transportation and Communication (149-159)	Other Services (147-148, 160-178)	Biomass Pellets	180 Unclassified	190 Total Intermediate Transaction
002	Maize	0	0	0	0	0	0	1,364,175	18,889,818	0	38,090,373
016	Rubber	13,384	26,948	0	0	0	0	0	22,017,590	0	163,452,788
017	Other Agricultural Products	0	0	0	1,533,650	0	6,140	5,862,061	3,199,686	131,334	59,715,374
024	Agricultural Services	0	0	0	0	0	0	0	0	0	37,510,249
025	Logging	0	0	0	6,397,912	0	0	0	8,962,529	212,354	51,407,964
026	Charcoal and Firewood	0	0	0	0	0	0	330,274	0	41,658	1,076,443
031	Petroleum and Natural Gas	0	0	352,820,674	0	0	0	0	0	0	1,377,855,515
043	Canning Preserving of Meat	0	0	0	0	0	0	12,292,456	0	182,948	13,726,362
045	Canning of Fruits and Vegetables	0	0	0	0	0	0	7,452,769	0	481,306	14,291,339
046	Canning Preserving of Fish	0	0	0	0	0	0	22,736,381	0	1,079,935	69,092,020
059	Coffee and Tea Processing	0	0	0	0	64,648	368,035	17,186,978	0	50,806	30,784,245
060	Other Food Products	0	0	0	0	0	1,537	29,131,869	0	497,918	73,960,052
061	Animal Feed	0	0	0	0	0	0	1,979,507	0	162,002	110,626,880
067	Spinning	233,576	1,862,384	0	0	59,456	0	224,823	0	618,314	121,332,389
069	Textile Bleaching and Finishing	0	0	0	0	0	0	0	0	303,883	8,259,087
081	Pulp Paper and Paperboard	1,151,156	257,009	18,838	487,695	554,211	21,681	70,191,669	0	1,254,092	198,850,874
084	Basic Industrial Chemicals	57,781,259	12,886,213	87,553	792,096	0	22,906	20,780,970	0	2,792,718	437,746,113
085	Fertilizer and Pesticides	0	0	0	298,116	0	0	23,425,494	311,509	1,159,277	231,129,788
086	Synthetic Resins and Plastics	30,914,587	4,893,742	0	39,363	0	0	269,085	0	2,459,088	485,775,937
093	Petroleum Refineries	52,400,436	4,498,636	1,742,925	21,902,777	7,178,844	186,555,633	111,395,323	162,049	917,762	928,648,773
094	Other Petroleum Products	24,478,388	387,809	7,402	5,708,856	498,427	20,528,360	4,878,045	0	1,413,849	115,593,602
095	Rubber Sheets and Block Rubber	829,566	3,415,954	0	0	0	0	0	0	2,463,660	71,920,369
096	Tyres and Tubes	51,620,772	0	0	0	0	3,546,694	1,946,252	0	150,778	66,773,255
097	Other Rubber Products	18,662,041	6,614,312	0	9,972,655	0	655,227	2,815,772	0	726,474	49,303,412
098	Plastic Wares	109,887,210	13,518,666	0	8,783,299	27,884,127	727,805	11,409,503	0	2,714,173	313,796,814
102	Cement	47,782	394	0	90,536,501	0	0	151,389	0	1,682,612	133,578,074
103	Concrete and Cement Products	918,288	0	0	122,855,996	0	0	0	0	1,370,642	126,970,811
106	Secondary Steel Products	537,669,239	9,304,195	0	100,116,135	0	44,044	9,878,800	0	1,570,419	767,337,755
107	Non-ferrous Metal	293,355,992	197,431,713	0	11,070,987	0	0	10,496,415	0	2,498,082	572,549,669
108	Cutlery and Hand Tools	9,177,171	868,587	0	1,315,783	846,997	146,743	9,337,685	0	756,308	40,631,919
110	Structural Metal Products	230,101	0	0	37,353,763	0	196	16,741	0	1,328,614	39,478,445
113	Agricultural Machinery	0	0	0	0	0	0	128,504	28,121	841,935	22,262,727
134	Other Manufacturing Goods	13,791,926	6,443,190	331,777	1,570,671	1,747,988	746,698	31,606,428	280,538	3,967,741	88,643,436
135	Electricity	114,422,779	14,398,052	5,535,254	6,920,611	49,378,739	27,927,948	269,860,580	17,954	1,547,440	806,355,281
137	Water Supply System	2,381,873	345,564	251,856	619,644	3,645,035	1,083,537	13,074,049	0	15,067	36,790,825
145	Wholesale Trade	0	0	0	0	0	0	0	0	0	0
151	Road Freight Transport	0	0	0	40,508,850	0	0	7,884	0	329,386	46,267,989
152	Land Transport Supporting Services	2,475,566	192,345	355,096	485,454	126,040	7,261,721	4,945,557	0	35,593	29,222,700
