

Energy Consumption Efficiency Research of Express Delivery Industry in China Based on Input-Output Model

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Abstract: The paper uses input-output method to analyze the energy consumption efficiency of express delivery industry. At first, an input-output model was made by introducing energy consumption. Then, the energy consumption efficiency of express delivery industry in China was analyzed using this model. The results show that direct consumption efficiency and complete consumption efficiency were on the low side in all the sectors.

Keywords Express delivery industry; Energy consumption efficiency; Direct consumption coefficient; Complete consumption coefficient

INTRODUCTION

Since man entered the industrialization society, rising oil and energy demand makes extensive use of the existing crude oil reserves getting exhausted. Energy issues become prominent global issues. In recent years because of China sustained and rapid economic growth, energy consumption will continue to increase. The commonly used method of quantitative analysis of the express delivery industry's energy consumption efficiency is direct analysis on the express delivery industry's energy consumption level, but the direct measurement method only considered the express delivery industry itself a direct effect on energy consumption, without taking into account its energy consumption indirect effects, such as the express delivery industry driving the transportation equipment manufacturing, and transportation equipment manufacturing industry will consume large amounts of energy. Express delivery industry as a new growth point of national economy, the indirect effect cannot be ignored. Therefore, how to calculate the overall energy consumption in the express delivery industry is essential. It is worth learning from input-output models as effective analysis tools.

EXPRESS DELIVERY INDUSTRY INPUT-OUTPUT MODEL OF ENERGY CONSUMPTION

Energy consumption in the express delivery industry in the traditional input-output table is based on the input-output table^[3], the introduction of energy consumption. Energy consumption is the primary energy consumption, including coal, crude oil, natural gas, hydropower, nuclear and other power energy (wind, geothermal, etc.) generating capacity. Low calorific value fuel production, biomass, solar energy and the secondary energy converted from the

primary energy production. In order to more clearly see the difference of the efficiency of energy consumption between the express delivery industry and other industries, the paper re-classified industries in Beijing input-output table. The 42 major sectors in national economy were divided into 5 sectors, the agriculture, the industry, the construction, the express delivery industry and the tertiary industry. Energy consumption is the primary energy consumption, including coal, crude oil, natural gas, hydropower, nuclear and other power energy (wind, geothermal, etc.) generating capacity. Low calorific value fuel production, biomass, solar energy and the secondary energy converted from the primary energy production. In order to more clearly see the difference of the efficiency of energy consumption between the express delivery industry and other industries, the paper re-classified industries in China input-output table. The 42 major sectors in national economy were divided into 5 sectors, the agriculture, the industry, the construction, the express delivery industry and the tertiary industry. Among them, the agriculture refers to the agriculture, forestry, animal husbandry and fishery; the express delivery industry refers to the transportation and warehousing industry and the postal industry; the third industry refers to other industries except for the express delivery industry.

$X = (x_{ij})_{n \times n}$ is the intermediate goods consumption matrix, which x_{ij} means that number of products of the j th sector consume the i th sector; $Y = (Y_1 \ Y_2 \ \dots \ Y_n)$ is the vector of industries end-use; $X = (X_1 \ X_2 \ \dots \ X_n)$ is the total output vector of each industry sector; $E = (E_1 \ E_2 \ \dots \ E_n)$ is the industry's energy consumption matrix, which E_j is the number of the j th industrial energy consumption; F is the final use energy consumption; G is the sum of energy consumption; $V = (V_1 \ V_2 \ \dots \ V_n)$ is the

industry added value vector; $X = (X_1 \ X_2 \ \dots \ X_n)$ is the total input of each industry.

Table 1. Express Delivery Industry Energy Consumption Input-Output Table.

Input		Intermediate Use					Final Use	Output
		Agriculture	Industry	Construction	Express Delivery Industry	The Tertiary Industry		
Intermediate inputs	Agriculture	$X = (x_{ij})_{n \times n}$					$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix}$	$X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix}$
	Industry							
	Construction							
	Express Delivery Industry							
	The Tertiary Industry							
Energy Consumption		$E = (E_1 \ E_2 \ \dots \ E_n)$					F	G
Added Value		$V = (V_1 \ V_2 \ \dots \ V_n)$						
Input		$X = (X_1 \ X_2 \ \dots \ X_n)$						

According to the 2011 "China Energy Statistical Yearbook" and the 2010 input-output table data, the basic flow of Input-Output table can be obtained, which includes the 5 sector in 2010.

Table 2. Input-Output Table in China in 2010.

Units: Billion Yuan, Tce/million Yuan

Input		Intermediate use					Output
		Agriculture	Industry	Construction	Express Delivery Industry	The Tertiary Industry	
Intermediate inputs	Agriculture	9220.25	40010.37	449.18	0	4233.10	69319.80
	Industry	15070.09	145038.41	56583.84	111.70	69813.19	774685.34
	Construction	17.27	262.98	1084.41	23.47	2075.63	102343.30
	Express Delivery Industry	18.86	146.83	9.47	10.00	325.90	574.60
	The Tertiary Industry	4459.73	73940.06	17555.41	202.11	60806.51	305721.83
Energy Consumption		6477.30	231101.82	6226.30	293.38	80840.35	

There is no direct data of express delivery industry in the yearbook. The business, organization and the operation mode of express industry are similar with transportation, warehousing and postal services. Assuming that the two have approximate intermediate input structure, according to the proportion of the intermediate input of the express delivery industry to the original transportation, warehousing and postal services, the intermediate input of the express delivery industry can be obtained by multiple the proportion.