153	Ocean Transport	0	0	0	0	0	0	0	0	0	12,101,153
154	Coastal & Inland Water Transport	125	0	0	0	0	0	0	0	538,961	2,089,186
155	Water Transport Services	0	0	0	0	0	0	0	0	878,121	16,433,693
157	Other Services	7,711,637	1,945,689	0	0	0	16,917,196	911,700	0	0	65,171,114

ID	Sector	Other Metal, Metal Products &Machinery (105-128)	Other Manufacturing (075-077, 129-134)	Other Public Utilities (135-137)	Other Construction (138-144)	Other Trades (145-146)	Other Transportation and Communication (149-159)	Other Services (147-148, 160-178)	Biomass Pellets	180 Unclassified	190 Total Intermediate Transaction
OTH	Other Agriculture (001-029)	61,805	1,735,671	0	58,602	0	2,361,558	223,210,444	-49,869,938	10,639,480	1,329,503,602
OTH	Other Mining and Quarrying (030-041)	7,705,402	12,470,843	0	91,478,427	0	37,177	131,117	0	3,025,137	297,832,448
OTH	Other Food Manufacturing (042-066)	60,910	9,527,219	0	0	2,674,748	9,184,780	398,546,765	0	14,392,602	878,957,914
OTH	Other Textile Industry (067-074)	8,108,872	5,957,409	0	433,543	5,373,050	1,695,506	39,923,806	0	3,976,402	274,246,127
OTH	Other Saw Mills and Wood Products (078-080)	11,706,428	2,635,106	17,670	20,538,796	2,241,211	152,797	3,146,068	0	1,150,938	103,214,189
OTH	Other Paper Industries and Printing (081-083)	20,968,114	2,550,345	241,348	743,538	10,527,937	2,427,218	103,880,600	0	1,277,553	185,216,785
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	122,517,805	8,470,443	33,491	24,197,728	2,144,823	1,806,300	241,998,038	-473,558	1,174,138	598,956,565
OTH	Other Non-metallic Products (099-104)	57,189,468	13,190,474	0	88,065,260	837,340	7,442	3,605,760	0	4,520,598	227,592,616
OTH	Other Metal, Metal Products and Machinery (105-128)	2,847,352,842	13,361,557	8,147,210	121,977,607	10,668,824	111,930,711	240,643,925	-28,121	30,421,808	3,760,519,658
OTH	Other Manufacturing (075-077, 129-134)	7,240,464	403,977,009	0	448,722	4,520,499	39,811	59,613,281	0	11,273,003	495,367,270
OTH	Other Public Utilities (135-137)	7,414,809	551,320	104,334,868	192,047	53,699	37,931,113	25,377,054	-17,954	1,596,922	529,834,610
OTH	Other Construction (138-144)	2,571,930	411,679	228,219	619,272	2,303,044	698,560	20,526,644	0	233,958	41,272,356
OTH	Other Trades (145-146)	0	0	0	0	0	0	0	0	0	0
OTH	Other Transportation and Communication (149-159)	23,542,919	7,588,420	2,587,165	2,448,878	27,638,278	150,707,371	131,061,625	0	11,116,760	491,088,365
OTH	Other Services (147-148, 160-178)	113,741,714	30,681,743	31,274,882	54,126,544	63,505,233	94,862,737	755,435,139	0	24,085,833	1,844,903,389
BIO	Biomass Pellets	-29,834	-5,753	-350,586	0	0	0	0	731,778	0	731,778
180	Unclassified	14,148,928	1,869,614	1,963,753	2,749,985	7,785,119	6,953,294	25,722,198	0	5,165,338	112,382,819
190	Total Intermediate Transaction	4,574,487,264	794,270,254	509,979,981	877,349,763	232,258,317	687,358,476	2,968,911,602	4,212,002	161,225,720	,048,219,048,225,286
201	Wages and Salaries	321,950,238	96,216,057	28,761,635	92,450,853	241,195,682	163,261,020	2,179,075,481	12,070,437	15,011,399	4,815,820,011
202	Operating Surplus	548,754,437	93,802,266	64,132,565	119,157,374	815,240,324	161,880,103	1,170,463,409	8,634,552	22,555,743	5,803,411,093
203	Depreciation	203,350,163	33,671,368	48,838,820	62,908,500	99,073,496	103,929,782	750,551,858	0	19,431,543	2,056,244,017
204	Indirect Taxes less Subsidies	261,866,784	21,466,007	9,625,453	16,406,639	40,547,644	23,908,161	179,099,216	0	6,893,602	1,257,364,826