ANALYSIS ON THE DIRECT ENERGY CONSUMPTION EFFICIENCY

Direct energy consumption coefficient which can be defined as direct energy consumption by producing unit production, denoted by a_{ej} , is calculated as follows:

$$a_{ej} = \frac{E_j}{X_j} \quad (1)$$

Direct energy consumption efficiency of express delivery industry is defined as the amount of energy consumed directly per million Yuan values, i.e. a_{ej} in

the input-output table. It reflects the express delivery industry energy consumption efficiency, mainly due to the express delivery industry technology level.

Table 3. Direct Consumption Coefficient.

	Agriculture	Industry	Construction	Express Delivery Industry	The Tertiary Industry
Direct Consumption Coefficient	0.0934	0.2983	0.0608	0.5106	0.2644

Direct energy consumption coefficient of express delivery industry was 0.4170, the largest in all industries, followed by the industry, the tertiary industry, agriculture and construction. Therefore, the direct energy consumption efficiency of express delivery industry in all sectors in the national economy was the lowest.

China's energy consumption is mainly concentrated in the second industry. However, in recent years, the growth rate of the third industrial energy consumption, has exceeded the first and the second industry, will gradually become the main energy consuming sectors. Among them, the energy consumption of transportation and post and telecommunications industry is the fastest growing, which is also the main aspect of the express industry energy consumption. China's express industry market is uneven and the professional level is low. Express industry energy consumption efficiency is hard to improve.

TOTAL ENERGY CONSUMPTION EFFICIENCY

The total energy consumption efficiency can be reflected by the total consumption coefficient. The total consumption coefficient is higher, which shows that the energy consumption efficiency is lower. The energy consumption coefficient of the above calculation reflects the direct consumption of primary energy in the production, and can calculate the complete energy consumption coefficient, which is used to express the direct and indirect consumption of primary energy. Complete energy consumption coefficient is added to the direct energy consumption coefficient and the size of the total energy consumption coefficient can reflect the degree of the energy product. The value of the energy consumption is increasing, and the value of the energy is reduced. Compared with the direct energy consumption

coefficient, the total energy consumption coefficient can reflect the economic overall dependence on the energy sector.

The express delivery industry total energy consumption coefficient is defined as: the sum of direct energy and indirect energy consumption amount per production in j th sector, denoted by b_{ej} .

$$b_{ej} = a_{ej} + \sum_{i=1}^n a_{ei}b_{ij} \quad (2)$$

According to the meaning of total consumption coefficient, the express delivery industry total energy consumption coefficient is denoted by b_{e4} .

$$b_{e4} = a_{e4} + \sum_{i=1}^n a_{ei}b_{i4} \quad (3)$$

Where a_{e4} is the direct energy consumption of

express delivery industry, $\sum_{i=1}^n a_{ei}b_{i4}$ is due to the needs of express delivery industry to other industries triggered the indirect energy consumption. b_{i4} is said total consumption coefficient of intermediate product consumption of the express delivery industry to i th sector. Total energy consumption efficiency of the express delivery industry is that the efficiency of total energy consumption of express delivery industry influenced by two factors: First, the industry's direct energy consumption coefficient values represent the energy consumption technology level; Second, total consumption coefficient value of intermediate product consumption of the express delivery industry to other sectors represent non-energy consumption technical standards.

Table 4. Total Consumption Coefficient

	Agriculture	Industry	Construction	Express Delivery Industry	The Tertiary Industry
Agriculture	0.1767	0.0799	0.0575	0.0338	0.0437
Industry	0.3544	0.2983	0.7936	0.4271	0.3835
Construction	0.0014	0.0016	0.0132	0.0457	0.0091
Express Delivery Industry	0.0005	0.0004	0.0006	0.0184	0.0015
The Tertiary Industry	0.1373	0.1616	0.3164	0.5105	0.3000

According to the calculation formula of the total consumption coefficient of the data in table 4 and

table3, the energy consumption coefficient of each department is calculated, seen in table 5.

Table 5. Total Consumption Coefficient

	Agriculture	Industry	Construction	Express Delivery Industry	The Tertiary Industry
Energy Consumption Coefficient	0.2523	0.4378	0.3877	0.7883	0.4635

From the above table can be learned that the energy is completely consumed by high efficiency from high to low in order for agriculture, construction, industry, the third industry, express delivery industry. The highest efficiency of agricultural energy consumption coefficient was only 0.2523, while the express delivery industry had reached 0.7883, the lowest in the five sectors. Through the calculation of the energy consumption coefficient of the express industry, the indirect consumption coefficient of the express industry is 0.2777.

Comparing energy consumption efficiency, it can be found that the energy consumption coefficients of agricultural and construction industry were relatively low, which indicated that the energy consumption efficiency of agriculture and construction industry were relatively high. While the energy efficiency of express delivery industry was the lowest, which directly reflected the express industry was a high energy consumption department and its energy consumption efficiency need to be reduced.

From the above analysis, we can know that there is a difference between the direct energy consumption coefficient and the indirect energy consumption coefficient, which means that we need to adopt different strategies to guide the departments of energy saving and emission reduction measures. For sectors with relatively high direct energy consumption, the energy efficiency of the energy

utilization can be improved as far as possible, and the relatively large indirect energy consumption can reduce the input of intermediate products, and the use of low energy consumption products can replace high energy consuming products and improve the utilization and conversion efficiency of the intermediate products.

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