209	Total Value Added	1,335,921,622	245,155,698	151,358,473	290,923,366	1,196,057,146	452,979,066	4,279,189,964	20,704,989	63,892,287	13,932,839,947
210	Control Total	5,910,408,886	1,039,425,952	661,338,454	1,168,273,129	1,428,315,463	1,140,337,542	7,248,101,566	24,916,991	225,118,007	32,981,065,233

Table A7 Input and output table of biomass pellet sector (sector 301 to 310) Unit: 1,000 Baht

ID	Sector	301 Private Consumption Expenditure	302 Government Consumption Expenditure	303 Gross Fixed Capital Formation	304 Increase in Stock	305 Exports (F.O.B.)	306 Special Exports	309 Total Final Demand	310 Total Demand
002	Maize	427,156	515,991	0	11,805,530	2,942,703	0	15,691,380	31,382,760
016	Rubber	0	15,579	0	28,992,851	55,533,672	0	84,542,102	169,084,204
017	Other Agricultural Products	1,767,232	2,169,390	0	0	8,229,772	0	12,166,394	24,332,788
024	Agricultural Services	0	0	0	0	0	0	0	0
025	Logging	0	0	0	-34,880,665	9,719,079	0	-25,161,586	-50,323,172
026	Charcoal and Firewood	10,574,737	0	0	0	430,563	0	11,005,300	22,010,600
031	Petroleum and Natural Gas	0	0	0	-79,361,894	1,751,254	0	-77,610,640	-155,221,280
043	Canning Preserving of Meat	10,165,549	41,222	0	10,224,209	58,091,937	722,702	79,245,619	158,491,238
045	Canning of Fruits and Vegetables	53,878,547	777,611	0	-16,202,621	91,155,059	658,744	130,267,340	260,534,680
046	Canning Preserving of Fish	29,961,247	40,562	0	-43,172,924	241,844,791	995,311	229,668,987	459,337,974
059	Coffee and Tea Processing	28,177,510	512,411	0	-23,228,223	13,306,661	379,285	19,147,644	38,295,288
060	Other Food Products	23,930,369	2,768,617	0	-12,508,258	64,653,482	31,481	78,875,691	157,751,382
061	Animal Feed	2,522,836	37,302	0	-72,676,743	48,074,350	0	-22,042,255	-44,084,510
067	Spinning	93,611	0	0	-7,773,550	54,214,202	0	46,534,263	93,068,526
069	Textile Bleaching and Finishing	0	0	0	0	0	0	0	0
081	Pulp Paper and Paperboard	0	488,749	0	-5,690,692	36,053,206	0	30,851,263	61,702,526
084	Basic Industrial Chemicals	0	0	0	-25,359,610	180,543,533	0	155,183,923	310,367,846
085	Fertilizer and Pesticides	3,921,393	22,693	0	-36,438,585	11,483,892	0	-21,010,607	-42,021,214
086	Synthetic Resins and Plastics	0	0	0	-75,799,498	285,322,324	0	209,522,826	419,045,652
093	Petroleum Refineries	253,570,835	35,991,066	0	4,736,059	224,483,840	66,868,376	585,650,176	1,171,300,352
094	Other Petroleum Products	10,732,421	2,725,789	0	-46,199,124	23,139,444	0	-9,601,470	-19,202,940
095	Rubber Sheets and Block Rubber	0	0	0	18,575,322	157,608,365	0	176,183,687	352,367,374
096	Tyres and Tubes	18,307,079	0	192,019	-25,496,653	122,488,237	0	115,490,682	230,981,364
097	Other Rubber Products	11,115,707	0	4,896,485	-32,353,550	84,169,578	4,021	67,832,241	135,664,482
098	Plastic Wares	86,893,641	1,136,355	4,512,447	42,648,038	153,987,904	760,972	289,939,357	579,878,714
102	Cement	228,449	580,998	0	-18,834,826	17,214,810	0	-810,569	-1,621,138
103	Concrete and Cement Products	0	435,638	0	-34,673,838	0	0	-34,238,200	-68,476,400
106	Secondary Steel Products	0	115,639	0	-164,956,306	43,447,041	0	-121,393,626	-242,787,252
107	Non-ferrous Metal	0	0	0	-44,449,708	116,463,950	0	72,014,242	144,028,484
108	Cutlery and Hand Tools	37,006,302	3,817,230	18,118,596	28,562,888	14,997,184	1,002	102,503,202	205,006,404
110	Structural Metal Products	411,966	0	8,129,535	46,849,772	30,192,180	0	85,583,453	171,166,906
113	Agricultural Machinery	61,026	6,012,308	20,768,352	-9,380,973	22,020,581	0	39,481,294	78,962,588
134	Other Manufacturing Goods	0	4,815,855	18,600,764	-4,908,301	51,823,841	20,660,809	100,703,903	191,696,871
135	Electricity	172,275,650	36,546,984	0	0	6,444,546	806	215,267,986	430,535,972
137	Water Supply System	28,908,893	7,037,388	0	0	0	402	35,946,683	71,893,366
145	Wholesale Trade	0	0	0	0	0	0	0	0
151	Road Freight Transport	816,353	36,335	0	0	0	1,294,358	2,147,046	4,294,092
152	Land Transport Supporting Services	9,651,226	1,209,687	0	0	0	817,328	11,678,241	23,356,482
153	Ocean Transport	0	0	0	0	0	56,773,060	56,773,060	113,546,120
154	Coastal & Inland Water Transport	133,039,978	0	0	0	0	35,301,597	168,341,575	336,683,150
155	Water Transport Services	0	0	0	0	0	5,649,412	5,649,412	11,298,824

ID	Sector	301 Private Consumption Expenditure	302 Government Consumption Expenditure	303 Gross Fixed Capital Formation	304 Increase in Stock	305 Exports (F.O.B.)	306 Special Exports	309 Total Final Demand	310 Total Demand
157	Other Services	69,292,197	0	0	0	0	88,063,998	157,356,195	314,712,390
OTH	Other Agriculture (001-029)	629,596,641	1,047,143	4,337,618	-2,580,610	55,765,351	20,215,791	708,381,934	1,416,763,868
OTH	Other Mining and Quarrying (030-041)	0	0	0	-95,820,132	19,863,156	0	-75,956,976	-151,913,952
OTH	Other Food Manufacturing (042-066)	1,305,390,386	2,191,319	0	-11,707,447	455,581,664	46,287,379	1,797,743,301	3,595,486,602
OTH	Other Textile Industry (067-074)	286,506,198	4,499,002	6,895,195	-62,132,169	201,285,909	124,234,856	561,288,991	1,122,577,982
OTH	Other Saw Mills and Wood Products (078-080)	31,936,574	32,363	77,227,952	-19,128,273	66,306,262	984,808	157,359,686	314,719,372
OTH	Other Paper Industries and Printing (081-083)	75,924,325	13,372,284	0	-36,138,578	17,182,365	23,044,509	93,384,905	186,769,810
OTH	Other Rubber, Chemical and Petroleum Industries (084-098)	261,296,334	9,801,251	0	-156,880,185	144,142,863	28,981,922	287,342,185	574,684,370
OTH	Other Non-metallic Products (099-104)	42,203,117	385,558	26,325,794	44,655,592	62,300,741	0	175,870,802	351,741,604
OTH	Other Metal, Metal Products and Machinery (105-128)	665,903,268	16,530,185	1,952,575,313	167,444,396	3,370,896,054	34,308,502	6,207,657,718	12,415,315,436
OTH	Other Manufacturing (075-077, 129-134)	284,287,754	12,968,151	111,359,844	5,285,498	592,187,481	89,997,658	1,086,375,451	2,182,461,837
OTH	Other Public Utilities (135-137)	154,403,831	2,047,997	0	166,770,827	735,481	0	323,958,136	647,916,272
OTH	Other Construction (138-144)	5,719,139	4,155,927	1,117,129,925	0	0	0	1,127,004,991	2,254,009,982
OTH	Other Trades (145-146)	10,784,757	0	0	0	0	0	10,784,757	21,569,514
OTH	Other Transportation and Communication (149-159)	528,099,899	26,034,226	0	0	0	319,611,194	873,745,319	1,747,490,638
OTH	Other Services (147-148, 160-178)	2,866,773,275	2,151,272,705	0	0	0	1,014,904,383	6,032,950,363	12,065,900,726
BIO	Biomass Pellets	73,178	0	0	0	658,600	0	0	737,187
180	Unclassified	28,152,583	852,581	0	84,989,684	7,643,572	5,721,174	127,359,594	254,719,188
190	Total Intermediate Transaction	8,174,709,991	2,353,042,091	3,371,069,839	-537,193,270	7,225,722,880	1,987,275,840	22,574,627,371	45,149,254,742
201	Wages and Salaries	-	-	-	-	-	-	-	-
202	Operating Surplus	-	-	-	-	-	-	-	-
203	Depreciation	-	-	-	-	-	-	-	-
204	Indirect Taxes less Subsidies	-	-	-	-	-	-	-	-
209	Total Value Added	-	-	-	-	-	-	-	-
210	Control Total	-	-	-	-	-	-	-	-